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LORD KELVIN

WITH the death of Lord Kelvin on December 17 there passes away the grandest figure of contemporary science, and with it closes an epoch in the history of physics. When William Thomson was born, in 1824, Ohm's law of the flow of electric currents had not been discovered, Oersted's discovery of the magnetic action of the current was but four years old, while Faraday's capital discovery of the induction of currents was not to come for seven years. The wave-theory of light had been but recently set on its feet by Young and Fresnel, and was not yet thoroughly believed, while the two laws of thermodynamics, perhaps the most important contribution of the nineteenth century, were unknown. All these things Lord Kelvin saw, and a great part of them he was. Probably no one, with the single exception of Helmholtz, born three years earlier, exercised a greater influence on the science of the nineteenth century, while to compare the influence of these two great physicists with that of Darwin is as bootless as to question whether the grass is greener than the sky is blue.

Whether William Thomson, born at Belfast, is to be classified as an Irishman, along with the great Sir William Rowan Hamilton, or by virtue of descent and almost lifelong residence in Glasgow, as a Scotchman, like that other genius Clerk Maxwell, we need not discuss, but that country in which, perhaps in all the world, intellect is most prized, may fairly claim him as her own. The fact that his father was professor of mathematics at the University of Glasgow, where his elder brother James became a distinguished professor of engineering, tends to show the hereditary nature of his talent. Brought up in the quadrangle of the university, Thomson as a boy must have enjoyed very unusual advantages of training, while he relates that the enthusiasm of J. P. Nichol, author of "The Architecture of the Heavens," first turned him in the direction of physics, while the good advice of the same master, encouraging him to read Fourier's "Théorie analytique de la Chaleur" bore quick fruit, which was renewed throughout his whole career. Precocious he certainly was, for his first paper, written at the age of seventeen, was on Fourier's expansion of functions in trigonometric series, followed by three others on the flow of heat, all written before he was eighteen. It is impossible to conceive of an American boy of seventeen to-day writing on such a subject, which still presents many difficulties even for the mature student, and at that time was understood only by the masters. The theory that precocity is a dangerous symptom receives a severe blow from Thomson's subsequent career.

After being educated at Glasgow University he went to Cambridge, and joined St. Peter's College, where he distinguished himself by becoming second wrangler in the Mathematical Tripos, and first Smiths Prizeman, a mathematical honor still more coveted, in 1845. On leaving Cambridge Thomson went to Paris, where in the laboratory of the distinguished physicist, Regnault, he had his first introduction to experimental methods of research. At this time he published the second of his papers on the laws of electrostatics, showing the analogy, never before noticed, between the distribution of what Faraday was calling electrical lines of force with the lines of flow of heat in a conductor. In this, as in most of his work then and later, we see the great influence that the work of Fourier had upon him, and the powers which he had obtained in the management of that analysis. In the same year he published his original method of spherical images, which has become of so great importance in all parts of mathematical physics.

In 1846, at the age of twenty-two, Thomson became professor of natural philosophy at Glasgow, where he remained fifty-three years, his jubilee being celebrated with great *éclat* in the presence of illustrious scientists from all over the world in 1896. Besides his powerful contributions to the theory of electricity and magnetism, which continued for many years, a new and no less important subject now began to engross him. The work of Sadi Carnot on the motive power of heat, though published in 1826, was but little understood, and belonged to the days when heat was supposed to be a substance. Almost simultaneously, Thomson in England, and Clausius in Germany brought out explanations of Carnot's principle that heat can do work only in falling in temperature, that is in passing from a hotter to a cooler body, each inventing a new axiom to take the place of Carnot's faulty analogy with the fall of water. The statement of this axiom by Clausius is easier to understand, and it led him to the important conception of entropy, but the line of argument of Thomson was no less original and compelling, and it led him to the idea of dissipation of energy, which amounts to the same thing. It is worthy of notice that when Thomson began to write on the subject of thermodynamics he still believed heat to be a substance, but he soon accepted the results of the reasoning of Helmholtz and the experiments of Joule on the nature of heat as work, or as we now call it, energy. The most important outcome of Thomson's thermodynamical work was the invention of the absolute scale of measurement of temperature, which is independent of the properties of any thermometric substance such as mercury or air. By a fortunate accident this scale (or one of the two proposed), coincides nearly with that of a thermometer using one of the more permanent gases like hydrogen or nitrogen. The question of how nearly it coincides could be decided only by experiment, and these experiments were carried out from 1852 to 1862 by Thomson and Joule in collaboration, the most important result obtained being that on being forced through a porous plug all gases except hydrogen were slightly cooled, this cooling being shown to be due to the slight attraction of the molecules of the gas for each other, in spite of the tendency of the gas to expand on account of the motion of the molecules. It is probably by these researches that Thomson as an experimental physicist will be chiefly remembered, for they furnish us, by the Joule-Thomson effect, with our only means of reducing the indications of an actual gas thermometer to the absolute scale.

We now come to a new subject, and the one which made Thomson famous in the eyes of the public, and which eventually procured him his knighthood. At the beginning of the agitation of the project of the Atlantic telegraph cable, Thomson plunging with enthusiasm directly into the heart of the matter, took up the mathematical question of the mode of propagation of signals in a telegraph line laid under water. To this he again applied his favorite Fourier mathematics, and in 1855 he communicated to the Royal Society a paper in which the theory was completely worked out, in which it was shown that the current is propagated exactly as heat is conducted, and that instead of being propagated with a definite velocity, like sound, so that a short signal would arrive, pass over and cease, the current would arrive gradually, increase to a maximum, and die away, always leaving an undesirable residue to trouble the next signal. The longer the cable the longer would it take for the current to rise to its maximum, but not in proportion. The vital question was, how long would it take, and how much current could be got through, and this he solved in the most convincing fashion, with the announcement of the possibility of the prediction of the action of one cable by the behavior of another. If K is the capacity per unit of length, R the corresponding resistance, the time at which a signal reaches its maximum value at a distance d away is proportional to the product KRd^2. This is the famous KR-law, and then follows the remarkable prediction, "We may be sure beforehand that the American telegraph will succeed, with a battery sufficient to give a sensible current at the remote end, when kept long enough in action, but the time required for each deflection will be sixteen times as long as would be with a wire a quarter of the length, such, for instance, as the French submarine telegraph to Sardinia and Africa." The mastery of the principles of the telegraph thus shown led to the appointment of Professor Thomson as electrician of the first cable laid in 1858, a position which he held many times for later cables. Not content with showing the conditions necessary for success of working, Thomson had invented an instrument to make possible the reception of the weak signals to be transmitted, and his mirror galvanometer was ready when the shore end of the cable was laid. The important principle of this galvanometer was not merely the long weightless index consisting of a beam of light, the mirror principle having been invented by Poggendorf, but the reduction of the moving magnet to a very small light affair weighing less than a small sewing needle, and giving wonderful sensibility. Thomson was the first to insist on the advantage of small size in magnetic and other measuring instruments, and his galvanometer became the model of all delicate galvanometers from that time to this, each increase in lightness having been attended with an increase of sensitiveness. It is interesting to recall, in connection with the first cable, which lived to transmit only 732 messages, that it was ruined by the practical, that is non-theoretical, electrician, Mr. Whitehouse; who applied to it currents from huge induction coils, probably giving potentials of two thousand volts. By the advice of Thomson, thus dearly paid for, this was reduced, on the 1865 cable, to a few volts, this being amply sufficient to work his delicate instruments. The mirror galvanometer, together with the electrometers invented before the cable was talked of, were the first of Thomson's many electrical measuring instruments, by which he will perhaps best be remembered by practical people. Later he invented the siphon recorder, still in use for *recording* cable signals. Thus Thomson became the first, as he was the greatest, of electrical engineers, telegraph engineers then, but now embracing the many fields of telegraph and telephone, wireless, and transmission of power. In this connection may be mentioned his connection with the establishment of practical units for all electrical measurements, first made imperatively necessary by the cable, and lying at the basis not only of all exact measurement, but of all practical engineering. A committee of the British Association for the Advancement of Science was appointed, with Thomson as chairman, to consider the question of units in general, and in 1863 they made the determination of a practical unit of resistance, now known as the *ohm*, the method of experimentation being devised by Thomson. Finally the efforts of this committee culminated in the proposition of what is known as the C.G.S. system of absolute measurements for every sort of physical quantity, this system being now in use by every scientist and electrical engineer in all parts of the globe.

We may now say a few words of Thomson's instruments. Of the galvanometer we have already spoken, this being the most easily understood of his instruments, and used for measuring current. For the measurement of potential he devised two electrometers, acting on the principle of the attraction and repulsion of statically electrified bodies. In one, the absolute electrometer, a horizontal plate was hung from the arm of a balance, which weighed the attraction due to a parallel fixed plate. This idea was again not invented by Thomson, but by Snow Harris, who, however, did not understand how to get correct results with it. The bright idea conceived by Thomson was to surround the disk with a so-called guard-ring, the idea being that as the calculation supposed an infinite plate, the suspended disk should be, as it were, a sample of a larger plane surrounding it, the disk alone being movable. Thus the demands of theory and practise were both met at once, and exact calculation became possible. In the quadrant electrometer a quite different, but equally original arrangement was adopted. The moving part was made in the shape of a horizontal figure of eight, and turned about a vertical axis, most delicately supported by a silk fiber, and attracted and repelled by a circular box enclosing it, cut into quarters, which alternately attracted and repelled, but so as to combine their action, giving a most delicate instrument. These instruments, like the galvanometer, have become classical. By his journeys on cable ships, and his practical experience as a yachtsman, Thomson devoted much thought to the needs of navigation, and invented a sounding apparatus using steel piano wire instead of rope, with a depth indicator depending on the pressure of the water, and a compass, both of which are to-day in universal use. The principle of the compass was again that of lightness for sensitiveness, the card being supported by silk strings. He also elaborated the method of correction of the compass for the ship's magnetism. Later on came instruments for the measurement of the large currents and potentials used in present-day practise.

The culmination of Thomson's application of Fourier mathematics, and perhaps his most sensational contribution to science, was his estimate of the age of the earth, based upon the time it has taken to cool, our knowledge being derived from the measurement of the rate of increase of temperature as we go below the surface of the earth. His conclusion was that the earth had required from one to two hundred million years to cool from its molten state to the present, a conclusion which was a violent shock to the geologists, who required a far greater period for the formation of the rocks.

None of the above-mentioned subjects was, however, Thomson's favorite subject of research, the place of which must undoubtedly be given to his speculations on the nature of the ether, and the constitution of matter. In fact, he stated at his jubilee that there had not been a day during the last forty years when he had not devoted some time to the consideration of these subjects, but that the total result must be summed up as failure, inasmuch as he knew no more of their true nature now than at the beginning. This discouraging admission must be taken with several pailfuls of salt, and attributed to that true scientific humility which is the characteristic of great minds, for there is no one who has contributed more to our knowledge of both ether and matter than Thomson. His fondness for this subject was a symptom of his devotion to and mastery of the principles of mechanics, whether in its applications to rigid bodies, to elasticity, or to hydrodynamics. In connection with his contributions to geology may be mentioned his powerful researches on the tides, of both fluid and solid spheroids, and his conclusion from the motion of the earth that it is nearly as rigid as a sphere of steel. Thomson and Tait's "Treatise on Natural Philosophy" (roguishly referred to by Clifford as $T + T'$) was an epoch-making work, conceived on a scale never before attempted, and destined to be completed only in the first instalment devoted to mechanics, on which subject it constituted a wonderfully inspiring guide. This work, which Helmholtz thought enough of to translate into German, is difficult of characterization, but we may mention its insistence on the value of Newton's ideas, and its exposition of the power of Lagrange's generalized methods in dynamics. The portion which perhaps best shows the originality of Thomson's genius is the chapter on systems containing rotating gyrostats, of whose peculiar action it gives the complete key. The recent application of these principles in the Brennan mono-rail railway and the Schlick gyrostat for preventing the rolling of ships is no more interesting than Thomson's use of them to construct from rigid materials a model of an elastic atom, in his "Steps toward a Kinetic Theory of Matter," read at the British Association meeting in Montreal in 1884, or his model of a gyrostatic ether whose elasticity was to be similarly explained.

This occasion of Thomson's first visit to the United States was otherwise signalized by the deliverance at the Johns Hopkins University of a remarkable series of lectures on "Molecular Dynamics and the Wave Theory of Light," before a very unusual auditory from both sides of the ocean. These lectures, first published twenty years later, were characteristically Thomsonian, and represented his long attempt to make the elastic theory of the ether work successfully. Constructing a model of a molecule by means of concentric hollow shells with springs between to give many modes of vibration, he was led to an explanation of anomalous dispersion, without knowing of its experimental discovery by Kundt and Christiansen, or its explanation by Helmholtz ten years before. This ignoring of the work of others was characteristic of both Thomson and Helmholtz, and perhaps constitutes the strength of great thinkers. Possibly in this way is to be explained Thomson's cold attitude toward the electromagnetic theory of light, which he maintained until after the world in general was convinced of its truth. He was determined at all hazards to make the elastic ether do, probably because he saw that even if light is to be explained as electromagnetic waves, we have still to give a dynamical explanation of electricity and magnetism. Of late years the pendulum has swung the other way, and there is now an attempt to explain all dynamics on an electromagnetic basis, but with this Lord Kelvin would probably have had no sympathy. In these Baltimore lectures we find a remarkable description of a probable way to make electric waves, which was almost exactly realized by the method of Hertz three years later, coupled with the erroneous opinion, from which Thomson could hardly rid himself, that they would be waves of compression, and would travel much faster than light. In order to explain elasticity, he had a penchant for the ideas of Father Boscovich, of forces emanating from centers, from which he built up atoms, ether, and even made application to radioactivity. One of his last papers is on a "Plan of an Atom to be capable of storing an Electrion with Enormous Energy for Radioactivity," and in a paper with the characteristic title of "Æpinus Atomized" he put forth the model of an atom consisting of a globe of positive electricity permeated by a multitude of minute negative *electrions*, as he persisted in calling them, ignoring the general use of the word electron.

Lord Kelvin devoted a considerable portion of his energies to tilting at windmills and championing lost causes. Of this his treatment of the elastic and electric theories is an example. Another *bête noire* in late years was the Maxwell-Boltzmann theorem of the partition of energy, which he characterized as a cloud upon the kinetic theory of gases. The writer once enjoyed the good fortune of spending several days in the company of Lord Kelvin, and of hearing him frequently training his guns on that target. At last he plucked up courage to ask, "Lord Kelvin, what do you consider to be the fundamental error in the argument of Maxwell and Boltzmann?" "I don't think there is a single thing about it that is right," was the instant comprehensive answer, to which there appeared no obvious reply.

Lord Kelvin's personality was a most attractive and original one. To see him and hear him talk was to be lost in admiration of his vigor, his quickness and his enthusiasm. Nothing was lost to him, and he was never idle. In the railway carriage on the return to London on the occasion mentioned he soon pulled out his note-book, and was figuring on the ether flowing through an atom, the result of which figuring was apparent the week after at the Paris congress. Helmholtz, on a visit to Thomson on his yacht, the *Lalla Rookh*, writes to his wife, after admiring the skill with which Thomson managed the yacht, "It was very pleasant and informal. W. Thomson has carried the freedom of intercourse so far that he always carries a mathematical note-book about with him, and as soon as an idea occurs to him, begins to reckon right in the midst of the company, which is generally regarded with a certain awe. How would it be if I should accustom the Berliners to that?" On the occasion of a visit in Glasgow he writes, "He has no vacation at Easter, but his brother James, professor of engineering at Belfast, and a nephew, are there. The former is a very clever head with good ideas, but hears and knows nothing but engineering, and speaks of it continuously at all times of the day and night, so that hardly any conversation can take place when he is there. It is funny, too, how each of the brothers explains something to the other, and neither listens to the other, and each talks of totally different subjects. But the engineer is the most obstinate of the two and generally puts his piece through." The friendship between these two great physicists, Helmholtz and Thomson, both without other peers, was most interesting from the fact that they many times almost simultaneously treated the same subjects, and that they were both examples of Helmholtz's statement that "in physical science he only can fruitfully experiment who has a penetrating knowledge of theory and according thereto can ask the right questions, and on the other hand, as is most brilliantly shown in the discovery of spectrum analysis, he only can fruitfully theorize who has a broad practical experience in experimentation." Would that these words and these examples might be carved in letters of gold in every laboratory in this land!

The honors heaped upon Thomson would fill a catalogue. Knighted in 1866, he is most familiarly known as Sir William Thomson, elected foreign associate of the Paris Academy of Sciences in 1877, he was raised to the peerage by Lord Salisbury in 1892, taking the title of Baron Kelvin, from the stream on which Glasgow is situated. He was president of the Royal Society, four times president of the Royal Society of Edinburgh, and member of nearly all the learned societies of the world. He was one of the twenty members of the recently instituted Order of Merit, of which the other scientific members are Lord Rayleigh, Sir William Huggins and Lord Lister. On his third visit to this country, in 1902, he was tendered by several scientific societies a great reception at Columbia University, where his praises were sung before a distinguished company. His visit to the American Physical Society was a memorable one for that society, of which he was the first honorary member. Kelvin's printed works comprise one volume of "Papers on Electrostatics and Magnetism," three volumes of "Mathematical and Physical Papers" (those not yet published will make another), Thomson and Tait's "Treatise in Natural Philosophy," in two volumes, and three volumes of Popular Lectures and Addresses. Of these many papers the majority are not of an experimental character, and Kelvin's experimental work that will be best remembered is probably comprised in his discovery of the Joule-Thomson cooling effect in gases and of the Thomson effect of the carriage of heat with or against the electric current.

Kelvin's great strength consisted in his mastery of the application of mathematical methods, and of mechanics in particular, combined with his rare physical intuition and his ability to construct models to make difficult phenomena tangibly realizable. Helmholtz says of him in his preface to his translation of Thomson and Tait, "William Thomson, one of the most penetrating and ingenious thinkers, deserves the thanks of the scientific world, in that he takes us into the workshop of his thoughts and unravels the guiding threads which have helped him to master and to set in order the most resisting and confused material." Again in his "Report on Sir William Thomson's Mathematical and Physical Papers" he sees the great merit of Thomson's scientific methods in the fact that, "following the example given by Faraday, he avoids as far as possible hypotheses about unknown subjects and endeavors to express by his mathematical treatment of problems simply the law of observable phenomena. By this circumscription of his field Thomson brought out the analogy between the different phenomena of nature much more clearly than would have been the case if it had been complicated by widely diverging ideas with reference to the inner mechanism of phenomena."

Though Kelvin is often mentioned as a mathematician, this is not correct in the strict sense, inasmuch as he did not add to the methods of mathematics proper. Indeed, it is very doubtful if he knew any more of mathematics at eighty than he did at twenty. He did not need to. For him a thorough familiarity with the methods of Lagrange, Fourier, Cauchy and Green amply sufficed. We never hear him mention a Riemann's surface or an existence-theorem. This we say not as a reproach, nor as an insinuation regarding the fertility of modern pure mathematics, but merely as an interesting fact. These methods may be taught, and in a reasonable time. Let us in America pray for teachers of this science which Helmholtz calls "die eigentliche Basis aller rechter Naturwissenschaft," of the inspiring quality of Lord Kelvin, the high priest of that most alluring goddess of the natural sciences, MATHEMATICAL PHYSICS.

ARTHUR GORDON WEBSTER
CLARK UNIVERSITY,
December 22, 1907

MEDICINE AND THE UNIVERSITY[1]

I BELIEVE that I make no mistake in assuming that the honor of the invitation to deliver this address came to me mainly through the official position which I chance to hold in the Association for the Advancement of Science and the desire to give prominence on this occasion to the sciences of nature in view of the approaching meeting of the association in this place. I must, however, disclaim any especial competence to speak for these sciences, and I know not where there is less need in our country of emphasizing the importance and significance of the natural and physical sciences, or where the representatives of these sciences have brought higher distinction to themselves and to their university, than here in the University of Chicago.

The past century is memorable above all others for the gigantic progress of the natural and physical sciences—a progress which has influenced more profoundly the lives and thought, the position and prospects of mankind, than all the political changes, all the conquests, all the codes and legislation. In this marvelous scientific advancement in all directions the sciences of living beings and their manifestations have progressed as rapidly and have influenced the material, intellectual and social conditions of mankind as much as the sciences of inanimate matter and its energies. So far as the happiness of human beings is concerned, there is no other gift of science comparable to the increased power acquired by medicine to annul or lessen physical suffering and to restrain the spread of pestilential diseases, although what has been accomplished in this direction is small indeed in comparison with what remains to be achieved. Man's power over disease advances with increased knowledge of the

[1] An address delivered at the convocation exercises of the University of Chicago, December 17, 1907.

nature and causes of disease, and this increase of knowledge has its sources in the educational system.

In asking your attention on this occasion to some of the conditions and problems of medical education and research, particularly in their relation to the university and to circumstances existing in this country, I am aware that the theme is trite and that I can add little that is new to its discussion, but the subject, however wearisome, requires ever renewed consideration so long as the conditions remain as unsatisfactory as at present and so many problems await final solution. Especially is it important that the nature of the problems should be realized by the teachers and authorities of our universities. I know that in this university much earnest thought has been given to questions of medical education, and wisely so, for I have every confidence that the medical department of this university, already doing such good work, is destined to be a leader in the promotion of higher medical education and the advancement of medical knowledge on this continent.

The historical and the proper home of the medical school is the university, of which it should be an integral part coordinate with the other faculties. Before there was a faculty of law at Bologna or of theology at Paris there was a school of medicine at Salernum, which, as is well known, occupies an interesting and unique position in the history of the origin and development of universities. From this early period to the present day no other type of medical school has existed on the continent of Europe than that of the university, and this union has been of mutual advantage, the renown of many universities being due in large part to their medical faculties, and these receiving the fostering care and the ideals of the university.

It was under the influence of these sound traditions of the proper relation of medical teaching to the universities that the first medical schools in this country were founded, that of the College of Philadelphia, now the University of Pennsylvania, in 1765; that of Kings College, now Columbia University, in 1767, and after somewhat longer intervals those of Harvard, Dartmouth and Yale. The model for these early schools was the medical department of the University of Edinburgh, which derived its traditions from the University of Leyden, as these in turn can be traced back to the great Italian universities of the sixteenth century. We can contemplate with much pride and satisfaction the early history of these first American medical schools, which, notwithstanding their feeble resources, were imbued with a spirit of high purpose and just recognition of the qualifications needed for the pursuit of medicine as a learned profession.

It is deeply to be regretted that their successors did not continue to build on such foundations as those laid by John Morgan, William Shippen and Samuel Bard, but rather adopted and carried much further the plan of the proprietary medical schools which originated in England in the latter part of the eighteenth century and attained their highest development there during the first three decades of the following century, after which the hospital medical schools of a type peculiar to that country gained the ascendancy. We can transfer from our shoulders, however, only a minor part of the responsibility for the conception and establishment of the proprietary medical school, for the English form of this school was a harmless thing which never dreamed of conferring the doctor's degree and was regarded with disfavor by examining and licensing bodies.

The proprietary medical school, conducted for gain, divorced from any connection with a university and free from any responsible outside control whatever, empowered by the state to usurp the university's right of conferring the doctor's degree and at liberty to set whatever standards it chose for obtaining this degree, which carried with it the license to practise, is a phenomenon unique in the history of education and a contribution to systems of education for which America is entitled to the sole credit. This is the type of medical school which prevailed in this country during the greater part of the nineteenth century, and familiarity has made it difficult for us fully to realize how anomalous and monstrous it really is. Even in the case of those schools which were united with a college or university the connection became in most instances so loosened as to be merely nominal and to secure practical autonomy to the medical school. In the common type of these schools there was no requirement of preliminary study worthy of the name, the only practical training was in the dissecting room and an occasional amphitheater clinic, and the degree and license to practise followed the passing of an easy examination after attendance on two annual courses of lectures lasting five or six months each, sometimes an even shorter period, the student hearing the same lectures each year.

It is needless to say that such conditions brought great reproach to American medicine and introduced evils from which we are not yet wholly free. Nevertheless the system, bad as it was, can be painted in too dark colors. The rapid multiplication of medical schools which followed the second decade of the last century was, although excessive, in response to the needs of a rapidly developing country pushing the boundaries of civilization ever westward. Still it would be difficult to find a sound argument for increasing the hardships of frontier settlements and struggling communities by a supply of poor doctors.

The main relief to the picture is that the results were not so bad as the system. Many of the teachers were devoted, able men who imparted sound professional traditions and whose personality in a measure remedied the defects of the system. The native force, ability and zeal of many students enabled them to overcome serious obstacles and to acquire in the course of time, in spite of adverse circumstances, a mastery of their calling, perhaps a resourcefulness engendered by these circumstances, for even under the best conditions education does not end with the modicum of knowledge imparted in school and college. Some were so fortunate as to be able to supplement their inadequate training by European study. But among those without foreign training who were entirely the products of American conditions not a few were the peers of their European contemporaries, such as Daniel Drake, Jacob Bigelow, John D. Godman, William Beaumont, Nathan Smith Davis, Samuel D. Gross, Austin Flint, Marion Sims and others who have left names illustrious in the annals of our profession. Native vigor and resourcefulness enabled such men to surmount defects of an educational environment to which the average man must succumb.

Most gratifying is the rapidity with which medical education has risen during the last two decades from the low estate to which it had sunk during the greater part of the past century in this country. Among the more important causes contributing to this result may be mentioned the operation of laws transferring and, in fact, restoring the licensure to practise from the medical schools to state boards of examiners, whereby worthless medical schools are crowded to the wall and out of existence and others have been compelled to raise their standards, the moral pressure exerted through an awakened sentiment for reform on the part of the organized profession and the better schools, closer union between medical school and university and the consequent interest of university teachers and authorities in the problems of medical education, the example set by a few schools of a high order, endowment—although very inadequate—of medical education, which formerly was almost wholly neglected as an object in need or worthy of private or public beneficence, the advancement of medical science and art, necessitating improved methods and higher standards of professional training, and a juster and wider appreciation of the significance of curative and preventive medicine to the welfare of the community.

The history of medical education in America is still in the making, but we now have a number of schools with high standards and adequate equipment capable of giving to students of medicine a professional education as good as that to be obtained in European universities. The best and most progressive schools are those in organic union with a university, and it seems clear that to schools of this type belongs the future of higher medical education in this country. Nearly twenty years ago in an address at Yale University I endeavored to set forth the advantages of the union of medical school and university, and, as addresses, fortunately for those in the habit of giving them, are soon forgotten, I shall here summarize what I conceive to be the more prominent of these advantages.

Of all professional and technical schools the medical, with its requirements for laboratories, hospitals and teaching force, is the most costly. A medical department of a university is much more likely to be the recipient of endowment funds than an independent school, and the university is a safer and more suitable custodian of such funds.

In manifold ways the environment of a university is that best adapted to the teaching and the advancement of medicine. The medical school needs the ideals of the university in maintaining the dignity of its high calling, in laying a broad foundation for professional study, in applying correct educational principles in the arrangement of the curriculum and in methods of instruction, in assigning the proper place and share to the scientific and the practical studies, in giving due emphasis to both the teaching and the investigating sides of its work, in stimulating productive research, and in determining what shall be the qualifications of its teachers and of the recipients of its degree. Most invigorating is the contact of medical teachers and investigators with workers in those sciences on which medicine is dependent—chemistry, physics and biology.

In the selection of teachers—a matter of the first importance—a university is in a superior position to secure the best available men wherever they can be found, regardless of any other consideration than fitness. Too often this choice has been determined in our medical schools by irrelevant influences and considerations and an outlook upon the world scarcely more than parochial in extent.

In the difficult matter of adjustment of professional training to conditions of collegiate education peculiar to our country there are manifest advantages in the union of medical school with university, especially where the periods of liberal and of professional study are made to overlap. Where the sciences adjuvant to medicine, as general chemistry, physics, zoology and botany, are included in the medical curriculum, as is done in the German and French universities, it is economical and highly desirable that they should be taught in the collegiate or philosophical faculty rather than that separate provision should be made for them in the medical faculty, where they do not properly belong.

The benefits of union of medical school and university are reciprocal, and not to the medical school alone. A good medical faculty, properly supported and equipped, is a source of strength and of renown to the university possessing it, and its work in training students and in extending the boundaries of knowledge greatly increases the usefulness of the university to the community. Nor is there anything in this work which does not appertain to the proper functions of a university, however high its ideals. Indeed I venture to assert that the present and prospective state of medicine and its relations to the well-being of individual man and of human society are such that there is no higher or nobler function of a university than the teaching of the nature of disease and how it may be cured and prevented, and the advancement of the knowledge on which this conquest of disease depends. If it be said that the medical art is largely empiric, I reply that this, while true, does not make medicine unworthy of shelter in the university. The empiric method of discovery by trial and error has its glorious triumphs as well as the scientific and is not to be disdained. To it we owe such beneficial discoveries as the curative properties of quinine in malaria, vaccination against smallpox and the anesthetic uses of ether and chloroform.

But there is a scientific as well as an empiric side to medicine and the distinctive feature of modern medicine is the rapid extension of the former and the curtailment of the latter. The fundamental medical sciences—anatomy, physiology, physiological chemistry, pathology, pharmacology, bacteriology and hygiene—are rapidly advancing and important departments of biological science, which have contributed and will continue to contribute enormously to the progress of practical medicine. In an address which I had the honor to deliver somewhat over ten years ago at the dedication of the Hull Biological Laboratories of this university I took occasion to dwell with some detail upon the biological aspects of medicine.

We should add to the specialized medical sciences already mentioned the study of the problems presented by the living patient in hospitals and laboratories attached to hospital clinics where chemical, physical and biological methods can be applied to the investigation of clinical problems, which do not fall within the scope of other laboratories or can be less advantageously attacked in them. These clinical investigating laboratories are an important addition to the older analytical and statistical methods of study of disease and mark an advance from which valuable results have been obtained and more valuable ones are to be expected. It is highly desirable that our medical clinics should be organized with regard to this newer direction of work, for which they will require considerable funds.

The science of medicine has advanced in recent years more rapidly than the art and in its various branches it constitutes to-day a field of work most alluring and most rewarding to the properly trained scientific investigator, who, if he have the rare genius for discovery, may reap a harvest rich in blessing to mankind.

But the art of medicine has profited greatly by the application of scientific discoveries. The physician and the surgeon to-day can do far more in the relief of physical suffering and in the successful treatment of disease and injury than was formerly possible, but the great triumphs have been in the field of preventive medicine. The horizon of the average man's interest in medicine scarcely extends beyond the circumference of his own body or that of his family, and he measures the value of the medical art by its capacity to cure his cold, his rheumatism, his dyspepsia, his neurasthenia, all unconscious, because he does not encounter them, of the many perils which medicine has removed from his path through life. What does he know of the decline in the death rate by one half and of the increase in the expectation of life by ten or twelve years during the last century? How many are there whose attention has been called to the significant fact that this increase in the expectation of life ceases with the forty-fifth year because we have as yet no such insight into the causes and prevention of the organic diseases of advancing life as we have into the manner of propagation of infectious diseases, which are responsible for the larger part of the mortality of the earlier years? The suffering and the waste of energy, money, production and human lives from preventable sickness and death are still incalculable, but how little heed do legislators and authorities in our national, state and municipal governments pay to the appeals of physicians and enlightened economists to make adequate provision to check this waste! For this condition of things the medical profession is largely responsible in failing to enlighten the public and in shrouding its art with the mystery of an occult science, but it is beginning to rise to its high mission of public education in ways of preserving health and of preventing disease.

I have touched on these matters relating to the present and future state of the science and art of medicine, not with the view of recounting the achievements of modern medicine, but to indicate something of their importance to individual and to civic life and to show that in fostering the teaching and study of medicine the university finds a field worthy of its highest endeavors in the propagation of useful knowledge and in service to the community.

From what has been said we may, I think, assume with confidence that the best and in time the prevailing type of American medical school is destined to be that represented in medical departments in vital union with universities. In so far our system of medical education will conform to that of Germany and France, but in an important respect there is and will doubtless remain a difference due to the fact that in those countries the courses of study and the qualifications for the degree and the license to practise are moulded into practical uniformity by the regulations of the state. Nothing is more characteristic of the conditions of medical education in our country than the great diversity of the requirements and curricula of the various medical schools, even of those of the better sort. Entire uniformity is not to be expected and not to be desired, but at least such a measure of agreement should be secured as will permit students to pass freely from one university to another and to acquire, it is to be hoped, something of the habit of wandering which is such an enviable feature of student life in the German universities.

No problem of medical education in this country is so perplexing or has given rise in recent years to so much discussion and difference of opinion as that of the preliminary education to be required for the study of medicine. If I could announce a universally satisfactory solution of this problem, I should claim the honors of an important discovery, but as I can not do so I shall forego on this occasion its detailed discussion, with a self-sacrificing forbearance which I trust may be commended by my hearers. It must suffice to enumerate the attempts at a solution, premising, what is generally recognized, that the difficulties arise from the anomalous development of the American college for many years, making it, however admirable it may be for certain educational uses, almost unadjustable to the needs of professional education.

The preliminary requirement of the bachelor's degree in arts or science should, in my judgment, carry with it the specification of collegiate laboratory training in physics, chemistry and biology, with a reading knowledge of French and German. These requirements have been in successful operation in the medical department of the Johns Hopkins University since its foundation in 1893, their adoption being necessitated by the acceptance of the terms of Miss Garrett's gift of endowment. We are satisfied with the working of these requirements and would not lower them if we could, but it must be conceded that, while there is room for medical schools with these standards, the country is not ripe for their general adoption. The medical department of Cornell University has recently announced the intention to introduce similar requirements, and the Harvard University Medical School demands the bachelor's degree without the other requirements mentioned.

In order to meet the objection that the average age of graduation from our colleges is at least two years beyond that at which professional study usually begins in Europe, various attempts have been made to truncate the college course or to telescope a quarter to a half of it into the period of professional study, making one course of study count for two degrees. Manifest objections and embarrassments attend all of these attempts to find a suitable stopping place between the high school and the end of the college course. The plan adopted in this university to demarcate with some sharpness the first two years of the college course from the remainder and to exact the completion of these two years of study as the requirement preliminary to the study of medicine has much to recommend it under existing conditions. I learn from the last report of the Council on Medical Education of the American Medical Association that one medical school, the medical department of Western Reserve University, demands as a prerequisite to the study of medicine three years of study in a college of arts or science, sixteen require two years of collegiate study, eleven of these schools being in the middle west or west, and thirty-one require one year, of these, nineteen being in the middle west or west.

The Council on Medical Education just mentioned, of which Dr. Bevan is the energetic and efficient chairman, has entered as a strong force for the elevation of standards of medical education in this country, and, while it has not the power of the British General Medical Council to make effective its recommendations, it can exert a most beneficial influence. It is significant that at its first conference, held in 1905, it recommended as the minimum preliminary requirement to be generally adopted by our medical schools an education sufficient to enable the student to enter the freshman class of a recognized college of arts or a university, and now it recommends that in 1910 to this shall be added a year's study of physics, chemistry and biology, with one modern language, preferably German. The time has gone by when it is necessary to emphasize before an audience such as this the importance of laboratory training in physics, chemistry and general biology as fundamental to the successful study of medicine.

While it is not feasible to exact the preliminary study of the ancient classics, save some acquaintance with Latin, I feel that they are of value to the physician and that a liberal education and broad culture raise the influence and standing of the physician in the community, enhance and widen the intellectual pleasures of his life, instil an interest in the history of medicine and give him greater joy in the pursuit of a noble profession. It is important, especially for medicine, that this culture be imparted by methods of liberal education which do not blunt man's innate curiosity for the facts of nature.

There can be no more striking evidence of the progress of medical education in this country during the last quarter of a century than that it is no longer the laboratory, but the clinical side of medical teaching which offers the urgent problems. Only a few years ago the cry was the need of laboratories; now, while a sufficient supply of good laboratories is still beyond the resources of many medical schools, their value is fully recognized and all of our better schools possess them and are devoting probably as much of the time and energies of teachers and students to work in the laboratories as is desirable. There is even some risk, I believe, that a subject which can be studied with facility and advantage in a laboratory may acquire, on this account, a position in the scheme of medical studies disproportionate to its relative importance. The structure of organized beings, normal or diseased, for example, is eminently adapted to laboratory study, and for centuries normal anatomy had an educational value all its own, because it was the only subject which students were taught in the laboratory, whereas the study of function, certainly not less important, is much more difficult to approach by the laboratory method, and even at the present time normal physiology and especially pathological physiology do not receive the attention in medical education to which their importance entitles them.

It is interesting to note the impressions which Professor Orth, of Berlin, an acute observer and most competent judge in all matters pertaining to medical education, received from his visit to this country three years ago regarding our laboratories and clinics. In an address conveying these impressions to the Berlin Medical Society he expresses his astonishment and satisfaction that, in contrast to the prevalent opinion in Germany as to our medical schools, he found that fully as much emphasis is placed on laboratory teaching here as there, that the laboratories which he visited are as good, their arrangements in some instances arousing his envy, and the methods of teaching practically the same as in Germany, whereas he gathered the impression that the opportunities and methods of clinical teaching are less satisfactory than in Germany and not commensurate with those of our laboratories.

I do not desire to instil sentiments of undue complacency regarding the condition of laboratory teaching in our medical schools, for there is still room for much improvement in this regard. Many schools are sadly deficient and even the best have not all that is needed in the supply and maintenance of laboratories, but the time has come to give especial emphasis to directions of improvement in the teaching of practical medicine and surgery. The making of good practitioners should always be kept to the front as the prime purpose of a medical school.

I believe that in most medical schools at present the clinic falls behind the laboratory in affording students opportunities for that prolonged, intimate, personal contact with the object of study, in this instance the living patient, which is essential for a really vital knowledge of a subject. To secure this, amphitheater clinics and ward classes alone do not suffice, valuable as these are, but students under suitable restrictions and supervision and at the proper period in their course of study should work in the dispensary and should have free access to patients in the public wards of hospitals, acting in the capacity of clinical clerks and surgical dressers as a part of the regular, orderly machinery of the hospital.

In order to place the clinical side of medical instruction on the same satisfactory foundation as that of laboratory teaching, two reforms are especially needed in most of our medical schools.

The first is that the heads of the principal clinical departments, particularly the medical and the surgical, should devote their main energies and time to their hospital work and to teaching and investigating without the necessity of seeking their livelihood in a busy outside practise and without allowing such practise to become their chief professional occupation. This direction of reform has been forcibly urged in this city and elsewhere by my colleague, Dr. Barker, whom we have reclaimed from you, in notable papers and addresses.

The other reform is the introduction of the system of practical training of students in the hospital, which I have indicated, and with it the foundation and support of teaching and investigating laboratories connected with the clinics, to which I have already referred, necessitating the possession of a hospital by the medical school or the establishment of such relations with outside hospitals as will make possible these conditions. This subject, as thus outlined, I made the theme of an address at the opening, six months ago, of the new Jefferson Medical College Hospital in Philadelphia, and I shall now recur only to the point which I endeavored there to establish, that the teaching hospital subserves the interest of the patient not less than that of the student and teacher and is the best and most useful kind of public hospital.

Hospitals make generally a stronger appeal to public and private philanthropy than the support of medical education, but I do not hesitate to affirm that a general hospital in a university city, whether maintained by public funds or by private benevolence, serves the community and the interests of its patients far better when it is readily accessible and freely available for the purposes of medical education than when it is divorced from connection with medical teaching. Witness the great public hospitals in Vienna, Berlin, Munich, Leipsic, Paris, London, Edinburgh, Dublin and a few in this country. It is most deplorable both for the hospitals and for the medical schools that these two institutions, which should be linked arms of medical education, should have developed in this country so far apart, that state and municipal authorities and private founders should have so little realization of the inestimable advantages which close association with a good medical school can confer on a hospital, and that the immense possibilities of public hospitals in our large cities for the education of students and physicians and for the advancement of medical knowledge should be utilized to so small an extent, often not at all.

It would be one of the greatest benefits to the cause of higher medical education if the University of Chicago, for its medical department, should come into possession of a good general hospital and fortunate the hospital which enters into this relationship. This university, the source of so many important contributions to the advancement of knowledge and of higher education, will then be, in larger measure than it now finds possible, a center of similar service to medicine.

Medical education partakes fully of the freedom, so amazing often to many of our European colleagues, with which we unhesitatingly try all sorts of educational experiments in this country—it is to be hoped and expected for the ultimate benefit of systems of education, whatever the immediate results may be in individual cases. The theme of this address naturally suggests many topics relating to methods of teaching and to the medical curriculum which are questions of the day, but which I must lay aside through lack of time. On one only I beg to say a few words.

In contrast to the German system, the tendency in our American medical schools has been toward a rigid curriculum, which, though widely divergent in different schools, is to be followed in precisely the same way by all students without any consideration of differing ability, capacity for work, special aptitudes and interests. One of many unfortunate results is that subjects and courses of study which can not properly be imposed as obligatory on already overburdened students find no place in our medical schools, which should aim to cultivate the whole field of medicine. I agree with Dr. Bowditch and my colleague, Dr. Mall, to whose admirable presentation of this subject I would refer those interested, that our students should have a greater latitude of choice than is now customary in subjects to be pursued, in the amount of time to be devoted to their study and in the order in which they may be taken. Complete freedom can not be granted. A minimum requirement for the principal subjects must be made obligatory, but if this minimum is properly fixed there remains room for a considerable range of choice of subjects and courses, greatly to the advantage of student and teacher. At the Harvard Medical School the system of electives for the fourth year of the course has been in operation for several years, and other medical schools have also introduced a similar plan. At the beginning of the current academic year we adopted at the Johns Hopkins Medical School a scheme by which a large number of elective courses are offered throughout the four years, and the plan is now working most successfully.

Some of our state boards of examiners are greatly exercised over the differences which they find in the curricula of the various medical schools in this country, and which in themselves are merely an indication that there is, and, in my judgment, there can be no agreement of opinion as to every detail of a medical curriculum. There are doubtless defects to be remedied, but in attempting to apply remedies these state boards should concern themselves with no other question than that of educational standards. They could make no greater mistake nor inflict more serious injury on the efforts of the better schools to improve their methods of teaching than to attempt to impose a uniform and rigid obligatory curriculum on all schools. They do not in their examinations apply any practical tests whatever to determine the candidate's fitness for the practise of medicine, whereas our better schools are exerting every effort to increase their efficiency by substituting practical work in laboratories, hospital wards and out-patient departments for didactic lectures. The work of students who gain their knowledge by serving as clinical clerks and surgical dressers in the hospital can not be measured by time standards in the same precise way as that of attendance on expository lectures. Above all, the better schools should not be hampered by restrictions imposed by state boards of examiners in freedom to extend the system of electives of which I have spoken.

The medical department of a university should be a school of thought, as well as a school of teaching, *academia* as well as *schola*. Although there has been gratifying progress in recent years, our medical schools have not advanced along the path of productive research to the same extent that they have in the way of improvement of their educational work. There are several reasons for this condition. For one thing we have been too busy setting our houses in order for their primary uses in the training of students to have given the requisite attention to other questions which, however important, may have seemed for the moment less urgent. With the degree of emphasis thus placed on the educational side teaching gifts rather than investigating capacity have been sought as the most desirable qualification of professors in our medical schools. The power of imparting knowledge, gained second-hand, fluently and even skilfully, is not an uncommon gift and is possessed by many who have never engaged in research and have no especial inclination or aptitude for it, but the teaching of him who has questioned Nature and received her answers has often, and I think commonly, in spite it may be of defects of delivery, a rarer and more inspiring quality.

A medical school or university can not expect to fill all of its chairs with men with the genius for discovery—if it has one or two it has a treasure beyond all price—but every effort should be made to secure as occupants of these chairs from among those who are available, wherever they can be found, the ones who have demonstrated the greatest capacity to advance knowledge by original investigation and the ability to stimulate research. Until this principle is more fully and generally recognized and acted on in the selection of heads of departments, our medical schools as a class will not become important contributors to knowledge. It is not enough that a few schools should encourage and provide for original investigation; the field must be a wide one in order to attract many to a scientific career, for of the many only a few will be found endowed with the power of discovery. There is no possible way of recognizing the possessor of this power before he has demonstrated it. Even when a university has succeeded in attaching to it those who can conduct scientific inquiry successfully, how often are their energies sapped by lack of adequate resources and enough trained assistants and by too great burden of teaching and administrative work imposed on them!

It is evident from what has been said, and indeed it has been a tacit assumption throughout this address, that, while with present resources considerable improvement in medical education in this country is possible, further progress is largely a question of ways and means. What makes modern medical education so costly is precisely its practical character, necessitating laboratories and hospitals, and it can be made self-supporting no more than any other department of higher education. For reasons already stated, the medical departments of strong universities are the ones most likely to receive the funds needed for the support of medical education and are in general the most deserving. There is a great future before the medical schools of many of our state universities, which are already developing with such promise and are sure to receive in increasing measure aid from the state as their needs and the benefits accruing to the community from their generous support are more and more fully appreciated. Other universities must look to private endowment, and I have endeavored to show that they should foster their departments of medicine as zealously as their other faculties. The university chest should be opened, so far as possible, to supply needs of the medical school, and authorities of the university should present the claims of medical education to financial aid as among the most important in their domain, and they can do so to-day with a force of appeal not possible a quarter of a century ago. President Eliot, whose services to the cause of medical education are great, in his address at the opening of the new buildings of the Harvard

University Medical School, set forth with admirable force and clearness the changes which advancing medicine has brought in the vocation of the physician, his greatly increased capacity of service to the community and his still higher mission in the future.

The discoveries which have transformed the face of modern medicine have been in the field of infectious diseases, and in no other department of medicine could new knowledge have meant so much to mankind, for the infectious diseases have a significance to the race possessed by no other class of disease and problems relating to their restraint are scarcely less social and economic than medical. The public is awakening to this aspect in the case of tuberculosis, and I need only cite as a further example the necessity of keeping in check the malarial diseases and yellow fever for success in digging the Isthmian Canal, an undertaking in which the triumphs of the sanitarian, Colonel Gorgas, are not outrivaled by those of the engineer. Such victories over disease as those of the prevention of hydrophobia by the inoculation of Pasteur's vaccine and the antitoxic treatment of diphtheria have made an especially strong impression on the public mind.

More than all that had gone before in the history of medicine the results achieved during the last quarter of a century in exploration of the fields of infection and immunity opened by the discoveries of Pasteur and of Koch have stirred men's minds to the importance of advancement of medical knowledge, and medical science at last has entered into its long awaited heritage as a worthy and rewarding object of public and private endowment. But it is to be noted that it is not so much the education of doctors as this advancement of knowledge which makes the strong appeal, as may be illustrated by the splendid foundation of the Rockefeller Institute for Medical Research through the enlightened generosity of the founder of this university, the Phipps Institute for the Study and Prevention of Tuberculosis, and the Memorial Institute for the Study of Infectious Diseases, established in this city by Mr. and Mrs. Harold McCormick, which under the efficient direction of Dr. Hektoen has become a most active and important contributor to our knowledge of infection and immunity.

These magnificent additions to the resources of this country for the promotion of medical investigations are of inestimable value, but not one of them could have justified its existence by results if it had been established in America thirty years ago, when medical education was so defective. The dependence of research on education is of fundamental importance. The prime factor influencing the development of scientific research in any country is the condition of its higher education. Scientific investigation is the fruit of a tree which has its roots in the educational system, and if the roots are neglected and unhealthy there will be no fruit. Trained investigators are bred in educational institutions. Independent laboratories are dependent on a supply from this source, and without it they can not justify their existence, but where proper standards of education exist such laboratories have a distinctive and important field of usefulness. I contend, therefore, that those interested in the advancement of medical knowledge should not be indifferent to the condition of education in our better medical schools and should not rest on the assumption that the educational side can be safely left to take care of itself.

Moreover, those who are to apply the new knowledge are physicians and sanitarians. The public is vitally interested in the supply of good physicians, never so much as to-day when their power to serve the welfare of the community has been so vastly increased and is rapidly growing, and if it wants good doctors it must help to make them.

I have been able, within the limits of this address, to indicate only a relatively small part of the increased strength gained by both medical school and university by the combination of their forces, but I hope that I may have conveyed some impression of the rich fields of discovery, of the beneficent service to the community, of the important educational work opened to the university by close union with a strong department of medicine, and of the inestimable value to medicine of intimate contact with the fructifying influences and vitalizing ideals of the university. Where is there a university which, if provided with the requisite resources, gives stronger assurance of securing these mutual benefits than the University of Chicago, so fruitful in achievement during its brief but eventful history, so vigorous in its present life, so full of high promise for the future, and where in all this land is there a location more favorable to the development of a great university medical school than here in the city of Chicago? Such a development is bound to come and the sooner it arrives the earlier the day when America shall assume that leading position in the world of medical science and art assured to her by her resources, the intelligence of her people, her rank among the nations and her high destiny.

William H. Welch
Johns Hopkins University

SCIENTIFIC BOOKS

Denatured or Industrial Alcohol. By Rufus Frost Herrick. 8vo, pp. ix + 516. 163 figures. New York, John Wiley and Sons. 1907. Cloth, $4.00.

The preliminary announcements, the contents and the preface of this book were full of promise and the reviewer opened it with great expectations. But, in reading, he experienced a succession of disappointments, and closed it with the sincere wish that he could be excused from the ungracious and uncongenial task of writing the review.

Chapter I. (16 pp.) contains some brief, interesting, historical items, also tables and extracts from consular reports relating to the use of denatured alcohol.

Chapter II. (47 pp.) describes methods of manufacture of alcohol from potatoes, corn, molasses and some other materials. Dr. Wiley's suggestion that cassava root is a promising raw material is not alluded to. There are numerous good cuts of machines. Under the heading "Theoretical *versus* Practical Yields of Alcohol" calculated yields are compared with those actually obtained from different raw materials.

The microorganisms and fermentation are not given space and thoroughness of treatment proportionate to their importance in the industry. The work of Pasteur, Hansen, Buchner, Effront and others, is disposed of in a few lines for each, and no references are added. A small figure in the upper corner of page 42 is the only illustration of yeasts and the magnification is not given. We could readily spare the picture of a floating thermometer (ordinary dairy or bath thermometer) on page 27 and the full-page illustration of "the largest fermenting tank in the world" on page 33, which shows nothing distinguishing it from a railroad water tank surrounded by a group of workmen, in order to make room for a little more information regarding those interesting microorganisms and the investigations done upon them.

There is an unnecessary duplication of some figures. For instance, cuts of ordinary floating hydrometers, the form of which may be assumed to be familiar to most readers, are found on pages 47, 48, 123, 142 and 259. On the other hand, pycnometers, probably less familiar objects and occurring in a greater number of useful forms, are not given one illustration.

Chapter III., upon the distillation and rectification of alcohol (58 pp.), abounds in electrotypes of fractionating flasks and towers used in the laboratory and elaborate cuts of commercial stills.

Chapter IV., on alcoholometry, contains 47 pages, of which 18 are tables for determining per cent. alcohol from the specific gravity—all of which belong in the appendix. It would have been well to insert a table for the conversion of readings on one technical scale into readings on another. The confusion and haziness in the definitions of "proof" alcohol are illustrated by the odd statement on page 123 ". . . (being equal to proof or 53.71 per cent. by volume of water and 50 per cent. by volume of alcohol) . . ."

The use of references and quotation marks is a little haphazard and sometimes one can not tell just what parts of the text are the author's and what parts he is taking bodily from the journals. This is nothing but carelessness and there is not the slightest indication of willful plagiarism. It is particularly noticeable on page 150, where, by the way, two references are given to the *American Chemical Journal* which can not be found in that journal. They are in the *Journal of the American Chemical Society*. There is no objection to reprinting journal articles bodily as is done very frequently in this book, only a journal article presupposes knowledge of technical details which it is the function of such a book as this to impart. There must be explanatory statements to make the article really useful to the average reader; there must be some editing, in other words. Mr. Herrick has not done enough of such editing and the result is that, despite the value of the numerous articles in themselves, the whole is not so instructive as it should be.

Chapter V. (38 pp.) is on the cost of alcohol and of alcohol-distilling plants. We have here many extracts from Bulletins of the U. S. Department of Agriculture and a few selections from the author's private correspondence. A little over one page of text is inserted, quite out of place, for it belongs under the head of the manufacture of alcohol, upon "The Manufacture of Ethyl Alcohol from Sawdust." Considering the possibilities latent in methods for obtaining alcohol from wood, this treatment is very inadequate. Not a single reference is given where more information may be obtained. The same chapter contains six full pages of coordinate paper on which the costs of buildings of different heights are laid off on one axis against length, width, etc., on the other. The information as to the cost of buildings is given elsewhere, and in more convenient form, as parts of general estimates for completed plants. At least five sixths of that space might have been saved and used to describe processes for obtaining alcohol from wood.

Chapter VI., "Alcohol as an Illuminant" (32 pp.). An interesting little historical sketch is followed by statements of the relative costs of lighting by alcohol and by oil. Methods for making photometric measurements are not touched. A simple diagram of the internal structure of an alcohol burner and a careful description would suffice, but there is an overwhelming array of figures showing lamps of different external appearance, hanging lamps, student lamps, bracket lamps, out door lamps, even a cut on page 231 of a gas jet fitted with an ordinary Welsbach mantle. Along here the text reads like a trade catalogue. For instance, on page 222:

> The accompanying cut shows the Phœbus Hanging Billiard Incandescent Alcohol Lamp. This lamp is of beautiful design and furnishes a very agreeable light for its purpose. The style shown is the large model, and is finished in rich reddish brown or sea-green. . . . The ornate hanging Phœbus lamp (Fig. 92) is finished in an exquisite variety of designs. . . . In Fig. 94, p. 224, is shown the beautifully decorated Phœbus Indoor Alcohol Lamp. This lamp is furnished with a rich head shade, which can be had in any colors desired.

Without a pause we must jump from this style of literature to statements which presume a knowledge on the reader's part of the significance of the symbols "B.T.U." and the merits of the Harcourt pentane lamp as a standard.

Chapter VII., "The Fuel Value of Alcohol," etc. (40 pp.). The Williams bomb calorimeter is the only form of calorimeter described. The calculations and tables are interesting and instructive. There follow cuts of flat-irons, curling irons, stoves for heating and for cooking, a "sterno-inferno coffee-machine set," and full-page illustrations of a "complete chafing-dish outfit trimmed with genuine ivory" and "teakettle set, trimmed with solid beaded edge."

Chapter VIII., "Alcohol as a Source of Power" (62 pp.). This chapter opens with twelve pages of excellent cuts and descriptive matter furnished by the Deutz Gas Engine Works "through the kindness of their American branch house, the Otto Gas Engine Works." Mietz and Weiss, Weber and Diesel, and Foos engines are illustrated.

Chapter IX., "Laws and Regulations for Denatured Alcohol" (32 pp.), is almost exclusively a compilation of circulars, regulations and acts of several governments; very interesting and useful, but they belong in the appendix.

A page on the recovery of denatured alcohol is forcibly injected into this chapter where it does not belong. The chapter closes with two pages on "spirit varnishes." This lost and forlorn little composition appears to contain all the book has to say upon the many important uses of denatured alcohol in chemical industries. It is indeed strange that a book on denatured alcohol should not give a brief sketch at least of the manufacture of ethyl ether, iodoform, artificial silk or smokeless powders. Chapter X. (14 pp.) gives extracts from consular reports, showing what enormous quantities of denatured alcohol are used for the above purposes in other countries.

Appendix (pp. 375–499). In this are reprinted government regulations, a report of a committee to the British Parliament, etc., all exceedingly interesting material, but almost all of it to be had for the asking and a postage stamp.

The bibliography on page 493 (not 489, as given in the index) is incomplete. Since some French and German titles are included, others should be. For instance, the *Zeitschr. f. Spiritusindustrie,* the German journal devoted to the subject, is not mentioned. Date and place of publication and authors' initials are in several instances omitted. If it is considered undesirable to include prices in a bibliography, the size of the work might be indicated in terms of pages. In his preface the author says: "The scarcity of literature treating the subject of denatured or industrial alcohol is so great that there are practically no books concerning it." The reviewer had occasion to look up the literature of the subject about a year ago and found many more articles than he had the opportunity to read.

The book as a whole has little claim to consideration as a scientific treatise, and its usefulness "practically" is somewhat problematical, although it contains much that is both good and useful, of course. It is a scrapbook made up from a superabundance of electrotypes, plenty of government publications and dealers' catalogues, some journal articles and too few references. It is raw material which one would naturally collect as a preliminary step to writing a book.

S. Lawrence Bigelow

Genera Avium. Edited by P. Wytsman. 4to. Brussels, V. Verteneuil and L. Desmet. Part VI., Picariæ.—Fam. Coliidæ. By P. L. Sclater. 1906 (1907). Pp. 6; pl. I. Part VII., Steganopodes—Fam. Pelecanidæ. By Alphonse Dubois. 1907. Pp. 4; pl. I. Part VIII., Picariæ—Fam. Musophagidæ. By Alphonse Dubois. 1907. Pp. 9; pls. II.

Three more parts[1] of this useful work have recently been published, one of which (part VI.), though dated 1906, apparently was not issued until May, 1907. The general treatment is the same as that of preceding parts, and need not again be explained. "Genera Avium" is, of course, not an exhaustive treatise, but the editor, Mr. P. Wytsman, deserves the thanks of ornithologists for his efforts to bring out a work that shall present in convenient, succinct form, the most important points regarding genera and species, with due regard for the results of recent research.

The Coliidæ, or colies (part VI.), a highly peculiar African family allied to the kingfishers, is considered by Dr. Sclater to con-

[1] For a notice of the five previous numbers, *cf.* Science, N. S., XXIV., 1906, pp. 438–439.

sist of eight species. No subspecies are admitted, notwithstanding that all but two of the species have been subdivided, and we think rightly, by recent authors. The nomenclature is not fully up to date, for two of the species have older tenable names than those here used. A new name, *Colius hæmatonotus*, is given, apparently by inadvertence, in the key on page three, to *Colius castanonotus* Verreaux. Our author refers all the species of this family to a single genus, but, as we have elsewhere shown, *Urocolius* Bonaparte, containing *Urocolius macrourus* and *Urocolius indicus* (= *erythromelon* Auct.), has more than one claim to recognition. The single plate in this part represents *Colius leucocephalus* and details of two other species.

The cosmopolitan family Pelecanidæ (pelicans) (part VII.) comprises, according to Doctor Dubois, the single genus, *Pelecanus*, with eleven forms, three of which he ranks as subspecies. In the case of *Pelecanus californicus*, which he considers a race of *Pelecanus fuscus* (or, as it should be called, *Pelecanus occidentalis* Linnæus), he is probably right; but *Pelecanus thagus* Molina is apparently a distinct species. The plate shows a figure of the somewhat doubtful *Pelecanus sharpei*, together with the heads of four other forms.

The Musophagidæ, or plantain eaters (part VIII.), another characteristic African family, are here referred to seven genera, without subfamilies. The largest genus, *Turacus*, contains twenty-one forms, including several subspecies; but all the other genera are small, none having more than four species. Two of them—*Corythæola* and the recently discovered *Ruwenzorornis*—are monotypic. We are glad to see that Doctor Dubois adopts the original form of the generic name *Chizærhis* Wagler, instead of the emendation *Schizorhis* so much in vogue. No new forms are described in this number. The two plates illustrate nine species.

HARRY C. OBERHOLSER

SCIENTIFIC JOURNALS AND ARTICLES

The American Museum Journals for November and December are both out containing much information in regard to the work of the Museum. There is a new departure in the shape of colored plates, one showing a boulder containing a deposit of precious opal on quartzite, the other the group of wild turkeys recently placed on exhibition. The December number contains accounts of the expeditions made in 1907 to obtain material for bird groups, of the making of an Attu basket, and of an ant-hunting trip to Europe. It also comprises the Index to Vol. VII.

The Bulletin of the Charleston Museum for November continues the "History of the Museum" by William G. Mazyck and covers the period from 1798 to 1850. We find here many notable and well-known names, such as Gibbes, Holmes, Holbrook, Bache, Maury and Twomey.

Bird Lore for November-December is of unusual interest and contains illustrated articles on "A Thrashing by Thrashers" by Herbert K. Job, "Around the Horn for Petrels" by John T. Nichols, "The Heath Hen" by George W. Field, "A Season's Field Work" by Frank M. Chapman, and the "Migration of Flycatchers" by W. W. Cooke. The number comprises a long and interesting Report of the Work of the Audubon Societies by the President, William Dutcher, and various Special Agents. This should be read by everyone.

The Museums Journal of Great Britain for November notes the gift to Bournemouth of the residence and collections of Mr. Cotes to form an Art Gallery, another of the many instances where collections made by men of wealth have eventually found their way to the public. W. W. Watts discusses "Some Uses of a Museum of Industrial Art," noting the importance of arousing interest in artistic objects, by showing their historical associations or the conditions under which they have been made. A. B. Meyer presents "Some Notes on the Peacock in Display" showing that the position of the wings may be different in different individuals.

SOCIETIES AND ACADEMIES

THE INDIANA ACADEMY OF SCIENCE

THE winter meeting of the academy was held in the Shortridge High School at Indianapolis, November 28 and 29. President D. M. Mottier presided and, at the opening session, delivered an instructive and interesting address on "The History and Control of Sex." The following papers were read either in general session or in the sectional meetings formed by grouping related subjects:

GENERAL

"The Origin of Adaptation in the Fresh-water Fauna," by C. H. Eigenmann.

"Spectacles—A Concession to the Theory of Evolution," by A. G. Pohlman.

"New Science Laboratories in Moore's Hill College," by A. J. Bigney.

"A Study of the Sex Ratio in the Fruit Fly," by W. J. Moenkhaus.

"Some Photographs (lantern slides) of Daniel's Comet, 1907," by W. A. Cogshall.

"The Celebration by the New York Academy of Sciences of the Two-hundredth Anniversary of the Birth of Linnæus," by G. W. Wilson.

"Hand Dexterity," by A. G. Pohlman.

"The Autopsy in Relation to the Public Health," by H. R. Alburger.

"An Investigation of the Fuel Value of Indiana Peats," by R. E. Lyons.

ZOOLOGY

"Tardy Humming Birds," by W. B. Van Gorder.

"The Moulting Mechanism of Lizards" (lantern slides), by H. L. Bruner.

"A Crow Roost near Remington, Ind.," by F. J. Breeze.

"The Relation of the Degree of Injury to the Amount of Regeneration and the Moulting Period in Gammarius," by Mary Harman.

"The Influence of Environment on Man," by Robert Hessler.

"Some Internal Factors controlling Regeneration in Scyphomeduson, *Cassiopea Xamachana,*" by Charles Zeleny.

"Selective Fertilization in Certain Fishes," by W. J. Moenkhaus.

"Heredity in the Tumor Cell," by H. R. Alburger.

"The Circulation through the Fetal Mammalian Heart," by A. G. Pohlman.

"The Technique of the Three-dimension Reconstruction Model," by A. G. Pohlman.

"Experiments on the Rate of Regeneration," by M. M. Ellis.

"Observations on the Senses and Habits of Bats," by W. L. Hahn.

"Some Notes on the Habits of the Common Box Turtle," by Glen Culbertson.

BOTANY

"The Peronosporates of Indiana," by G. W. Wilson.

"The Existence of *Rœstelia pencillata* and its Teliosporic Phase in North America," by F. D. Kern.

"The Heterotype Chromosomes in *Pinus* and *Thuja,*" by I. M. Lewis.

"Insect Galls of Indiana," by Mel T. Cook.

GEOLOGY

"A Probable Origin of the Small Mounds of the Mississippi and Texas Regions," by A. B. Reagan.

"Indiana Soil Types," by C. W. Shannon.

"Structures in the So-called 'Huron' Formation of Indiana, induced by the Solution of the Mississippian Limestone Beneath," by J. W. Beede.

"Stratigraphy of the Richmond Formation of Indiana," by E. R. Cummings.

"Some Peculiarities of the Valley Erosion of Big Creek and its Tributaries in Jefferson County," by Glen Culbertson.

PHYSICS

"The Cause of Surface Tension," by A. L. Foley.

"Loss of Weight in Chemical Reactions," by J. B. Dutcher.

CHEMISTRY

"The Electrolytic Production of Selenic Acid from Lead Selenate," by F. C. Mathers.

"Some Complex Ureids," by James Currie.

"Thiocarbonylsalicylamide and Derivatives," by R. E. Lyons.

"The Volumetric Determination of Selenic Acid," by R. E. Lyons.

The attendance at the meetings was about seventy-five and the interest shown in the work being done in the state was above the average. New members were elected and the treasurer's report showed a satisfactory condition of the finances. Professor Amos W. Butler, secretary of the state board of charities and one of the oldest members, called attention to the fact that two years hence would occur the quarter centennial anniversary of the organization of the academy, and suggested the desirability of a meeting befitting the occasion. As a result plans were started looking to the celebration of the event. The academy's library, which now numbers several thousand volumes of books and pamphlets, was consigned to the care of the state librarian, who is to catalogue and shelve the collection, and make it as available for use by the members and the public as is any part of the library. The academy reserves the right to remove the collection at any time under certain stipulated conditions.

A discussion of the general welfare of the academy developed the need of bringing more of the science men into closer touch with the work of the academy, and of extending its influence to every part of the state. For this work a committee was appointed whose duty it is to devise a way of bringing the work of the academy more directly to the attention of the scientists. And as a further means to the same end it was decided to hold the winter meetings at different educational centers instead of at Indianapolis, which for years has been the stated meeting place. Finally, it was the general feeling that interest would increase if the state appropriation for publishing the *Proceedings* could be increased so that the papers would appear in a more extended form and if separates of the papers could be secured at a more reasonable price. The summer meeting was discontinued for the present.

James H. Ransom,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 639th meeting of the society was held November 23, 1907—President Hayford in the chair. Mr. Fred E. Wright spoke of "Recent Improvements in the Petrographic Microscope" describing briefly the most important improvements which have been made in the petrographic microscope during recent years. The different attachments and accessories were considered especially with reference to their general applicability and the degree of accuracy attainable by their use. The speaker explained that the improvements had been chiefly brought about by the demands of geologists and mineralogists. The optical principles involved in the study of minerals, and how these can be applied in mineral classification, were briefly defined. With the microscopes now available it is possible to measure the refractive index of mineral grains that are only a few thousandths of a millimeter in diameter. Special mention was made of the double micrometer ocular for determining optic axes of minerals. By its aid the optical angle can be measured to one degree if both axes are visible, or to 3° if only one is visible. Special appliances were also shown for measuring the extinction angle by the use of which the best accuracy attainable is from 10′ to 15′.

Mr. W. P. White presented a paper on "Calorimetric Measurements within the Electric Furnace." The special furnace which it was proposed to use in the high temperature measurements, and the conditions which the electric furnace imposes on high temperature problems were briefly mentioned. The difficulty of obtaining a good calorimeter was pointed out.

The method of dropping heated bodies from a furnace into a calorimeter is familiar and satisfactory, but fails to give many inversion—and latent heats which require to be determined on a rising temperature. Dropping into a furnace or manipulation with it is exceedingly difficult. By measuring the heat flowing into a crucible by means of the difference of temperature between crucible and furnace wall, a new and simple radiation method is obtained. In a preliminary survey, this method was satisfactorily applied to 2-gram charges of silicates as high as 1560°. The temperature rose 8° a minute; the temperature difference (furnace wall—crucible) was about 3°, which was measured to 0.1°. Results agreed within six per cent. By keeping the temperature difference constant and varying the rate, systematic errors in the reading of the thermoelements were avoided. This method compares the latent with the specific heat, which is then to be determined by the dropping method.

R. L. Faris,
Secretary

THE TORREY BOTANICAL CLUB

The meeting for November 27, 1907, was called to order at the Museum Building of the New York Botanical Garden at 3:45 p.m. by the secretary, and Dr. N. L. Britton was elected chairman. Nineteen persons were present.

Mr. G. V. Nash exhibited a flowering specimen of the orchid *Masdevallia bella*. The Rev. Leander T. Chamberlain read an extract copied from the Province Laws of Massachusetts, 1736–1761, p. 153, entitled "An Act to Prevent Damage to English Grain, arising from Barberry Bushes." All persons in the province having barberry bushes growing on their land, were ordered to destroy them before a named date. Severe penalties were prescribed on failure to comply with this law. A brief discussion of the subject followed.

Dr. Britton exhibited a specimen from Jamaica, W. I., illustrating an economic use of cat-tails. This was a "bed," made from the split stems of the *Typha domingensis*.

The following scientific program was presented:

A New Utricularia from Long Island: John Hendley Barnhart.

The new species was described and specimens of it exhibited. The paper and description will be published in full in the *Bulletin of the Torrey Botanical Club*, for December, 1907.

Some Anomalous Leaf-forms: C. Stuart Gager.

Specimens were shown illustrating the formation of ascidia in the white (?) clover and in a leaflet of the licorice (*Glycyrrhiza*); variations in the branching of the leaf-blade of a species of *Fraxinus;* transitions, in *Aralia racemosa,* from a once-compound to a normally twice-compound leaf; branching of the leaflets of *Hicoria ovata* and of *Æsculus hippocastanum;* and various stages of transition, in *Gleditschia triacanthus,* from once-compound leaves to twice- and thrice-compound ones, the transitional forms occurring in some instances on the same branch, and even on the same leaf. Rosette leaves were also shown from several species of Biotian asters, showing gradual transitions from a slight indentation of the margin of the blade along its basal half to the development of petiolate leaflets, so that the leaf appeared to be a pinnately compound one. The possible causes of these variations were briefly discussed.

Brief discussion followed the presentation of both papers.

C. Stuart Gager,
Secretary

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

The third regular meeting of the session of 1907–8 was held at the Chemists' Club, 108 West 55th Street, on December 6.

Messrs. T. J. Parker, L. H. Baekeland, Hugo Schweitzer, G. C. Stone, E. G. Love and Morris Loeb were elected to represent the section in the council of the society.

The following papers were read:

The Relative Solubility of Silver Halides and Silver Sulphocyanate: Arthur E. Hill.

The solubilities of silver chloride, sulphocyanate, bromide and iodide are compared by the method of solution equilibrium; when silver chloride, for example, is treated with a solution of potassium sulphocyanate a partial decomposition of the chloride occurs, as shown by the expression

$$AgCl + KCNS \rightleftarrows AgCNS + KCl.$$

According to theory,

$$\frac{S_1}{S_2} = \sqrt{\frac{C_1}{C_2}}$$

where S_1 and S_2 stand for the solubilities of the two difficultly soluble salts, expressed in equivalents per liter, and C_1 and C_2 are the concentrations of their anions in solution when equilibrium has been reached. The salts considered are well suited to study by this method, since the dissociation constants of the potassium salts are equal, and the silver salts are all totally dissociated; hence no corrections for inequalities in dissociation are necessary. By application of the foregoing formula to the four salts mentioned, in solutions of varying concentration, the relative solubilities at 25° C. are found to be as follows:

$$\begin{aligned} AgCl &= 1.00000 \\ AgCNS &= 0.07480 \\ AgBr &= 0.05500 \\ AgI &= 0.00077 \end{aligned}$$

The results are in close agreement with those that have been obtained by other methods.

The Hypothesis of Radiant Matter: MORRIS LOEB.

Dr. Morris Loeb reviewed the present status of the hypothesis of radiant matter. He showed that the Electron Hypothesis rests partly upon the Lorenz-Maxwell electromagnetic theory of light, especially as exemplified in the Zeeman effect, and partly upon the electro-conductivity of gases, as studied by J. J. Thomson and others. To this must be added the various phenomena of the electric discharge in vacuo as well as of the radiations from thorium, uranium and radium, which are likewise explained upon the assumption of small particles actually propelled from the electrodes or expelled from the atoms. This has led further to the idea of a corpuscular structure of the atom, for which corroboration is sought in the apparent decomposition of the elements, the "degradation" of those of higher into others of lower atomic mass. In the opinions of many, the constituent corpuscles are themselves not matter but electric disturbances of the ether. Dr. Loeb pointed out certain discrepancies between various parts of the theory, which must be explained away, before it could be accepted as a whole. Thus, measurements upon the Zeeman effect indicate a very small number of electrons; while Rutherford's transformation hypothesis calls for a very large number of freely moving particles within the atom. A nebular or corpuscular structure of the atoms would give the electrons of the cathode rays a so much greater free path, than would result from the existence of atoms as solid bodies, that it becomes difficult to account for the various phenomena attending increasing rarefaction in the Crookes tube upon the kinetic reasoning usually applied. The speaker also showed that most of Thomson's calculations upon the speed and masses of the electrons, which are usually cited as showing the non-existence of matter, really depend upon the arbitrary assumption that the numerator rather than the denominator of the ratio e/m is a constant; while he really transfers the chief attributes of matter to energy, without, as a matter of fact, reducing the number of our fundamental ideas. Discussing the recent experiments of Cameron and Ramsay, he argued that the appearance of sodium and lithium in a copper nitrate solution, exposed to the emanation from radium, could not be taken as proof for the decomposition of copper, until a corresponding loss of the latter metal shall have been demonstrated. It will be remembered that Cameron and Ramsay ascribe the transformation of the emanation into helium, the lightest of the inert gases, to the bombardment of α particles; when water is present to take up some of the energy, neon is produced; while copper salts still further shield the emanation atoms, so that they are only degraded to argon, the heaviest member of the series. In view of the great excess of water-molecules in the copper nitrate solution, Dr. Loeb holds that this hypothesis calls for the presence of a great deal of neon, mixed in with the argon, while Ramsay and Cameron emphasize its absence.

The Stereochemistry of Indigo: K. GEO. FALK and J. M. NELSON.

Experiments upon Barfoed's Acid Cupric Acetate Solution as a Means of Distinguishing Glucose from Maltose, Lactose and Sucrose: F. C. HINKEL and H. C. SHERMAN.

C. M. JOYCE,
Secretary

DISCUSSION AND CORRESPONDENCE

TWO NEW METEORITES

Ainsworth Meteorite.—This siderite, to which I propose to give the name of the town near which it was found, was recently purchased from Mr. J. C. Toliver. It was found last winter by one of Mr. W. G. Townsend's little boys, who called his father's attention to it, partly buried in the sand beside a small creek in Brown Co., Nebraska, about six miles northwest of Ainsworth. It measures approximately $4\frac{1}{2} \times 6 \times 7$ inches, and weighs $23\frac{1}{2}$ pounds (10.65 kilograms). The specific gravity of the whole mass is 7.85. A fractured surface—showing beautifully the coarse octohedral structure—on one of the sharper edges and adjoining side, shows where a considerable piece, weighing perhaps two pounds, was broken off, antecedent to its burial, probably at the time it fell. Two of the projections on one side are flattened, as if by pounding, but closer examination shows fine striæ running evenly across both surfaces, which are in the same plain and partly join each other, suggesting that the meteorite in falling may have glanced on a rock, making a slickensided surface. The meteorite also shows two marks made by a sharp tool, like an ax, which also apparently antedate its last burial in the sand. But the most marked feature about this iron is the presence, on the surface, in a number of places, of bright unaltered triolites with a part of a crystal face showing in one place. This feature, in connection with the general freshness of the iron and the presence of what seems to be the original surface over a good part of it, indicates that it is a comparatively recent fall.

Williamstown Meteorite.—I secured this siderite last March from Mr. A. E. Ashcraft, who found it April 25, 1892, on his farm in Grant County, Ky., three miles north of Williamstown. It is a nearly square, thin, flat-shaped iron about $16 \times 12 \times 2\frac{1}{2}$ inches thick in the center, thinning to a blunt edge at either end. It was entire when it reached me, with the exception of a few ounces broken from one edge, and weighed 68 pounds (30.85 kilo.) and has a specific gravity of 8.1. It has already been cut into a number of sections, which etch very readily, showing the structure to be that of a Mediam octohedrite. Three distinct systems of Kamacite lands are cut at approximately right angles, while a third is cut at an angle of 60° or 70°, thus showing an apparent breadth of about three times that of the other lands. Triolite seems to be pretty generally distributed throughout the mass in very small grains, although two nodules about one half inch in diameter were revealed, but the total amount of this mineral is small, as might have been inferred from the general smoothness of the surface, and the specific gravity.

A fuller description of both of these meteorites will be given when the analysis, which will be made at the National Museum, is completed.

Edwin E. Howell

Washington, D. C.,
September 17, 1907

DR. ARMSBY'S NEW UNIT FOR ENERGY

In a paper read before the Society for the Promotion of Agricultural Science[1] Dr. Armsby suggests a new unit for energy. This unit is a million gram-calories and he calls it a *Therm*—spelled with a capital *T*. Since the word *therm* has been suggested and occasionally used to mean the gram-calorie, and since we are accustomed to use the prefixes *kilo* and *mega* to denote, respectively, a thousand and a million—as in kilometer, kilogram, kilowatt, megadyne, megohm—would it not conform better to our customary nomenclature to call the kilogram-calorie a *kilocalorie* and a thousand kilogram-calories a *megacalorie?* These names have the advantage that they would at once be understood by a man who had never seen them before, whereas the name *Therm* would for a time need explanation.

A. T. Jones

Purdue University

SPECIAL ARTICLES

SOME LIFE-HISTORY NOTES ON MEGARHINUS SEPTENTRIONALIS[2] D. AND K.

Some observations upon the life history of this rather rare and beautiful species of mosquito were made at this station[3] during the past season.

On September 10, 1906, the senior author collected 24 larvæ of this species and several of a smaller species, probably *Culex pipiens*, from a half-barrel tub of rain water, not more than 100 feet from an inhabited dwelling, on a farm near Church Hill, Tenn. All were placed in a small pail together and carried overland twenty-three miles in a buggy and then forty on the train to this laboratory,

[1] Science, Vol. XXVI., p. 670.

[2] Smithsonian Miscellaneous Collections, Vol. 48, Part 3, No. 1657.

[3] Tennessee Agricultural Experiment Station, Knoxville.

where they arrived September 14. When examined the next morning but two of the larvæ and one pupa of the smaller species remained, the others having been devoured by their larger predatory companions.

The *Megarhinus* larvæ, which had just passed through the last molt (September 10–11, 1906), were placed in beakers containing tap-water, allowing several individuals to each beaker, and kept in the laboratory. They were fed on the larvæ of smaller species, chiefly *Stegomyia fasciata* and *Culex* sp., until October 10, after which time we were unable to secure a further supply of these out of doors.

When feeding upon the smaller larvæ the *Megarhinus* larvæ swallow their prey bodily, but when practising cannibalism, as was observed in two cases, the victim is held in the strong mandibles and slowly devoured. So far as observed these larvæ make no apparent effort to pursue their prey, but remain quietly near the bottom of the water until a smaller larva approaches, when with a quick movement the latter is seized in the powerful mandibles and speedily disappears. In the several instances observed no effort was made to change the hold, whether the prey was first seized near the head, middle or tail. One larva was seen to seize a nearly mature larva of *Culex salinarius* near the middle, and without loosening its hold to swallow it gradually, the head and tail disappearing together. Considerable difficulty attends an attempt at swallowing their prey head foremost, as one instance was noted where the usual three or four minutes were stretched to more than an hour before the still struggling victim finally disappeared. The *Megarhinus* larvæ are able to remain entirely submerged for hours at a time, even during comparatively warm weather, which fact probably accounts for their habit of wintering in the larval stage.

Four of the larvæ died before December 10, 1906, and on that date six of the remaining twenty were transferred to an earthen jar containing about three inches of mud, above which was two inches of water. This jar was sunk into the ground almost up to the rim in a wire screen house out of doors and sheltered from the direct rays of the sun. Here these six larvæ remained throughout the winter. The lowest temperature to which they were subjected was $+13°$ F., on the morning of December 24, 1906. This cold snap continued two days, freezing ice three fourths of an inch in thickness on the water in the jar. On the afternoon of December 26 the ice had thawed around the edges sufficiently to allow it to be lifted out of the jar, when one larva was found with its anal breathing tube frozen fast in the ice. The other larvæ were lying on the surface of the mud in a semi-torpid condition. One of the larvæ died as a result of this freeze, and by March 12 two others were dead. On March 25 one of the remaining outside larvæ pupated, and another on the thirtieth. A drop in temperature to $+30°$ F. on the morning of April 2 caused the death of the remaining outside larva and one pupa. The other pupa was so weakened by a freeze on April 15, when the mercury fell to $+26°$ F., that it died two days later.

On December 15 five of the fourteen larvæ kept in the laboratory were transferred to a beaker, in the bottom of which was about two inches of mud, thus duplicating the conditions of the lot kept outside, except as to temperature. No difference in behavior could be noted, except that the larvæ were more active, as would naturally be expected from the higher and more uniform temperature of the steam-heated room.

Of this lot two larvæ transformed to the pupa state, in which condition one died, the other emerging as adult (female) on April 4. The last larva died April 18.

Soon after the mud was placed in the beaker a number of cyclops and other small water animals were observed swimming about. These were still present this spring, although the mosquito larvæ were without food for a period of five months, during which time they continued active, but were never seen to make any attempt to feed upon these smaller forms of water life. Nor did they during this time resort to cannibalism; but when several larvæ of *Culex salinarius* were placed in the beaker on March 12 they were devoured with great avidity. This interesting observation indicates a narrow food habit for this species.

Of the nine remaining larvæ of the original lot, five were reared to the adult state. The first pupa appeared March 8, the adult emerging five days later. Thus 179 days had elapsed between the date of collection and the date of pupation, during the last 149 of which the larvæ had been without food.

Among the larvæ kept out of doors, which were under nearly natural conditions, the first pupa appeared 196 days after the date of collection and the last 201 days. The latter lived 18 days, but the adult failed to emerge.

This would indicate that under natural conditions one would expect the pupæ to appear during the latter part of March and most of April and the adults during April and possibly May.

The average length of the known larval life of the ten individuals which transformed to the pupa state was 196.5 days. The shortest period was 179 days, and the longest 205 days. How much it would be necessary to add to this in order to arrive at the total larval life is not known; nor do we know the incubation period, as we were unable to secure eggs.

The shortest pupal period was five days, the longest 11 days, and the average 7.3 days. The shortest adult life was one day, the longest 11 days, and the average 6.8 days. It is probable that with natural conditions the adult stage would have been somewhat lengthened, for this species is rather shy and could not be expected to thrive well under close confinement.

From the fact that a few adults were present when the larvæ were collected, September 10, 1906, together with the dates of emergence of those we reared, we are led to believe that there are at least two broods per year at this latitude. These broods probably are not sharply defined, because of the variation in time required to hatch the eggs of those mosquitoes which lay their eggs singly. It is probable that during the latter part of summer all stages may be found together.

H. A. Morgan
E. C. Cotton

DISSOROPHUS—A CORRECTION

In the *American Naturalist* for November, 1895, Professor E. D. Cope described (p. 998) a new form of Paleozoic amphibian, from the Permian of Texas, which he designated by the name of *Dissorophus multicinctus.* He based the new form on a series of "ten consecutive vertebræ and their appendages" and on account of the peculiar carapace referred to it as a "batrachian armadillo." He characterized the new form as follows:

> The neural spines are elevated, and the apex of each sends a transverse branch which extends in an arch on each side to the ribs. These spinous branches touch each other, forming a carapace. Above and corresponding to each of them is a similar dermal osseous element, which extends from side to side without interruption on the median line, forming a dermal layer of transverse bands which correspond to the skeletal carapace beneath it.

In the *Proceedings of the American Philosophical Society* for May 15, 1896, Cope published on Plate X. three figures of the same specimen and gave the name as *D. articulatus* Cope. Again in the *American Naturalist* for November, 1896, under the title of "Permian Land Vertebrates with Carapaces" (p. 936), he gave additional notes on *Dissorophus* and repeats the same figures which were given in the *Proceedings of the American Philosophical Society,* 1896, Plate X., and again gives the name as *Dissorophus articulatus* Cope.

In Hay's "Catalogue of the Fossil Vertebrata of North America," there are given two species of *Dissorophus, D. multicinctus* Cope, and *D. articulatus* Cope, and reference to the *Proceedings of the American Philosophical Society,* 1896, Plate X., is omitted. Broili ("Paleontographica," 1904) follows Hay, evidently, in making out his list of the Stegocephalia of the Permian of Texas, since he also gives the two species of *Dissorophus.*

There can be no doubt that there is but one species of *Dissorophus* and that species is *Dissorophus multicinctus* Cope first described in 1895. That the specimen first described is the same as the one figured on Plate X. of the *Proceedings of the American Philosophical Society,* can not be questioned. Cope says the specimen consisted of "ten consecutive vertebræ and their appendages," and this is the number of vertebræ figured on the plate. Nowhere is *D. articulatus* designated as a new species and the original description applies exactly to the figures there given.

Cope's ability to shift names is well known to those who are accustomed to deal with subjects treated by him, but usually such shifted names were detected, either by Cope or others. This appears not to be the case with *Dissorophus* and, so far as I can learn, the correction has never been made. *Dissorophus multicinctus* Cope is the only species of that genus which is valid and it is desirable that the synonymy of *D. articulatus* with the first described *D. multicinctus* should be established before the mistake goes further into the literature. Roy L. Moodie

The University of Chicago,
November 14, 1907

CURRENT NOTES ON LAND FORMS

THE PENEPLAIN OF NORTH CENTRAL WISCONSIN

The peneplain of north central Wisconsin has been recently described with rare skill by S. Weidman in a state survey report (Chap. XII., pp. 575–631, in "Geology of North Central Wisconsin," Bull. XVI., Wisc. Geol. and N. H. Surv., 1907). The teachers of the state and geographers in general will here find excellent account and illustration of the still undissected parts of the peneplain, of the well-defined, though small, monadnocks that rise above it, and of the valleys that have been eroded beneath it; they will find also a well-considered and lucid discussion of the origin of these features. The once continuous upland is ascribed with good reason to the destruction of ancient mountains of disordered and generally resistant rocks in an almost complete pre-Cambrian cycle of subaerial erosion. The submergence of the resulting peneplain, its burial beneath an unconformable cover of paleozoic strata, the elevation of the region with the resultant removal of the covering strata and resurrection of the buried peneplain, and the dissection of the peneplain by superposed rivers are all clearly set forth. The upland rises from 1,000 feet at its southern border to 1,500 feet at the northern part of the area. As the rivers are followed southward, there is a gradual transition from well-enclosed valleys, 200 or 300 feet deep, floored and sided with disordered rocks, through shallower valleys, floored with disordered rocks but sided with stratified rocks, to open valleys, floored and sided with stratified rocks. There is a corresponding passage from higher, more northern uplands of disordered rocks, through somewhat lower uplands, patched over with scattered remnants of the once more extensive cover of stratified rocks, to the lower ground of the still remaining, continuous stratified cover. All these features are so well presented that they may be accepted as standard accounts of typical physiographic features. If a hesitating geographer is still to be found, unconvinced of the desirability of replacing older empirical methods by newer explanatory methods in the description of land forms, let him read this essay.

The attention of others engaged upon physiographic reports for state surveys may well be directed not only to the general plan of this report, but particularly to four helpful block diagrams (pl. 68–71), which promptly and concisely set forth the essentials of the story to be told, so that its details may afterwards be apprehended in proper relation to the more general features. The chapters on glacial and alluvial deposits also contain geographical material. One of the very few points on which Weidman's form of statement might be changed to advantage is that concerning the adjustment of rivers. It is said: "Under normal conditions, streams . . . tend, not only to flow in nearly direct courses, but also to avoid the harder rocks, thus seeking to establish their courses upon the softer formations and to move along lines of least resistance" (p. 616). This might give the impression that the establishment of stream courses along belts of weak rocks is accomplished by the preexistent streams themselves, as an active, almost intentional process. The quoted phrase might be changed to read: "Streams of early origin are often led to avoid the harder rocks by the later development of subsequent streams along belts of weaker rocks." It is not clear why the technical term, baselevel, should be printed as two words in a report which makes a single word of waterfall.

W. M. D.

DEFLECTION OF RIVERS BY THE EARTH'S ROTATION

The sufficiency of the earth's rotation to deflect rivers has now been debated many years. The deflective force is well understood to be independent of azimuth and to increase with the sine of the latitude, but to be so weak as to be of questionable value in spite of its persistence. Nevertheless, the observations of von Baer and others regarding Russian rivers, the well-marked asymmetry of the radial valleys on the great fan of Lannemezan in southwestern France, and the occasional instances of unsymmetrical valleys reported in different parts of this country by Kerr, Gilbert and others, have kept the matter in the mind of geographers. As to the Russian rivers, particularly the Volga, where a long-maintained right-handed tendency has resulted in a strong inequality of valley-side slopes, no efficient explanation in place of the deflective force of the earth's rotation has been offered. As to the radial valleys of the Lannemezan fan, L. A. Fabre has given good reasons for regarding their steeper right and less steep left sides as dependent on the westerly source from which their rains usually come; and as to the greatest of our own rivers, for which the detailed maps of the Mississippi river commission give unusually accurate quantitative measures of lateral erosion, the studies of I. Bowman, published in Science a few years ago, leave little doubt that the rotation of the earth, which would turn this south-flowing river westward, has less control than the prevailing winds, which brush it eastward.

A presumed effect of deflection upon river courses has been pointed out by certain Austrian geographers, who have noted that some of their larger rivers, especially the Danube, turn to the left in long curves, convex to the right, while passing across alluvial plains between notches in rock ridges; the left-handed turning of the river curves being the necessary result of the right-handed pressure of the river between its pairs of (relatively) fixed points. Had the original course of these rivers been direct, from notch to notch, the deflective force of the earth's rotation, even though quantitatively weak, would have been at least qualitatively appropriate to bring about the existing curved courses.

DEFLECTED RIVERS IN AUSTRALIA

Few examples of deflected rivers have been noted in the southern hemisphere; hence an especial interest attaches to some instances reported by T. G. Taylor in Australia ("A correlation of contour, climate and coal; a contribution to the physiography of New South Wales," *Proc. Linn. Soc. N. S. W.*, XXXI., 1906, 517–529). It is pointed out that several members of the Murray river system, on the inner plains west of the mountains back of Sydney, exhibit a persistent tendency to turn to the left, while sweeping around long curves convex to the right. It is urged that as the rivers flow for several hundred miles across a nearly level district where there are no rock outcrops to determine their courses, the earth's rotation should become a prime factor in guiding them.

It is with regret that we have to conclude that the explanation offered by Taylor for these left-curving rivers is not valid. There is no indication that the rivers are held in rock notches at the ends of their curves, and it is, moreover, evident that if the reason given for the Danube curves were applied to the Australian rivers, they ought to turn to the right in long curves convex to the left. The case would then be somewhat analogous to that of cyclonic winds, which being deflected from the barometric gradients by a right-handed force in the northern hemisphere, there curve to the left in spiral inflows to low pressure centers; or by a left-handed force in the southern hemisphere, there curve to the right. It is implied by Taylor that the Murray river branches were originally straight, presumably on lines now indicated by the tangential prolongation of their upper waters; hence the greatest amount of deflection should have been in the lower course of each curved branch; but this does not appear to be a legitimate consequence of the earth's rotation. Moreover, Taylor goes on to say that the two rivers least deflected are the Murrumbidgee and the Murray, "which is what one would expect, since their course is practically at right angles to the meridians." But the deflective force being independent of azimuth, and these two rivers being farther from the equator than any other members of the Murray system, they are precisely the two that should show the greatest deflection. Finally, no adequate consideration is given to other possible controls of the river courses in question; yet in view of the fact that the left-hand curving of the rivers leads them toward the lower part of the trunk river, it may well be that their courses are essentially consequent upon the various processes that have in a general way given shape to the Murray basin. It does not, therefore, seem warranted to regard these Australian rivers as having been deflected by the earth's rotation.

W. M. D.

THE WORK OF OUR LARGER MUSEUMS AS SHOWN BY THEIR ANNUAL REPORTS

A number of museum reports, including those of our largest institutions, have appeared during the past summer, all somewhat belated, though any one acquainted with the work of museums can understand and excuse much of this delay. They comprise the reports of the United States National Museum, American Museum of Natural History, Field Museum of Natural History, Carnegie Museum, Museum of the Brooklyn Institute and the Public Museum of Milwaukee. These are the largest of our museums and it may be well to note what they are doing for the public.

The cramped and crowded condition of the present building of the United States National Museum precludes many changes in or additions to material on exhibition, but the accessions to the collections have been many and valuable. The most important among them were the collection of arms, numbering 569 pieces, deposited by the United States Cartridge Company, and the Schaus collection of Lepidoptera, comprising about 75,000 specimens. That research work has not flagged is shown by the list of papers published in the *Proceedings,* and the liberal policy of allowing others than members of the museum staff to study material or publish the results of their observations. The list includes many names and covers a great range of subjects.

As a forecast of future arrangements in connection with the new museum building, it is noted that this will contain the collections of archeology, ethnology, natural history and geology; that a portion of the Smithsonian building will be given over to art and that the present building will contain the technical collections.

As to art, the gifts of the Freer and Evans collections provide the opportunity for removing the stigma that the United States is the only large nation without a national gallery of art.

The report of the American Museum of Natural History is, as usual, somewhat brief and formal, though presenting a concise view of the year's work.

It seems to be taken for granted that museum reports will only be read by those directly concerned, and, acting on this assumption, little is done to make them interesting, though the illustrations probably appeal to the average man rather than the text.

Two prominent features of the year are the acquisition of a considerable number of skeletons of whales, the commencement of a life-sized reproduction of a sulphurbottom whale and the installation of a number of new and beautiful bird groups. Hitherto cetaceans have been but poorly represented in this museum and it is the evident intention to remedy this defect. The bird groups are an attempt to show certain phases of the bird life of North America in a more realistic and more beautiful manner than has hitherto been done. The methods employed are an adaptation and amplification of those in use, or suggested, and the results far in advance of those previously attained. Groups of animals may be treated from various standpoints, the one most commonly taken being that introduced by the British Museum, in which birds or other animals are shown as nearly as possible with their exact surroundings. This often results in subordinating the animal to its accessories. Another plan is to either select such animals as are particularly interesting in themselves, or more or less remarkable in habits, or, when commoner animals are shown, to make the surroundings more or less subordinate, to suggest nature rather than imitate it. In the one case the result is a beautiful picture in which the animals are a small part. In the other emphasis is laid on the animal itself. Both methods have their uses and the museum that can will do well to employ both in its exhibition series.

It is sad to note that the first report of the Field Museum of Natural History should be the one to record the death of its founder, Marshall Field, whose portrait forms the frontispiece of the volume. By his liberality this museum came into existence full-fledged and started with greater collections than have fallen to the lot of any other new museum.

The plans for the new museum building, which had been in preparation for some time, called for the expenditure of more than the four millions left by Mr. Field for that purpose, and the plans have accordingly been revised. As soon as the legal obstacles that have for some time stood in the way have been removed, the work of construction will be commenced. This museum is well to the fore in anthropology and is making rapid strides in botany and the principal accessions of the year have been in these departments. In spite of the probable removal of the museum, the work of installation has proceeded steadily.

A part of the report of the Carnegie Museum is couched in apologetic language, and expresses the dissatisfaction of the director at seeing the doors thrown open to the public before the museum was in proper condition to receive them. As the director says:

> What has been accomplished only represents the partial fulfilment of his ideals, and it undoubtedly will be several years before the museum will begin to assume proper shape and the various collections which it is destined to contain will have been brought into thoroughly systematic order.

But we fear if museum directors waited until they were prepared for the public, the doors of the museums would never be opened, and in answer to Dr. Holland we quote as follows from the report of the Brooklyn Institute Museum:

> The outlook at times too may seem most discouraging, there are so many things planned and so few completed. Work of all kinds remains unfinished, important specimens are needed in all departments, labels are lacking, cases disarranged and many things conspire to render the lot of an energetic curator an unhappy one. Moreover, a museum is generally the resultant of many forces and consequently a compromise of what the director would like to have it and what he is compelled to do.

Finally, no apologies are necessary from Dr. Holland, but congratulations for what has been accomplished. For in spite of the obstacles which may have interfered with its activities, but have not stopped its growth, work has steadily gone on, especially in the section of paleontology, which has become so important and striking a feature of this institution; and valuable material has been collected from the Fort Benton Cretaceous, and the mounting of the great Diplodocus skeleton completed. This institution also ranks high in the number and character of its publications, the most important for the year being a memoir on the crayfishes of Pennsylvania, which is a good example of work that may be done near home.

The Museum of the Brooklyn Institute is the most recent of any under consideration, having been opened in June, 1897. It differs from the others in being a museum of art as well as of science, thus differing from most other institutions in the United States, for while the Carnegie Institute includes museums of art and science, these have each their own director, their common bond being through the board of trustees. It differs also in distinctly providing for children and teachers by its Children's Museum, whose exhibits and lectures are directly planned to interest the one and aid the other. Various institutions, notably the American Museum and the Carnegie Museum, provide lecture courses for teachers and children, the initiative having been taken by Professor Bickmore more than twenty-five years ago. The Carnegie Museum, American and Milwaukee Museums also issue loan collections, the commencement having been made by the Milwaukee Museum.

The chief accessions of the year in the line of natural history were the Ward collections of sponges and corals, the first numbering over 800 species, the latter over 200. They provide for an unusually full exhibit in these branches of zoology, as the specimens were originally brought together with a view to exhibition and not for study. Work was continued among the Indians of the southwest, in order to round out the important collections of that region, but especial attention was directed to the Pomo tribe of California. The approaching completion of the new wing of this museum will finish the north front and provide for future growth.

Perhaps the most important deduction to be drawn from a perusal of these reports is that a great amount of attention is being paid to the educational side of museum work and large expenditures of thought and money are made to render them not simply instructive, but attractive to the public. And there are many weighty reasons for believing this to be the correct view of the duty of the museum.

These institutions are largely supported by public funds and the public has a right to expect a due return for its investment. Dr. Boas may be, undoubtedly is, wrong in some of his views regarding the principles of museum administration, but he is entirely correct in his assumption that the majority of visitors to a museum do not seek anything beyond entertainment. If he errs at all, it is in placing the proportion of such visitors too low. Therefore, in the exhibition of specimens, the aim should be not merely to furnish information to the man who is looking for it, though this should assuredly be done, but to attract and interest the chance or indifferent visitor and to arouse in him a desire for further knowledge.

The particular attention given to the collection, study, and display of fossil vertebrates is a direct outcome of the extensive deposits of fossils in the western states. These afforded an opportunity that was embraced by American men of science and the art of collecting and mounting this class of material has reached a higher point here than in any other country, skeletons of gigantic dinosaurs and tiny mammals being mounted as if they were the skeletons of modern animals. Thus the life of the past, once considered as a mysterious branch of research, has been brought within the grasp of the average museum visitor.

The American Museum has in this line of work literally carried the war into Africa and despatched an expedition to the Fayum in search of examples of the primitive elephants and other interesting animals discovered by Beadnell and Andrews.

We are accustomed to regard the number of visitors to a museum as a measure of its importance and public usefulness, but it may more properly be looked upon as an indication of its interest for the public and to some extent of the state of the weather. If it is of interest to the public, there is small doubt but what it will prove to be useful.

The Milwaukee Museum is so arranged that the attendance can not well be taken; the Carnegie Museum has been closed for the past year; attendance at the others was as follows:

U. S. National Museum and Smithsonian Institution	360,547
American Museum of Natural History	476,133
Field Museum of Natural History	254,516
Brooklyn Institute Museum, including Children's Museum	229,028
A total of	1,320,224

The visitors at the U. S. National Museum are largely from out of town, but the great majority of those at other institutions are residents, and it speaks well to those who know how inconvenient of access is the Field Museum that a quarter of a million of people should have found their way to it. When this museum is transferred to the Lake front, the attendance will be vastly increased just as the number of visitors at the American Museum nearly doubled the year after the establishment of the elevated station at 82d Street. This museum now enjoys the best location of any in the country, so far as ease of access is concerned and not unnaturally stands first in the number of its visitors.

Museum attendance, as shown by the report of the U. S. National Museum, is subject to great fluctuation and, like sun-spots, has its maximum and minimum periods. After each inaugural year there is a drop to below the normal and in the years 1905 and 1906 attendance was less than in any previous year. There is a curious correlation between the loss here and the great falling off in attendance at the British Museum, where the Bloomsbury Square institution reports a loss of 122,000 and the Museum of Natural History of 95,000 visitors. It can not be said that this is due to any fault or deterioration of the exhibits or administration of these or other museums.

The American and Field Museums both offer extended series of lectures on topics akin to the work of the museums and these are fairly well attended. The Field Museum has arranged to have its lectures during the coming year given in the Hall of the Art Institute, in which it will not be handicapped by its location.

After all, the amount of real good effected by lectures is somewhat of a problem. Formerly lectures were given because the speaker had something to impart, but not unnaturally the pictures have come to be regarded as more important than the words, or at least more desired by the public. This is not wholly to be wondered at or deplored, for pictures often give a clearer idea of facts and things than descriptions, illustrations being the equivalent of the objects on exhibition in a museum.

It is very evident from the lists of material received and papers published that the scientific side of museum work is not receiving any less attention than heretofore, simply the public is very properly getting more.

F. A. Lucas

THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

A committee of the general society has been formed to arrange for a meeting to be held on April 23, 24 and 25, 1908. The committee consists of George F. Barker, Philadelphia; John A. Brashear, Pittsburg; William Keith Brooks, Baltimore; Ernest W. Brown, New Haven; Thomas C. Chamberlin, Chicago; Charles F. Chandler, New York; Edwin Grant Conklin, Philadelphia; Henry H. Donaldson, Philadelphia; Charles L. Doolittle, Upper Darby, Pa.; Arthur W. Goodspeed, Philadelphia; I. Minis Hays, Philadelphia; Morris Jastrow, Jr., Philadelphia; David Starr Jordan, Stanford University, Cal.; Charles R. Lanman, Cambridge; Marion D. Learned, Philadelphia; Simon Newcomb, Washington; Edward L. Nichols, Ithaca; Henry F. Osborn, New York; Edward C. Pickering, Cambridge; Henry A. Pilsbry, Philadelphia; Ira Remsen, Baltimore; William B. Scott, Princeton; Thomas Day Seymour, New Haven; Edgar F. Smith, Philadelphia; Edward B. Titchener, Ithaca; William Trelease, St. Louis, Charles D. Walcott, Washington; Woodrow Wilson, Princeton; William H. Welch, Baltimore; Robert S. Woodward, Washington.

This committee has sent out the following letter:

The American Philosophical Society has satisfactorily shown that the interests of useful knowledge in the United States may be greatly promoted by the annual general meetings of the society. Such meetings have proved attractive to its members in all parts of the country, not only because of the general interest in the scientific communications offered, but also because of the opportunities afforded of renewing and extending acquaintanceship among workers in the various fields of knowledge, and they have markedly broadened the field of usefulness of this, the oldest scientific society in America.

The general meeting of 1908 will be held on April 23 to 25, beginning at 2 p.m. on Thursday, April 23, and the above committee has been appointed to make the necessary arrangements.

Members desiring to present papers, either for themselves or others, are requested to send to the secretaries, at as early a date as practicable, and not later than March 25, 1908, the titles of these papers, so that they may be announced on the program which will be issued immediately thereafter, and which will give in detail the arrangements for the meeting.

Papers in any department of science come within the scope of the society, which, as its name indicates, embraces the whole field of useful knowledge.

The publication committee, under the rules of the society, will arrange for the immediate publication of the papers presented.

The activity of the society is reflected in the increasing volume of its publications, which constitute a series covering one hundred and forty years, and include *Transactions* in quarto and *Proceedings* in octavo; its exchange list embraces most of the scientific societies of the world. The society thus offers valuable avenues of prompt publication and wide circulation of the papers read before it.

SCIENTIFIC NOTES AND NEWS

THE colleagues and friends of Professor A. A. Michelson and those who appreciate the honor done to this country by the conferring on him of the Copley medal of the Royal Society and the Nobel prize in physics, have arranged to unite in a dinner at Chicago on January 3, the last day of the meeting of the American Association for the Advancement of Science.

THE Munich Academy of Sciences has elected as corresponding members Mr. G. K. Gilbert, of the U. S. Geological Survey, and Professor J. J. Thomson, professor of experimental physics at Cambridge University.

THE Hayden memorial geological medal of the Academy of Natural Sciences of Philadelphia will be presented to Mr. Charles D. Walcott, secretary of the Smithsonian Institution on Tuesday evening, January 7. The presentation address will be made by Dr. Persifor Frazer.

SIR W. H. BENNETT has been elected president of the Institute of Hygiene, London, in succession to the late Sir W. H. Broadbent.

DR. BERTHOLD LAUFER, lecturer in anthropology in Columbia University, has accepted the position of curator in the Field Museum of Natural History in Chicago and will proceed on January 7 to Thibet, where he will spend three years. The money for the expedition has been given anonymously.

PROFESSOR DUGALD C. JACKSON, of the Massachusetts Institute of Technology, Boston, has consented to act as temporary technical assistant of the expert accountant engaged in devising a system of bookkeeping by which the city can keep informed of the financial operations of the Chicago Telephone Company under the new ordinance.

DR. GEO. I. ADAMS, has returned to Washington from Peru, where since 1905 he has been chief geologist to the government of Peru.

A SMITHSONIAN grant has just been approved by Secretary Walcott in favor of Professor William Hallock, of Columbia University, New York, to investigate a 3,300-foot well near Oakland, Maryland. Among other things, Dr. Hallock will determine, if possible, the conductivity of gas at this extreme depth and will try to get information as to the possible radioactivity of rock far below the surface.

PROFESSOR HENRY B. WARD, of the University of Nebraska, has been elected a foreign member of the Russian Imperial Society for the Acclimatization of Animals and Plants.

THE Société d'Anthropologie de Paris has elected Dr. Ales Hrdlička an associate foreign member. Heretofore he had been a corresponding member.

DR. STROUD proposes to resign the Cavendish professorship of physics in Leeds University, after twenty-two years' service.

DR. HERMANN GRAF ZU SOLMS LAUBACH, professor of botany at the University of Strasburg, has retired from active service.

DR. GUSTAV JÄGER, of Stuttgart, known for his contributions to hygiene, has celebrated the fiftieth anniversary of his doctorate.

IT is stated in *Nature* that Mr. Haffkine has accepted an appointment to a post at Calcutta offered to him by the secretary of state for India. It will be remembered that Mr. Haffkine was held responsible for an unfortunate accident that occurred in the Punjab in connection with plague inoculation, an accident for which a large body of scientific opinion has pronounced him to be in no way to blame.

WE learn from the *Geographical Record* that Mr. Leo Frobenius, the German ethnologist and explorer, whose researches along the

Kasai River in 1904–6 are well known, has returned to inner Africa, to make further investigations. He is accompanied by Dr. Hugershoff as surveyor and geologist and Mr. Fritz Nansen as cartographer and photographer. The party will study, for a year, the little-known region to the south of the great Niger bend. Another year will be spent along the lower Niger, and, if the health and resources of the expedition permit, similar investigations may be extended to Togo and the Cameroons.

Dr. Ernest H. Starling, professor of physiology in the University of London, will give the Herter lectures of the year on the subject "The Fluids of the Body," beginning on January 6 at 4 P.M. and continuing at the same hour throughout the week at the Carnegie Laboratory of the University and Bellevue Hospital Medical College, 338 East 26th Street, New York City.

Dr. Frank Thilly (A.B. Cincinnati, '87), Sage professor of philosophy at Cornell University, made the address on the occasion of the first reunion of the colleges of the University of Cincinnati. The subject of his address was "University Ideals."

At a meeting of the Geographical Society at Philadelphia on December 19, Captain Roald Amundsen gave an illustrated account of his discovery of the Northwest passage.

It is reported that the remains of the philosopher Kant are to be transferred to the Fürstengruft of the cathedral in Königsberg.

We regret to record the death on December 29 of Dr. Coleman Sellers, at the age of fifty-nine years. Dr. Sellers was chief engineer of the Niagara Falls Power Company and chief mechanical engineer of the Canadian Niagara Power Company. He had been president of the American Society of Mechanical Engineers and of the Franklin Institute of Philadelphia.

The death is announced of Mr. M. Walton Brown, secretary of the British Institution of Mining Engineers.

The Rev. George Nelson Webber, D.D., who had been professor of philosophy at Middlebury College and Smith College, died on December 20, at the age of eighty-one years.

Professor Oskar Lassar, of the University of Berlin, known for his work in dermatology, died on December 23, at the age of fifty-eight years.

There will be a civil service examination on January 15 and 16 to fill four vacancies in the position of aid in the U. S. Coast and Geodetic Survey with a salary of $750 per annum. An examination is also announced for the position of chemist aid in the Bureau of Chemistry, department of agriculture, at a salary of $1,000. Applicants will not be assembled for this examination, but will be graded on their education and training. On January 29–30, 1908, there will be an examination to fill at least three vacancies in the position of miscellaneous computer, Naval Observatory, Washington, D. C., and vacancies requiring similar qualifications as they may occur in that observatory. The department states that miscellaneous computers are paid by the hour and earn from $1,000 to $1,200 per annum. Promotions are made from this grade, without further examination, to the grade of assistant, at $1,200 per annum, as vacancies occur.

At the meeting of the Department of Superintendence of the National Education Association in Washington, D. C., February 25–26–27, considerable attention will be given to agricultural education. A round table conference will be held at which will be discussed among other things "Cooperation between the State Agricultural College and the State Normal School in Training Teachers for Elementary Agriculture" and "Cooperation between the United States Department of Agriculture and State School Authorities in Promoting Agriculture in the Public Schools." Arrangements have also been completed to organize at the February meeting a "Department of Rural and Agricultural Education" coordinate with other departments of the National Education Association. Permission to organize this department was given by the board of directors of the National Educational Association at the meeting in Los Angeles in July, 1907.

At the meeting of the Cardiff City Observatory committee on November 30, says *Nature,* it was announced that arrangements are busily proceeding for the installation of a seismograph at the observatory on Penylan Hill. The seismograph is being provided by the Cardiff Naturalists' Society, its up-keep being undertaken by the city council. It is hoped that the instrument may be installed early in the new year, and that Professor Milne will be able to attend the opening. Professor Milne has urged the establishment of a seismograph at Cardiff, which will form a triangle with the existing stations at Birmingham and Shide.

It is stated in *Symon's Meteorological Magazine* that the commonwealth of Australia has inaugurated a meteorological bureau for the whole continent, with its headquarters in Melbourne, and Mr. H. A. Hunt has been appointed the first commonwealth meteorologist. The new bureau will have control of the weather service over an area scarcely less than that of the United States or the Dominion of Canada, and very much larger than that of India.

A number of government bureaus and scientific societies of Germany have united to establish a series of meteorological stations extending through western Anatolia and Mesopotamia, situated at Marash, Urfa, Mesereh, near Kharkut; Kalat Shergat and Babylon. It is expected that these stations will supply information concerning the meteorological conditions of the high plateau and mountain land of the Taurus system and of the plateau and steppes as well as the alluvial region of the Euphrates and Tigris.

Captain Benard, the commander of the *Jacques Cartier,* a vessel now being equipped for a Polar expedition which is expected to leave France at the end of March, has given some particulars of the enterprise to the press. It appears that the expedition has been organized by a group of French students of oceanography, the object being the observation of facts belonging to that branch of science, as well as maritime meteorology, the discovery of new fishing grounds, and the exploration of territory believed to contain valuable mineral deposits. There is no intention to break the Polar record, but merely to explore an almost unknown region, opening up a new field of action to the owners of fishing fleets and to the French mining industry. Scientific observations will be made in the bays of Novaya, Zemlya, the Matotchkin Shar, and the Kara Sea, which will benefit not only France but all Europe.

The Royal Meteorological Society, in order to encourage the teaching of facts regarding weather and climate in schools, are inviting elementary teachers and others to send in essays in the form of an original nature-study lesson on weather or climate (not exceeding 1,500 words in length), together with a brief synopsis of five other lessons to cover the whole subject of climate and weather. If essays of sufficient merit are received, three prizes will be awarded of £5, £3 and £2, respectively.

We take the two following notes from the *Journal of the American Medical Association:* "The Vienna papers announce that forty-five grains of radium have been extracted from ten tons of ore given the Vienna Academy of Sciences by the government. The Austrian government refuses to sell the ore to foreigners." "The German railroads have ordered that the vision of employees must be tested henceforth with the colored plates originated by Professor W. Nagel, of Berlin, in place of the Holmgren skeins and yarns, hitherto used for the tests."

According to the London *Times* the British Weights and Measures Association has presented to the Chinese Minister in London a petition signed by 100 British firms doing business in China. By an imperial edict issued in Peking on October 9 the Board of Revenue and Commerce was ordered to introduce a uniform system of weights and measures throughout the Chinese empire and to fix the standards within six months. The petition asks that the standards to be adopted as the base of the new uniform system should be uniform with or multiples and sub-multiples without fractions of, the English standards, on the ground, among others, that the trading relations between the Chinese and the British empires are now based on these standards, which are, the petitioners contend, those in most general use in the commerce of the world.

We learn from the London *Times* that the general purposes committee of the Birmingham Chamber of Commerce, having instituted an inquiry relative to the proposed compulsory adoption of the metric system, reports that opinion is divided on the question. The strongest opposition to compulsory adoption so far as the Birmingham and Midland district is concerned is to be found in the engineering trades. "It is stated," the committee reports, "that practically all engineering standards are based upon the inch, and it follows that all British-made ships, rolling stock, machinery gauges and tools, etc., are constructed according to these standards, the equivalents of which it is impossible to specify accurately in metrical measure. English-made machinery now in use in every part of the world made to our standard gauges on the interchangeable principle can have spare parts sent out of stock, but if any other standard is set up it would be necessary for the user of such machinery when ordering spare parts to specify whether the machinery was made before the passing of the proposed act, and would cause endless confusion and annoyance with customers at home and abroad." Whilst recognizing that the metric system is now much more widely used by traders in foreign transactions than was the case a few years ago, the committee seriously urge every trader interested in foreign trade to make use of the metric system wherever it may appear to be to his interest to do so. They are convinced that the commercial interests of the country will be much better served by gradual and voluntary adaptation than by legislation of a compulsory character.

UNIVERSITY AND EDUCATIONAL NEWS

Trinity College, Cambridge University, benefits to the extent of $2,000,000 by the death of Lady Pearce. Her husband, Sir William George Pearce, chairman of the Fairfield Shipbuilding and Engineering Company, died on November 2 last. By his will his fortune was bequeathed to Trinity College on the death of Lady Pearce.

Lord Newlands has given £20,000 to Glasgow University for the establishment of scholarships to be held by students going from Glasgow University to Balliol College, Oxford.

M. Théodore Vautier has given 100,000 francs to the University of Lyons for research work in experimental physics.

Mr. W. F. King, boundary commissioner of Canada, has given to the geological laboratories of the Massachusetts Institute of Technology a valuable collection of rocks. The institution has further received from the estate of Caroline Whitney a seismograph, which for the present at least will be installed at the Blue Hill Observatory.

The Administration Hall of the Oklahoma State University, erected about four years ago at a cost of $85,000, was totally destroyed by fire on the afternoon of December 20. The flames started from the explosion of a gasoline stove in use on the roof by some workmen engaged in painting the dome. Arrangements are complete for the distribution among the other buildings of the classes affected, so that no recitation will be omitted on account of the fire. The records were saved and the loss on equipment was slight. By hard work the library building, and more especially Science Hall were saved without damage except slightly from water. The hall was insured for $67,000, and rebuilding will begin at once.

The Edward Davies Chemical Laboratories at Aberystwyth University College, the gift of the Llandinam family, have been opened by Mr. Asquith.

A chair for photography is to be established in the Technical Institute at Dresden.

Dr. William H. Welker, assistant in biological chemistry at Columbia University, has been appointed demonstrator of physiological chemistry at the University of Pennsylvania, where he succeeds Dr. P. B. Hawk.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JANUARY 10, 1908

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REPORT OF THE GENERAL SECRETARY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE FOR THE CHICAGO MEETING, CONVOCATION WEEK, 1907-8

THE fifty-eighth meeting of the American Association for the Advancement of Science was held from December 30, 1907, to January 3, 1908, inclusive, at the University of Chicago.

This was the second meeting in Chicago, and, including the one at New Orleans, the ninth which has been held so far west. The first Chicago meeting, the seventeenth of the association, was held in August, 1868. Several things about it seem of interest in this connection. The sessions were held in the Assembly Hall of the Y. M. C. A. Building and the Baptist Church, both located in what is now the downtown business section of the city. The meeting was under the auspices of the citizens rather than of any scientific or educational body.

During the war no meetings were held, but in 1866 an effort was made to revive the association, and a meeting was informally called at Buffalo. It was attended by 79 persons.

No better success as to numbers attended the regularly called meeting of the next year at Burlington, only 73 being present. The leaven was working, however, and the first Chicago meeting may be said to have begun a new period of prosperity.

This meeting was attended by 259 persons, the total membership being 428 at the time of assembling, showing a remarkably large ratio of attendance to membership. The enthusiasm which had been aroused was indicated by the fact that 261 persons took membership in the association at this meeting. The list of names is interesting. It includes many business men whose names have been and are prominent in connection with the enormous growth and development of Chicago's commercial interests.

It seems especially noteworthy that the list includes John Crerar, Orrington Lunt and G. C. Walker, whose names are associated, respectively, with the John Crerar Library in the city; the Orrington Lunt Library at Northwestern University, and the Walker Museum of the University of Chicago.

The majority of the 261 names belong to the city of Chicago, but the addresses are widely enough distributed to show that interest in science and in the association was awakened in all settled parts of the north. There were 151 papers presented on a wide range of topics. To one whose contact with the association is confined to later years, it seems odd to find a single sectional program containing papers on subjects belonging to astronomy, physics, chemistry, economics and engineering. Present at the meeting and presenting papers was G. W. Hough, then of Albany, N. Y., but for years professor of astronomy in the Northwestern University. So far as the writer could ascertain, he is the only one of those attending this first Chicago meeting who also attended the one just held, where he was present at the sessions of Section A.

The opening session of the meeting at the University of Chicago was held Monday, December 30, in Leon Mandel Hall, at 10 A.M. It was called to order by retiring President William H. Welch, who introduced President E. L. Nichols, who presided. Addresses of welcome were made on behalf of the university by Dean George E. Vincent, representing President Judson, and on behalf of the city by Mr. George E. Adams, vice-chairman of the local committee. President Nichols replied briefly on behalf of the association. An interesting feature of the addresses was the graceful reference of the speakers to the recent conferring of both the Copley medal and the Nobel prize on Professor A. A. Michelson, of the University of Chicago.

The address of retiring President Welch was delivered in the same hall on Monday evening and was intently followed by a large audience. After it the members of the association were received by Mrs. H. P. Judson and Dean Vincent.

The number of members officially registered for the meeting is 725. Members of affiliated societies not members of the association registered to the number of 185. It is certain that many members of the association failed to register, while comparatively few from the affiliated societies registered with the permanent secretary. No account was taken of visitors not members of any society. From data available at the close of the meeting, it is fair to assume that the number of persons attending was close to 2,000. The members of the association who registered are distributed as follows:

Illinois	221	North Dakota	3
Ohio	57	New Jersey	3
New York	56	North Carolina	3
Dist. of Columbia	47	Louisiana	3
Indiana	38	Texas	2
Wisconsin	36	Maine	2
Michigan	34	Mississippi	2
Minnesota	32	Kentucky	1
Missouri	31	Delaware	1

Iowa	25	Alabama	1
Pennsylvania	20	Virginia	1
Nebraska	16	Rhode Island	1
Massachusetts	15	Utah	1
Connecticut	11	California	1
Canada	11	Georgia	1
Kansas	10	South Carolina	1
Maryland	8	Oklahoma	1
Colorado	6	England	1
South Dakota	5	Hawaii	1
Tennessee	5	Japan	1
New Hampshire	4		

Taking the number present at 2,000 and applying the same geographical distribution would indicate that about 1,300 persons attended from within a radius of 500 miles against nearly 700 from a greater distance. As to distribution east and west, it appears that, leaving out Illinois and the two from outside the continent, the registered attendance from east of Chicago was 324, while from west of Chicago 178 persons registered.

During the meeting 309 new members were elected. One hundred and forty-two members were elected to fellowship. About one half of these are from membership in affiliated societies under the general rule adopted at the Philadelphia meeting.

The societies meeting in affiliation were the American Society of Naturalists, the American Mathematical Society (Chicago Branch), the American Physical Society, the American Chemical Society, the American Physiological Society, the American Society of Biological Chemists, the American Society of Zoologists (Central Branch), the Association of American Anatomists, the Association of American Geographers, the Society of American Bacteriologists, the Entomological Society of America, the Botanical Society of America, the American Psychological Association, the Western Philosophical Association, the American Anthropological Association, the American Folk Lore Society and the Bibliographical Society of America. In practically all cases one or more joint sessions of the society were held with the corresponding section of the association. In some cases the joint meeting included more than one affiliated society, and in at least one case two of the sections.

At one of these joint sessions occurred a symposium on "Cooperation in Biological Research"; at another a symposium on "Immunity." The one occurring in Mandel Hall, on Thursday, was devoted to an important and significant symposium on public health.

On Monday afternoon and Tuesday, sections A and B, with the Chicago section of the American Mathematical Society, listened to a series of addresses and discussions on the teaching of mathematics to students in engineering colleges. The large attendance to hear these addresses and discussions, together with the lively and often spicy character of the latter, fully attests the wide-spread and deep interest in this subject, one of great importance to engineering education. A committee was appointed to make an investigation of actual conditions bearing on the subject and to report its findings and recommendations to the Society for the Promotion of Engineering Education. This society took steps last summer to appoint a committee of somewhat wider scope, and it is presumed that the committee appointed at Chicago will work in conjunction with that of the professional society. A full account of the proceedings relating to the teaching of mathematics will appear in Science.

Among the discussions of general interest was the very vigorous one before Section I on "The Panic of 1907, and the Monetary System of the Nation." It is hoped that a full report of each of these general discussions will appear later in this journal.

The American Chemical Society, in affiliation with Section C, held a large and enthusiastic meeting. Including the general papers and addresses, and the programs of the different sections of the society, over 150 papers were presented before this body. On Tuesday, Wednesday and Thursday mornings, sessions of general interest were held.

An important action of the council of the Chemical Society was the organization of the industrial chemists into a Division of Industrial Chemistry and Chemical Engineering, and the undertaking of the publication of a special journal of industrial and engineering chemistry.

The number of resolutions touching matters of general import which were adopted at the Chicago meeting was larger than usual. Of prime interest in this connection is the following letter:

The White House,
Washington Dec. 31, 1907.

My Dear Sir:—

I am sending you herewith copy of a letter which on November 11th I addressed to the Governors of each of the several states relative to a proper conservation of the natural resources of this country and inviting the Governors, with their experts, to meet in conference on this subject at the White House on May 13, 14 and 15 next.

I enclose also a copy of a letter recently received from the Chairman of the National Advisory Board on Fuels and Structural Materials, in which he suggests that in bringing this matter before the people of the country I invite the cooperation of the National Engineering Societies and other national organizations for research and development.

The suggestion is an excellent one; and I am led to believe that these organizations can render no more important service at this time than to develop among the people of this country a realization of the fact that these resources, upon which the future as well as the present welfare of the nation depends, are being exhausted rapidly, wastefully, and, in many cases, permanently.

I invite the cooperation of the American Association for the Advancement of Science in properly bringing this matter before the people; and it gives me added pleasure to invite you, as the President of the Association, to take part in this conference at the White House during May 13, 14 and 15 next.

Sincerely yours,
Theodore Roosevelt

The President of the American Association
for the Advancement of Science

Resolutions in accordance with this request were adopted as follows:

Realizing the rapid rate at which important natural resources of the country are being exhausted and the wasteful methods employed in the mining and utilization of other important mineral resources:

Resolved, That the American Association for the Advancement of Science joins President Roosevelt in calling the attention of the people of this country to the need of wisely conserving these resources for the future, as well as the present, needs of the nation; and in doing this the association asks the cooperation of its affiliated societies and other similar organizations throughout the country.

The association also urges upon the federal and state governments the importance of providing for such investigations and the enactment of such legislation as may prove necessary in preventing all unnecessary waste in the utilization of the nation's resources.

Resolved, That copies of this resolution be sent by the secretary of the association to the President of the United States, President of the Senate and to the Speaker of the House of Representatives in Washington; to the presidents and secretaries of the societies affiliated with the association, and of other similar organizations in the United States.

Resolved, That the president of the association appoint a committee of five on the conservation of resources, this committee to take such further action in carrying out this resolution as from time to time the conditions may demand.

Other resolutions of a public character which were adopted follow:

Resolved, That the American Association for the Advancement of Science reaffirms its resolution passed at the New York meeting, favoring the establishment by Congress of the Southern Appalachian and White Mountain Forest Reserves, and reappoints the same committee to present this matter to the Speaker of the House of Representatives and the President of the Senate in an endeavor to secure at this time at least a beginning of this important work.

Relative to the National Bureau of Education, the following resolution was presented from Section L and adopted:

WHEREAS, The National Bureau of Education has for forty years rendered a much-needed service to the educational interests of the country, and

WHEREAS, Owing to inadequate support its growth has for many years lagged far behind the general educational growth of the country at large and far behind the growth of the needs for such service as it can render, and

WHEREAS, It is undertaking to meet the new demands of educators by the publication of bulletins, by the reorganization of its library and bibliographical service, and by providing a national clearing house for all kinds of needed educational information; therefore, be it

Resolved, That the American Association for the Advancement of Science earnestly recommends to Congress the enactment of legislation in regard to the National Bureau of Education that will:

1. Foster and encourage its work and enable it to expand in such a manner as to render its services to American education increasingly effective and scientific.

2. Strengthen it by additions to its present staff of specialists.

3. Enable it to secure quarters adequate for its new work and in keeping with its dignity and usefulness.

4. Provide it with means to render more complete service as a distributing center for such information as is currently needed for the improvement of education in all its grades and enable it to include the collection and dissemination of information needed in the further development of professional and technological schools and the graduate departments of our universities.

5. Raise the salaries of the commissioner and staff of experts to such a point as will enable the bureau not only to secure men of the highest grade, but to retain them permanently in its service.

Relative to research in tropical medicine, the following resolution was adopted:

WHEREAS, There exists at the present time in Panama an extraordinary opportunity for research work in certain phases of tropical medicine, through the existence there of well-equipped hospitals and well-trained medical men under the supervision of an expert sanitarian, himself a member of the Isthmian Canal Commission, and

WHEREAS, The solution of problems connected with this subject is of the highest importance to the welfare of this and other countries, be it

Resolved, That it is the sense of the American Association for the Advancement of Science that Congress at its present session should appropriate funds for the purpose of establishing a research laboratory at the Isthmus which shall devote itself to the solution of existing problems in tropical disease.

Relative to public health there was adopted the following:

WHEREAS, The American Association for the Advancement of Science has appointed a Committee of One Hundred on National Health, and this committee is performing a work of great importance for the welfare of the nation, be it

Resolved, That all members of this association are urged to cooperate with the committee in its efforts to conserve and improve the health of the people and especially in its plans to increase the efficiency of the national government in dealing with the problems of public health.

The following resolution was adopted on the recommendation of Section F:

Realizing that the work in the Panama Canal is changing biological conditions in Panama and that the completion of the canal will enable the fresh-water faunæ of the two slopes to mingle freely and that many marine animals will succeed in passing the completed canal, the American Association for the Advancement of Science urges upon the President and Congress to make provision for a biological survey of the Panama Canal zone.

Since the conditions will be permanently changed as soon as the canal is completed and the work can not be satisfactorily done after the completion of the canal, there is great urgency that provisions for the work be made at once.

Resolved, That the permanent secretary be instructed to send copies of this resolution to the President, the Vice-President, the Speaker of the House and the Secretary of the Smithsonian Institution. (Signed) C. H. EIGENMANN,
C. C. NUTTING,
Committee

On recommendation of Section F the Association endorsed as its own the following resolution:

Resolved, That the American Society of Vertebrate Paleontologists will aid in any way practicable those measures legislative, international and local which will prevent the now imminent extermination of the great marine vertebrata, especially the cetaceans and manatees, seals, green and other turtles on the coasts of the United States or in the high seas.

The secretary of the committee on Seismology submitted the following resolutions which were adopted:

Whereas, The organized study of earthquakes lately undertaken in other countries is leading to a better understanding of their causes and to the discovery and adoption of means for mitigating their disastrous consequences, be it

Resolved, That, in the opinion of the American Association for the Advancement of Science, the government of the United States should at once make suitable provision for the installation and maintenance of seismographs in properly distributed stations, and,

Whereas, The United States Weather Bureau is the best equipped of the government bureaus for undertaking these studies, be it further

Resolved, That in the opinion of this association the necessary appropriations should be made to the Department of Agriculture for the United States Weather Bureau, and be it further

Resolved, That a copy of these resolutions be forwarded to the Committee on Agriculture of the United States House of Representatives.

At the suggestion of the Committee on Policy, as appears below, the following resolution was adopted:

Whereas, The late Major James Carroll, M.D., U.S.A., was the first to submit voluntarily to the bite of an infected *Stegomyia* and from the bite of this mosquito suffered a severe attack of yellow fever, the effects of which led to his ultimate death, and

Whereas, This was the first experimentally-produced case of yellow fever leading to the present knowledge of this disease, which has practically enabled its complete control, therefore, be it

Resolved, That the American Association for the Advancement of Science now in session in Chicago, Ill., recommends to the Senate and to the House of Representatives of the United States of America the passage of a bill securing to Mrs. Jennie Carroll, widow of the late Major James Carroll, of the Yellow Fever Commission of the United States Army, a special pension for the support of herself and her seven children.

The Darwin Memorial Committee, appointed at the New York meeting, reported as follows:

To the American Association for the Advancement of Science:

Charles Darwin was born February, 1809, and the "Origin of Species" appeared in November, 1859. In celebrating the semi-centennial of the latter we have the opportunity of celebrating the centennial of the former. Your committee consequently recommends:

1. This double celebration.

2. The date of the celebration to be during Convocation Week, 1908–9.

3. That the method of celebration be as follows:

(*a*) That a morning and afternoon of the meetings of the American Association for the Advancement of Science during Convocation Week, 1908–9, be devoted to a series of addresses on various aspects of the theory of evolution, and that these be given solely by persons actively engaged in research bearing on evolution.

(*b*) That a dinner be arranged on the evening of the same day, followed by addresses of a more general nature concerning Darwin and his work.

(*c*) That all addresses be published in a Darwin Anniversary volume, to appear during 1909, the anniversary year.

(*d*) That the committee have full power to arrange the program.

4. It is recommended that the committee be authorized to raise a fund to pay the expenses of Mr. Francis Darwin or other foreign speaker or speakers.

The Committee on the Investigation of the Cave Fauna of North America presented through the recorder, Professor C. H. Eigenmann, a report which will be printed later.

The Committee on Seismology through its secretary, Professor Wm. H. Hobbs, reported as follows:

Your committee organized with Professor H. F. Reid, of Johns Hopkins University, as chairman, and Professor W. H. Hobbs, of the University of Michigan, as secretary. The following sub-committees were named:

1, A committee to determine the best form or forms of seismograph for the seismological stations to be established; Messrs. Reid, Marvin and Bauer.

2. A committee of three members with power to add to its number to report as to what action is deemed desirable in reference to recommendations concerning earthquake-proof construction; Messrs. Lawson, McGee and Campbell.

3. A committee on stations. This committee is working in cooperation with the Weather Bureau, looking toward the establishment of seismographs in the stations of the Weather Bureau.

The Committee on Bibliography of Science submitted the following report:

The committee appointed a year ago has secured from Dr. Haviland Field full details in regard to the work of the Concilium Bibliographicum and from Dr. Cyrus Adler a series of documents bearing on the work of the International Catalogue of Scientific Literature. There is some duplication in the work of the two institutions, but we are of the opinion that the Concilium Bibliographicum should be supported. Apart from the Swiss state and municipal subventions, the only appropriation in 1906 for its work was that of the American Association for the Advancement of Science. It is somewhat doubtful whether the research fund of the association should be used for bibliographical purposes; but we are inclined to recommend the continuation of this grant if there are no more urgent demands on the fund.

The members of the committee live so far apart that meetings could not be arranged during the year. We are of the opinion that an active committee on the bibliography of science could render an important service to the association and for the advancement of science, but the members of the present committee fear that it will be impossible for them to undertake this work. We therefore recommend a new standing committee on the bibliography of science.

(Signed) R. S. Woodward
C. B. Davenport
Jas. Lewis Howe
J. McK. Cattell

The Committee on Policy through its chairman, R. S. Woodward, made the following recommendations of general interest, which were adopted:

1. That the committee on policy should in the future consist of the president, the retiring president, the treasurer, the permanent secretary and five other members.

2. That any member of the affiliated societies joining the association during the year 1908 should have his admission fee remitted and that a letter stating this fact should be addressed to all members of affiliated societies not already members of the association.

3. That the four great engineering societies (Civil, Mechanical, Electrical and Mining) and also the American Medical Society be invited to send representatives to the council of the association, and that the chairman of the committee on policy and the permanent secretary be appointed a committee to conduct the necessary correspondence.

4. That hereafter the annual volume be greatly reduced in size by omitting addresses and abstracts, and confining it simply to a list of members, constitution and the business of the meeting, and to devote the sum saved, not to exceed $850, to additional clerical help for the permanent secretary.

5. That the sum of $500, presented by an unknown client of Mr. John L. Bissell, of New York City, to the association be invested as a permanent fund, the income to be used for the general purposes of the association.

6. That the Committee of One Hundred on Public Health appointed by Section I of the association be made a committee of the association.

7. That the council adopt a resolution concerning a pension for the widow of the late James Caroll, the said resolution to be formulated by Messrs. Welch and Howard.

8. That the council approve the application of the American Federation of Teachers of the Mathematical and Natural Sciences for affiliation with the association.

9. That the council authorize a committee to consider the feasibility of a plan suggested by Mr. Newcomb concerning the advisability of the publication of reports of progress similar to those published by the British Association.

10. That the association look forward to the time when it shall employ a permanent secretary who may devote his full time to the work of the association and who shall receive an adequate salary.

11. That the committee on the relations of the association with the journal Science be discharged, and that a standing committee of three on organization and membership be appointed by the president.

One of the most earnestly discussed matters at the Chicago meeting was the relation of the association with the affiliated societies. The council reaffirmed its action taken at the Philadelphia meeting permitting sectional committees to dispense with a sectional program whenever an affiliated society meets with the section, and to turn over all technical papers to a joint program of the society and the section. In discussing this question there appeared a wide divergence of opinion as to what action was *immediately* necessary. There was reported from some of the sections a strong sentiment in favor of making this action mandatory rather than permissive. The reaffirmation was accepted as a temporary expedient, and a resolution was adopted instructing the officers of sections to confer with the officers of the corresponding societies usually meeting in affiliation with reference to programs and policy, and to report to the permanent secretary for presentation to the council at the next meeting of the association.

The importance both to the association and to science of the proper solution of this problem of affiliation was clearly recognized. Conditions influencing it are different in the case of different sections, and some degree of patience and of toleration on the part of all concerned is called for during the effort to work it out. At Chicago the relations between the sections and the societies were of the most cordial nature, and this condition augurs well for the effort to arrive at a better working arrangement.

In accordance with various resolutions of the council the following committees were appointed by the president:

Additional members of the Committee on Policy, Messrs. Wm. H. Welch and N. L. Britton.

On preservation of the national resources, Messrs. T. C. Chamberlin, Irving Fisher, M. T. Bogert, W. F. M. Goss and Gifford Pinchot.

On organization and membership, Messrs. R. S. Woodward, L. O. Howard and J. McK. Cattell.

Section C appointed a committee to look into the question whether the report adopted by the section some years ago regarding the spelling of chemical terms represents the best present usage, or now has the endorsement of the section. The committee named consists of Messrs. W. A. Noyes, Chairman, L. P. Kinnicutt and C. L. Parsons.

In accordance with the recommendation of the Committee on Grants there was granted \$100.00 to the Concilium Bibliographicum and \$100.00 to the Committee on Cave Fauna. An appropriation of \$50.00 from the general fund was made to pay the expenses of the committee on seismology.

The engineers and mathematicians dined together on Monday evening. The annual dinner of the American Society of Naturalists and that of the American Association of Geographers occurred on Tuesday evening. The former was followed by the address of the president of the society, Dr. J. P. McMurrich. On Wednesday evening there was held a smoker for the American Society of Naturalists, the Association of American Anatomists, the American Physiological Society, the American Society of Biological Chemistry, the American Society of Bacteriologists, the American Society of Zoologists and the Botanical Society of America. The annual banquet of the Sigma Xi Society was held on Thursday evening.

Social events ended with the meeting in a fitting climax at the dinner in honor of Professor Albert A. Michelson recent recipient of the Copley medal and the Nobel prize. Noteworthy among those present on this occasion was Professor Edward W. Morley, sometime a collaborator of the guest in honor, and who was present with Professor Michelson at the meeting of the Royal Society in December and received on that occasion the society's Davy medal.

The general committee fixed the place of the next regular meeting at Baltimore and the time Convocation Week 1908–9. It also voted to hold a summer meeting, probably during the week beginning June 28, 1908, at Dartmouth College, Hanover, N. H.

Dr. T. C. Chamberlin, of the University of Chicago, was elected president of the association.

Dr. J. Paul Goode, of the same institution, was elected general secretary.

Dr. Dayton C. Miller, of Case School of Applied Science, was chosen secretary of the council.

The sectional officers stand as follows:

A—Mathematics and Astronomy.
Vice-president—C. J. Keyser, Columbia University.
Secretary—Professor G. A. Miller, University of Illinois.

B—Physics.
Vice-president—Carl E. Guthe, State University of Iowa.
Secretary—A. D. Cole, Vassar College.

C—Chemistry.
Vice-president—Louis Kahlenberg, University of Wisconsin.
Secretary—C. H. Herty, University of North Carolina.

D—Mechanical Science and Engineering.
Vice-president—Geo. F. Swain, Massachusetts Institute of Technology.
Secretary—G. W. Bissell, Michigan Agricultural College.

E—Geology and Geography.
Vice-president—Bailey Willis, U. S. Geological Survey.
Secretary—F. P. Gulliver, Norwich, Conn.

F—Zoology.
Vice-president—C. Judson Herrick, University of Chicago.
Secretary—Morris A. Bigelow, Columbia University.

G—Botany.
Vice-president—H. M. Richards, Columbia University.
Secretary—H. C. Cowles, University of Chicago.

H—Anthropology and Psychology.
Vice-president—R. S. Woodworth, Columbia University.
Secretary—Geo. H. Pepper, American Museum of Natural History.

I—Social and Economic Science.
Vice-president not chosen.
Secretary—J. Pease Norton, Yale University.

K—Physiology and Experimental Medicine.
Vice-president—Wm. H. Howell, Johns Hopkins University.
Secretary—William J. Gies, Columbia University.

L—Education.
Vice-president—G. Stanley Hall, Clark University.
Secretary—C. R. Mann, University of Chicago.

F. W. McNAIR,
General Secretary

THE INTERDEPENDENCE OF MEDICINE AND OTHER SCIENCES OF NATURE[1]

SIXTY years ago, when the American Association for the Advancement of Science was founded, all of the main divisions of the sciences of nature existed as they do to-day, but no greater change has come over the face of science during these years than the many subdivisions which have arisen. Then the naturalist or the natural philosopher—how unfamiliar even the names are beginning to sound!—or the chemist could follow with critical judgment at least the work of all who were cultivating his own broad field of science, and a single scientific association, such as ours, could unite all of the workers in the natural and physical sciences into a relatively homogeneous and compact group, supply their needs for intercourse with each other and furnish a comprehending audience for presentation of the results of scientific investigation. To-day no man of science can pretend to follow all of the work even in his own department, and the investigator more often than not must seek an audience capable of critical understanding and discussion of his studies in a society of biological chemists, or of experimental zoologists, or of plant pathologists, or of dairy bacteriologists, or whatever may be the body

[1] Address of the retiring president of the American Association for the Advancement of Science, delivered at the meeting in Chicago, December 30, 1907.

which represents his own particular corner of science.

We may regret the loss of many charming features which have been erased from the landscape of science by all of this minute specialization, of which no one can foresee the end, but such a sentiment is much the same and as unavailing as that for the return of the days of the stagecoach. The great instruments of progress in modern life—steam and electricity in the industries, subdivision of labor and increasing specialization in science—are not altogether lovely, but they are the conditions of advancement in material prosperity and natural knowledge.

A necessary expression of the changed conditions of modern science has been the rapid formation of more and more highly specialized societies, which, it must be admitted, meet the personal needs of many individual workers more fully than a general association, representative of all the natural sciences, can possibly do. But the horizon of a man of science must indeed be narrowly circumscribed, if he can not look beyond what he conceives to be his personal needs and the little plot of ground which he cultivates to those necessities of science as a whole which an organization such as ours is designed to serve. The common interests of science grow with its expansion, and the more minute and specialized its subdivision, the greater the need of an association representative of these common interests—a central, national organization which shall keep to the front the essential unity of all the sciences of nature and of man, and the vital importance to the welfare of the community of the extension and application of scientific knowledge in all directions.

In order to serve most efficiently these common interests of science the central organization requires from time to time readjustment in details of plan and working to changed conditions resulting from the development of science and national growth, but its underlying purpose remains always the same. This purpose is so fundamentally important that its attainment in the fullest measure possible by this association should secure the personal service, the active interest and the zealous loyalty of all scientific workers and lovers of science in this country. The association becomes a living organism through the devotion of its members to its interests and, when fired by this breath of life, the machinery of organization, otherwise inert, is made a powerful instrument for the advancement of science. Gratifying as has been the growth of the association in recent years in membership and usefulness, no one will claim that it has taken full possession of its rightful heritage. The membership of the association should be doubled, yes trebled, to secure needful additions to its resources and influence. The time is near, if it has not already arrived, when the association urgently needs a central office and the services of an executive officer and secretary sufficiently recompensed to enable him to devote his main time, thought and energies to the perfection of the organization, to the extension of membership, to the voluminous correspondence, to the arrangements for the meetings and to other manifold interests of the association. Familiarity with the benefits which such an arrangement has secured for the medical profession through the remarkably effective reorganization within recent years of the American Medical Association leads me to place the first emphasis upon this direction of improvement for the organization of science.

In speaking, as I have done, of modern science as subdivided and specialized, in order to indicate some of the problems relating to the organization of this association, there is danger of giving a false impression to those not fully informed of the actual conditions of science. In truth, the boundaries between the divisions and subdivisions of the sciences are being rapidly effaced by a deeper insight into the nature and phenomena of the material universe. Natural science has been compared to a continent separated into kingdoms, but a more appropriate comparison, it seems to me, is to the spectrum composed of different rays which merge imperceptibly into each other and combine into one white light with radiant energy to be discovered beyond the limits of the visible.

Who will undertake in these days of physical chemistry to separate the domain of the physicist from that of the chemist? The problems of the geologist have long been recognized as essentially physical and chemical in their nature. An ever larger part of the biological sciences, including the medical, is opening to exploration and conquest by physical and chemical methods. To mathematics belongs the primacy, for the exactness of a science is in direct ratio to the degree with which its subject-matter can be investigated by measurement and calculation, that is by mathematical methods. The ideal thus implied has been fully attained only by celestial mechanics, but it is approached by some other departments of physics. It is in accord with this ideal that Priestley admirably said that the object of science is "to comprehend things clearly and to comprise as much knowledge as possible in the smallest compass." The ultimate problems of reality and of knowledge belong to metaphysics which we may, following Descartes, bury deep in the soil as the root of the tree of science.

While this mutual dependence of all the sciences of nature, so significant of the operation everywhere of common principles and forms of energy and of an underlying uniformity in the order of nature, both animate and inanimate, is closest between the physical sciences in the restricted sense, it is strikingly illustrated in the history of the biological sciences, and it has seemed to me that the consideration of certain aspects of the interdependence of that department of biological science with which I am most familiar and the other sciences of nature would be an appropriate theme for an address by a representative of the science of medicine upon this occasion. It is to be understood that under the sciences of nature I include those of inanimate nature, the physical sciences, as well as those of organized beings, and indeed I shall dwell more particularly upon relationships between the medical sciences and physics and chemistry, for the points of contact between the various branches of biological science and medicine are self-evident and more familiar.

It need hardly be said that any systematic and full consideration of this broad theme far transcends the limits of an address and that in selecting particular aspects of the subject and certain illustrations I am quite aware that other points of view and other examples will come to the minds of my hearers as equally, if not more, worthy of presentation. Medicine has derived such inestimable benefits from the physical and natural sciences that I desire to lay some emphasis upon the services which it has rendered to them. For my present purpose it is not necessary to assign any limits to the operation of physical and chemical laws in living beings, for the most extreme vitalist must leave so large a part of the phenomena of living beings under the subjection of these laws that their application in medical and biological studies must always be of the highest importance.

An historical sketch, necessarily brief and inadequate, of some of the principal phases in the reciprocal relations between medicine and the physical sciences, up to the time when the latter became fully independent at the close of the seventeenth century, will show with what propriety medicine has been called the "mother of the sciences."

Physical science has derived from the Greeks no such extensive records of sound observation and experience as those which medicine has inherited from the writings of Hippocrates and his followers. Physical theories embodied in the speculations of the nature-philosophers concerning the constitution and properties of matter furnished the starting point for the Hippocratic doctrine of the four humors and other generalizations, but these theories sat so lightly upon Hippocrates that his name is attached to that method of medical study which rejects dogma, authority and speculation and confines itself to the observation and record of clinical facts. As Gomperz in his admirable work on the "Greek Thinkers" has clearly pointed out the age of enlightenment in scientific thought was inaugurated by Hippocrates and his medical contemporaries.

The influence of physical theories upon medical thought in antiquity can be traced not only in the humoral doctrines of Hippocrates and of Galen, but also in rival schools, and especially in the so-called methodic school founded upon the atomistic philosophy of Democritus, which is so interesting in the history of scientific theories. As this school produced such admirable physicians as Asclepiades, Soranus and Aretæus it is to be regretted that their solidistic pathology was so completely displaced by the authority of Galen.

The large body of medical knowledge and doctrine which had grown up during the six centuries since Hippocrates was further developed and fixed by Galen at the end of the second century after Christ into a system not less complete in its field, nor less satisfying to the minds of men for nearly fifteen centuries, nor scarcely less remarkable as a product of the human mind than the physical and philosophical systems of Aristotle. Within their respective spheres the system of doctrine of each of these great men has exerted a similar dominating influence upon human thought and has met a similar fate through influences almost identical.

Although the contributions of the Greeks to mathematics were of the highest order, and the names of Aristarchus, Eratosthenes, Hipparchus and Ptolemy attest the great debt of astronomy to the school of Alexandria, and Archimedes had founded one branch of mechanics, and the works of Aristotle on "the history" and on "the parts of animals" entitle him to be called the "father of zoological science," I think that it is safe to say that the largest body of ordered natural knowledge in any single domain bequeathed by the ancients to posterity was represented by medicine. The botanists trace the beginnings of their science to the physicians, Theophrastus and Dioscorides, but botany was then, as it long remained, an integral part of pharmacy.

As medicine, practically in the shape in which it left the hands of Galen, continued for many centuries to be the shelter for most of the natural sciences, it is worth considering how worthy a home it furnished. For this purpose it is not necessary to enter into details of doctrine or even the state of existing knowledge. A few words concerning the general scope and spirit of medicine, as conceived and transmitted by the Greek physicians, must suffice.

Gomperz formulates the ideal of these physicians as regards their conception of the relation of medicine to the philosophy of nature in these words:

> The human being is a part of the whole of nature, and can not be understood without it. What is wanted is a satisfactory general view of

the process of the universe. Possessing this, we shall find the key in our hand which will open the most secret recesses of the art of medicine.

Certainly such an enlightened conception of the relations of medicine, however unattainable it may be, is broad enough to provide welcome lodging under the roof of the healing art to any additions to the knowledge of nature. Although priestly and magic medicine and charlatanry existed then by the side of rational medicine, as they have always done, the Galenic system, which was a development of the Hippocratic, was in essence observational and inductive, mainly physical, as distinguished from vitalistic, and nearly devoid of superstition and the supernatural. Galen conceived medicine as a science and constituted anatomy and physiology its basis. He himself made valuable use in his physiological studies of the method of experiment, the singular and almost unaccountable lack of which is largely responsible for the fantastic, though often singularly prophetic, ideas and the sterility of the Greek natural philosophers as contributors to natural knowledge. Although later cultivators of the domain of medicine followed far behind these ideals of Greek medicine, there survived enough of their spirit to enable us to understand why the sciences of nature were for so long a time fostered within this domain, which furnished them a fitting and no unworthy abode until they were strong enough to build their own homes.

Although the Byzantine, Arabic and medieval periods afford a number of interesting illustrations of my theme, I shall not take time to consider them, for these periods were relatively unproductive for most of the sciences as well as for medicine. It may be noted, however, that the majority of the names which appear in the histories of the various natural sciences for these times figure also in the history of medicine.

The great awakening of western Europe, marked by the revival of learning and the reformation, stirred the long dormant spirit of inquiry and led to revolt against authority, a fresh outlook upon a wider world, the study of original sources, the questioning of nature at first hand and the search for new knowledge in all her kingdoms. The seat of learning was transplanted from the cloisters to the universities, which multiplied and flourished in the sixteenth and seventeenth centuries as never before.

For medicine and the sciences of nature the fire was kindled and for two centuries burnt brightest in the universities of northern Italy. Here the science of human anatomy was reformed and marvelously developed by Vesalius and an illustrious line of successors in the sixteenth century, and from this period onward anatomy never ceased to be taught by practical dissection, that is to say, by the method of the laboratory. It deserves to be emphasized that for over two hundred and fifty years human anatomy was the only subject taught in the universities by the laboratory method and that it thereby acquired a commanding position in the study of medicine. Bearing in mind the exceptional educational value thus imparted to the study of anatomy and that for a long time medicine was the only technical subject taught in the universities, we can not doubt that under conditions existing previous to the nineteenth century the study of medicine furnished the best available training for the pursuit of any branch of natural science. From his practical anatomical work the student could acquire the habit of close observation, manual dexterity and the sense for form in nature, and learn that real knowledge comes only from personal contact with the object of study. The term "comparative anatomy," even if it serves no other useful purpose, at least points to the historical fact that human anatomy was the starting point and basis of comparison for the morphological study of the lower animals.

In the sixteenth century practically all of the valuable contributions to botany and to zoology were made by physicians, so that natural history scarcely existed apart from medicine. Of the medical contributors to botany it must suffice to mention the names of Brunfels, Fuchs, Dodoens, Gesner and above all Cesalpinus, who has been called "the founder of modern scientific botany," the most important name before John Ray in the history of systematic botany, and a distinguished figure likewise in medical history. Of names associated with the history of zoology in this century the most important are those of the physicians, Conrad Gesner, a marvel of encyclopædic learning, and Aldrovandi, who ranks with the founders of modern zoology and comparative anatomy; of lesser lights Edward Wotton may be singled out for mention as the pioneer English zoologist. He was doctor of medicine of Padua and of Oxford, president of the Royal College of Physicians, and physician to Henry VIII.

A name of the first rank in the history of science is that of the physician, Georg Agricola, who founded before the middle of the sixteenth century the science of mineralogy and developed it to a state where it remained for nearly two hundred years without important additions. I may here remark in passing that the first American chair of mineralogy was established in 1807 in the College of Physicians and Surgeons of New York and was occupied by Dr. Archibald Bruce, a name familiar to mineralogists, the founder of the first purely scientific journal in this country, the *American Journal of Mineralogy,* which was the immediate predecessor of Silliman's *American Journal of Science.*

The difficult step from Hippocrates and Galen to Euclid and Archimedes was surmounted by several physicians of the sixteenth century, as it has also been repeatedly in later times. The reader of Don Quixote will recall that as late as the seventeenth century the physician was also called "*algebrista*" in Spain, a survival of a Moorish designation—and the sixteenth-century physicians Geronimo Cardano, as extraordinary a figure in the history of medicine as in that of mathematics, and Robert Recorde, the author of the first treatise on algebra in the English language, exemplified the union of the healing art with the pursuit of mathematics as strikingly as did the Sedbergh surgeon, John Dawson, in the latter part of the eighteenth century, who had eight senior wranglers among his pupils and was one of the few British analysts of the period who could follow the work of the great contemporary, continental mathematicians. It may here be mentioned that of the celebrated Bernoulli family of mathematicians, two of the most distinguished, John and Daniel, were doctors of medicine, the latter being for a time professor of anatomy and botany at Basel.

The student of medical history, who takes up a history of physics, such as that of Rosenberger, will probably be surprised to find how many of the contributors to the latter subject in the sixteenth century were physicians and that among these are such old friends as Fernel and Fracastorius, whom he has identified so intimately with the annals of his profession. It is to be presumed that he already knew that the most famous of all, Copernicus, was a doctor of medicine of Padua and practised the medical art gratuitously among the poor in Frauenburg.

Far more important for the subsequent history of science than any relations between medicine and physics at this period was the union between medicine and chemistry effected by Paracelsus and strengthened by van Helmont and Sylvius in the following century, a union so intimate that for nearly a century and a quarter chemistry existed only as a part of medicine until freed by Robert Boyle from bonds which had become galling to both partners. The story of this iatro-chemical period, as it is called, has been told by Ernst von Meyer in his fascinating "History of Chemistry" in a way not less interesting to the student of medicine than to that of chemistry, and should be there read by both.

In reply to the question what benefit accrued to both medicine and chemistry from their mutual interaction during this period von Meyer says:

> The answer is, a mutual enrichment, which did almost more for chemistry than for medicine; for the former was raised to a higher level through being transferred from the hands of laboratory workers, who were mostly uneducated, to those of men belonging to a learned profession and possessing a high degree of scientific culture. The iatro-chemical age thus formed an important period of preparation for chemistry, a period during which the latter so extended her province that she was enabled in the middle of the seventeenth century to stand forth as a young science by the side of her elder sister, physics.

Paracelsus in carrying out his program that "the object of chemistry is not to make gold but to prepare medicines" made the pharmacist's shop a chemical laboratory and until the establishment of laboratories by Thomas Thomson and by Liebig in the first quarter of the nineteenth century this continued to be the only kind of laboratory available for practical training in chemistry. Through this portal entered into the domain of chemistry Lemery, Kunkel, Marggraf, Klaproth, Scheele, Proust, Henry, Dumas and many others. Liebig, who also began as an apothecary's pupil, has graphically described these conditions.

That strange, iconoclastic genius, Paracelsus, typifies, as no other name in science, the storm and stress, the strife, the intellectual restlessness and recklessness of the sixteenth century which prepared the way for the glorious light of science which illuminated the following century. With boundless enthusiasm minds, now fully liberated from the bondage of authority, entered upon new paths of philosophical thought and scientific discovery and achieved triumphs unequaled even in the nineteenth century. The great achievement was the full recognition and the fruitful application of the true method of science in all its completeness.

Although isolated and limited use had been made of the method of experiment in former times—I have already cited Galen and I might have added physicians of the Alexandrine school—the real birth of experimental science was toward the end of the sixteenth and the beginning of the seventeenth centuries. Medicine can hardly be said to have presided at this birth, but its influence was not absent. Galileo was a student of medicine, one of his teachers being the celebrated physician and botanist, Cesalpinus, when in 1583 he watched the great bronze lamp swinging before the high altar of the Cathedral of Pisa, and I question whether it would have occurred to anyone without some interest in medicine to determine the isochronism of the pendulum by counting the beats of the pulse. It seems improbable that without his medical training Galileo would have made the measurement of the pulse the first application of the new principle and have called the instrument the pulsilogon. Nevertheless we must bear in mind that natural philosophers of this period and throughout the seventeenth century were greatly interested in anatomy and physiology. Dr. Weir Mitchell in an address, as charming as it is erudite, has called attention to interesting observations of Kepler on the pulse, which the great astronomer believed to have some relation to the heavenly motions, in this and certain other views exemplifying, as some modern physicists have done, the compatibility of a firm hold of positive scientific truth with an irresistible tendency to mysticism and occult science. Kepler was not, as has been stated, the first actually to count the pulse, for we read that as long ago as the Alexandrine period Herophilus timed the pulse with a water-clock.

But if Galileo was only half a doctor of physic, as Dr. Mitchell calls him, his elder contemporary, William Gilbert, second in importance only to Galileo among the creators of experimental science, the founder of the science of magnetism and a significant name in the history of electricity, was fully identified with the profession, being the most distinguished English physician as well as man of science of his day, physician to both Queen Elizabeth and James I., and president of the Royal College of Physicians.

Galileo's younger contemporary, William Harvey, the discoverer of the circulation of the blood, occupies in the history of experimental science an independent position, quite unlike that of the other experimental physiologists of the century. These other physicians, as Sanctorius, Borelli, Lower, Mayow, consciously took possession of the method of experiment as a powerful and newly discovered instrument of research and were swayed in all their physiological work by the discoveries of the physicists. Not so Harvey, who was influenced but little by contemporary physical science and is linked on, not to Galileo or to Gilbert, as exemplars of experimentation, but in a very direct way to the experimental physiologist, Galen, and to Aristotle, as well as to the Italian anatomists of the preceding century. Harvey's genuinely scientific mind was in greater sympathy with Aristotle than with the essentially unscientific Lord Bacon, who was his patient and of whom he said, "He writes philosophy like a Lord Chancellor."

There is no more striking characteristic of seventeenth-century science than the wide range of inquiry covered by individual investigators. The natural sciences were no longer apprenticed to medicine, after Boyle had liberated chemistry, but the problems of anatomy, of physiology and even of practical medicine were not separated from those of the natural philosopher and of the naturalist. With unparalleled versatility every one seemed to roam at will over the whole domain of knowledge and thought. How they leaped and tumbled in the virgin fields and hied "to-morrow to fresh woods and pastures new"!

Descartes was an anatomist and physiologist as well as philosopher, mathematician and physicist, and John Locke, the other great liberator of thought in this century, was educated in medicine, practised it and, like Boyle, accompanied Sydenham on his rounds. Kepler studied the pulse, contributed to physiological optics and calculated the orbits of the planets. Borelli was an important mathematician, physicist and astronomer, as well as one of the greatest physiologists and physicians of the century. Bartholinus was also professor of mathematics as well as of medicine, and discovered the double refraction of Iceland spar. His even more remarkable pupil, Steno, left a name memorable in geology and paleontology as well as in anatomy and physiology, and died a bishop of the Roman Catholic Church. Mariotte, a pure physicist, discovered the blind spot in the retina. Boyle anatomized, experimented on the circulation and respiration, started chemistry on new paths and perpetuated his name in attachment to an important physical law. Hooke, most versatile of all, claimed priority for a host of discoveries, and did in fact explore nearly every branch of science with brilliant, though often inconclusive results. Malpighi was an investigator equally great in vegetable and in animal anatomy and physiology, and what a glorious time it was for the microscopists, like Malpighi, Leeuwenhoek, Swammerdam and others, who could immortalize their names by turning the new instrument on a drop of muddy water, or blood, or other fluid, or a bit of animal and vegetable tissue! From the funeral sermon upon Nehemiah Grew, practitioner of physic and one of the founders of vegetable anatomy and physiology we are assured that he was "acquainted with the theories of the heavenly bodies, skilled in mechanicks and mathematicks, the proportions of lines and numbers, and the composition and mixture of bodies, particularly of the human body" and also "well acquainted with the whole body of Divinity and had studied Hebrew to more proficiency than most divines."

The early proceedings of the various scientific societies and academies, started in this century and destined to become powerful promoters of science, afford excellent illustrations of the wide scope of scientific inquiry. A quotation from the narrative of the famous mathematician, Dr. Wallis, gives further evidence of the position of the medical and other sciences in the aims and work of the little band of thoughtful students of nature who assembled in Oxford in 1645 and later in London, constituting the so-called invisible college, which grew into the Royal Society. He says:

> Our business was (precluding matters of theology and state affairs) to discourse and consider of philosophical enquiries and such as related thereto:—as Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chymicks, Mechanicks and Natural Experiments; with the state of these studies and their cultivation at home and abroad. We then discoursed of the circulation of the blood, the valves in the veins, the venæ lacteæ, the lymphatic vessels, the Copernican hypothesis, the satellites of Jupiter, the oval shape (as it then appeared) of Saturn, the spots on the sun and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the improvement of telescopes and grinding of lenses for that purpose, the weight of air, the possibility or impossibility of vacuities and nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of heavy bodies and the degree of acceleration therein, with divers other things of like nature.

The work and publications of the small group of physicians and men of science composing the Accademia del Cimento, which was established in Florence in 1657 and flourished unfortunately for only ten years, exemplify in an equally striking manner the combination of medical with other scientific pursuits and the wide range of study.

Borelli, the most important member of this academy, founded the so-called iatrophysical school of medicine, which contested the field for supremacy with the iatro-chemical, to which I have already referred, during the greater part of the seventeenth century. The story of these two schools is epochal and occupies the larger part of the history of physic during this century. Medicine owes to adherents of each school a large debt for important contributions to knowledge and fresh directions of thought. Where physical methods and knowledge, as they then existed, were applicable, as in investigation of the circulation and of the action of muscles, the iatro-physicists carried off the palm, Borelli's "De motu animalium" being one of the medical classics. But notwithstanding the great inferiority of chemistry to physics at this time the paths of discovery opened, although not traveled far, by the iatro-chemists have led to more important results. The beginnings of our knowledge of digestion and of secretion and even of the chemistry of the blood and other fluids are to be traced in the main to the iatro-chemical school, and the study of fermentation, although this was not conceived in the same sense as to-day, of gases, salts, acids and alkalis was of importance to medicine as well as to chemistry.

There never has been a period in medical history, not even in recent years, when so determined an effort was made to convert medicine into applied physics and chemistry as that in the seventeenth century. Descartes's dualistic philosophy, which left no more room for the intervention of other than mechanical forces in the organized world than in the inorganic, had great influence upon the minds of physicians as well as of physicists. Galileo had founded, and a line of great experimental philosophers from him to Newton had vastly extended, the science of dynamics, which then seemed to many, as in potentiality it may be, as applicable to all the activities of living beings as to the inanimate universe. There came in the first quarter of the century the greatest physical discovery in the history of physiology, that of the circulation of the blood, which opened the large biological tract of hæmodynamics to rewarding study by the new physical methods. The balance, the pendulum-chronometer, the thermometer and other newly invented instruments of precision were turned to good account in anatomical, physiological and pathological investigations, and physicians began to count, to weigh, to measure, to calculate and to discover a world of form and structure hidden from their unaided vision. Such chemistry as existed was pursued almost exclusively by physicians and primarily in the interest of medicine.

What wonder, then, that physicians who came under the influences of this great awakening in physical science and took no small part in its advent and promotion, should have entertained hopes, soon doomed to disappointment, of the benefits to medicine from application of the new knowledge and have promulgated hypotheses and systems of doctrine which seem to us so false and extravagant! Great as was the advance in physical knowledge, it was utterly inadequate for many of the purposes to which the iatro-physicists and iatro-chemists applied it, and to this day many of their problems remain unsolved.

Grateful we should be for valuable discoveries and new points of view which medicine owes to these men, often so unjustly criticized, but the time had come for men of our profession to resume the Hippocratic method of collecting facts of observation within their own clinical field, and Sydenham, of all the physicians of his century the name, next to Harvey's, most honored by medical posterity, in calling out, "back to Hippocrates!" turned the face of medicine again toward nature.

There are interesting points of comparison between Sydenham's position in the history of medicine, and that of his fellow-countryman and contemporary, John Ray, in natural history. I am sorry that my profession, which has fostered so many ardent students of nature, including Linnæus and Agassiz, the respective bi-centenary and centenary anniversaries of whose birth have been celebrated with such enthusiasm in the year now closing, can not claim this greatest naturalist of his century. Both Sydenham and Ray stood apart from the great scientific movement of their day; both, little influenced by theory or tradition, concentrated their efforts strictly within their respective fields of observation, and both introduced new methods of studying their subjects. As Ray, the plants and animals, so Sydenham described diseases as objects of nature, his discriminations and descriptions being in several instances the first, and to this day in some cases unsurpassed and unimpaired by new knowledge. Like Ray, he was not a mere species-monger, but he had the synthetic power to assign the proper place to single observations and to combine them into well-ordered groups. By way of contrast, the attempt of Linnæus to classify diseases into species and genera, although of some historical interest, was utterly barren, the subject-matter permitting no such method of approach as that which enabled this great systematist to start a new epoch in botany and zoology.

With the close of the seventeenth century we reach a dividing line, which limitations of time compel me to make on this occasion a terminal one, in the historical survey of the interrelations of medicine and the natural sciences. I can not, however, refrain from at least the bare mention of the influence of physicians on the development of science in America—a theme which I hope on some other occasion to take up more fully. Leonard Hoar, doctor of medicine of Cambridge, England, brought something of the new experimental philosophy to America, and during his short incumbency of the presidency of Harvard College (1672–1674) planted the first seeds of technical training on American soil, but too early for them to germinate. Of much greater importance was Cadwallader Colden, an Edinburgh doctor, acquainted with the Newtonian mathematics and physics, and a botanist of note in his day, who did much to instil an interest in physical and natural science among physicians and others in Philadelphia and New York in the first half of the eighteenth century. Besides John Bartram, who studied and to some extent practised physic, the founder on the banks of the Schuylkill of the first botanical garden in this country, there is a long line of American medical botanists, as Clayton, Colden, Mitchell, Garden, Kuhn, Wistar, Hosack, Barton, Baldwin, Bigelow, Torrey, the teacher and collaborator of Asa Gray, himself a graduate in medicine, Engelmann, whose names are perpetuated in genera of plants, and many others up to this day. Until the coming of Agassiz, who trained many who did not enter medicine (although among his pupils were also not a few medical men, including the Le Contes and A. S. Packard), most of the zoologists were also physicians, and Agassiz found already at work in his field in Boston the physicians, Gould, Storer, Harris, and one worthy of a place by his side, Jeffries Wyman. Of the delightful naturalist type of physician there have been many, such as Samuel Latham Mitchell, John D. Godman, Jared Kirtland, and above all a man who belongs to the world's history of biological and paleontological science, Joseph Leidy, whose monument was recently dedicated in Philadelphia. Geologists will call to mind such names as Gibbs, Newberry, John Lawrence Smith, also a chemist and mineralogist, and the Le Contes; and ethnologists the names of Samuel G. Morton, Daniel G. Brinton and Edward H. Davis. How many of the Arctic explorers from this country, as Kane, Parry, Hayes, Schwatka, as well as from England, have been physicians! There have been many whose interest in science was first awakened by the study of medicine, but who were not graduated as doctors, as Joseph Henry, Sears Cook Walker, Thomas Sterry Hunt and Spencer F. Baird. Particularly interesting as investigators in physical science were members of the medical families of the Drapers, the Le Contes and the Rogers. This bare mention of a few of the American medical contributors to science, mostly of an earlier period, will perhaps afford some indication of the services of medicine to scientific development in this country.

After the seventeenth century in Europe the natural sciences, though often cultivated by those educated in medicine and practising it, were independent and followed their own paths, which, however, communicated by many by-ways with the road of medicine and with each other.

Botany and zoology acquired their independent position probably more through the work of Ray and Willughby than by that of any other naturalist. Botany, however, remained for over a century still mainly in the hands of physicians. An interesting chapter in its history is the story of the various apothecaries' and other botanical gardens established through the efforts of physicians and conducted by them primarily for the study of the vegetable materia medica. From such beginnings has grown the Jardin des Plantes in Paris, started by two physicians, Herouard and la Brosse, in 1633, into the great museum of natural history made by Buffon, Cuvier and others as famous for the study of zoology as by Brongiart and his successors for botany. Less humble was the foundation of the British Museum and its appanage, the great Museum of Natural History in South Kensington, the gift to the nation of his valuable collections in natural history and other departments by Sir Hans Sloane, a leading London physician in the first half of the eighteenth century.

Boyle's name is associated especially with the foundation of chemistry as a separate science. William Cullen deserves to be remembered in the history of this science, who, although not an important contributor to chemistry as he was to medicine, was in the second half of the eighteenth century the first to raise the teaching and study of chemistry to their true dignity in the universities of Great Britain, and imparted the first stimulus to his pupil and successor in the Edinburgh chair of chemistry, William Black.

Mechanics, never really dependent upon medicine, was lifted by Newton to analytical heights, rarely scaled by disciples of Æsculapius, although, as Thomas Young and Helmholtz have exemplified, not wholly beyond their reach. But not all of physics stands on the lofty plane of abstract dynamics constructed by Newton, Lagrange, Laplace and Gauss, the highest probably hitherto attained by the human intellect. There have been many educated in medicine who have made notable contributions to the physics of sound, heat, light, magnetism, electricity and the general properties of matter and energy. I have collected, without any pretence to exhaustiveness, the names of over a hundred physicians or men trained for the practise of medicine or pharmacy who have made contributions to physics sufficiently notable to secure them a place in the history and records of this science. A few of the more important are Gilbert, van Musschenbroek, Sir William Watson, Black, Galvani, Berthollet, J. W. Ritter, Olbers, Wollaston, Thomas Young, Oersted, Dulong, Mayer, Thomas Andrews, Sainte-Clair Deville, the Drapers, Foucault, Helmholtz. Sir Humphry Davy literally sprang out of the lap of medicine into the Royal Institution, just founded by Count Rumford, who himself had begun the study of medicine before he left his native country. If the surgeons of England at that time had only heeded what Davy told them concerning the anesthetic properties of nitrous oxide gas, America would have been deprived of the greatest service which she has rendered to medicine.

In the long line of important physiologists of the past century who represent especially the physical direction of investigation in their important branch of medicine and biology, there are not a few whose names find a place in the histories of modern physics, as E. H. Weber, Du Bois Reymond, von Brücke, Ludwig, Fick, Vierordt, Poiseuille and others, and the studies of the botanists, Pfeffer and de Vries, on the turgor of vegetable cells opened an important field of physical chemistry.

Aspects of my subject, full of interest, which I can now barely touch upon, are the influence of previous medical or biological training upon the work of a physicist or chemist, and closely connected with this the extent to which purely physical problems have been approached from the biological side. Call to mind how the central physical and chemical problem of the eighteenth century, the nature of combustion, was throughout this period intimately associated with the kindred physiological problem of respiration, and how John Mayow in the seventeenth century, approaching the subject from the biological side, reached a conclusion in accord with that fully demonstrated a century later by Lavoisier, who thereby opened a new era for physiology as well as for chemistry. For the first time clear light was shed upon the function of respiration, the nature of metabolism and the sources of animal heat, and such physical interest was attached to the study of these physiological phenomena that physicists of the rank of Laplace, in association with Lavoisier, Dulong, W. E. Weber, Magnus, A. C. Becquerel, Hirn, Regnault, and of course Helmholtz, have all made valuable contributions to the elucidation of these subjects.

The study of electricity, especially after the physiologist, Galvani's epochal discovery, more correctly interpreted by Volta, engaged the attention of physicians and physiologists scarcely less than that of physicists. The latter became greatly interested in animal electricity, a subject partly cleared up by the physicists, Ritter and Nobili, but mainly by the physiologist, Du Bois Reymond. Ostwald points out, as a matter of interest in the history of the human mind, that the physician Soemmering was led to conceive of the transmission of intelligence by electricity from analogy with the conveyance of impulses by the nerves, and thus to invent his practically useless form of the electric telegraph. However fanciful such a relationship may be, it is interesting, as Sir David Brewster discovered, that the first proposal for an electric telegraph worked by statical electricity was made and actually carried into effect as early as 1753 by the Greenock surgeon, Charles Morrison. It is now well understood that no one has the sole credit of inventing the electric telegraph, the idea of which was implicit in Stephen Gray's observation in 1727 of the transmission of electricity by a wire.

Of curious interest is the introduction of electricity for the treatment of disease by the physicists, Kratzenstein, Nollet and Jallabert, shortly before the middle of the eighteenth century, who reported cures by its use.

There is no more striking illustration of the correlation of two apparently distinct lines of approach to the same problem than the attack from the biological and from the purely physical sides upon the thermodynamic problem, which is as fundamental for biology as for physics. The conception of the principle of conservation of energy was supplied independently and almost simultaneously on the one hand by students of the conditions of mechanical work done by the animal machine and on the other hand by investigators of technical machines. Much of the essential preliminary study was on the biological side by Boyle, Mayow, Black and Lavoisier. Mainly from the same side the physician and physicist, Thomas Young, first formulated the modern scientific conception of energy as the power of a material system to do work. Davy and Rumford contributed, and from the physiological side Mohr, Mayer and Helmholtz, and from the purely physical side, after preliminary work by Poncelet and Sadi-Carnot, Joule, Thomson and Clausius reached the same grand conception. The first to enunciate clearly and fully the doctrine of the conservation of energy and to measure the unit of mechanical work derived from heat was the physician, J. R. Mayer. Joule's work completed the demonstration, but Mayer's name is deservedly attached to this principle by Poincaré and others, as Lavoisier's is to that of the conservation of mass, and Sadi-Carnot's to the principle of degradation of energy. As regards this last principle it is almost as interesting to biologists as to physicists that in the so-called Brunonian movement, discovered by the physician and more eminent botanist, Robert Brown, and the subject of interesting physical investigations in recent years, we behold an apparent exception to the principle of degradation of energy, such as Clerk Maxwell pictured as possible to the operations of his sorting demon.

I must forego further citation of examples of this kind of correlation between the work of physicists and of physiologists, and leave untouched the chemical side, which is much richer in similar illustrations. The significance to organic chemistry of the synthesis of urea by Wöhler, and to agricultural chemistry of the bacteriological studies of nitrification in the soil and fixation of nitrogen in plants, will perhaps indicate how large and fascinating a field I must pass by.

The great advances in physics and chemistry initiated in France toward the end of the eighteenth and beginning of the nineteenth century were quickly reflected upon the medical and biological sciences through influences which in large part are attributable to this new movement in physical science. New methods of physical examination of the patient were introduced, and pathology and experimental and chemical physiology were developed as biological sciences of the first rank. This reformation of the medical sciences in the first third of the nineteenth century was mainly the work of Frenchmen, the great names in this development being those of Lavoisier, Bichat, Laennec and Magendie, the last a friend and physician of Laplace, and contemporary of Cuvier, who represented a like movement in zoology. Liebig, the pupil of Gay-Lussac and founder of biological chemistry as a distinct science, carried in the third decade of the century the new spirit to Germany, where Johannes Müller and his pupils became the center of a movement which rescued medicine and biology from the shackles of the philosophy of nature and has given Germany the supremacy in these fields of science. The experimental physiological work of the brothers Weber, two being physicians and the third the great physicist who was so intimately associated with Gauss in Göttingen, was of great influence in introducing the physical direction of physiological research, but Magendie stands first in making the experimental method the corner-stone of normal and pathological physiology and pharmacology.

Most pertinent to my theme is it to note that the light which has transformed the face of modern practical medicine came in the first instance not from a physician but from a physicist and chemist, Pasteur. The field of bacteriological study was placed on a firm foundation and thrown open to ready exploration by Robert Koch, and thereby that class of diseases most important to the human race, the infectious, became subject in ever-increasing measure to control by man. Thus hygiene and preventive medicine, through their power to check the incalculable waste of human life and health and activities, have come into relations, which have only begun to be appreciated, with educational, political, economic and other social sciences and conditions, and with the administration of national, state and municipal governments. It is an especial gratification to record the stimulating recognition of these relationships by the social and economic section of this association in which was started a year and a half ago a movement for public health, particularly as related to the federal government, which has already assumed national significance.

To the marvelous growth of the medical and other sciences of living beings during the past century, and especially in the last fifty years, physics and chemistry and the application of physical and chemical methods of study have contributed directly and indirectly a very large and ever-increasing share. In many instances there is no telling when or where or how some discovery or new invention may prove applicable to medical science or art. Who could have dreamed in 1856 that Sir William Perkin's production of the first aniline dye should be an essential link in the development of modern bacteriology and therefore in the crusade against tuberculosis and other infectious diseases? As Robert Koch has said, it would have been quite impossible for him to have developed his methods and made his discoveries without the possession of elective dyes for staining bacteria, and no other class of coloring agents has been discovered which can serve as substitutes for the anilines in this regard. And how much assistance these dyes have rendered to the study of the structure and even the function of cells! If we trace to their source the discovery of Röntgen's rays, which have found their chief practical application in medicine and surgery, we shall find an illustration scarcely less striking.

No important generalization in physical science is without its influence, often most important, upon biological conceptions and knowledge. I have already referred to the great principles of conservation of mass and of energy which are at the very foundation of our understanding of vital phenomena. Although we can not now foresee their bearings, we may be sure that the new theories, regarding the constitution of what has hitherto been called matter, will, as they are further developed, prove of the highest significance to our conceptions of the organic as well as of the inorganic world. Clerk Maxwell in his article on the atom in the ninth edition of the Encyclopædia Britannica, on the basis of a computation of the number of molecules in the smallest organized particle visible under the microscope, reached a conclusion which he states in these words:

> Molecular science . . . forbids the physiologist from imagining that structural details of infinitely small dimensions can furnish an explanation of the infinite variety which exists in the properties and functions of the most minute organism.

Larmor, in the tenth edition of the same work in his article on the ether, points out that upon the assumption of either vortex atoms or electric atoms physical science is concerned only with the atmosphere of the atom, that is with the modification impressed on the surrounding ether, whereas the nucleus or core of the atom may perhaps be taken into account in the problems of biology, although it would appear that nothing can be known of this nucleus. With still later developments of the dynamical hypothesis, which resolves matter into nothing but activity or energy, there are those who think that the hard knot of ages is to be untied and the animate and inanimate worlds come together under a satisfying monistic view of the whole as in essence active energy.

The ultimate problems of biology reside in the cell. Whatever the future may hold in store, at the present day only a relatively small part of these problems are approachable by physical or chemical methods, and the day is far distant, if it ever comes, when cellular physiology shall be nothing but applied physics and chemistry. We can not foresee a time when purely observational and descriptive biological studies, which to-day hold the first place, shall not continue to have their value. They represent the direction which makes the strongest appeal to the great majority of naturalists. The broadest generalizations hitherto attained in biology, the doctrine of the cell as the vital unit and the theory of organic evolution, have come from this biological, as distinguished from physical, direction of investigating living organisms, and were reached by men with the type of mind of the pure naturalist, who loves the study of forms, colors, habits, adaptations, inheritances of living beings.

It is well that the sciences of nature hold out attractions to so many different types of mind, for the edifice of science is built of material which must be drawn from many sources. A quarry opened in the interest of one enriches all of these sciences. The deeper we can lay the foundations and penetrate into the nature of things, the closer are the workers drawn together, the clearer becomes their community of purpose, and the more significant to the welfare of mankind the upbuilding of natural knowledge.

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SCIENTIFIC BOOKS

Neure Anschauungen auf dem Gebiete der Anorganischen Chemie. By Adolph Werner. Braunschweig, Vieweg und Sohn. 1905. Pp. xii + 189. Price 6 marks.

The book before us presents a system for classifying inorganic compounds in such a way that "complex salts," "molecular compounds," hydrates, etc., as well as simple substances, may be included. The fundamental idea which underlies Werner's scheme is a new conception of valence. It is a well-established fact that in many cases compounds in which all of the valences of the individual atoms seem to be fully saturated, still possess the power of combining with other similarly saturated compounds to form complex salts. From this fact Werner draws the conclusion that we must drop our idea of independent, definitely directed valences. In place of this conception he introduces that of "affinity"—an attractive force acting, in the manner of an electrical charge on a sphere, from the center of the atom and uniformly distributed on its surface. Valence is then simply an empirical relation regarding the effect of this force on other atoms. Through considerations based on manifold experimental data he decides that this valence—the manifestation of "affinity"—must be of two kinds which he calls, respectively, *principal* and *subordinate* valence. The former produces the combinations of atoms met with in ordinary salts, giving rise to ionizable radicles; this property can be expressed in modern terms by saying that principal valences can bind atoms or molecules to electrons. Subordinate valences are also active in joining atoms to atoms, but in no case can they produce ionizable substances. Thus in the case of compounds between platinum, ammonia and chlorine we have the following series of compounds in which Cl outside of the brackets represents ionizable chlorine—primary valence—and that enclosed by the brackets non-ionizable chlorine—subordinate valence:

$$[Pt(NH_3)_6]Cl_4;\ \left[Pt{(NH_3)_5 \atop Cl}\right]Cl_3;\ \left[Pt{(NH_3)_4 \atop Cl_2}\right]Cl_2;$$
$$\left[Pt{(NH_3)_3 \atop Cl_3}\right]Cl;\ \left[Pt{(NH_3)_2 \atop Cl_4}\right].$$

It will be seen that the total number of molecules bound directly to platinum is a constant—six—called by Werner the "coordination" number. He has found that for all of the elements forming "complex salts" this "coordination number" is either four or six.

That there is ground for Werner's dissatisfaction with the present conception of valence, no one can doubt, especially after reading the introductory chapters of this book. It is equally clear that in his new classification

Werner has given a sufficiently elastic idea of the action of atoms upon one another to account for many of the facts which at present are anomalies. The chapters on isomerism and steroisomerism too are suggestive and a number of interesting new relations have been presented. It is unfortunate, however, that the direct evidence for his theory is given in this book in so unsatisfactory a manner. His use of physico-chemical arguments is frequently very careless, his proofs for the constitution of compounds are often unconvincing, and the great mass of material is presented in no very clear and orderly fashion. The result is that the reader, if not previously acquainted with Werner's ideas and work, finds that the book leaves merely a confused impression. For a clear, brief presentation of the subject the reviewer recommends the reading of a lecture delivered by Werner before the *Deutsche chemische Gesellschaft* (Ber., 40, 15). The book will then be valuable as an amplification of his paper.

Herman Schlesinger
University of Chicago

A Manual of Biological Projection and Anesthesia of Animals. By Aaron Hodgman Cole, A.M., Instructor in Biology and Projection in the Chicago Normal School. Chicago, Neeves Stationery Company. Pp. 200. $1.50.

The author of this little volume is to be congratulated on having produced a very useful and timely manual on the technique of projection. The scope of the work will be seen from the following partial table of contents: outline of methods and comments of educators on results obtained; available lights and their limitations; solar projection apparatus and its management, methods of darkening rooms, different types of screens; artificial lights and their management; methods of anesthetizing typical animals and plants; how to collect a large variety of species of animals and plants suitable for micro-projection and keep them alive in aquaria; directions for making different types of glass cells in which live animals and plants are mounted for projection; the knack of mounting and projecting various microscopical preparations, including live plants and animals; the projection of pictures and other opaque objects by the use of reflected light.

From the viewpoint of composition, with the possible exception of a few involved and somewhat obscure sentences, the book is clearly written and the subject-matter well arranged, although, in a few instances, there is a tendency toward what appears to be unnecessary repetition. However, the author doubtless feels—and justly so—that this may be forgiven in the interest of clearness. There seems to be no possible contingency in method or material that the author has not anticipated and given explicit directions for obviating, from which it is evident that the book is the outcome on his part of years of practical experience in projection work. The "ready reference table" (p. 180) for mounting and projecting a large number of objects, ranging from bacteria to living chick embryos, should prove of great convenience to the manipulator. The text is farther elucidated by the aid of twenty-eight figures and diagrammatic sketches.

In the words of the author, "every method described is the outgrowth of a need felt in teaching in some grade in grammar and high school, college and popular educational work, and each one has been tested in practise." This statement in itself is indicative of the wide range of uses to which the projection microscope may be put to-day.

M. F. Guyer

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES

The New York Academy of Sciences held its annual meeting on Monday evening, December 16, at the Hotel Endicott, about seventy members and their friends being in attendance.

The report of the corresponding secretary showed that during the last year the academy had lost, by death, one honorary member, Professor Asaph Hall, and three corresponding members, Professor George Chapman Caldwell, Professor W. H. Chandler and Dr. Charles B. Warring. The names of two honorary members and twelve corresponding members have been removed from the rolls through failure to reply to communications for five years or more. At the meeting three honorary members were elected, viz.: Dr. James Ward, professor of mental philosophy in the University of Cambridge, England; Professor J. D. Hooker, late director of the Royal Botanical Gardens, Kew, England, and Professor William Bateson, professor of zoology in the University of Cambridge, England. There are now forty-nine honorary members and one hundred and forty-six corresponding members upon the rolls.

The recording secretary reported that there were now five hundred active members of the academy, nineteen of whom were associate active members. Of the active members one hundred and twenty-two are fellows.

The chief features in the history of the academy during the past fiscal year were the exhibition of the progress of science which was held at the American Museum of Natural History, December 28 and 29, 1906, and the celebration of the two hundredth anniversary of the birth of the naturalist Linnæus on May 23, 1907.

After the reading of the reports was finished the academy elected the following list of fellows from among the active members: William Campbell, A. H. Elliott, L. P. Gratacap, Robert T. Hill, Isaac Adler, Emerson McMillin, Herman Knapp, John B. Smith, Ernest E. Smith and Horace White.

The treasurer's report showed that the financial condition of the society was flourishing. One feature of the report upon which emphasis should be laid is the fact that the academy has in its keeping two important funds, the income of which is available for the encouragement of scientific research. These are the Esther Herrman Building Fund and the John Strong Newberry Fund. Grants from the income of these funds are made to members of the academy or of the affiliated societies upon application and endorsement by the society of which the applicant is a member.

The librarian's report showed a large increase in the library and an enhancement of value through the filling of some important vacancies in our sets of books. Members and the public in general should bear in mind that the library, which is cared for by the American Museum of Natural History, may be freely used any week day between the hours of nine and five, and that such users are very welcome.

According to the editor's report, part 3 of Volume XVII. of the *Annals* is nearly ready for distribution, and the printing of Volume XVIII. has been begun.

The annual election resulted in the choice of the following officers for the year 1908:

President—Charles F. Cox.

Vice-Presidents—A. W. Grabau, Frank M. Chapman, D. W. Hering, Adolf Meyer.

Recording Secretary—Edmund Otis Hovey.

Corresponding Secretary—Henry E. Crampton.

Treasurer—Emerson McMillin.

Librarian—Ralph W. Tower.

Editor—Edmund Otis Hovey.

Councilors (three years)—Charles Lane Poor, William J. Gies.

Finance Committee—Charles F. Cox, George F. Kunz, Frederic S. Lee.

After the business meeting the members of the academy and their friends sat down together at dinner, at the conclusion of which the retiring president, Professor Nathaniel L. Britton gave an address upon "The New York Botanical Garden: Its Organization and Construction" which was illustrated with stereopticon views.

E. O. Hovey,
Recording Secretary

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY

The section met on December 9, 1907, at the American Museum of Natural History. The following program was presented:

The Effect of Centrifuging the Eggs of the Mollusc Cumingia: Professor T. H. Morgan.

Experiments were carried out in order to discover whether the cleavage pattern in a type with "determinate cleavage" is governed by the distribution of the visible substances of the egg, and also to discover whether the formation of the embryo is possible when the visible inclusions ("organ forming substances") of the protoplasm are artificially shifted.

The eggs of *Cumingia* when laid contain the first polar spindle in the center of the egg. The centrifugal force drives the scattered yolk granules to one pole, the pinkish pigment to the opposite pole. Between these two there remains the perfectly clear kinetoplasm, in which the spindle lies, forming any angle with the induced stratification. Its original position has, in fact, been little affected by the movement of the other substances through the egg, although its polar rays may suffer to some extent by prolonged centrifuging. Under the pink cap and concealed by it in the living egg is a vesicular material that is the nuclear sap of the ovarian egg. The polar bodies may appear at any point of the surface of the egg, so far as the location of the three zones is concerned. It is probable that the spindle comes to the same pole as in the normal egg. Since the eggs are not oriented as they fall any one of the three kinds of materials may lie at the "animal pole."

The cleavage always begins beneath the polar bodies, as in the normal egg, and the cleavage pattern, the size of the cells, and their tempo of division are exactly that of the normal. All of the yolk, for example, may be contained in the small cell of the first two, yet the size of this cell and its rate of division are not thereby affected.

It follows that in this egg *the determinate type of cleavage is not caused by the distribution of the visible substances of the egg.* Sections show that between the time of centrifuging and the appearance of the cleavage planes the induced distribution is to a large extent retained, the amount of disturbance depending on the length of time elapsing and on the location of the polar spindle, etc. The results confirm observations on the living egg, and show that the yolk or the pigment may go largely or entirely to one of the first formed cells.

The centrifuged eggs produce swimming embryos, and in some cultures a large percentage of such embryos. Until isolation experiments have been successfully carried out it is necessary to speak with some reserve concerning the percentage of normal embryos.

In the sea urchin egg Lyon has shown that the cleavage follows the induced stratification while in *Cumingia* this is not the case. The difference is due to the shifting of the nucleus in the egg of the sea urchin, while the spindle in *Cumingia* retains its original orientation.

The Replacement of an Eye by an Antenna in an Insect: Dr. RAYMOND C. OSBURN.

The specimen in question is a male of *Syrphus arcuatus* Fallén (Diptera), a common and widely distributed species, and was collected at Montreal, Canada, by Mr. G. Chagnon who noted nothing unusual in its behavior. The right side of the head is normal, but on the left side the large compound eye is entirely wanting. A third antenna appears on this side of the head posterior to the normal left antenna and entirely separated from it, occupying a fossa of its own. It is normal in structure except that the arista, or dorsal bristle, is undeveloped, and it is slightly smaller than the normal ones. This condition calls to mind Herbst's experiments in Crustacea (*Palæmon, Sicyonia*) where an antenna developed in regeneration after the excision of the eye, but no similar case is known among insects as far as the writer is aware. It is possible that the eye may have been suppressed owing to some accident during metamorphosis and that the antenna was produced in place of it. A second vertical triangle also appears in this specimen alongside of the normal one. This supernumerary triangle is similar to the normal in pilosity and in the arrangement of the ocelli, but the anterior median ocellus has no cornea and is represented merely by a small prominence.

A fuller description with figures will appear elsewhere.

Lantern slides were also exhibited showing views of a two-headed turtle with many abnormalities in the carapace and plastron.

A Naturalist in British East Africa: Mr. HERBERT LANG.

The Tjäder Expedition to British East Africa was undertaken for the purpose of collecting material representing the fauna of that region. From Mombasa, the expedition (which consisted of Mr. Richard Tjäder and Mr. Lang, accompanied by 100 negro porters) proceeded 327 miles inland by the Uganda Railroad to Nairobi. A strip of territory one mile on either side of the railroad is set aside as a government game preserve, and is a place of refuge for mixed herds of antelopes, zebras and ostriches.

After spending a month collecting with great success on the Athi Plains, the expedition moved northwest into the Rift Valley, encamping at Kijabe and at various points in the lake country.

Thence the course was southeast over the Laikipia Plateau to Mount Kenia (18,000 feet), which the party ascended to a height of 14,000 feet. Lack of provisions, however, compelled a return to the railroad, whence the party proceeded to the coast, stopping to collect at intervals.

Four and a half months' collecting netted the expedition a total of about 500 skins of birds and mammals. The most noteworthy of the latter was the skin and skeleton of a fine bull elephant carrying 160 pounds of ivory, 4 rhinoceroses, 1 buffalo, 2 giraffes, one of which is unusually large, 8 zebras representing different districts, and a fine series of antelopes. Lions, spotted hyenas, aard-wolves and other carnivores were also taken. Mr. Lang also secured a remarkable series of photographs illustrating the flora, fauna and ethnology of the region. The talk was well illustrated with colored lantern views.

Roy Waldo Miner,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 194th meeting of the society on October 30, 1907, Mr. F. E. Wright exhibited a model for use in the study of crystal optics and also described a new method for measuring extinction angles of minerals in the thin section.

Regular Program

A Visit to the Alps: Mr. Bailey Willis.

Mr. Willis gave an account of a trip in the Alps during August and September. He stated that he had investigated the geological structure of the northern or front Alps and of a part of the Bernese Oberland with reference to the character of the great overthrust faults. He outlined his results in a broad way, but reserved more definite discussion for future presentation to the society. An especially pleasing feature of the trip was the cordial and generous assistance rendered by Swiss geologists.

A Comparison of some Paleozoic and Pre-Cambrian Sections in Arizona: Mr. F. L. Ransome.

The Paleozoic rocks of the Grand Canyon of the Colorado south of the Kaibab Plateau rest with conspicuous unconformity upon the Algonkian sediments and upon the basal crystalline rocks. Between the Algonkian sediments (Unkar and Chuar terranes) and the crystalline rocks is another great unconformity. Considerable confusion has arisen in the literature of the pre-Unkar crystalline rocks which Walcott called the Vishnu series and described as metamorphosed sediments. These crystallines, from the point where they emerge from beneath the Unkar south of Vishnu's Temple to the foot of the Bright Angel trail and west of that point, are dark, fine-grained gneisses cut by red granite and are probably all Archean. There appears to be no ground for describing the Vishnu as "bedding quartzite" or as metamorphosed sediments, and the vertical bedding referred to by Powell and Walcott is gneissic banding or foliation.

On the basis of Powell's and Walcott's characterization of the "Grand Canyon schists," or Vishnu, as metamorphosed slates and quartzites, certain crystalline schists in the Bradshaw Mountains, and in the Globe, Clifton and Bisbee districts, which are clearly metamorphosed sediments, and which are unconformably beneath the Cambrian (Tonto), have been tentatively correlated with the Vishnu. There is, however, little real warrant for this correlation if the Vishnu is not an altered sedimentary series. It is suggested that the Pinal schist of Globe, Clifton and Bisbee and the Yavapai schist of the Bradshaw Mountains may be equivalent in age to the Unkar and Chuar groups in the Grand Canyon. In that case, the great unconformity found at the base of the Paleozoic rocks in the Range Region of Arizona is the pre-Tonto, and not the pre-Unkar, unconformity of the Grand Canyon.

The Tonto sandstone (Cambrian) of the Grand Canyon is probably the equivalent of the Apache group in the Globe District, of the Coronado ~~Colorado~~ quartzite in the Clifton District, and, without much question, of the Bolsa quartzite of the Bisbee District. The Tonto shale of the Grand Canyon section apparently becomes more calcareous to the south and is correlated with the Abrigo limestone of Bisbee. Both carry middle Cambrian faunas, according to Mr. Walcott. Neither Ordovician nor Silurian is known in the Grand Canyon, nor at Globe nor Bisbee. Mr. Lindgren, however, has found Ordovician at Clifton and some beds of this period may possibly occur in the lower part of the Globe limestone, which is chiefly Devonian and Pennsylvanian. The persistence of the comparatively thin Devonian from the northern to the southern boundary of Arizona is rather remarkable in view of the fact that in the Grand Canyon the Devonian Temple Butte limestone is seldom over 100 feet thick, is lacking in some places and is bounded above and below by unconformities. At Bisbee, the Devonian Martin limestone is about 350 feet thick. The Mississippian and Pennsylvanian limestones are both strongly developed at the Grand Canyon and at Bisbee, but the Pennsylvanian has not been found at Clifton. At Globe only Pennsylvanian fossils have been found but between the Devonian and Pennsylvanian horizons are a few hundred feet of apparently conformable limestones which may in future yield Mississippian fossils.

FRED E. WRIGHT,
Secretary

DISCUSSION AND CORRESPONDENCE

A BETTER METHOD OF PREPARING HERBARIUM SPECIMENS

MODERN critical study and exacting taxonomic methods require to-day more abundant and better-prepared herbarium specimens. These must be made by specialists for specialists. The private herbarium can no longer be maintained, and the training we give students must be such as will fit them to do the work the well-organized educational or research institutions demand.

Mere illustrative material in elementary botany beginners should collect in great abundance—the profit of their course of instruction depending largely on their assiduity manifest in getting and studying judiciously selected specimens, including, of course, careful observation of the environment and the conditions under which the plants occur. This work, in fact, serves well as a preparation or training for collecting and preparing good herbarium specimens. The better knowledge one possesses the better collector he may be. Supposing, however, that the collecting has been properly done and the specimens ready to go in press, we will now concern ourselves with the modus operandi of drying.

The old method of using "dryers" to take up the moisture, substituting dry sheets of the absorbent paper for the moist ones after ten to twenty-four hours, repeating the operation continuously for at least the larger part of a week, is unsatisfactory for two distinct reasons. First, too much labor is required and too much time is consumed; second, many of the specimens do not become dry quickly enough and therefore lose the fresh life-like appearance and natural color which quick drying generally secures. A better method will reduce the labor, shorten the time, and almost or quite invariably ensure better results.

Such a method is dependent on an altogether different principle, namely, removing the moisture by a current of dry warm air instead of absorbing it by bibulous paper and then promptly removing the latter. It is extremely easy of execution. The ordinary slat press may be used—the sides, however, may be plane boards, or stiff cloth-board, if that is preferred. The pressure is secured by straps or cords in the usual way.

In place of the "dryers," or rather alternating with these, *corrugated straw boards* are used. The rolls of such paper, usually found in the wholesale paper stores, have corrugations on one side only. After being cut the usual size, twelve by eighteen inches, they should be glued two and two, so that each piece would then present corrugations on both exposed sides—the corrugations running crosswise, not lengthwise.

To fill the press, proceed as follows: Place on the work-table one side of the press, and on it lay a sheet of thick soft paper, or the ordinary "dryer" sheet may be used. On this put the thin species-sheet, on or in which the prepared specimen has been placed; then cover with a corrugated board. On the latter a specimen would be laid as in the beginning, again add a soft sheet or "dryer"; finally another corrugated board; and so on until all the specimens have been inserted.

If the pile is six to eight inches high, or even higher, all the better. After strapping the press properly, suspend it over the stove or other form of heater. The rising warm air will pass freely by the corrugations and quickly carry the moisture from the specimens.

The next day remove the specimens, when ready to put in others freshly collected. If leaves or stems are succulent, or if there are berries or other fruits containing very much moisture, five or six hours' drying will scarcely suffice, as it will in case of ordinary specimens; in that event, they would be allowed to remain in the press longer.

In a few stubborn cases it is not possible to arrange twigs, leaves or flowers to best advantage until they have lost some of their moisture. It would be well to place such occasional specimens in the old-fashioned press, or between "dryers" under some pressure for a short time, possibly over night; and then transfer them to the warm-air press to be quickly completed for the herbarium.

It is desirable to have the rope, which is used to suspend the press over the heater, follow the upper edge but *pass under the two straps* or cords that secure the press and furnish the pressure on the specimens; the weight of the packet itself will then continue the necessary pressure—which otherwise the shrinkage by loss of moisture would tend to lessen. If the press is set on the hot register or radiator, or on an iron support over a heater, it will be desirable to have a short spring inserted in each of the straps, so that the slack will be promptly and effectually taken up as the drying proceeds.

If a small oil stove or a lantern is used to induce the current of warm air—usually the case when one is off on an extended expedition—it is quite necessary to have the press three feet or more above the heater. Then a piece of canvas or thick muslin, a yard wide, must be drawn around the press closely, hanging down so as to form a chute or sleeve to properly direct the warmed air.

The "soft" sheet separating the two specimens that are between each two corrugated boards, might be the ordinary "dryers" used in the old-style press, as signified above, provided, however, that they are not hard or firm. It is very desirable to have something *easily indented* by thick parts, otherwise they will injuriously press into the corrugated boards. The Riker Company, that first made this kind of press furnished a layer of cotton batting for the *soft* intermediate sheet; but it does not prove satisfactory on continued use. Somewhat similar material, perhaps that which is delicately faced, "dress wadding," might be entirely satisfactory. I confess that I myself have not yet passed the experimental stage touching this part of the work.

The suggestion that specimens dried so quickly and thoroughly would be exceedingly brittle does not seem to have proved true; but even if that should be the case, the specimens are much improved in this respect by following Dr. Millspaugh's method of poisoning, namely, by using some glycerine in the corrosive-sublimate solution. After use in the tropics in making an enormous number of herbarium specimens, I can say that the principle embodied in this plant-press seems to be abundantly sanctioned by experience. Not only that, but it is possible to quadruple or quintuple the work accomplished. Besides, mouldy specimens—even when made in rainy seasons or in the moist tropical countries—are wholly unknown to this new press.

W. A. Kellerman
Ohio State University

SPECIAL ARTICLES

ALTAMAHA FORMATION OF THE COASTAL PLAIN OF GEORGIA[1]

THE name, Altamaha, was applied by Dr. W. H. Dall[2] in 1892 to a sandstone and gritty clay formation prominently exposed along the Altamaha and Ocmulgee Rivers of Georgia. The study of the formation was confined mainly to the above-mentioned rivers. Mr. R. M. Harper[3] later studied the formation in some detail from a phytogeographical standpoint. The age of the Altamaha and its relation to other formations of the coastal plain, however, have been unsettled. The writer has spent considerable time during the past summer in studying and mapping the formation and presents some conclusions concerning it.

The Altamaha is the most widespread formation of the coastal plain of Georgia, covering approximately 21,000 square miles or three fifths of the entire coastal plain of Georgia. Occurrences have been noted to within a few miles of the Atlantic coast. Good exposures of red sand and clay are found near Savannah, Waynesville, Brunswick and Kingsland, while the probabilities are that it occurs on the sea islands. It thence extends northward into Burke County to within twenty miles of Augusta on the Fall Line. Thence going in a southwestward course its northward extent is marked by the towns of Tennille, Dublin, Hawkinsville and Vienna to Flint River. West of Flint River no formation has been identified with certainty as the Altamaha, except in Decatur County, in the extreme southwestern part of the state. Southward it extends into Florida.

As a whole the Altamaha consists of yellow and red sand and both massive and stratified layers of gritty clay, with local areas of indurated grit or sandstone and clay. The surface aspect, which is peculiarly characteristic throughout the terrane, is a mottled or "calico" effect; that is, the weathered surface is a splotched red, yellow and white and very frequently purplish and white, due to unequal weathering and oxidation of iron minerals. At some localities small brown iron oxide accretions from the size of buckshot to walnuts are abundant at the surface, and the land where these are found is commonly referred to as "pimple" land. These iron oxide pebbles are products of weathering of the Altamaha clay-sand and are almost certain evidence, where found, that the underlying formation is the Altamaha. The topography of the Altamaha formation is rolling and unlike that of any other coastal-plain formation.

The sand of the formation is usually a coarse quartz sand, red and yellow or orange in color, and occasionally has a brownish tint. It is always more or less argillaceous and contains, frequently, layers of small quartz pebbles. A characteristic of these pebbles is their angularity, some being lath-shaped, showing scarcely any rounding of the angles. The pebbly feature is nowhere very prominent and is exceptional rather than general. In a few localities, the pebbles are rather large, attaining a diameter of four or five inches. Near the Atlantic coast and in the southwestern part of the state the sand may be fine grained, rarely micaceous, cross-bedded, and interstratified with thin layers and leaves of plastic clays. These clay layers may not exceed an inch in thickness. Such structure is seen in the exposures of the Altamaha near Jesup and Waynesville in Wayne County and near Whigham in Grady County.

The clay of the Altamaha is fairly uniform in texture and composition throughout the Altamaha area. It is a greenish or drab, very fine-grained and highly plastic and always more or less sandy. It has a low specific gravity and absorbs a high percentage of water. It often has an acid or sour taste, due, likely, to aluminum sulphates. It occurs in thick irregular pockets or thin lenticular layers or leaves, never persisting as in individual beds over any large area. A tolerably characteristic appearance throughout is greenish clay, full of coarse angular quartz particles and subangular decomposed feldspar pebbles. The clays may be locally indurated, the ce-

[1] Published by permission of the state geologist of Georgia.

[2] Bull. No. 84 U. S. G. S.

[3] *Annals N. Y. Acad. Sci.*, Vol. XVII., Pt. I.

menting material being opaline silica. As above mentioned, the clays are generally green and drab, but in the vicinity of Thomasville there are white clays containing as little as two per cent. of iron oxide.

The grit or sandstone feature of the Altamaha, the feature which is most striking and which was first studied, is typically exposed along the Altamaha River. It consists of gray or greenish aluminous sandstone more or less mottled and stained by iron oxide. In restricted localities pebbles are imbedded in the sand and clay matrix, and cemented into a conglomerate; but, except for the pebbles, these beds do not appear different from the typical Altamaha sandstone. The percentage of clay in the indurated rock varies from five to ten per cent. to such a high percentage that the rock is an indurated clay rather than a sandstone. The cementing material is an opaline silica and the rock may be extremely hard and even glassy and quartzitic in appearance, but is generally, however, soft and friable. The rock is strikingly similar in its lithological aspect throughout widely separated areas and is easily identified, although it is entirely devoid of any fossils. Except along the Altamaha River, only widely separated outcrops occur. It never presents any great thickness, jutting beds fifteen or twenty feet thick being exposed over a few acres. Exposures of grit are common throughout the northern part of the Altamaha region, but are not observed near the coast nor the Florida boundary line. It is believed that these isolated exposures are local indurations only and not parts of a continuous sandstone bed.

While in the foregoing the sand, clay and sandstone are described separately, they do not form stratigraphical units. Sand, clay and sandstone may be seen in the same vertical section, in which the clay may be replaced by sand, and sand and gritty clay may be seen gradually changed from non-indurated to indurated rock, from soft sand and clay to typical Altamaha grit.

The thickness of the formation can be ascertained only from data from deep well borings. The Altamaha in Georgia attains a known thickness of 350 feet and probably reaches 500 feet. From this maximum thickness, which occurs in the counties of Emanuel, Tatnall, Toombs, Coffee and Tift, it is attenuated both northward and southward. The thickness in the southwest part of the state can hardly be more than 200 feet as a maximum, and on the Atlantic coast probably does not exceed 100 feet. As a whole, the study shows evidence of a rapid deposition in a shallow basin-like sea. There is a notable absence of any calcareous layers or nodules, chemical analyses, even of both the clays and the sandstone, showing only a trace of lime or none at all. The material composing the Altamaha was largely derived from the metamorphic and igneous rocks of the Piedmont region.

The Altamaha has been observed overlapping and overlying Eocene, Lower Oligocene, Upper Oligocene, Miocene and questionably Pliocene strata and is to some extent a superficial deposit.

In Burke and Washington counties, in the northeast part of the coastal plain, the Altamaha is observed overlapping red sand and gravel belonging to the Claiborne (Eocene) group. The red sand of the Claiborne contains thin quartzitic layers with Eocene fossils, and can hardly be mistaken for the Altamaha, although the two may in places have similar texture and color.

It overlaps Lower Oligocene rocks (Vicksburg group) in the counties of Pulaski, Dooly and along the east side of Flint River down to Camilla. Near the contact with the Vicksburg group it is frequently found to contain flint fragments, which are evidently derived from the Vicksburg.

At a number of points in Decatur, Grady and Thomas counties, the Altamaha overlies beds of Upper Oligocene age, seemingly without unconformity. On the Monticello road, four miles southwest of Boston, red and brown sands of the Altamaha pass by a gradual transition into clay and sand containing fragments of oysters and the coral, *siderastrea*, which identify the beds as Upper Oligocene. This might be taken as evidence of identity of beds, but more probably the deposition of the Altamaha resulted in the intermixing of beds of similar material, thus obliterating any sharp line of contact between the two, and the apparent continuity of deposition may be thus accounted for. Likewise, at Attapulgus, in Decatur County, red sands and green clay overlie without noticeable unconformity a fuller's-earth deposit, which is regarded as being the equivalent[4] of the Alum Bluff beds.

An excellent vertical section, showing the relation of the Altamaha to Miocene strata, is exposed in the bluff of the Altamaha River at Doctortown, where thirty feet of stratified Altamaha clay and sand overlie a fossiliferous bed containing Miocene pectens. The fossiliferous bed here is four feet thick and is composed of bluish-gray sand full of large pectens and a calcareous sandy layer one foot thick, full of small bivalves and comminuted shells. The section of the bluff is:

	Feet
1. Yellow and mottled argillaceous sand	10
2. White and yellow cross bedded sand containing thin layers of small pebbles	10
3. Red and yellow stratified sand, containing thin clay laminæ or leaves	10
4. Calcareous fossil sand	1
5. Bluish sand, containing pectens	3
6. Bluish sand clay	7

No. 1 of this section has the typical mottling of the Altamaha sand and brown iron oxide accretions are found at the surface as elsewhere over the Altamaha region. The above section is of considerable interest because of the light that it throws on the age of the upper thirty feet of strata. The bluff is referred to by Dall[5] as being Altamaha grit and is described by McGee[6] as Lafayette. A section identical with the one given above occurs at Linders Bluff, three miles above Doctortown, and similar sections are found in the bluffs of the Altamaha River several miles below Doctortown—the upper and lower Sancivilla bluffs. No fossils, however, were observed at the Sancivilla bluffs, except bits of lignitized plant remains.

[4] T. W. Vaughan, Bull. No. 213, p. 392.

[5] Bull. No. 84, U. S. G. S.

[6] U. S. G. S., 12th Ann., Pt. I., p. 484.

The Altamaha has not been identified with certainty lying in contact with strata bearing Pliocene fauna, but there is strong probability that it does overlie such strata. A marl bed overlain by clayey sand outcrops on the Satilla River six miles below Atkinson, from which fossils were collected by Mr. S. W. McCallie and identified by Mr. T. H. Aldrich, as being Pliocene. The Altamaha is exposed at Waynesville, a few miles east of Atkinson, and undoubtedly overlies the above-mentioned marl beds on the Satilla River. Also, marine shells and vertebrate remains brought up by recent dredgings at Brunswick further suggest the probability of Pliocene fossil beds near the coast.

Overlying the Altamaha formation unconformably there is everywhere a thin mantle or superficial layer of loose sand of Pleistocene age. This sand is a light gray or brown in color, shows no stratification, is free from clay, and is always easily distinguished from the Altamaha. It varies in thickness from 0 to 50 or 60 feet, and the average thickness is not more than 10 feet. This sand presents a remarkable uniformity in color and texture throughout the whole coastal plain, from the sand hills of the fall line to the Atlantic coast.

Summing up the known facts concerning the Altamaha formation, the writer is inclined to regard it as being late Pliocene in age. The formation itself contains no fossil evidence which will aid in determining its position, being devoid of all fossil remains except a few bits of wood; and the conclusion concerning its age is reached from the knowledge that it overlies Miocene and Pliocene strata and is older than the coastal Columbia sand, which is of Pleistocene age. The correlation of the numerous exposures of the Altamaha has been determined by stratigraphical continuity, homogeneity and physiographic features. Beginning with an outcrop of typical Altamaha in the northern part of the Altamaha region, it was traced by examination of exposures at short intervals to the Atlantic coast and to Florida. In Georgia, at least, it is believed that it is identical with the formation which McGee considered Lafayette. In his study of the Lafayette in Georgia, in the Twelfth Annual Report of the U. S. Geological Survey, references are made to Millen, Green's Cut, Waycross and Doctortown as being localities where the Lafayette might be seen. The beds at the localities mentioned can undoubtedly be correlated with the Altamaha.

Otto Veatch

Geological Survey of Georgia

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

LIGHTNING VAGARIES

In the *Quarterly Journal of the Royal Meteorological Society* for October, 1907, there is an account, given by Professor A. Herschel, of a remarkable excavation made by lightning in peat earth in a moorland district of Northumberland. A large hole, four or five feet in diameter, was found on a flat part of the moor, radiating from which there were six or seven furrows, and pieces of turf were thrown in various directions. The largest turf, about three feet in diameter and one foot thick, was lying 26 yards away, and other pieces were lying around within 20 yards of the hole. On excavating the hole it was found that a number of small holes radiated to various depths. Col. J. E. Capper gives an account of a captive balloon being struck by lightning.

CLOUD CLASSIFICATION

Professor Willis I. Milham, of Williams College, has published a useful pamphlet on *Cloud Classification,* intended for the use of his students in meteorology, as a guide in their practical work on cloud classification and origin (8vo, pp. 9). This pamphlet considers very briefly (1) the early history, (2) the international system, (3) the causes of clouds and (4) the thirteen cloud forms. The discrepancy between the usual ten forms of the International Classification and the thirteen here referred to comes from the fact that Professor Milham counts fracto-stratus, fracto-cumulus and fracto-nimbus each as one form. Together with the description of the individual types, reference is made to the methods of formation.

METEOROLOGICAL FORMULÆ AND TABLES

Professor Paul Schreiber, director of the Meteorological Service of Saxony, publishes a series of "Formeln und Tabellen" as a *Vorarbeit* to his Annual Report for 1903 (Dresden, 1907, fol.). These formulæ and tables deal chiefly with the thermodynamics of the atmosphere, and are designed for practical use in meteorology. The formulæ are given at the beginning. A discussion on their use follows, and a series of diagrams at the end illustrates the various physical conditions and processes concerned.

A "STEP" ANEMOMETER

At a recent meeting of the Royal Meteorological Society (*Quart. Journ. Roy. Met. Soc.,* October, 1907) Mr. Walter Child exhibited and described his "step" anemometer, which he has designed to obviate the "sheltering error." This instrument is a Robinson anemometer, with the cups so placed on the spindle that the arms are in different horizontal planes. Thus one cup does not shelter another, and the system comes to rest more rapidly when the wind drops.

R. DeC. Ward

THE MEETING OF THE INTERNATIONAL SEISMOLOGICAL ASSOCIATION

The first general assembly of the International Seismological Association since its formal inauguration in 1905, and the second meeting of its permanent commission, were held at the Hague from September 21–26, last.

Twenty-two states are now members of the association, England, Austria and Canada having joined since last year. Although France has not formally joined, preliminary steps have been taken for this purpose and it is hoped that she will soon be a regular member. Chile, the Congo, Norway, Portugal and Roumania are the only countries, members of the association, which were not represented at the meeting. There were about fifty persons present either as delegates or as invited guests, and this included a majority of the leading seismologists of the world. Professor van der Stok and his assistants made all the arrangements for the meeting most successfully. We were given free use of the excellent social club at the Hague: the Minister of Colonies gave a dinner and a reception, and an excursion was made by boat through the canals; altogether the visit to the Hague was extremely agreeable and its memory will always be a pleasure.

According to the by-laws only the delegates are admitted to the meetings of the permanent commission, but this rule has never been enforced, so that all persons attending the general assembly also attended the meeting of the permanent commission. The general assembly has not a permanent president, but the chair is occupied in rotation by different members. The permanent commission elects its president for four years. Signor Palazzo, of Italy, was the retiring president; and Professor A. Schuster, of Manchester, England, was elected president for the next four years. Professor Forel, of Switzerland, was elected vice-president for two years; and the next meeting of the permanent commission was fixed to take place in Switzerland two years hence; Strassburg was continued as the central bureau of the association for the next four years.

The report of the central bureau showed that it had made careful studies of seismological instruments at Strassburg during the last year and that it had published the catalogue of earthquakes for the year 1904. This list is arranged chronologically, but it was suggested that future lists, which are to be made by the central bureau, should have a different arrangement, namely, that the earthquakes should be grouped regionally. The details of the publication of the new catalogues were put in the hands of a sub-committee. The central bureau has also published all the seismograms of the Valparaiso earthquake, or at least all of which it could obtain the originals. These have been reproduced by a heliograph process so as to be exact, and comprise 140 plates, 32 by 42 cm. each. This will furnish an opportunity for a careful comparison of the seismograms of one great world-shaking earthquake.

At the Rome meeting of the permanent commission in October, 1906, a prize was offered for the best cheap seismograph, the details of the competition being left to the central bureau. The conditions imposed were that the instruments should not cost more than about 300 Marks, that it should record one component of the movement and should magnify from 40 to 50 times. The results were not very satisfactory. The low limit of the price seems to have kept out some competitors, so that only four competing instruments were exhibited at the Hague. One of these, shown by Professor Agamennone, consisted of two horizontal pendulums at right angles to each other and supported by pivots; between them was a horizontal pendulum arranged to record the vertical motion. All three instruments recorded on smoked paper and on a single drum. The price of this instrument was 550 Marks; but in view of the fact that all three components were registered, it was admitted to the competition. Spindler and Hoyer, mechanics of Göttingen, exhibited an inverted pendulum of the Wiechert type weighing about 80 kilograms, which recorded the two horizontal components on a single drum, and magnified from 40 to 120 times. The price of the instrument was 350 Marks. The same mechanics also exhibited a pendulum for vertical movement which had a gridiron arrangement to prevent shifting of the instrument by changes of temperature. This instrument cost 550 Marks and was accordingly excluded. The third instrument, made by Schmidt, of Utrecht, Holland, was a small inverted pendulum recording the two horizontal components on a single drum; the whole instrument did not occupy more space than about one cubic foot and its magnifying power was about 200. These instruments are to be sent to Strassburg and their relative efficiency carefully tested before the prize is awarded.

It has been the tendency of the association to refer all investigations to the central bureau. There was a reaction against this at the Hague meeting, and the new investigations ordered were put into the hands of special committees. For instance, a special committee was appointed to consider the form of the next catalogue of earthquakes; another to consider the question of seismological bibliography; a third will collect information regarding mistpoeffers, and a fourth will study microseismic movements; the latter are continued movements of periods usually between four and eight seconds, which sometimes last for hours and even days. They have been observed throughout the world and have been supposed to be due to variations of the barometer, to winds, to the beating of the waves upon the shore, etc.

There were a number of scientific papers presented. Professor Wiechert gave his conclusions regarding the interior of the earth as the result of seismological observations. He finds that the velocity of the first preliminary tremors of an earthquake is about 7.2 kilometers per second at the surface of the earth and increases gradually to a depth of 1,500 kilometers; there it suddenly increases to 12.8 kilometers per second. Below that depth the variations are slow for some distance but finally approach the velocity of 10 kilometers near the center. Professor Wiechert considers that this confirms his earlier idea of a central core of iron or steel surrounded by a stony layer, and that it fixes the radius of the core at 4,500 kilometers, and the thickness of the stony layer at 1,500 kilometers. The existence of long vibrations of periods of 18 seconds or more reveals, he thinks, the existence of a layer of liquid or plastic material at a depth of about 30 kilometers from the surface.

Prince Galitzin advocated the use of strong electro-magnetic damping and electro-magnetic recording for seismographs. He showed a small horizontal pendulum provided with coils of wires in a strong magnetic field. One set of coils served to damp the instrument and the second set was connected with a dead beat galvanometer whose deflections are recorded photographically. The velocity and not the displacement of the pendulum is recorded. Although requiring considerable skill for its installation, this instrument promises to be very valuable.

Professor Rosenthal gave the results of his studies of seismograms. He thinks that the periods of vibrations, during the principal part of the movement, increase progressively and therefore concludes that the seismogram is drawn out for somewhat the same reason that the spectrum is. It is to be noted, however, that other observers have failed to detect the progressive change of period.

Harry Fielding Reid

SCIENTIFIC NOTES AND NEWS

A "Life of Lord Kelvin" is in course of preparation by Professor Sylvanus P. Thompson. It will be published by The Macmillan Company.

At the Chicago meeting of the American Society of Naturalists, Professor D. P. Penhallow, of McGill University, was elected president, and Professor H. E. McKnower, of the Johns Hopkins University, secretary.

The president of the American Chemical Society, Professor Marston T. Bogert, of Columbia University, has been reelected for the ensuing year.

Professor George E. Stratton, of the Johns Hopkins University, has been elected president, and Professor A. H. Pierce, of Smith College, has been elected secretary, of the American Psychological Association.

Professor Hugo Münsterberg, of Harvard University, has been elected president, and Professor W. P. Montague, of Columbia University, vice-president, of the American Philosophical Association.

The Chicago Section of the American Mathematical Society, meeting in affiliation with the American Association, elected Professor G. A. Miller chairman, and reelected Professor H. E. Slaught secretary, for the ensuing year.

Dr. Walter M. Mitchell has been appointed director of the Haverford College Observatory.

Dr. Theobald Smith, professor of comparative pathology at Harvard University, has received the degree of doctor of laws from the University of Chicago.

Dr. Nicholas Senn, whose lamented death occurred while the American Association for the Advancement of Science was meeting in Chicago, had just received the Order of Merit of the Japanese Society of the Red Cross by the sanction of the Emperor of Japan. Dr. Senn had likewise been elected an honorary member of the Royal Medical Society of Budapest.

President Arthur T. Hadley, of Yale University, will complete his course of lectures in the Roosevelt professorship, established by Columbia University at the University of Berlin, in about five weeks and, with his family, will sail for this country, arriving in New Haven about March 1.

Sir Thomas Clifford Allbutt, M.D., regius professor of physic, at Cambridge, was entertained on December 16 at a complimentary dinner by the Master of Downing and the medical men of Cambridge, in the hall of Downing College, upon the occasion of his being created a Knight Commander of the Bath.

Count Maurice de Périgny gave a lecture before the Geographical Society of Pennsylvania on January 8, entitled "Some Unknown Ruins in Yukatan."

The Society of Biblical Literature and Exegesis at a meeting held at the University of Pennsylvania on December 31, passed the following resolution:

Whereas, Charges reflecting on American Oriental scholarship have been publicly made against Professor H. V. Hilprecht.

Resolved, That this society shares in the desire already expressed by a number of American Oriental scholars that a complete reply to these charges be made in the journal of the society or elsewhere.

A memorial to Herman Brehmer, the inaugurator of sanatorium treatment of tuberculosis, is to be unveiled at Breslau, at the time of the twenty-ninth Balneological Congress, which convenes on March 5.

According to foreign journals, the Russian Physico-chemical Society has arranged to hold a conference of general and applied chemistry in honor of Mendeléeff in the course of the present month at the University of St. Petersburg. Several discourses will be delivered on the great chemist's life and works. A subscription has been started for the purchase of a Mendeléeff House, which, like the Hofmann House in Berlin, would be used for the meetings of learned societies.

Dr. Charles Augustus Young, the eminent astronomer, died at Hanover, N. H., on January 4.

Dr. Nicholas Senn, the distinguished surgeon of Chicago, professor in the Rush Medical College, died on January 2, at the age of 63 years.

Peter Townsend Austin, Ph.B. (Columbia '72), Ph.D. (Zurich '76), at one time professor in Rutgers College and the Brooklyn Polytechnic Institute, and since 1896 practising as a chemical expert, died on December 30, aged fifty-five years.

Pierre Charles Cesar Janssen, director of the Meudon Astrophysical Observatory, died on December 23, at the age of eighty-three years.

The Association of American Universities has been meeting at the University of Michigan, Ann Arbor, this week.

The American Breeders' Association will hold its fourth annual meeting at Washington, D. C., January 28–30, 1908, in the National Rifles Armory and Carroll Hall. The program includes reports on scientific investigations in heredity and also addresses and discussions by practical men on the improvement of animals and plants. The scientific, economic and human aspects of heredity will also be substantially presented in the reports of over forty permanent committees of the association.

The Oklahoma University Science Club was organized in October last, to meet twice a month. Membership is limited to regular faculty instructors in the various science departments and includes at present seventeen individuals. The officers are: *President*, Edwin DeBarr, professor of chemistry; *Vice-president*, Cyril M. Jansky, professor of physics; *Secretary-treasurer*, Henry H. Lane, professor of zoology and embryology; *Chairman* *of the Executive Committee,* Albert H. Van Vleet, professor of botany. The object of the club is "to promote original research" among its members. The following papers have already been read:

"The Snakes of Oklahoma," by Professor Van Vleet.

"Modern Methods in the Extraction of Ores," by Professor De Barr.

"Recent Advances in Serum-therapy," by Professor Williams.

"Some Observations n the Cuban Cave Fishes," Professor Lane.

The department of anthropology of the University of California has come into possession of the linguistic and ethnological manuscripts of the late P. S. Sparkman, of Valley Center, California, comprising the results of his many years' studies of the Luiseño Indians.

A restoration of the skull of a great horned dinosaur has just been installed for exhibition in Peabody Museum, Yale University. It is nearly nine feet long, and about six feet broad, and is said to be the largest skull of any prehistoric land animal.

Austrian papers announce the formation, by the joint action of the Academies of Sciences in Vienna, Prague and Krakow, of an Austrian Egyptological institute at Cairo. The yearly expenses are estimated at 30,000 to 40,000 crowns. The first excavations are to be made at Fayûm.

In order to observe the eclipse of the sun on January 3, which appeared as a total eclipse in the tropical Pacific Ocean, Mr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, has been sent to Flint Island, 400 miles northwest of Tahiti. The eclipse was total between eleven and twelve o'clock in that longitude, which corresponds to between four and five o'clock Washington time. Mr. Abbot, with an assistant, joined a party headed by Professor W. W. Campbell, of Lick Observatory, California, sailing on the steamship *Mariposa* from San Francisco to Papeete, Tahiti, on November 22. The gunboat *Annapolis* furnished transportation between Tahiti and Flint Island. Mr. Abbot's observations comprise an examination with the Langley bolometer of the sun's corona, especially toward its inner part, to help decide what is the most probable cause of its luminosity. For this coronal light three sources have been suggested: (1) the reflection of ordinary sunlight, (2) the emission of light owing to the high temperature of small particles near the sun, and (3) the emission of light by luminescence like that of the aurora borealis. It was proposed also to observe with instruments the peculiarities of sky light before the day of the eclipse so that even if clouds should obscure the eclipse, there would still be something of value brought back from the trip.

According to the London *Times* Dr. Sven Hedin, writing from Gargunsa, under date of November 8, states that he has been down to Nepal from Tradum, crossing the Pass of Kore-la. The explorer afterwards crossed for the fifth time the mountain range, about 2,000 miles long, from the Salwin to the Panj, collecting valuable details. Dr. Sven Hedin has discovered the true source of the Brahmaputra River—namely, the Kubitsampo, which rises from a glacier on the northern side of the northernmost parallel range of the Himalayas. The Marium-chu, which has hitherto been regarded as the source, is merely a small tributary flowing in from the west. After a careful study of the hydrographic problems regarding the Manasarowar and the Sutlej, Dr. Sven Hedin proceeded round the Troly Kailas, discovered the true source of the Indus, and traveled northeast to the thirty-second degree of latitude north. He is now proceeding to Ladakh and Khotan *via* the road running east of the Karakoram Pass. In the spring he will travel either to Peking or India.

There was a meeting at the Carnegie Institute, Pittsburg, on January 2, of those interested in medical education, at which the following questions were discussed:

First—Realizing that four years in college and four years in a medical school are too much of a man's life to ask in preparation for his profession, the Academy of Medicine proposes to so arrange the college courses and the medical courses that six years only will be required.

Second—"State medical examination laws."

Each state requires a state medical examination before a doctor can practise within its borders. The academy proposes that a uniform examination be held in every state and that a doctor who has passed this examination in one state may be admitted to practise in any other state without again taking an examination.

Damages to the amount of $456,746.23 were awarded the New Liverpool Salt Company on December 31, by Judge Olin Wellborn, in the United States District Court, against the California Development Company on account of the destruction of its property in the Salton Sea caused by the overflow of the Colorado River. The overflow resulted, it was alleged, from the construction of canal intakes by the development company.

In the material received from the Belgian government for the Congo exhibition, at the American Museum of Natural History, are extensive assortments of native mats, baskets, iron implements and musical instruments. Among the musical instruments are an unusually long ivory trumpet and a drum five feet in length. Other articles of interest are those which constitute a Congo sorcerer's outfit, consisting of a face mask, a dog-tooth necklace and several fetishes in the form of human figurines rudely carved in wood. The museum has secured from Professor Eugene Schroeder a collection of ethnological material from the Bismarck Archipelago in the South Pacific Ocean. Among the objects in the collection are several Malagans, or idols, from a Tabu, or Ghost house; an example of the ancient Death Drum, which was sounded only on the demise of a chief, and several masks which were used by the men in the Init dance. The remainder of the collection consists of implements of war and the chase, musical instruments, personal ornaments, clothing and household utensils.

The *Nation,* which now has a department devoted to science, says: "Professor Charles Moureu of the École Supérieure de Pharmacie has studied various springs at the spot where the water gushes from the ground. He finds that they give out continuous emanations of radium and comparatively large quantities of such rare gases as argon, neon and helium. The single spring of the Lymbe at Bourbon-Lancy yields annually more than 10,000 litres of helium. The Académie de Médecine commissioned three young physicians, having proper scientific attainments, to study certain well-known springs. M. Ameuilles found Plombières and Bad Gastein in Austria the most active, with an emanation which has all the properties of radium emanation. The sediment is also radio-active, and the surrounding atmosphere lightly so. An observation, which explains why it is not the same thing to use bottled waters and 'take the waters' at the springs, shows that this radio-activity disappears in a short time; within four days half of it was lost in water taken away from the spring. It is even probable that all spring water, taken at its source, is slightly radio-active."

The London *Times* states that the Indian Humanitarian Committee recently called the attention of Mr. Morley to the strong feeling which exists among Indian people against the multiplication of Pasteur institutes and the spread of "preventive inoculation" under the patronage of the government of India, and expressed the hope that steps would be taken to lessen the large sum of animal suffering which is inflicted in physiological laboratories. The secretary has received the following reply from Mr. Morley's private secretary, saying that the secretary of state has "recently been in communication with the government of India regarding the restrictions enforced in that country on experiments on living animals, and that the principles of the English act (which have been generally observed in practise), will be formally applied to all laboratories and institutes. When the Royal Commission has reported, the subject will be further considered in the light of its recommendations."

The coal fields of thirteen states and territories were examined by geologists of the United States Geological Survey in 1906, and the results of this work have been published by the survey as Bulletin No. 316. The importance of the coal industry at the present time is well illustrated by a comparison of the values of the leading mineral products of the United States for the year 1906:

Coal	$513,079,809
Iron	505,700,000
Copper	177,595,888
Clay products	161,032,722
Oil and gas	137,318,667
Gold and silver	132,630,200

So far as fuels are concerned the work of the Geological Survey is divided into three classes, geologic, technologic and statistical, the last of which is in charge of the Division of Mineral Resources, whose work for 1906 yielded the figures given above. All the geologic work on mineral fuels of the United States is under the general supervision of Mr. M. R. Campbell. The work is of various grades and degrees of precision, depending on the needs of the public and the conditions under which the surveys are carried on. In the region west of the one hundredth meridian the coal fields are comparatively unknown and the work of the survey is largely exploratory. Rapid reconnaissance surveys are made over large areas to determine the limits of the field and to obtain such information regarding the number and character of the coal beds and their attitude as may be possible in the present undeveloped condition of the field and with the hasty method of examination. In the eastern fields information is needed almost as badly as in the west, but the work is of a much more detailed character and involves not only a thorough study of the geologic conditions under which the coal occurs, but also a study of the quality of the coal and its adaptability to various commercial uses.

Messrs. Sotheby, Wilkinson and Hodge have, as we learn from the London *Times*, concluded a two-days' sale of books and manuscripts, chiefly scientific, and including the technical library of the late Dr. M. T. Masters, F.R.S., for over forty years editor of the *Gardener's Chronicle*, and other properties. A total of £1,677 7s. was realized. The sale included: L. and H. G. Reichenbach, "Icones Floræ Germanicæ et Helveticæ," 1834–60, Vols. 1 to 19, with fine colored plates—£54 10s. (Wheldon); T. C. Jerdon, "The Birds of India," 1862, the author's own copy prepared for a new edition, with the collection of drawings made by the author to illustrate his book and also the original MS.—£250 (Grote); an extensive collection of about 1,000 English and foreign pamphlets, chiefly botanical, formed by Dr. Masters and bound in 131 volumes—£38 (Wheldon); C. Loddiges, *The Botanical Cabinet*, 1818–33, 20 volumes, with 2,000 colored plates—£27 10s. (Quaritch); and two works by J. Gould, "Monograph of the Trochilidæ, or Family of Humming Birds," with the supplement, 1861–87—£35 10s. (Quaritch); and "The Birds of New Guinea," 1875–88—£39 (Parsons).

UNIVERSITY AND EDUCATIONAL NEWS

Mr. John D. Rockefeller has added $2,191,000 to his previous gifts to the University of Chicago, making the total amount of these nearly $24,000,000. Of Mr. Rockefeller's recent gift, the sum of two million dollars is for permanent endowment; the sum of $155,000 is to meet the deficit for 1907, and the sum of $36,000 is for miscellaneous purposes.

Colorado College has completed an addition of $500,000 to its productive funds, towards which the General Education Board and Mr. Andrew Carnegie each contributed $50,000. The town of Colorado Springs raised $50,000 toward the fund in two weeks.

Miss Katherine Greenhill has bequeathed to Trinity College, Oxford, about $3,000 to found an exhibition for a medical student in memory of her father, the late William Alexander Greenhill, M.D., of Oxford.

The French government will build a college for women at St. Germain-en-Laye.

Miss Laura D. Gill has resigned the deanship of Barnard College, Columbia University. Dr. William T. Brewster, professor of English, is acting dean.

Dr. Edwin G. Conklin, since 1896 professor of zoology in the University of Pennsylvania, has accepted the chair of biology in Princeton University. It is understood that Princeton University has offered Professor Conklin unusual facilities for his research work as well as a larger salary than is received by any professor at the University of Pennsylvania.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JANUARY 17, 1908

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A PLEA FOR THE BROADER EDUCATION OF THE CHEMICAL ENGINEER[1]

IT has become my duty, under a provision of the constitution of the American Association for the Advancement of Science, to mark my retirement from the office of vice-president and chairman of Section C by an address. Sir Boverton Redwood remarked on a recent occasion that such addresses offer an opportunity for the dissemination, from time to time, of highly specialized information. I might follow this custom and talk to you about one of the chemical industries in which I have specialized, but these subjects are of such limited interest that I shall avoid them and turn to one which appeals to me as being of the greatest importance at the present time, although, at first thought, it may seem to have received sufficient consideration of late, in view of the address of my predecessor in office, and many others, on the same and allied subjects. I believe, however, that no apology is necessary for asking your attention to the subject of the education of the chemical engineer, and this will include what he should be in the light of what he will be called upon to do, what characteristics he should possess, how he should be directed and encouraged, what training he should submit himself to in order to meet the demands which will be made upon him, and, finally, how his profession may be raised thereby to the level of the other learned professions such as

[1] Address of the vice-president and chairman of Section C—Chemistry—of the American Association for the Advancement of Science, Chicago meeting, December 31, 1907.

law, medicine and civil engineering, as exemplified by their most successful practitioners and representatives, since it is not too much to hope that it may, in the near future, be elevated to a place of due honor and prominence and given proper recognition in our national life, and that, eventually, the chemical engineer may fill many of the executive and administrative offices of our largest and most important industries.

That our industrial progress within the last half century has been phenomenal is too evident to require mention. Much of it has been based, however, on a very wasteful use of our natural resources, and, with their approaching exhaustion, reforms must be instituted and economies practised. There is a marked demand for an improvement in the quality of the output of some of our industries. The field for invention of new processes and new products is large. That the chemical engineer will play a large part in the development and regulation of the industries of the country along these lines can not be denied. It is already evident in what he has done in connection with the use of the electric current available at Niagara Falls and elsewhere. He has become, and will remain, the mainstay in certain particulars of the regulation and development of our many industries.

President Stone, of Purdue University, has said:

> True industrial progress consists in utilizing with ever-increasing economy and accuracy, natural forces and materials by more scientific methods of operation and management, in securing better conditions of life for industrial workers, in furnishing products of better quality at lower cost, and narrowing the gap between the employer and the employee.
>
> There comes a time inevitably when the mine is empty, the forest destroyed, the virgin soil exhausted. Then will arise the real question of industrial ability which can only be met by education and training.

As the chemical engineer will have a large part in solving this problem and as the demand for his services must increase to a great extent, it becomes an important question as to how he shall be selected, educated and trained to fill the rôle which he will have to play. It is this question which I wish to discuss to-day in the light of the opinions which have been expressed by others, and in that of my own experience, the latter being that the graduate of our technical and scientific schools who proposes to adopt the career of chemical engineer is the product of a too narrow training, being at the best an expert chemist, and in no sense fitted to deal with affairs or impress himself upon others. My plea will be for a broader education for the young man who proposes to become a chemical engineer, and for avoiding the making of the intense specialist with his narrow point of view and lack of culture. My remarks will be addressed as well to the young man who is contemplating entering upon such a career, or is already in preparation for it, as to those who will be responsible for his training, or, as industrialists, look forward to the advantages to be derived from having available broad-minded, liberally educated and cultivated men who are, at the same time, chemists and men of affairs, and, as such, fitted to take part in the development of our industries.

We must formulate our idea of what constitutes a chemical engineer. In my opinion, a chemical engineer is, primarily, a chemist, but essentially a man of affairs and executive ability who is engaged in the application of the principles of chemistry in the arts and industries, with special reference to the commercial development of the industries and establishment of new ones, to perfecting the arts, and by his advice and cooperation, assisting other engineers in the practise of their professions.

There are, of course, many types of chemical engineer: the inventive type, in some ways the highest; the type which adapts and makes practicable the discoveries of the inventor; the administrative and economic type, which is that of a large number of the profession; the constructive type, dealing principally with the design and construction of apparatus and plants, and approaching more nearly the civil and mechanical engineer, and, finally, the advisory type, which is engaged almost entirely in a consulting and inspecting capacity, and who more nearly resembles the counselor at law and is closely allied with him in litigation involving facts or opinions which must be interpreted in the light of chemical principles or experience. The type into which any individual may develop will depend upon his temperament and aptitude and upon the opportunities which he may have opened to him.

The mere technologist or industrial chemist is often confused with the chemical engineer, but should be sharply distinguished from him. The former is merely acquainted with the details of the various arts and industries, as they are carried on at present, and he sees that they are properly conducted according to rule and custom. He does not originate, nor does he study them from the point of view of the chemical investigator. He is more nearly an empyric. He is unable to meet the demands which are made upon the chemical engineer, or to take a leading part in the affairs of the world.

The chemical engineer must not be content to remain a mere technical man. He must be practical. As President Humphrey has remarked of the civil engineer: "His work must be based upon correct and complete theory, but it must be, first and last, practical," while Professor John Perry calls attention to the fact that:

> He must have all the knowledge of the scientific man, and ever so much more. He uses the methods of the scientific man and adds to them methods of his own. . . . They come to him through a very wide experience of engineering processes, of acquaintance with things and men.

We should have in the chemical engineer, at once, the thorough chemist, the man of imagination, the leader of men who inspires confidence in those about him. He should be an executive of the first order, who, having an eye for the selection of others of a capacity for special duties, is able to direct them so as to obtain the greatest return from their services. He should not waste a moment's time in doing anything which another can do equally well, and should reserve all his energies for the higher problems which may be met. He should have tact in dealing with others, and, in particular, should be able to express himself by word of mouth and in writing in a forceful manner, that is to say, he should have command of the English language and some literary capacity. He should also have a knowledge of German and French so that the scientific literature of these countries may be available to him and enable him to keep in touch with the specialists who are at work there in his own and allied professions. He must be at all times a student and a wide reader. He should not neglect research and should inspire his subordinates with the necessity of it for the prevention of that tendency to fall into a rut which is so common. He should be a man of personality to enable him to make a favorable impression upon those with whom he is brought in contact. He should avoid all antagonisms and should only permit himself to indulge in destructive criticism on rare occasions. Above all, he should possess initiative, imagination and perspective. He should be a person of original ideas and not a mere follower of those of others. He should not be afraid of the improbable and the unlikely, and, in this respect, may well take to heart the advice of Sir William Ramsay.

For the making of the successful chemical engineer, as for other professions, the best material only is suitable, if the result is to be more than mediocre. Unfortunately, the human race is not bred to points, either physically, mentally or for special aptitudes, in the same way that is practised with the race horse, with high-grade cattle or dogs, to develop their most desirable characteristics; the importance of national eugenics has only recently been brought to our attention by Galton and Pearson. We have recourse, therefore, only to what chance may produce. Nevertheless, chance has done much for us. Professor H. E. Armstrong calls attention to the fact that:

> Americans may be said to be a distinct if not an improved breed. Certain proclivities have been, undoubtedly, unconsciously selected out and there has been much cross-breeding; hence a race has developed differing in important respects in its type of thought if in no other way, from those represented in Europe. Moreover, success has given them belief in themselves, and leads them to trust themselves.

We should make our choice of those youths who have had the best of home discipline and restraint. Sir John E. Gorst calls attention to the fact that:

> The chief causes which produce formation of character are met with in the homes of the people.

The individual who has been subjected to the most favorable environment in his early years and in the secondary schools will be the most satisfactory, if he possesses the proper aptitude to be a chemical engineer.

Aptitude, or what is sometimes denominated a natural gift, is inborn and must be sought out. It can not be developed, but may be encouraged and directed. Professor A. Lawrence Lowell, of Harvard, has wisely said that the problem of the schools is to discover and stimulate the right kind of men more than to directly instruct them. There is too great a tendency to attempt to make chemical engineers out of all who have a fancy for dabbling in a laboratory. For this reason, it seems to me, a great responsibility rests upon our schools in guiding the youth into proper channels and restraining him from fields where he can only meet with disappointment.

Taking what chance may offer as regards breeding, and chance at times offers very good material if we exercise selection, we must endeavor to impart direction from the earliest years of the individual's training.

> It is for wise direction that the coming generations cry; and it is our business to see that they get it,

as the man of science remarks in "A Modern Symposium."

In our secondary schools there is too little consideration of the individual or of his direction. There is too much routine, too much system and uniformity. The bright and the dull boys are advanced through the various grades at the same rate. What we need is, as stated by President Eliot, the promotion or advancement of each pupil by subject and not by mere time. By the present system, much time is lost to the bright boy. Individuality, and not uniformity, should be the rule in all branches of education, and particularly in the case of those who propose to become professional men. Dr. Böttger appreciates the situation in our American high schools when he says:

> In America one finds the object of the high school instruction to be to enlarge the capacity of the average man, while in Germany the main object is well known to be the complete development of the best student.

While this object is a praiseworthy one as applied to the average man in America, it is not satisfactory in the case of those who propose to follow a professional career. President Remsen, however, in reviewing

Böttger's book, thinks that while it may be true of our colleges and technical schools, it is wrong as regards the graduate work of our universities, and this is probably true of our graduate schools of the higher class, but plainly not so in those which turn out some of our weaker doctors of philosophy.

Hugo Münsterberg points out, in a way well worthy of consideration, some of the faults of our secondary educational system. He says:

I do not want to be misunderstood as seeing no fault in the American system of instruction. There are not a few wrong tones which hurt the ear of the newcomer, discords to which he will never become insensible. But these fundamental errors belong to the school rather than to the college. It is enough to point out the most devastating one; the lack of mental discipline at the very beginning of the intellectual growth. The school methods appeal to the natural desires and do not train in overcoming desires; they plead instead of commanding, they teach one to follow the path of least resistance instead of teaching to obey. The result is a flabby inefficiency, a loose vagueness and inaccuracy, an acquaintance with a hundred things and a mastery of none. Public life has to suffer for it, a community which does not get a rigid mental discipline through home and school influence must always remain the plaything of the lower instincts.

How much more the American college might have been able to produce if it could have received into its freshman class young disciplined minds, trained in accurate and careful learning and in the restraint of primitive impulses. The college would not have been burdened by wasting much of its costly time in repeating the elements of learning and patching up the slang-disfigured English language.

Professor C. A. Waldo, in his vice-presidential address before Section D of the American Association for the Advancement of Science at St. Louis in 1903, on "The Relation of Mathematics to Engineering," said, dealing with the question of our preparatory schools:

This is the indictment of the schools, that they use, largely to the exclusion of the thought element, a mass of formal and conventional educational material and thus paralyze thought and make abortive any natural mental growth.

Professor J. J. Stevenson remarks (*Popular Science Monthly*, January, 1904):

The old adage says: "He who would command must first learn to obey." That American lads are sorely in need of such training is only too evident. . . . Such training means—training to think, to reason. Lads often fail to receive this training in secondary schools, as any instructor who has had to deal with freshmen can testify. Secondary schools to-day are little better than cramming houses to fit pupils to answer odds and ends of questions in papers for entrance examinations. Loose training and restlessness under restraint characterize the American students in the lower classes at college; lack of home training may be in part responsible for the latter characteristic, inferior teaching in secondary schools for the former.

There is much of truth in the preceding assertions. Our secondary and high schools are unsatisfactory. They offer to the colleges a mass of more or less unformed material which must be worked over again at great loss of time and energy. It is evident, therefore, that one of the first steps in the improvement of the education of the chemical, or, in fact, of any engineer, lies in a modification of his early training.

If we can not expect as much as might be desired from the secondary schools, we may at least study the material that is offered, selecting and directing that which is most suitable for encouragement, but we must not force the crude product into the professional schools. That, it seems to me, is the great crime of to-day, especially in the case of those who propose to become engineers of any type.

What provision can be made to avoid these difficulties? I believe this lies in postponing professional training except in so far as elementary science may form a part of any ordinary liberal education, until a proper foundation can be laid for it. We do not find at universities of the highest standing that students are received into the schools of law or medicine until they have prepared themselves for the study of these professions by a liberal education involving the taking of a bachelor's degree, which is accompanied by the attainment of the necessary degree of maturity. Is chemistry as a profession one which does not need the same foundation? In my opinion, this is not the case. A sound foundation is quite as much needed as in law or medicine.

The subject has been discussed, pro and con, at great length in numerous recent addresses. Professor George F. Swain, in opening a discussion on engineering education before the American Society of Civil Engineers in 1906, said:

> Most people will admit to-day that civil engineering, like other branches of engineering, belongs to the learned professions, and should require a preliminary training corresponding to that necessary for the lawyer or physician.
>
> The trouble with the young man between the ages of sixteen and twenty-two, who is given the opportunity of a higher education, is that he fails to realize his opportunity and does not take advantage of it, and, as a result, many of the graduates of technical schools and colleges have neither accurate knowledge of any one subject, nor the ability to think clearly and logically, nor the power of taking up a new subject and mastering its fundamental principles without assistance. . . .
>
> In laying out an engineering course, the aim should be, first of all, to develop broad-minded men who can observe correctly, reason logically, express themselves in language and on paper, men with imagination and with character, and with good physical development.

He adds:

> Studies which involve discipline of the mind and observation should be preferred to those which merely give information.
>
> Subject to the above restrictions, what is taught is not as important as how it is taught.
>
> The choice of a profession should be made as early as practicable and a continuous course should be arranged with that profession in view from the beginning of the higher education.

Professor Hugo Münsterberg in a recent address at Lafayette College, already referred to, in which he sings a song of praise for the American college and advocates the establishment of one in Germany at Hamburg, says:

> The idea was that in Hamburg, just as in Harvard, the youth ought to get in common, in years of academic freedom, the inspiration of cultural work in history and economics, in literature and philosophy, in art and natural science, before their ways are divided to go either to the professional schools of the typical German university or to the practical enterprises which commerce or industry or agriculture or politics may offer.
>
> That which is needed for the Germany of to-day, and still more for the Germany of to-morrow, is an academic institute of a new type—a university where the full freedom of academic life can be joined to studies of a purely cultural character, where young men may enter two years before they have reached the present goal of the professional university, and where a three or four years' course would prepare them for the duties of life without any thought of their later occupation.

He adds that in America:

> Public opinion was thus imbued with the correct idea that these professional studies did not in themselves guarantee a high level of culture. The real culture, on the other hand, the making of a gentleman, was left to the college. . . . The highest professional schools to-day demand the bachelor degree at their threshold.

If Professor Münsterberg demands something of the sort for Germany, why should it not be put to greater use in the education of our chemical engineers in this country, where it can be had for the asking?

The board of visitors to the Military Academy at West Point for the present year appreciated the necessity of overhauling the curriculum at that institution, with a view to bringing about a broader culture, the course now evidently being too intensive. The board states:

> An officer of the army should be an all-around educated gentleman. As it is now, his entire training, both preparatory at the academy and post-graduate, is almost purely technical,

and within a few weeks President Schurman, of Cornell, has emphasized the importance of such considerations in his annual report for 1906–7.

In an address, well worthy of careful consideration, before the graduating class of the Rose Polytechnic Institute in 1903, Dr. C. E. Mendenhall, of the University of Wisconsin, discussed the subject of whether the technical education there given compared favorably with the so-called liberal education of the regular college or university. He concludes:

It is apparent, then, that technical education, as at present understood, is strong in the matter of the discipline of the mind and will; it will help a student to think clearly; it will give him self-confidence and self-control, and teach him the virtue of the necessity for work. It is equally apparent that the system is weak on the side of broad general knowledge and cultivation, and there is no doubt that this is a serious defect.

And after discussing various remedies for the situation, he adds:

In ways like these will it become more and more true, let us hope, that the engineering graduate has had the essential features of a liberal education in addition to his professional training.

He asks the question:

But do we fully grasp the fact that we are called upon to be broad men as well as specialists, and that there is a sort of success to be attained quite distinct from our professions?

The president of Case School, in his inaugural address in 1904, said:

It [a technical course] does not teach him all that an educated man ought to know. It would be much better if our technical graduates were broadly educated men as well as trained engineers, if they had received a college training before entering on a technical course. . . . I believe the student should be trained to know, to search, to think, before he enters the technical school. During his whole life he would have a broader outlook, a deeper sympathy with men and events, a greater influence upon the community. I am sure he would be a better engineer.

President James, in his inaugural address on assuming the office of president of the University of Illinois, in 1905, said:

The university is the institution which furnishes a special professional, technical training for some particular calling. This special, technical, professional training must, however, be scientific in character and must be based upon adequate preliminary preparation of a liberal sort.

By this requirement of a liberal preparatory training, the university is differentiated from the technical school or trade school of secondary grade.

In the light of the preceding statements, it would seem that my plea for a broader education of the man who is to adopt a professional career has been supported very generally by those who have given the subject consideration. The requirements of the Harvard Schools of Medicine and Law are recognized as applicable to other professional schools, and in this respect I am putting forward nothing novel. I believe, however, that but little has ever been said in regard to the necessity of a similar requirement in the schools where our chemical engineers are trained, although an equal necessity, in my opinion, exists. I am ready to grant that the individual who proposes to follow the career of an investigator in pure science may, perhaps, succeed by specializing from his earliest years, but it can not be granted in the case of the engineer who must train himself as well to deal with men and affairs as with his strictly professional subjects. The question, of course, always arises as to what the education shall be of those who are to occupy places of minor rank, and form the rank and file of industrial chemists, but who will never attain eminence as chemical engineers. Here a good education is demanded along technical lines alone, and in the more narrow field little else is called for. Our technical schools can accomplish this work, but there is always danger that the graduate may be led to think that his degree, without any regard to his natural abilities, will lead him to the higher places in the profession, and, when he finds that he is not the great success that he has pictured to himself, he blames the system of education, and not entirely without cause. There are too many graduates of the technical schools, especially of the middle west, who are spoiled by being educated beyond their capacities. They would be better off with a good high school education and with a trade. This, however, is a different problem from that which we are considering. What we must take up is: how can the student of sufficient capacity obtain the training and education for which I have pleaded? It will, of course, involve the expenditure of more time and money than if the mere technical training is sought. If time and money are insuperable objections, the more satisfactory course must be abandoned, and reliance placed upon the possibility of making up the deficiencies in the school of application in after life. It is my belief, however, that great efforts should be made to follow the course which I have laid down. On its completion, the man will find himself a more matured and better informed person, he will have greater confidence in himself, he will make a better impression on those with whom he comes in contact, and will command a greater remuneration. He will find that he is well repaid for the effort which has been made. Of course, in the case of the individual who is not hampered for means or time, there can be no question, for the same reasons, as to what to do.

It has not been the usual course for the chemist as yet. It approaches more nearly to that of the college graduate who, with the A.B. degree, spends three or more years in obtaining a Ph.D., and, as far as a knowledge of chemistry is concerned, such a course would be satisfactory. As Professor L. M. Dennis has remarked:

> There should be no distinction between the training of the technical chemist and one who is to devote himself to pure science and investigation.

The chemist who is to become a chemical engineer, however, must also be equipped in other ways which can not be done in the mere attainment of a doctorate. He must acquire his professional attainments in a different school and atmosphere. He must perfect himself in allied subjects and be competent to cooperate with other engineers.

My own idea is that the plan offered by Harvard will furnish the most desirable training for the chemical engineer, whether practised at that university or elsewhere. At Harvard, on the point system, a liberal education and the bachelor's degree can readily be attained in three years by one of slightly more than average ambition. During these three years he will have been subject to an environment which will mature and broaden him if there are any broad qualities to be brought out. He will find himself and his capacity, and how to direct himself. He can, in addition to the liberal courses which he may take, select such others as will enable him to satisfactorily enter the graduate school of applied science and to there pursue his technical studies. He is in a position to take up the professional work of the school with every probability of approaching it as a mature and well-balanced man. Two years in this school is rewarded with the degree of master of science in chemistry, and the graduate is then ready for more advanced studies or for entrance into the final and great school of application.

At the present time the number of students in the graduate school of applied science at Harvard is sixty-three, of which, I regret to say, only one is a student of chemistry. This is not large as compared with many of our scientific and technical schools, but the quality of the men enrolled, and the number of undergraduates in Harvard College who look forward to entering this school later, and are planning their work to that end, is so large that the corporation of Harvard is entirely satisfied with the experiment that it has made. It is, in fact, so well satisfied that within a few weeks it has definitely committed the university to the policy of placing the technical work in the university on a graduate basis, and it has closed the Lawrence Scientific School to the further admission of new students.

It is evident, therefore, that Harvard University has made a very great step in advance along the lines which I have suggested for the preparation of the individual for professional studies and fitting him to become a chemical engineer. It seems to me that it will acquire the same reputation from its move in this direction as it has in its law and medical schools.

At Columbia a similar course can be pursued, taking the B.A. in the college or the B.S. in the scientific school after four years' study and then proceeding in two years to the degree of chemical engineer.

Johns Hopkins has a graduate school of applied science, largely devoted to research, while in 1903 the Massachusetts Institute of Technology issued a prospectus for a graduate school of engineering, leading to the degree of doctor of engineering, which has not, as yet, materialized to any great extent, but which we may hope to see encouraged under the direction of the present acting president of the institute, our colleague, Dr. A. A. Noyes.

There are, no doubt, equally satisfactory opportunities in other schools for such a training as I have demanded, if the desire for it is expressed, and I would by no means suggest that continuous study in any one locality is necessary or even desirable.

The instruction in some of our schools is intensive, in others, broad. In one, the student meets an environment which is purely local, in so far as all, or the majority, of the instructors are graduates of the school in which they teach. In another, they have been assembled from a wider field, have brought to the school a broader conception of the science, and a more liberal point of view. The latter is surely the more desirable. It is quite possible, therefore, that it may be as well to move from place to place for the change of atmosphere which may be obtained.

The main thing to be accomplished is the making of the liberal-minded man of broad intelligence who shall possess those qualities which I have cited as being necessary in the chemical engineer and which, in my opinion, are not found in the graduates of our technical schools as they are now thrown on the world.

If time and my confidence in your patience permitted, I might go at length into some other defects in our system of educating the chemical engineer, more especially as to the evils of examinations and of making undue exertions to obtain degrees. But these subjects must be reserved for another time and place. The views of many prominent persons in regard to them are well known to you, and I may add that I am in sympathy with the idea that they are both evils which need very careful consideration.

It is to be hoped that the suggestions which have been made, although in no way novel, may, by reiteration, arouse some attention in so far as they may point out a way of making the chemical engineer of the future a larger, broader and more influential man than he is to-day, and one who will occupy a position in the community of as great importance as the leaders of the other great professions.

Clifford Richardson

THE MECHANISM OF HEREDITY[1]

Heredity is to-day the central problem of biology. This problem may be ap-

[1]Address of the vice-president and chairman of Section F, Zoology, American Association for the Advancement of Science, Chicago meeting, 1907–8.

proached from many sides—that of the breeder, the experimenter, the statistician, the physiologist, the embryologist, the cytologist—but the mechanism of heredity can be studied best by the investigation of the germ cells and their development. Although many phenomena of inheritance may be discovered in the absence of any definite knowledge of the mechanism of inheritance, a scientific explanation of these phenomena and practical control over them must wait upon our knowledge of their causes. Only a beginning has been made in this study and it seems probable that it may engage the attention of many future generations of biologists, but, nevertheless, we have come far since that day, only about thirty years ago, when Oscar Hertwig first saw the approach and union of the egg and sperm nuclei. Indeed, so rapid has been the advance of our knowledge within this field that it is hard to realize that this entire period lies well within the lifetime of most of those here present, and that many of the pioneers in this work are still active in research.

In the short time at my disposal I can not present even the briefest summary of the many important discoveries in this field; I can hope only to discuss a few of the most suggestive facts and theories as to the mechanism of heredity.

I

Heredity, which originally meant heirship, or the transmission of property from parents to children, has come to mean "the transmission of qualities or characteristics, mental or physical, from parents to offspring" (Century Dictionary). These qualities are frequently regarded as independent entities or "unit qualities," which are "transmitted" from one generation to the next through the agency of an "inheritance material" or "bearer of heredity." Such terms are not without fault when used merely as figures of speech, but when interpreted literally, as they frequently are, they are altogether misleading; they are the result of reasoning about names rather than facts, of getting far from phenomena and philosophizing about them. The comparison of heredity to the transmission of property from parents to children has produced confusion in the scientific as well as in the popular mind.

It is only necessary to recall the most elementary facts about development to recognize that in a literal sense parental characteristics are never transmitted to children. Every new individual is only a detached portion of an old one, and whether derived as bud, or spore, or egg, it owes its similarity to its parent to the fact that it was once a part of it, and not to something which has been "transmitted" from one generation to the next. Furthermore, from its earliest to its latest stage an individual is one and the same organism; the egg of a frog is a frog in an early stage of development and the characteristics of the adult frog develop out of the egg, but are not transmitted through it by some "bearer of heredity."

Indeed, heredity is not a peculiar or unique principle for it is only similarity of growth and differentiation in successive generations. The fertilized egg cell undergoes a certain form of cleavage and gives rise to cells of particular size and structure, and step by step these are converted into a certain type of blastula, gastrula, larva and adult. In fact, the whole process of development is one of growth and differentiation, and similarity of these in parents and offspring constitutes hereditary likeness. The causes of heredity are thus reduced to the causes of the successive differentiations of development, and the mechanism of heredity is merely the mechanism of differentiation. The peculiarity which distinguishes the differentiation of the egg cell from that of any tissue cell is the fact that the latter gives rise only to a particular type of cell, with the formation of which differentiation comes to an end, whereas the former undergoes a long series of differentiations and gives rise to a complicated organism.

II

The causes of differentiation, and hence of heredity, are in general twofold, intrinsic and extrinsic; the former are represented by the germinal protoplasm, the latter by practically all other conditions. Similarity of differentiation in successive generations, or hereditary likeness depends upon similarity of both the intrinsic and the extrinsic factors. The differentiations of the germ follow a definite sequence because the substance of the germ undergoes definite chemical transformations, which are predetermined by its initial constitution. Similarity of sequence is involved in similarity of germinal substance and of environment.

There are no vital structures or functions which are absolutely independent, self-acting, self-moving, self-differentiating or independently variable. Each part and function exists only in close relationship with other parts and functions and with environmental conditions. Many of the criticisms which have been recently brought against "unit characters," "units of heredity," "organ-forming substances," "individuality of the chromosomes," indeed against heredity and variation as a whole, are applicable only to extreme views, which no one consciously holds. To be sure, an individual, whether a unit quality, a chromosome, a substance or a person, can not exist apart from its environment, but who has ever maintained the contrary?

A study of the phenomena of development, no less than the principle that every effect must have an adequate cause, makes it certain that the characteristics of an organism are in some way predetermined within the protoplasm of the fertilized egg cell. From a frog's egg only a frog will develop, from an echinoderm's egg only an echinoderm, and the course of development is, under constant external conditions, marked out in each case, even down to the minutest details. Since, however, these external conditions may be exactly the same in the case of two eggs, and yet the results of development be very different in the two, we can only conclude that the physical basis of inheritance is to be found in the properties of the germinal protoplasm. To assume that extrinsic causes determine whether there shall hatch from an egg a chicken or an eagle would be the sheerest nonsense. The fact is there is no escape from the conclusion that all really inherited characteristics are predetermined in the structure of the germinal protoplasm. But it should be observed that to say that characteristics are predetermined is a very different thing from saying that they are preformed. The one merely affirms that the causes of the transformations which lead from one step to another in the development are determined by the initial constitution of the fertilized egg; the other affirms that these transformations have already taken place within the egg.

III

It is practically certain that in the last analysis the characteristics of the germ are dependent upon its chemical and physical constitution. Fick has lately maintained that not only the protoplasm of every species, but also that of every individual, must be different from that of every other. At the same time he points out the fact that this apparently stupendous assumption is readily possible within the limits of the composition of protoplasm, since Miescher has shown that a molecule of albumin with forty carbon atoms may have as many as one billion stereoisomers. Reichert and Brown[2] have recently found that many genera and species of vertebrates may be distinguished with certainty by the properties of their hæmoglobin crystals. Here is positive proof that the molecular constitution of at least one important substance differs in different species, and if this be true of hæmoglobin it may be safely assumed to be true of the constituents of the germinal protoplasm.

For the present, however, we must be content to find the distinguishing characteristics of different germ plasms in their morphological and physiological properties rather than in their molecular constitution. And fortunately for the possibilities of research the morphological and physiological characteristics of the germ cells are sufficiently numerous and evident to afford a most fruitful and fascinating field for research.

In practically all theories of heredity it is assumed that there is a specific "inheritance material," distinct from the general protoplasm, whose function is the "transmission" of hereditary properties from generation to generation, and whose characteristics, as compared with the general protoplasm, are greater stability, independence, and continuity. This is the Idioplasm of Nägeli, the Germ-plasm of Weismann. It is further assumed that this germ plasm is itself composed of ultramicroscopical units, which are capable of undergoing transformation during the course of development into the structures of the adult. These are the hypothetical Plastidules, Gemmules, Pangenes, Plasomes, Idioblasts, Ids, Determinants, Biophores of various authors. However necessary such units may be for a complete philosophical explanation of development, it must be confessed that at present they constitute a purely hypothetical system which may or may not correspond to reality. We know that the germ cells are exceedingly complex, that they contain many visible units such as chromosomes, chromomeres and microsomes, and that with every great improvement in the microscope and in microscopical technique other structures are made visible which were invisible before, and whether the hypothetical units just named are present or not seems to be a matter of no great importance, seeing that, so far as the analysis of the microscope is able to go, there are differentiated units which are combined into a system—in short, there is organization.

On the other hand the evidence in favor of an inheritance material, which is distinct from the general protoplasm of the germ and whose function is the reproduction of hereditary characters, is not convincing. All the living substance of the egg cell is converted by growth and differentiation into the mature organism. That there is a species plasm, or an individual plasm, which is continuous from generation to generation, and from which all the qualities of the mature organism are differentiated, is almost a certainty, but there is no satisfactory evidence that this substance is distinct from the general protoplasm of the young germ cells.

IV

Differentiation, and hence heredity, consists in the main in the appearance of unlike substances in protoplasm and their localization in definite regions or cells. Such a definition is as applicable to the latest stages of differentiation, such as the formation of muscle fibers, as it is to the earliest differentiations of the germ cells, and the one is as truly a case of inheritance as is the other. In short, different sub-

[2] By the kindness of the authors I am permitted to refer to this very important research which will soon be published by the Carnegie Institution.

stances appear at an earlier or later stage in the development of all animals, and these substances are then sorted out and localized; this is differentiation. Physiological division of labor involves morphological division of substance; sorting out of functions implies sorting out of the material substratum of functions.

Unfortunately, we do not know many of the steps by which different substances appear within protoplasm. Even the formation of non-living products, such as oil, yolk and secretions, is but imperfectly understood, while the manner of formation of different kinds of protoplasm is almost wholly unknown. No one doubts, however, that different kinds of protoplasm are formed in the course of development, that the substance of a muscle cell, for example, is different from that of a nerve cell, and that both are different from the germinal protoplasm; furthermore, no one doubts that the relatively few substances of the germ cells give rise through many transformations to the relatively numerous substances of the adult.

But although little is known regarding the method of origin of the different substances which appear in the process of differentiation, in all cases which have been carefully studied one significant fact appears, viz., the importance of the interaction of the nucleus and cytoplasm. It is well known that many differentiations first appear in the immediate vicinity of the nucleus; indeed, in many cases various substances have been seen to come out of the nucleus and to mingle with the cytoplasm, while the nucleus in turn absorbs substances from the cytoplasm. It is known that constructive metabolism, differentiation and regeneration never occur in the absence of a nucleus. On the other hand, Verworn has shown that the nucleus alone is incapable of performing these functions, and he maintains that the chief rôle in the life of the cell can not be assigned to either the nucleus or the cytoplasm, but that both are concerned in vital phenomena. Judged merely by the results of observation and experiment, and wholly apart from current theories, it must be admitted that there is good reason to believe that the different substances which appear in the differentiation of a tissue cell arise through the interaction of the nucleus and cytoplasm, and not from either of these alone.

Turning now to the differentiations of the fertilized egg cell, we find that essentially the same conditions obtain as in the differentiation of a tissue cell. Here, also, different substances appear in the egg cell and become localized in different regions of the egg or embryo. In most animals the different kinds of substance in the unsegmented egg are not numerous nor conspicuous, though in all cases so far studied at least three kinds of substance may be separated by means of the centrifuge. Here, as in the case of the tissue cells, it is known that there is an active interchange of nuclear and cytoplasmic substances. In the long growth period of the egg the nucleus grows enormously, evidently at the expense of substances received from the cell body. On the other hand, it is well established that substances issue from the nucleus into the cell body and mingle with the cytoplasm during this stage, and it is generally believed that one of the substances thus formed, the yolk nucleus, is instrumental in the formation of yolk. At the end of the growth period of the egg the nuclear membrane dissolves and a relatively enormous quantity of nuclear material is thus liberated into the cell body, while an insignificant quantity persists in the form of chromosomes and gives rise to future nuclei. During every cleavage of the egg the nucleus grows by absorbing substances from the cell body, only to give back other substances to the cell at every mitosis, thus constituting a sort of systole and diastole of the nucleus, and it may be suggested that this interchange between nucleus and cytoplasm is one of the primary functions of mitosis. Many of the substances which are liberated from the nucleus are visibly different from the other substances of the cell body, and in some cases they may be traced through successive stages of development until they give rise to particular portions of the embryo.

The time at which particular embryonic differentiations appear differs widely in different animals. In some cases the earliest visible differentiations which may be correlated with the later differentiations of the embryo or larva, appear about the time of the formation of the blastula or gastrula, and here the cleavage cells are apparently all alike. In other cases the cleavage cells are not alike; even the first cleavage, as well as the later ones, may be of differential value, thus giving rise to cells which differ in size, symmetry and substance, and these features of the cleavage are inherited as certainly as are the form and character of the larva or adult. In still other cases marked differentiations of the egg are visible before cleavage begins, while in some instances these differentiations are present even while the eggs are still in the ovary.

But whether these differentiations appear early or late, there is reason to believe that the processes by which they arise are essentially the same in all cases, and that there is therefore no fundamental difference between eggs which differentiate early and those which differentiate late. It is quite possible that the time of appearance of differentiations depends less upon the time of formation of different substances in the egg than upon the time of their localization or segregation in specific regions or cells. All eggs hitherto examined show certain differentiations of the cytoplasm even in the earliest stages, though in most cases the different substances are not segregated before the cleavage stages. When such eggs are submitted to a strong centrifugal force the substances of the unsegmented eggs of practically all animals may be separated into at least three zones, which correspond in a striking manner to the three zones which are normally present in the unsegmented eggs of ascidians. This indicates that the real difference between eggs which are highly differentiated and those which show little or no differentiation of the cytoplasm may be in the segregation of unlike substances rather than in the presence or absence of such substances.

Regarding the other factor of differentiation, viz., the segregation or localization of unlike substances, rather more is known than in the case of their origin. Segregation of the different substances of the unsegmented egg and of the cleavage cells is known to take place chiefly by protoplasmic flowing, the direction of the flow being correlated with the initial polarity of the cell, and with the chemotropism of the substances concerned. Segregation thus produced is still further emphasized and rendered permanent by cell division and the formation of partition walls. I have recently found that when different substances of the egg are displaced by strong centrifuging they tend to come back to their normal positions unless prevented by partition walls which have formed in the meantime. In the early cleavage stages of many animals the cell divisions are differential both as regards the size and the substance of the daughter cells, but in such cases the cleavage is not responsible for the differentiation as is plainly shown by the fact that the segregation of the different substances occurs before division, and the inequality of the cleavage may be foreshadowed by lobes of the cytoplasm even before the nucleus begins to divide. Lillie has shown that differentiation may proceed far in the case of *Chætopterus* in the absence of any cleavage. On the whole then, although the lines of cleavage tend to follow the preexisting lines of differentiation the principal part played by cleavage in the process of differentiation is in rendering permanent the segregation of the different substances.

Finally we may conclude that the nucleus plays a less important rôle in the localization of different substances than in the formation of those substances. Nevertheless, in differentiation, as well as the metabolism, there is every reason to believe that the entire cell is a physiological unit. Neither the nucleus nor the cytoplasm can exist long independently of the other; differentiations are dependent upon the interaction of these two parts of the cell; the entire germ cell, and not merely the nucleus or cytoplasm, is transformed into the embryo or larva; and it therefore seems necessary to conclude that both nucleus and cytoplasm are involved in the mechanism of heredity.

V

It is well known that many biologists believe that the nuclei, and more particularly the chromosomes of the germ cells, are the exclusive seat of the inheritance material. O. Hertwig and Strasburger first formulated this hypothesis as a result of their studies on fertilization. Roux suggested that the chromatin is the most important part of the nucleus, in view of the exact manner in which it is divided in mitosis. Van Beneden and Boveri discovered that the chromosomes come in equal numbers from the egg and the sperm; that the number of chromosomes in each of the germ cells is one half the number characteristic of the species, and that by the union of these cells the characteristic number is reestablished; and finally that the maternal and paternal chromosomes are distributed with exact equality to all the cells of the developing organism. Furthermore, it was shown by Rabl and Boveri that there is a continuity (or persistent individuality) of the chromosomes from one cell cycle to the next. That the nucleus alone is the bearer of the inheritance material was affirmed by Hertwig in 1892, in view of the following facts: (1) The equivalence of the inheritance material in male and female; (2) the equal distribution of the inheritance material to all cells of the organism; (3) the prevention of the summation of the inheritance material, by its reduction before fertilization; (4) the isotropy of the protoplasm.

Since that time many additional evidences that the chromatin is the seat of the inheritance material have been brought to light, only a few of which can be summarized here. Boveri found in the development of *Ascaris* that the germ cells, which preserve all the characteristics of the species, also preserve all the chromatin of their chromosomes, but that in the body cells, which undergo differentiation, the chromosomes undergo diminution. Weismann assumed as a logical necessity that in the maturation of the egg and sperm there must occur a division of a peculiar type, a reduction division, the significance of which is the halving of the germ plasm and its contained hereditary units, in preparation for the union of egg and sperm in fertilization. Such a reduction division of the chromosomes has since been observed by many investigators in a large number of organisms. More recently Montgomery, McClung, Paulmier, Wilson and others have found chromosomes of many different sizes and shapes within the same nucleus, and Boveri has shown, by a masterful analysis, that in echinids the hereditary value of individual chromosomes is different, although here they are all alike in form.

Boveri also discovered that enucleated egg fragments of *Echinus* fertilized by sperm of *Strongylocentrotus* produced larvæ which had purely paternal characteristics. These results have, however, been called in question by Seeliger, Morgan and Driesch; but even accepting Boveri's results, this experiment does not completely demonstrate that the chromosomes are the only "bearers of the inheritance material," as we shall see later. Finally, as a fitting climax to this chapter of remarkable disclosures as to the chromosomes, may be mentioned the epoch-making discovery of McClung, Wilson and Stevens that in certain groups of insects the dimorphism of the sexes is correlated with a chromosomal dimorphism of the spermatozoa.

These are but a few of the many notable discoveries which have been made within recent years regarding the chromosomes, and while they do not demonstrate the truth of the chromosomal inheritance theory, they do prove the very great significance of the chromosomes in the process of heredity. Boveri concludes his last great work on "The Development of Dispermic Sea-urchin Eggs" with these words (p. 260):

> After all has been said, I believe that we may regard the view that specific characteristics are transmitted from the parent to the child through the chromosomes of the egg and the sperm nuclei, as a theory which has a series of facts in its favor and up to the present time not a single one against it.

VI

Against the extreme form of this theory, as held for example by Hertwig, many general and specific objections may be urged. General objections are based upon the consideration that the entire cell, cytoplasm as well as nucleus, is concerned in differentiation and that neither is capable of embryonic development in the absence of the other. Differentiation is indeed the result of the interaction of nucleus and cytoplasm, and how then can it be said that the nucleus is the only seat of the inheritance material? If held rigidly, this theory involves the assumption that the cytoplasm and all other parts of the cell are the products of the chromosomes, and that therefore the chromosome and not the cell is the ultimate independent unit of structure and function—an assumption which is contrary to fact. Furthermore, since heredity includes a series of fundamental vital processes such as assimilation, growth, division and differentiation, there is something primitive and naïve in the view that this most general process can be localized in one specific part of the cell—something which recalls the long-past doctrines that the life was located in the heart or in the blood, or the ancient attempts to find the seat of the soul in the pineal gland or in the ventricles of the brain.

Among specific objections may be mentioned the fact that the cytoplasm is not isotropic, as Hertwig supposed, but rather that many fundamental differentiations are found in the cytoplasm of the egg at the time of fertilization and immediately after. As evidences of such differentiations may be cited, (1) polarity and symmetry, (2) differential cleavages, (3) positions and proportions of important organ bases, (4) various types of egg organization, (5) experiments in hybridization.

1. So far as is known, the animal pole of the egg becomes the aboral pole of the gastrula in all animals, while the cytoplasm in this region gives rise to the ectoderm of the developing animal. This polarity of the egg may be traced back through its ovarian history to its earliest stages, and it is probable that in some cases at least it is directly continuous from generation to generation. Here then is an important character which is inherited through the cytoplasm and not through the nucleus.

2. Similarly, the symmetry of the cyto-

plasm of the egg frequently corresponds to the symmetry of the adult. In many bilateral animals the fertilized egg is bilaterally symmetrical. Such bilaterality is found even in the ovarian eggs of insects and cephalopods, while in other cases, such as ascidians and amphibians, it appears immediately after fertilization. In still other groups there is reason to believe that a bilateral organization may be present in the unsegmented egg, even when it may not be directly visible. Thus in most gasteropods there is no direct evidence of bilaterality in the unsegmented egg, but in *Neritina* Blochmann observed a group of granules on each side of the animal pole, and in later development these were found in the velar cells of the right and left sides. In all gasteropods the velum arises from similar cells of the early cleavage, and yet the bilateral groups of "Urvelargranula" have been found only in *Neritina*. Is it not probable that in other gasteropods similar bilaterally distributed substances are present, although not directly visible?

Gasteropods also show a striking correlation between the distortion of bilateral symmetry in the spirally coiled body of the adult and the symmetry of cleavage. It is well known that in certain gasteropods the body is coiled to the right, in others to the left, and corresponding to this inversion of the symmetry of the adult, Crampton found that there was an inversion of the symmetry of the cleavage. The cleavage of a half-dozen genera of sinistral gasteropods is now known and in every instance it is the reverse of that found in dextral gasteropods. Furthermore, this inversion of symmetry may be traced back to the unsegmented egg. Such a case shows conclusively that not only bilaterality is present in the cytoplasm of the egg, but that even departures from such symmetry are also present.

3. In the cleavage of the eggs of many animals it has been shown that the position, shape, size and substance of the blastomeres; the direction, time and quality of cell-division; the size of the nucleus, centrosomes and chromosomes, are all under cytoplasmic, rather than nuclear control. That the type of cleavage, its rhythm, rate and direction are determined by the cytoplasm of the egg has been shown by myself in the normal development of gasteropods, and by Boveri and Driesch in the case of echinoderm hybrids; that the size of the nucleus, centrosomes and chromosomes is dependent upon the volume of the cytoplasm is clearly shown in Crepidula, where, in the large and small blastomeres, these structures are invariably proportional in size to the volume of the cytoplasm. In the case of echinoderms, on the other hand, Boveri holds that the size of the nucleus is dependent upon the number of chromosomes which it contains, and that the size of the cell is controlled by the size of the nucleus. The latter is certainly not the case in annelids, mollusks or ascidians.

4. Another direct correspondence between the cytoplasm of the egg and the structure of the larva may be found in those animals in which particular substances of the egg become localized in definite regions and finally give rise to specific parts or organs of the embryo or larva. Such cases are known among animals belonging to a large number of phyla. Among ascidians the substances which are to enter into the formation of the ectoderm and endoderm, the muscles, mesenchyme, notochord and nervous system are present in the two-cell stage in relatively similar positions and proportions to the corresponding organs of the larva. If any of these substances is removed from the egg, the embryo which develops from such an egg lacks the corresponding organ; and conversely, if these substances are forced into abnormal positions in the egg, the

characteristic organs to which they give rise appear in these same abnormal positions. There is, therefore, in this case, both negative and positive proof that these materials of the cytoplasm of the egg are actually "organ-forming substances."

5. In different phyla there are marked differences in the localization of the ooplasmic substances, corresponding to differences in the location of the organs in the embryo or larva. Many different phyla may, therefore, be distinguished by the type of ooplasmic localization which they show. In its general features, therefore, the characteristics of the phylum are present in the cytoplasm of the egg cell.

All of these observations on the cytoplasm go to show that it is not isotropic, as Hertwig supposed, but that it is differentiated and that many of the characteristics of animals, especially such as apply to their general type of organization, are represented in the cytoplasm of the egg.

6. Finally as evidence that inheritance may take place through the cytoplasm of the egg, reference must be made to the extremely important work of Loeb and of Godlewski. By concentration of hydroxyl ions Loeb found that it was possible to cause the spermatozoa of starfishes and ophiurans to fertilize the eggs of sea urchins. The embryos and larvæ resulting from such crosses showed only the characteristics of the mother. Later Godlewski, using the same methods, was able to fertilize the eggs of a sea urchin by the sperm of a crinoid, and although such hybrids were raised to the larval stage they showed only maternal characteristics. Still more, enucleated urchin eggs fertilized by crinoid sperm produced gastrulæ of purely urchin type. These results demonstrate, as Boveri admits, that the chromosomes of the sperm do not in this case influence or modify the cytoplasm of the egg cell; while the experiments on the enucleated egg show that the characteristics of the organism, at least as late as the gastrula stage, are derived entirely from the egg cytoplasm.

Boveri long since showed that the early stages of development, perhaps as late as the blastula or gastrula, are uninfluenced by the spermatozoon and are purely maternal in type; in the case of Godlewski's hybrid larvæ he supposes that the sperm chromosomes remain permanently inactive. But however this result is to be explained, it may be considered as definitely settled that the early development of animals is of purely maternal type, and that it is only in stages later than the gastrula, and consequently after the broad outlines of development and the general type of differentiation have been established, that the influence of the spermatozoon begins to make itself felt; and it is equally certain that this type of differentiation is predetermined in the cytoplasm of the mature egg cell, rather than in the egg nucleus.

On the other hand, there is no doubt that the differentiations of the egg cytoplasm have arisen, in the main, during the ovarian history of the egg, and as a result of the interaction of nucleus and cytoplasm; but the fact remains that *at the time of fertilization the hereditary potencies of the two germ cells are not equal, all the early development, including the polarity, symmetry, type of cleavage, and the relative positions and proportions of future organs being predetermined in the cytoplasm of the egg cell, while only the differentiations of later development are influenced by the sperm. In short, the egg cytoplasm fixes the type of development and the sperm and egg nuclei supply only the details.*

This conclusion is not a refutation of the nuclear inheritance theory, but it is a profound modification of it. At once it destroys the argument that since there is equality of inheritance from both parents there must be equivalence of inheritance material in egg and sperm. So far as those characteristics are concerned which appear late in development, it is highly probable that there is equality of inheritance from both parents, but in the early and main features of development, hereditary traits, as well as material substance, are derived chiefly from the mother.

Finally I may call attention briefly to the bearing of these conclusions on the mechanism of evolution. I have elsewhere (Science, No. 536) discussed the proposition that the evolution of organisms must take place through the evolution of their germ cells, and that relatively slight modifications in the localization of the formative substances of the egg may produce profound modifications in the adult.

One of the principal difficulties in explaining, on evolutionary grounds, the origin of different phyla has been the dissimilar locations of corresponding organs or parts. These difficulties are well illustrated by the theories which attempt to derive the vertebrates from the annelids or from any other invertebrate type. If evolution takes place through the transformation of the egg cell rather than of the adult, it is no more difficult to explain the different locations of corresponding parts in these phyla than their different qualities. Changes in the relative positions of parts which would be absolutely impossible in the adult may be readily accomplished in the unsegmented egg, as is shown by cases of inverse symmetry.

In the light of the conclusion that only the later and more detailed differentiations are influenced by the sperm, it follows that experimental work which aims to modify the fundamental features of an organism must be directed to the ovarian egg rather than to the sperm, or to the developing embryo.

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THE INFLUENCE OF FRICTION IN ECONOMICS [1]

There has always prevailed, since the foundation of systematic political economy, a conflict between men of theory and men of action. Men engaged in practical business affairs and even in great financial operations have refused again and again to accept the abstract conclusions drawn from so-called economic laws, and have insisted that the rule of practical common sense, if based upon a careful observation of facts, was a safer guide than economic theory. In the field of tariff legislation this divergence of opinion has perhaps been more marked than in the field of finance. This difference, so far as it exists, tends to support the view which is here laid down—that the economist has erred in a measure in seeking to apply abstract principles too rigidly to actual conditions by failing to take account of friction in the application of these principles.

The economist, working out the theory of the conduct of the economic man according to the principles of enlightened self-interest, finds in them a harmony and a rule of law which in his mind give them something of the beauty and precision of the movement of the spheres. He is impatient of qualifications which detract from the simple and direct operation of the principles derived from these theories. The principles of the flow of capital to the market where the price paid for its use is the highest, of changes in prices according to changes in the quantity of money, of the evolution of production and manufactures in such a manner that each community and each individual shall find his most profitable work under the regime of free competition, are principles so simple to his mind that he can not understand how they can be disputed.

Nor could such principles be long disputed, if the current of trade flowed as freely as the waters of the ocean into a vacuum wherever scarcity indicated a given demand, and if money and capital

[1] Address of the vice-president and chairman of Section I—Economics and Social Science—American Association for the Advancement of Science, Chicago meeting, 1907–8.

moved without restraint to the market where they found the most profitable use. If every one bought in the cheapest and sold in the dearest market, then universal free trade might prevail among the nations, imperialism would fold its flag and sheathe its sword, and every community would be producing either the agricultural products or manufactured goods which experience had taught that it could produce with the greatest efficiency and in exchange for which it could obtain the greatest sum of the desirable products of other communities.

But we know that this is not the case. No peace conference and no appeal to the universal brotherhood of man can prevent wars based upon the intensity of industrial competition. The world of to-day is organized upon the system of competing nationalities. Many generations distant is the dream of universal peace among the nations, such as Rome by her power enforced for four centuries throughout nearly the entire civilized world from the time of Augustus to that of the third Valentinian. The origin of modern wars, as was doubtless the case in reality with many ancient and medieval wars, is the struggle for existence. Few nations have yet been willing to stand forth, as does Great Britain in the field of trade, seeking no shelter behind artificial barriers against the competition of other peoples. The cause of free trade, which it was believed in Cobden's time had only to be presented to civilized men, like the teachings of the gospel, in their simple beauty, to make converts of all the world, has made little visible progress in recent years. On the contrary, a great wave of protectionism swept over Europe in the eighties and the barriers have been erected higher in most cases rather than lower within our generation. Converts to the principles of Adam Smith and John Stuart Mill and Cobden have undoubtedly been made among thinking men, but even those men, when exalted to official place, have usually found that they had to deal with a *status quo* which was too enormously complicated to permit the cutting of the Gordian knot of special privilege and interdependent industries during the time in which they were likely to continue as public servants.

More significant still of the general belief of responsible governments, that universal free trade and the unfettered movement of capital are still far in the future, has been the policy of imperialism which has followed on the heels of protection and been deemed sufficiently important to justify the sacrifice of thousands of lives and millions of treasure, even by that champion of economic freedom, the empire of Great Britain. Experience has shown that "trade follows the flag" to a large extent, not perhaps because competition in a free field would not make the flag a negligible factor, but because by skilful regulations and legislation can be created discriminations and favors of many sorts which give potent advantages to those under the flag over alien rivals. Even the policy of "the open door" in the East, which did honor to the memory of Secretary Hay as much as it did violence to the professed economic views of some of his predecessors, was not potent enough to insure that equality of opportunity for non-Russians in Manchuria which it was designed to secure and did not prevent the greatest death-struggle of our generation between Russia and Japan as to who should in future attend to the execution of this avowed policy of equality.

If the professor of political economy, therefore, desires to exercise a greater influence than he exercises to-day in molding the policy of this nation or any other, he may well give greater weight than heretofore to the influence of friction in economics instead of reposing upon the comfortable assumption that economic forces operate in a vacuum. Experience demonstrates that even the movement of capital is not without friction. If friction did not exist, the interest rate for loans upon equally secure collateral would be the same in New York as in London, in St. Petersburg as in Paris, in Arkansas as in Chicago. Wherever good opportunities for loans arose, money would flow like water into the vacuum of demand. The merchant of Little Rock, other things being equal, would obtain his borrowed capital at the same rate as the mercer of London or the jeweler of the Rue de la Paix. But the merest tyro in finance knows that this is not the case. Not only has the creation of physical means of communication been necessary to bring markets together, but the creation of the means of exchange has also been necessary. And so far as markets have been brought together, it is largely by state-created, but not state-operated, institutions. How could the market of Paris draw to itself the savings of France for investment in the securities of the world and maintain the lowest and most uniform discount rate of any great market but for the giant mechanism which Napoleon created, under the guidance of Mollien, under the name of the Bank of France? How could Canada enjoy comparative uniformity of interest rates in all her provinces but for the Canadian banking law, which confers upon institutions of limited liability the privilege of issuing circulating notes and establishing branches in every part of the Dominion? As Bagehot truthfully declared of the conditions under which capital is transferred, "You can not have it unless you have a strong government, which will keep peace in the delicate line on which people are moving." And again he sets forth, as indicating the narrow limits within which the law of the transfer of capital operates even in modern society:

> But though the loan fund begins so early in civilization, and is prized so soon, it grows very slowly; the full development—modern banking such as we are familiar with in England—stops where the English language ceases to be spoken.

And if there are fetters upon the free movement of capital, how much greater are those upon the free movement of labor! It is a favorite argument, and a sound one, of even the most orthodox of economists, that the effect of a depreciating currency is felt in the rise of prices before it results in the rise of wages. The friction which attends the lifting of the wage scale is forged into a powerful argument in favor of giving steadiness to the unit of value. Why then is not the effect of this friction worthy of consideration when it affects rates of customs duties and other national economic policies? I do not say that this argument is not often abused, but I do say that the classical economist is not justified in appealing to its finality in the one case and treating it as beneath contempt in the other.

The abstract principle of wages is that, other things being equal, similar service should command the same equivalent in every part of the world. But one finds skilful carpenters in Manila working for about fifty cents a day in gold, and in America at two dollars and fifty cents. In Hong Kong in 1901 I was told that good Chinese brick-layers were working for forty cents a day in silver or about twenty cents in gold. Why did they not strike for the same wages as their fellow-workmen in London or New York, or San Francisco? Because, behind them, in the interior of China, were millions upon millions of their fellow-countrymen, as ready to take their places in the ranks of cheap workers as the loyal Japanese soldiers and sailors who were ready to climb over the bodies of their dead comrades to victory before the walls of Vladivostock or on the smoking decks of their battleships in the China Sea. Would it be of any use to preach to the Chinese mechanic in Hong Kong the doctrine of the eventual equalization of wages by the movement of masses of laborers from poorly-paid markets to those well paid until wages in Hong Kong rose to the level of those in London? Would he not reply that an equalization which could not be accomplished in perhaps three generations was too remote to justify his hazarding his job?

The operation of the quantity theory of money is another field in which economists themselves have been compelled by the exigencies of their own arguments to admit the influence of friction upon the working out of theory. Whatever may be thought of the principles laid down when the use of money was not so extensively supplemented as at present by instruments of credit, it is now obvious that those principles rarely operate in a vacuum. Other influences, so important that they often outweigh changes in the quantity of the metallic monetary stock, come constantly into operation. The argument of a few extremists in the silver campaign, that "money of ultimate redemption," or "basic money," alone influences prices, would hardly be defended to-day even by the followers of Mill. Those, on the other hand, who depart farthest, either from his theories or from their practical application, contend that prices are influenced by the volume of banking credits, by the rate of discount, and preeminently by the demand and supply for particular articles which interacts in one case upon demand and supply for other articles, so that there is never reached a static point at which a proportionate increase in the quantity of money is accompanied by a like and uniform increase along the entire line of manufactured and exported goods.

The friction which takes place in the introduction of a new stock of gold from the mines into general circulation has been made the subject of elaborate studies by Cairnes, Chevalier and many others. Their arguments are often quoted in support of the contention that out of this friction emerges ultimately a definite relation between prices and the quantity of money. But if this friction occurs in this first flow of the new metal from the mines, then it almost inevitably follows that it occurs also in its later movements between communities and even in its relation to different articles. The supply of any article may be so uniform that it is inadequate under certain conditions of demand and excessive under new conditions of demand. Hence come about relations of supply to demand which affect such articles differently from those whose supply can be promptly curtailed or promptly expanded according to the conditions of the market. Friction operating with different degrees of intensity in the case of different articles thus makes it practically impossible that at any given moment such friction shall have been overcome in equal degree for all commodities and that they shall show a uniform increase or decrease in price based upon a corresponding change in the quantity of money. Of this friction intelligent economists now generally take note, even where they adhere to the theory that in the end prices become adjusted to an increase or decrease in the stock of the standard metal.

If the influence of friction, then, can be admitted in respect to the movement of capital, the tendency of wages, and changes in the quantity of money, is it not illogical to insist too strongly that it should not be recognized in systems of taxation and especially in rates of customs duties? The contention that "the foreigner pays the tax," made by the extreme protectionists in framing the McKinley and Dingley laws, may find verification in specific instances, where the foreigner would prefer to hold a market already acquired, even at a lower rate of profit, rather than to sacrifice a plant built entirely or chiefly for supplying that market. Cases of this kind do not, of course, justify the attempt by political legerdemain to impose upon other nations the fiscal charges of the state. Indeed, to the enlightened cosmopolitan they appear a rather undignified and pitiful device to rob somebody else to obtain one's daily bread. But the fact can hardly be disputed that the operation of those simple economic harmonies which were the dream of Mill and Bastiat and Cobden is essentially hampered by the inability of capital and labor to move instantly from one place to another or from one employment to another.

A nation which has built up even an artificial system can not perhaps afford to throw down the structure at a blow. It may be demonstrable that the sooner it is destroyed the more fully will come into operation the principle that labor finds its most efficient employment under the system of free competition. But if the existing capital of the nation is invested, as in the case of the United States, in manufacturing establishments to the extent of thousands of millions of dollars, too great a sacrifice may be involved in abandoning enterprises suddenly, even where the capital invested in them was misapplied. Hence practical statesmen, whatever their theoretical views, have in but few cases proposed the sweeping abolition of protective tariff laws. Changes which will afford free raw materials to manufacturers, and will reduce excessive profits and unnecessary exactions upon the customer, can undoubtedly be made with wisdom in this and most other protective countries. The appeal to throw down the structure, however, must almost inevitably be treated by practical statesmen, like the quantity theory of money and the theory of the free movement of capital, as representing what might be desirable if economic forces operated in a vacuum, but what is rarely, if ever, attainable in the world of practical affairs.

The science of political economy can afford to recognize these limitations upon its application to practical affairs, without yielding that devotion to abstract truth which gives charm to the work of its greatest exemplars. If there have been conflicts in the past between men of theory and men of action, they have been largely due to this failure to recognize the restrictions imposed by actual conditions, the disposition to insist that a fundamental truth once demonstrated should be accepted by all men, without regard to limitations of time and space, just as the great teachers of Christianity have sometimes urged that the existing social order should be forsaken and that Christ's mandate should be put in immediate force, to sell all that one hath and give to the poor. The practical theologian knows as well—perhaps better—than the political economist, that these principles are not of immediate application in their extreme form and that if the world can be guided steadily towards those heights where truth lies, it will make more rapid progress than by preaching the impracticable in a world of practical men and practical affairs. It is the duty of the political economist to continue to preach these fundamental truths which have been worked out by the masters of the science within the past two centuries, but this need not lead him to reject and spit upon the practical considerations which the statesman has to face in applying abstract principles to mundane conditions.

It should not be forgotten that economic science differs in essential respects from the physical sciences. In those sciences we find forces which work according to fixed laws. Even in them we find the effect of those laws mitigated or offset by friction and opposing forces. In the world of economic science we do not deal with conditions so unvarying. The so-called laws of economic science are simply the interpretation of what is likely to be the action of men under the stimulus of self-interest in the field of free competition for the acquisition of goods and the accumulation of capital. But while two streams of water act in exactly the same way under similar physical laws, no two men act in precisely the same way under the operation of mental laws. At least, if laws exist which compel such uniformity of mental action, they are too abstruse to have yet been discovered and formulated.

From the standpoint of existing conditions, therefore the psychological element is an important factor in mitigating the operation of so-called economic law. To acquire commodities and save capital is not man's sole impulse. On the contrary, in the midst of the most highly developed civilized society to-day, a large percentage of men are influenced by other motives than the desire to achieve the greatest result by the utmost exertion of their labor. Some prefer idleness to labor; others prefer spending to saving; others pursue ambitions which have their roots only remotely in the acquisition of money. And if this is so in civilized communities, how much more is it so in those where commerce is feebly developed, where the church or the state, or immemorial custom prescribe the routine of each man's life, and where competition in our modern American sense is almost a thing unborn.

Economic law does not operate in a vacuum or in anything approaching a vacuum even in the most advanced modern society. It gropes blindly in a mist of disturbing forces, and with many digressions from its true objective, even where its operation is most nearly unhampered. The political economist, therefore, can afford to admit that the man of practical affairs sees in some respects as clearly as himself regarding existing requirements, even though his eyes are fastened upon the ground while his own are uplifted to the stars.

Charles A. Conant

SCIENTIFIC BOOKS

Ice Formation, with Special Reference to Anchor-Ice and Frazil. By Howard T. Barnes, M.A., D.Sc., F.R.S.C. New York, John Wiley and Sons. 1906. Pp. 260.

To persons living in moderate climates, the statement of Dr. Barnes, in his introduction, is very striking that where surface ice is prevented from being formed "as in a rapidly flowing river we meet with the worst effects from the presence of ice"; notwithstanding the fact that the temperature of the water never varies more than a few thousandths of a degree from its freezing point, even when the air is 30° or 40° lower. The account which Mr. Barnes gives of the difficulties which the ice causes in the St. Lawrence River at Montreal entirely substantiates the statement. There are three kinds of ice which are met with; the surface ice, the anchor-ice, which is formed in the bed of the river and the frazil, which is formed as small individual crystals at the surface of the swiftly flowing water. The frazil is formed in the rapids and is carried under the surface ice in the quiet water below and adheres to its under surface. Thus the ice becomes thick enough to choke up the channel of the river and cause a serious flood. Frazil also interferes with the water power used at Montreal by choking up the machinery, and a commission has existed for some time for the purpose of studying the condition leading to the formation of frazil and the best methods of preventing the damage done by it. This commission had made many determinations of the temperature of the water with mercury thermometers and had failed to discover any real variations from the freezing point, but the Callendar platinum resistance thermometer makes it possible to determine the variation of the temperature easily to a thousandth of a degree centigrade, and Dr. Barnes's familiarity with this instrument enabled him to make extremely accurate observations showing the condition existing when frazil and anchor-ice are formed.

The first few chapters of the book are devoted to a compilation of the laws of the transfer of heat, the various methods of determining the different constants of ice and water, and the general structure of ice. In referring to the various workers in these fields, Dr. Barnes gives their names and the year of their work but does not give references to their original publications, which would be very useful for students of the subject. The platinum resistance thermometer is then described and the degree of accuracy obtainable with it is shown to be in the neighborhood of 1/10,000 of a degree centigrade, under good laboratory conditions; these were not obtainable at the river bank where Dr. Barnes made his observations, but he considers that the water temperatures which he determined are accurate to a thousandth of a degree. The rest of the book is devoted almost entirely to the study of anchor ice and frazil, and their occurrence in the St. Lawrence River.

Many observations and opinions regarding the formation of anchor ice are cited and Dr. Barnes wisely makes a long extract from two papers by the Rev. Dr. Farquharson, in the *Philosophical Transactions* for 1835 and 1841. His observations were made on the rivers Don and Leochal in Aberdeenshire, and they were so well made that one is entirely convinced that he is right in ascribing the formation of anchor-ice to the cooling of the bottom of the streams by radiation. The absorption of water for radiation of long wave-lengths is not well known but Dr. Barnes made a preliminary experiment to show that bodies at low temperatures can radiate through water and glass; a coil of platinum wire covered with a layer of water between glass, was exposed to radiation on a clear night; the coil became cooler by radiation.

Careful observations made near Montreal show that anchor-ice is not formed except on cold clear nights and in situations permitting free radiations into space. Anything interfering with this radiation, such as a bridge or a clouded sky, will entirely prevent the formation of anchor-ice, and a very short period of bright sunshine is sufficient to loosen the ice from the bottom and cause it to rise, sometimes in great quantities, to the surface.

Frazil, on the other hand, is formed at the surface, where the water is so disturbed by currents or strong wind as to prevent the formation of a surface sheet. All that is necessary for the formation of this kind of ice is very low temperature and rough water. The water becomes undercooled to a few thousandths of a degree and small crystals of ice are formed and carried down with the current. Bright sunshine is sufficient to prevent the formation of frazil; and the experiment of Dr. Barnes shows how quickly the undercooled water is brought up to the freezing point when the sun shines upon it. His experiments were carried out in a small hut on the shore of the river. It is necessary in these experiments to have as a basis for comparison a mixture of snow and water exactly at the freezing temperature; some difficulty is found in obtaining this to the degree of accuracy required. Dr. Barnes found that when the water was freezing the temperature of the mixture was slightly lower than the freezing point; on the other hand, when the ice was melting the temperature was slightly higher, and he found that the variations from the freezing point depended upon the relative proportions of ice and water in the mixtures. This led him to the suggestion that "a freezing point mixture must be defined as an intimate and equal mixture of ice and water, neither gaining nor losing heat."

The final chapter in the book tells of the difficulties attending the use of water-power machinery at Montreal on account of the formation of frazil ice, and the way these have been met. One very simple method, which has served pretty well, is to take the water from a quiet part of the river which freezes over entirely in cold weather rather than from a point on or below the rapids where frazil is formed in great quantities.

The most important parts of the book are those dealing with the formation of anchor-ice and frazil, and Dr. Barnes's temperature observations. The small section on glacier motion is hardly in accord with the present ideas of glacialists.

To any one interested in the engineering problems brought about by ice, or in the general phenomena of ice formation this book will be extremely interesting and useful.

Harry Fielding Reid
Johns Hopkins University,
Baltimore

The Chemistry of Commerce, A Simple Interpretation of some new Chemistry in its Relation to Modern Industry. By Robert Kennedy Duncan. New York and London, Harper and Brothers. 1907.

This is a book intended by its author "to interpret into simple terms and for educated lay-folk some new science in its relation to modern industry." The author seems to have realized the difficulty involved in this problem which he had planned for himself or which had been submitted to him by others. Whether the "one object of the book" indicated in the opening sentence of the introductory chapter, "to convince the manufacturer, through instances taken here and there, how absolutely applicable is modern science, to the economy and progress of manufacturing operations" will have been attained through it remains to be seen. Certainly it is not easy to make a manufacturer, prosperous in spite of his wastes, realize the importance of the economies which may be discovered and applied through the aid of thoroughly educated men, and lead him to the practical application of such economies. Adversity and active competition are the influences which are most effective in bringing about such policy, wise, at all times, and it is exceedingly doubtful if it can be brought about by even the most attractive presentation of generalities—carefully prepared balance sheets are far more interesting and intelligible to the manufacturers of this country at least; and while the author has made a most interesting and readable book, it will, we fear, be read with closer attention and appreciation by those lay-readers who least need it, in view of the object of its preparation. In twelve chapters the following subjects have been treated: Catalysis, Fixation of Nitrogen, Rare earths and their uses, High Temperatures and Modern Industry, Modern Chemistry and Glass-making, Industrial Alcohol, Floral Perfumes, Making of Medicines, Microbe Inoculation, Cellulose, Industrial Fellowship. Each subject furnishes the author with illustrations of the importance of the application of scientific methods and the truths they develop, in industrial work. Manufacturers who are inclined or are desirous to proceed in rational ways to attain the best results in quantity and quality of product and in cost of operation, must certainly be attracted by what the author has presented. But those who most need the book will not, we fear, read it; while those who will read it need it least. Yet those of us who know the full truth of all that is presented in the book will at least hope that it may be widely read and that the suggestions it offers may find extended application not only for the good of manufacturers, but for the world at large. The book then is generally acceptable, but it may be criticized by some readers on account of the statement to be found on page 177. "But this was in the days long ago . . . when experimental medicine was carried on by physicians like Paracelsus, who stood by the bedside of his patient, watch in hand," etc. Many readers will remember that the first watch was made one hundred years or more after the death of Paracelsus. Such pleasantries seem out of place in such a book and the technical description of the analytical method for standardizing drugs involving "dissolving out with chloroform and ultimately titrating them with sulphuric acid" will scarcely attract the lay-reader. The use of the word "dubiety," when the more familiar "doubt" would serve, may unfavorably affect some of the lay-readers the book is specially intended to influence favorably.

Furthermore, the statements regarding the cost of manufacture of industrial products, such as alcohol, unless they have been scrutinized and confirmed by experienced manufacturers, must be accepted with reserve and may also have some tendency to defeat the object of the book.

Wm. McMurtrie

Synopsis of Mineral Characters. By Ralph W. Richards. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1907.

This is an alphabetically arranged list of minerals and their chief physical characteristics, with concise definitions and descriptions; the chemical composition expressed by an empirical formula. Simple blowpipe reactions are also given. The book is intended as a reference work for those who have studied mineralogy and need notes to aid in the identification of minerals in the field. It is a compact 12mo of 100 pages, which may be carried about in the pocket conveniently, and will undoubtedly prove very useful to students and field workers.

J. P. Iddings

SOCIETIES AND ACADEMIES

THE FORTIETH ANNUAL MEETING OF THE KANSAS ACADEMY OF SCIENCE

At the meeting of the Kansas Academy of Science held in Emporia on November 29 and 30, among the many important papers read the following may be mentioned:

"Natural Gas obtained from Trees," by F. W. Bushong and D. F. McFarland. This paper gives an analysis of natural gas obtained by boring into cottonwood trees. The authors showed that this gas contained 7.21 per cent. of carbon dioxide and about 61 per cent. of marsh gas, and 30 per cent. of nitrogen. L. E. Sayre discussed the percentage of extractives in certain drugs and spices, and commented on the necessity of having improved and reliable methods for making these determinations. He also mentioned some "fake" medical preparations that were upon the market, and referred to the work of the board of health in trying to reform the fraudulent methods of labeling. Considerable attention was paid to the progress of the water survey of Kansas in papers read upon the chemical work by E. H. S. Bailey and F. W. Bushong, on the bacteriological work by M. A. Barber and W. J. Starin, on the field work by H. N. Parker, and upon engineering problems by W. C. Hoad. C. F. Menninger read a paper on "Gastric Ferments," showing the remarkable advancement in the knowledge of this subject that has recently been made. F. B. Dains and E. W. Brown reported on the reaction of formanidines, giving an account of some newly discovered bodies. Some new finds in the Kansas Chalk beds were reported by Chas. H. Sternberg. A fossil tooth and other bones from Phillips County was discussed by J. T. Lovewell. A very practical paper on the "Food Habits of the Blue Jay" was read by L. L. Dyche. In this he showed the murderous intent of this bird, not only from observation, but also from numerous dissections of the blue jay, in which the heart and other vital parts of birds were found in the crop. Grace R. Meeker discussed a curious "Impatiens" recently found. W. Knaus, besides reporting on additions to Kansas coleoptera, mentioned some new coleoptera found in New Mexico, and many interesting species collected at night in McPherson, Kansas. "A Parasite on Eggs of Mantis" was the subject of a paper by Mrs. L. C. R. Smyth. L. C. Wooster read a paper on the "Antiquity of Man's Body-building Instincts." B. R. Rogers in a paper upon "Tuberculosis" emphasized the importance of greater precautions to prevent the spread of this disease. "The Abnormal Character of Man" was the title of a paper by J. M. McWharf. W. F. Hoyt in an entertaining way gave a report on some scientific frauds and fallacies. The "Buried City of the Panhandle" was the subject of a paper by F. L. Eyerly. B. B. Smyth discussed harmonics and magic hexagons. The advantage of fireless cooking was explained by J. T. Lovewell. H. P. Cady gave a résumé of his work on the occurrence of neon in natural gas, and showed that it was possible to obtain neon in appreciable quantities from this source. Papers on the "Quantity of Water found in Oysters" as they are marketed, and the "Occurrence of Copper in Oysters," were presented by J. T. Willard. A description of a fossil tusk found in Equus beds was given by E. O. Dare. The nomenclature of the carboniferous, showing the most recent classification as adopted by the Kansas Geological Survey, was discussed by E. Haworth and J. Bennett. The use of a score-card for the comparison of natural waters with the use of a different rating for surface waters, deep wells and shallow wells was discussed by E. H. S. Bailey. "Some Preliminary Studies on the Moon" was the subject of a paper by F. A. Marlatt.

The retiring president, J. A. Yates, gave the presidential address on the "Value of the Work of the Scientist to Humanity."

E. H. S. Bailey

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 640th meeting was held on December 7, 1907, Vice-president Bauer in the chair. In accordance with the by-laws of the society, the evening was devoted to hearing the president's address, which was delivered by Mr. John F. Hayford, on "The Earth, a Failing Structure."

The full text of this address will soon appear in Volume XV. of the *Bulletin of the Philosophical Society of Washington.*

The 37th annual meeting of the society was held on December 21, 1907, and was devoted to the presentation of the usual annual reports and the election of officers.

The following officers were duly elected for the ensuing year:

President—L. A. Bauer.

Vice-Presidents—A. L. Day, E. B. Rosa, C. K. Wead and C. G. Abbot.

Treasurer—B. R. Green.

Secretaries—G. K. Burgess, R. L. Faris.

General Committee—C. Adler, L. J. Briggs, E. Buckingham, W. A. DeCaindry, W. S. Eichelberger, E. G. Fischer, L. A. Fischer, R. A. Harris and P. G. Nutting.

R. L. Faris,
Secretary

DISCUSSION AND CORRESPONDENCE

THE NOBEL PRIZES

To the Editor of Science: Incorrect statements about the Nobel prizes and the supposed misappropriation of certain parts of the Nobel funds crop up every year as regularly as the question of the awarding of the prizes. These discussions began several years ago both in scientific journals and in the daily press, especially in America. There seems to be an impression that American scientists and authors are being neglected by the institutions which are distributing the awards. Such an opinion was expressed, for instance, on page 50, Vol. XVI., of the *National Geographic Magazine.* It was stated in regard to the fact that up to that time (January, 1905) no American had received a prize, that "the reason is not lack of appreciation abroad of what we are doing in this country, but the neglect of Americans to apply for the prizes." This sentence was frequently quoted by daily papers, which ruminated the same old question, using in yellow-journal style the most vituperative language against the Scandinavian institutions which have to do with the awarding of the prizes. But the papers referred to omitted what is mentioned in the editorial note in the *National Geographic Magazine.* It is there said, "In the awarding of prizes only those persons are considered who are formally nominated as candidates by some institution, college or scientific society of rank and character."

The Nobel prizes are not applied for, and those having the nominating power are not confined chiefly to Swedes, as is claimed in an article in the January, 1907, number of *The Popular Science Monthly* (pp. 91–92). The statutes concerning the distribution of prizes give the right to nominate a candidate for the literary prize competition to "Members of the Swedish Academy and of the Academies in France and Spain, which are similar to it in constitution and purpose; members also of the humanistic classes of other academies and of those humanistic institutions and societies that are on the same footing as academies; and teachers of esthetics, literature and history at university colleges." This certainly gives the nominating power to others than Swedes, and probably America has the lion's share of persons with power to nominate candidates. The Swedish Academy has eighteen members, and there are two or three other institutions in Sweden which "are on the same footing" as the academy, while the professors of literature, history and esthetics at Swedish universities do not number more than a dozen.

The nominating power for the medical prize lies with members of the medical faculties at the Caroline Medical Institute, Upsala and Lund universities in Sweden, Christiania University in Norway, Copenhagen University in Denmark, and Helsingfors in Finland, while members of at least six other medical faculties "selected in the way most appropriate of the just representation of the various countries," and in addition any number of scientists whom the staff of the Caroline Institute may see fit to select, are empowered to nominate candidates. It does not seem that the charge of the writer in *The Popular Science Monthly* is just. In regard to the scientific prizes the right to nominate candidates belongs to "home and foreign members of the Royal Academy of Science in Stockholm, members of the Nobel Committees of the physical and chemical sections of the Nobel foundation, scientists who have received a Nobel prize, professors of physics and chemistry at the universities above referred to, as well as at the Royal Technical College in Stockholm, and professors of the same sciences at at least six other universities, as well as other scientists to be selected by the Academy of Science of Stockholm. Also in this case by far the smaller number of persons with right to nominate are Swedes.

The article in *The Popular Science Monthly* referred to also says that as Nobel's "large fortune was made in Great Britain by the discovery and manufacture of dynamite, it seems likely that the instructions of his will would have been more adequately carried out if their execution had been entrusted to the Royal Society and the British courts." Of all the charges made in regard to the Nobel prizes this is certainly one of the most extravagant. Nobel's will directs that "the prizes for physics and chemistry shall be awarded by the Swedish Academy of Science in Stockholm; the one for physiology or medicine by the Caroline Medical Institute in Stockholm; the prize for literature by the academy in Stockholm (Svenska Akademien), and that for peace by a committee of five persons to be elected by the Norwegian Storting." It is difficult to see the reason why the Royal Society or the British courts should have been entrusted with the execution of the will, which particularly mentions the institutions in whose power the distribution of the prizes is placed.

That the instructions of the will "would have been more adequately carried out" by the Royal Society is a statement which, I am sure, no fellow of that august institution would ever claim.

The writer in *The Popular Science Monthly* further says that "it is truly sad and discouraging that there should be lack of good faith in the administration of a fund intended, as the testator states, 'to benefit mankind.'" His further charge that "the prizes have so far been awarded annually, but it is to be feared that when the money is needed in Sweden, it will be kept there," is as slanderous as it is undignified.

In an editorial in the same journal (Vol. 58, pp. 107–108) for November, 1900, it is also stated that

> Nobel's intentions have not been exactly carried out; the chief deviations being that part of the money is used for the establishment of certain Nobel institutes, the objects of which are not exactly defined. . . . Any attempt to divert the funds to the encouragement of the local institutions or to the education of inferior men should be carefully guarded against. Nobel's will explicitly ordered that the money be awarded in prizes for eminence and without any consideration of nationality.

If the writers of these articles referred to and all those others who appoint themselves judges in regard to this question had taken the trouble to inquire about the actual cause of the apparent "violations" of Nobel's will, they would have found that the executors of the will appointed by the testator were men who knew him intimately, and subsequently acted in full accordance with the wishes expressed by the testator during his lifetime.

Nobel was a patriot as good as any one, and although his main object was in the interest of mankind generally, his second thought was his own country, and it is well known that he left the distribution of the prizes with certain Swedish institutions for the express purpose of putting Sweden in closer contact with the great scientific, literary and peace movements of the rest of the world.

As for the right of the executors to change the stipulations of the will there are several points to be taken into consideration. The will was very general in its wording, and all who have had to execute a general order of any kind know that when coming down to the details the exact directions given often have to be somewhat modified. In this special case there are many instances where the actual provisions of the will are not only difficult, but impossible to carry out. The testator directed that prizes be awarded to "those persons who shall have contributed most materially to benefit mankind during the year immediately preceding." This may seem very easy to accomplish, but as a matter of fact, very few discoveries of any importance have been immediately acknowledged. Let us say that an investigator within the province of medicine makes a discovery this year, which he himself and probably some of his friends would recognize as a valuable and epoch-making discovery of the greatest "benefit to mankind." But it is not very likely that the medical world in general would immediately accept the discovery as correct or acknowledge its superiority above anything else done the same year. This would not be in accordance with the scientific spirit to investigate thoroughly before accepting a statement as truth. Nor could it be expected that any scientific body in the world could be ready to immediately pronounce this discovery as the greatest accomplishment during the year. In no single case where Nobel prizes have been awarded has the work on which the award was based been recognized as a great work during the same year. All those critics who are so ready to offer their advice in regard to the execution of Nobel's will apparently do not realize that the exact words of the will are impossible to follow literally in practise. It is most difficult to fix the exact date for an important discovery. Moreover, the author may not be able to publish and prove his discovery within a year's time, and if the provisions of the will were to be taken literally, a discovery made in 1905 but published in 1907 would be disqualified for competition in 1909, the year in which it was ascertained that the discovery was really of great "benefit to mankind." Such an interpretation would be ridiculous, but it is really what many of the critics claim as the only right one.

In the execution of Nobel's last will it has also been found necessary to provide that:

If it be deemed that not one of the works under examination attains to the standard of excellence required, the sum allotted for the prize or prizes shall be withheld until the ensuing year. Should it even then be found impossible, on the same grounds, to make any award, the amount in question shall be added to the main fund, unless three fourths of those engaged in making the award determine that it shall be set aside to form a special fund for that one of the five sections, as defined by the will, for which the amount was originally intended. The proceeds of any and every such fund may be employed, subject to the approval of the adjudicators, to promote the objects which the testator ultimately had in view in making his bequest, in other ways than by means of prizes.

This is often objected to as "illegal," "in direct violation of the provisions of the will," etc. Any one who cares to reflect over the proviso in the will that the prizes be given annually will find that this latter may not always be possible. In the constant stream of literature appearing each year it may be found that no work can be singled out for its excellence or considered worth a prize of about $40,000. What would these practical, well-meaning critics do in such a case? Award at all events. It is very doubtful if such a course would be to the "benefit of mankind" or in accordance with the general tendency of the testator's will.

Professor Svante Arrhenius, of Stockholm, wrote me in regard to this question, a letter dated May 28, 1905, and I give here a translation of some extracts:

It can hardly be said that any violation of Nobel's will has been committed. The will is so briefly worded, that it could hardly serve as a foundation for the distribution of the prizes without explanatory additions. On account of the Utopian form of the will some of Nobel's heirs commenced a lawsuit against the institutions which Nobel had appointed as distributors of the prizes. Rather than lose a part of the funds in a lawsuit, which could be prolonged for an uncertain length of time, the said institutions decided to compromise with the heirs, and to interpret the will by the statutes which were drawn up by a committee, in which the said institutions and the heirs were represented, and which statutes were later approved by the government. All these parties were interested in reaching as far as possible the aims which Dr. Nobel had intended by his will. In this regard the committee in question naturally had much better knowledge of the facts than the testator.

It was then acknowledged that it was impossible to award the prize "to the person who shall have contributed most materially to benefit mankind during the year immediately preceding." The great inventions, especially the theoretical ones, are generally not of such a nature that their value is acknowledged immediately after their publication. It was therefore decided to change "preceding year" to "late times." I can not see that this is a "violation" of the idea of the will. I also think I can say that the authorities who have the execution of the will in their hands have exercised great care not to award prizes for discoveries which have been made a very long time ago, although many proposals to this effect have been presented. The said institutions further agreed that one tenth of the proceeds should annually be added to the main fund in order to prevent a decrease in the amount of the prizes on account of any future lowering of the money value or the rate of interest. Finally these institutions considered that the amounts, which could be set apart for defraying of expenses connected with the judging of the proposals submitted, should primarily be used for the establishment of Nobel Institutes, the purpose of which is to promote in other ways the aims of the will. By this arrangement the prizes have decreased (by 25 per cent.), but I have not yet heard any prize winner criticize this. Whether the recipient of a prize receives $40,000, as is now the case, or $52,000 is rather unimportant. The indirect result of the prizes is the greatest. It may also be pointed out that the distributors of the prizes have shown great impartiality in following the testators wishes, that Scandinavians should not have any preference before others. . . . This fall (1905) a Nobel Institute in physical chemistry is to be established. The annual expenditure for this (including rents, etc.) is only $4,400. I have been elected chief of this institute, and I expect to be able to promote the aims of the will more in this capacity than on account of the fact that I shall have received a Nobel prize.

As Professor Arrhenius says, an adjustment of interests was amicably entered into to prevent the possible loss of a considerable amount of the funds by a long lawsuit, and in the deed of adjustment it was affirmed and declared by the testator's heirs, that:

By these presents we do acknowledge and accept Dr. Nobel's Will, and entirely and under all circumstances relinquish every claim for ourselves and our posterity to the late Dr. Nobel's remaining property, and to all participation in the administration of the same, and also to the possession of any right on our part to urge any criticism upon the elucidations of, or additions to the said Will, or upon any other prescriptions with regard to the carrying out of the Will or the uses to which the means accruing from the bequest are put, which may either now or at some future time be imposed for observance by the Crown or by those who are thereto entitled:

Subject, nevertheless, to the following express provisos:

(*a*) That the Code of Statutes which is to serve in common as a guide for all the corporations appointed to award prizes, and is to determine the manner and the conditions of the distribution of prizes appointed in the said Will, shall be drawn up in consultation with a representative nominated by Robert Nobel's family, and shall be submitted to the consideration of the King;

(*b*) That deviations from the following leading principles shall not occur, viz.:

That each of the annual prizes founded by the said Will shall be awarded at least once during each ensuing five-year period, the first of the periods to run from and with the year next following that in which the Nobel-Foundation comes into force, and

That every amount so distributed in prizes in each section shall under no consideration be less than sixty (60) per cent. of that portion of the annual interest that shall be available for the award, nor shall the amount be apportioned to more than a maximum of three (3) prizes.

In an article reproduced in Science for August 16, 1907, it is said in regard to the use of certain parts of the income for the purpose of ascertaining that the prizes are worthily awarded:

This might be justifiable if the money were spent for this purpose. If the committees used the laboratories and libraries they have established out of the Nobel fund for the purpose of testing the real value of alleged inventions it would do much to promote science and assist in the discovery of struggling genius. But no man is allowed to present his own claims. He must first have the endorsement of scholars occupying certain narrowly specified official positions in his own land.

It would be interesting to know how much the writer of this article referred to knows about the work done at the Nobel Institutes, whether this is done for the purpose indicated or not. It is evident how unpractical it would be if each man presented his own claims to a discovery, and the committee on awards had to test in each case the actual value of the claims. It would be equally interesting to know what method of selection the writer of the article referred to would suggest. To persons with ordinary intelligence it seems fairly evident that the foremost specialists in each country are the best judges as to discoveries in their own line, let it be that these specialists may occupy "certain narrowly specified official positions" only, and do not represent the general public. A popular vote would hardly be the correct method for judging the value of scientific discoveries or achievements in literature.

It must be remembered in regard to the Nobel Institutes that they are not by any means reserved for Swedes, as is often claimed. Paragraph 12 of the Code of Statutes provides that "the adjudicating corporations are at liberty to appoint foreigners, either men or women, to positions at the Nobel Institutes." Of the more than thirty prizes so far distributed only one has been awarded a Swede, and there is no man who could raise any objection in that case. One prize has been given a Norwegian, and this was done not on account of love or relationship, as any one conversant with Scandinavian politics can testify. One prize was awarded a Dane, whose discovery was generally recognized as fully meriting this encouragement. All the other prize-winners have been non-Scandinavians. One American has received a prize so far, and it was not given him on account of nationality, but for his personal accomplishments in the line in which he received a prize.[1]

It can not rightly be claimed that parts of the Nobel funds have been diverted for local purposes, as the institutes are in every way of the most international nature, as all science should be. When the writer in *The Popular Science Monthly* makes the statement that the Nobel Institutes "have been founded in dishonor" he is going too far, and by such an unverified accusation he certainly does himself no credit.

I have repeatedly been approached by countrymen on this side of the Atlantic to reply to some of these attempts at discrediting not only our foremost Swedish scientific institutions, but the Swedish government and nation which have sanctioned the actions of the administrators of the Nobel Fund. I have hesitated to do so, but a recent letter received from a university in the United States brought up the question again, and the new awards of prizes that will be made to-day, on the anniversary of the death of Dr. Alfred Nobel, will probably cause a renewed outburst of comments from newspapers and others. It is well that at least American scientists hear the other view of this question.

Pehr Olsson-Seffer

Mexico City,
December 10, 1907

UNIVERSITY REGISTRATION

To the Editor of Science: In connection with the university registration statistics published in the issue of November 29, I wish to call your attention to the following corrections:

The students of the University of California credited to commerce and architecture constitute a group of students who at other insti-

[1] The recent award of the prize in physics to Professor A. A. Michelson, of Chicago, is further evidence that those concerned in the distribution of the prizes are recognizing true merit, without considering nationality.—P. O.-S.

tutions would probably be classified as students in liberal arts with their major subjects in political science or architecture. On the other hand, Stanford, which was given fourth place in the number of academic students, makes no distinction in its returns between academic students and students in applied science. The men in the undergraduate schools of this institution are very largely registered for major work in the departments of applied science, just as they are at the University of California and at other western institutions.

In the case of Indiana University, the figures for 1902–03 as reported by the registrar's office include all students enrolled in the university from November to November, thus including in each case two freshmen classes. For the years following 1903 the figures include the enrollment from the beginning of the summer term in June to November of the same year, and do not include the new enrollment between November and the following June. Accordingly, the totals for 1902–03 are much too large and the totals for the following years are too small. The actual total enrollments for the university are as follows:

1901–1902	1,285
1902–1903	1,469
1903–1904	1,418
1904–1905	1,538
1905–1906	1,684
1906–1907	1,821

RUDOLF TOMBO, JR., *Registrar*

COLUMBIA UNIVERSITY

ANOTHER FLEA REMEDY

TO THE EDITOR OF SCIENCE: Anent the communication from Dr. L. O. Howard in your issue of November 29, the following preventive, which insures a comfortable night's rest in spite of the proximity of fleas, may be of interest. In sleeping in farmhouses and country hotels in western Oregon, where there was not only a reason to suspect the presence of fleas, but where their presence had been demonstrated beyond question, I secured immunity by pouring a little camphor in solution in the palm of my hand, and rubbing limbs and body with the same. This method is, I believe, in quite general use in infested regions by travelers who have not reached the climax of indifference enjoyed by the natives.

F. L. WASHBURN

MINNESOTA EXPERIMENT STATION,
December 5, 1907

SPECIAL ARTICLES

THE FOSSIL SAWFLY PERGA COLORADENSIS

IN SCIENCE of October 4, p. 446, I recorded a large fossil sawfly from Florissant, apparently referable to the Australian genus *Perga*. In the course of unpacking the Florissant materials, the reverse impression, which I had not seen before, has come to light. It shows certain parts of the wing not clearly visible in the original, and enables me to see that there is a lanceolate cell, traversed by a cross-nervure, after the manner of *Cimbex*. As the marginal cell has no trace of a cross-nervure, wherein it agrees with *Perga* and not with *Cimbex*, the insect finds no place among modern sawfly genera, and may be placed in a new genus *Phenacoperga*.

Phenacoperga coloradensis differs from *Cimbex* not only in the character just mentioned, but in the position of the cross-nervure of the lanceolate cell, which has retreated far toward the base of the wing, so that it is more than twice as distant from the apex of the lanceolate cell as from the base of the wing. This may probably be regarded as a step toward the condition in *Perga*, where the cross-nervure may be considered to have retreated to the very base, and the lower side of the cell then to have failed.

The new genus appears to confirm Konow's classification, wherein *Cimbex* and *Perga* are associated in the same subfamily. According to his system, it would form a new tribe between the Syzygoniides and Cimbicides.

I will take this occasion to refer to *Atocus defessus* Scudder, another extinct genus of sawflies from Florissant. According to Scudder's figure, the insect appears to be anomalous from the total absence of any subcostal nervure. I recently examined the type at Cambridge, and can affirm that the subcostal is present, although its points of attachment are not clear.

T. D. A. Cockerell
University of Colorado

THE SORGHUM MIDGE

For many years growers of sorghum in our southern states have noted a common failure to produce a full crop of seed. This trouble is generally known as "blast." Many scattered references to this condition may be found in agricultural literature and in correspondence. Different theories as to the cause of this observed sterility have been advanced from time to time. Chief among the agencies which have been regarded as possible causes are fungi, insects and various meteorological conditions, such as excessive precipitation, high humidity, severe drouth and hot winds. Among the growers themselves, it is quite generally held that this sterility results from the washing away of the pollen by heavy rains during the blooming period.

In the spring of 1907, experiments were planned to determine the cause of sterility. The work was largely done at Baton Rouge, La., and San Antonio, Texas. In Louisiana, the writer was assisted by Professor H. R. Fulton, pathologist of the Agricultural Experiment Station, and in Texas by Mr. F. B. Headley, superintendent of the U. S. Experimental Farm at that place. Many of the data on the life history are due to the studies of Professor Fulton.

The first examination of the plants at Baton Rouge, made by the writer late in July, disclosed the presence of large numbers of a small fly on and around the heads. These insects proved to be females actively engaged in depositing eggs within the fertile spikelets. A search of the literature available in the library of the Louisiana Crop Pest Commission brought to light the publication by Coquillet[1] of a new species of Cecidomyiid, *Diplosis sorghicola,* received in sorghum heads in 1895 and again in 1898. A comparison of the insects in hand with this description proved them identical with Coquillet's species. This identity was subsequently confirmed by Professor F. M. Webster.

Observation showed that egg-laying began as soon as the tips of the heads emerged from the boot or upper leaf sheath, and continued until the flowering period was wholly past. Heads in every stage of development, from the beginning of emergence to the close of anthesis, were protected from the midges by means of paper bags. The results of all bagging experiments were in substantial accord. Heads protected from the midge were uniformly fertile, where normal growth continued. Heads exposed during the first half of anthesis and then protected were sterile in the upper portion and well seeded below. Heads exposed until flowering was wholly completed were uniformly sterile when midges were abundant during anthesis, and partly fertile when midges were scarce. From 500 to 1,160 midges were hatched from each of several infested heads. Exposed heads examined a few days after anthesis showed living larvæ lying in close contact with the shrunken and undeveloped ovaries. The injury is due to the absorption of the juices from the young and tender ovary, thus causing development to cease. This absorption is through the body walls of the larva, the ovary being not eaten or otherwise injured though oftentimes discolored. This method of obtaining nourishment is shared also by the larvæ of the closely related wheat midge, *Diplosis tritici,* and by those of the well known Hessian fly. Numerous additional facts concerning the habits and life history of the midge will be presented in a more appropriate place.

Sterility or failure to produce seed in various sorghums is thus shown to be due to the attacks of the Cecidomyiid midge, *Diplosis sorghicola* Coquillet, for which the name, sorghum midge, is here proposed. At Baton Rouge the midge was accompanied by a Chalcid parasite, a species of *Aprostocetus.* According to Professor Webster, this parasite

[1] Coquillet, D. W., "A Cecidomyiid Injurious to the Seeds of Sorghum," U. S. Dept. Agr., Div. of Entomology, Bulletin (New Series), 18: 81–82, 1898.

is not, however, the one noted by Coquillet (*l. c.*) but an entirely new species.

Carleton R. Ball,
Agronomist in Sorghum Investigations
U. S. Department of Agriculture,
Washington, D. C.

TWELFTH ANNUAL MEETING OF THE NATIONAL ASSOCIATION OF STATE UNIVERSITIES

The twelfth annual meeting of the National Association of State Universities was held in Washington, D. C., on November 18 and 19, 1907. In this association upward of forty universities are entitled to membership and thirty-nine are active members; thirty-five universities were represented at the meeting. It was one of the most important meetings of the association ever held in point of attendance, bearing of the topics discussed, business transacted, and investigations ordered.

The president's address, "Some Problems of American Universities," gave a comprehensive view of the field of higher education in America and suggested many vital topics for possible future investigation. The question of a "National University" was again to the front and a definite scheme was endorsed for a non-degree-conferring institution that should add to research opportunities several unique practical functions. A committee of the association in conjunction with a committee of the National Educational Association is charged with the duty of presenting the plan to Congress. A committee met the trustees of the Carnegie Foundation and further discussed the claim of the state universities to the benefits of the retirement fund. At this writing the question is still open. Moreover, a committee on "standardizing" American universities was appointed. This question involves the vital and difficult problems of reorganization of higher education and the action of the association may be of far-reaching importance.

Among the many other questions discussed were "Development of Graduate Schools in State Universities" and "Preparation of High School Teachers."

The Secretary of the Interior and the Commissioner of Education attended part of the meetings and evinced a helpful interest in the problems before the association. A reception was given by the president and faculty of George Washington University.

The relation of state universities to the educational interests of each state, the efficiency of the organization and its representative character make the American Association of State Universities a natural leader in discussing some of the many problems of higher education which are pressing for solution.

James H. Baker,
President of the Association for 1907
University of Colorado

THE AMERICAN SOCIETY OF AGRONOMY

The American Society of Agronomy was organized in Chicago on December 31, 1907. According to the constitution, the object of the society shall be the increase and dissemination of knowledge concerning soils and crops and the conditions affecting them.

It is expected that the membership will be composed largely of scientific workers in agronomy. A strong feeling has been prevalent for some time that an opportunity is greatly needed for college and station men to meet and discuss methods of experimentation and instruction in agronomy.

Provision has been made for including as charter members all who join the society before July 1, 1908. Arrangements were also made by which local sections may be established in any part of the country on application of three members of the society. The agricultural colleges may thus have local organizations for discussion of agronomic subjects.

By resolution the society expressed its desire to assist the Society for Promotion of Agricultural Science in bringing about affiliation of all the scientific agricultural organizations.

The officers for the present year are as follows:

President—M. A. Carleton.
First Vice-president—C. P. Bull.
Second Vice-president—J. F. Duggar.
Secretary—T. L. Lyon.
Treasurer—E. G. Montgomery.

Time and place of meeting and form of publication are to be decided later.

T. L. Lyon,
Secretary

Ithaca, N. Y.,
January 10, 1908

THE WORK OF THE MAGNETIC SURVEY YACHT "GALILEE" IN THE PACIFIC OCEAN DURING 1907

The early part of the year found the *Galilee* on her way to the Marquesas Islands, having left San Diego, California, on December 22, 1906, with the following scientific personnel on board: W. J. Peters, commander; Messrs. J. C. Pearson and D. C. Sowers, magnetic observers, and Dr. G. Peterson, surgeon and recorder. Captain J. T. Hayes, as heretofore, was the sailing master.

From the Marquesas Islands, the route followed to Shanghai, touched at Tahiti (Society Islands), Apia (Samoan Islands) and Yap (Caroline Islands); Shanghai was reached on May 8. At all of the ports visited special examinations with regard to the distribution of the magnetic elements were made and comparisons secured, whenever possible, between the *Galilee* magnetic instruments and magnetic observatory standards. In addition, magnetic observations were made at sea whenever conditions permitted.

Leaving Shanghai on May 31 course was set for Sitka, Alaska, where the vessel arrived on July 15. Here she was inspected by Dr. L. A. Bauer, and some instrumental changes decided upon in consultation with the commander, Mr. Peters. At this port Mr. J. C. Pearson, who had been continuously on sea duty for a year and a half, was relieved and assigned to important magnetic work in the Yukon territory. In his place on board ship was assigned Mr. P. H. Dike, who in addition to taking part in the regular magnetic observations will likewise attempt special experimental work in atmospheric electricity.

After having completed the required shore operations at Sitka, the *Galilee* set out once more, under the command of Mr. Peters, for a cruise extending this time over both the North and the South Pacific Ocean. Leaving Sitka on August 10 she arrived at Honolulu on August 28. Here again shore magnetic observations were made and instruments were tested and compared at the Coast and Geodetic Survey Magnetic Observatory near Honolulu.

Leaving Honolulu on September 26, the *Galilee* was sighted off Midway Island on October 6 on her way to Jaluit, of the Marshall Islands, and she finally arrived at Lyttleton, near Christchurch, New Zealand, on December 24, having been delayed somewhat in her progress by calms.

It is expected that she will leave the last named port about January 15 for Callao, Peru, where she is due to arrive early in March. From thence she will return to her home port, San Francisco, about May 1. The aggregate length of the cruises of the *Galilee* since August 1, 1905, will then have amounted to about 65,000 miles, embracing the Pacific Ocean from the American coast to the Asiatic coast, and from the Aleutian Islands down to New Zealand.

A complete determination of the three magnetic elements (magnetic declination, magnetic inclination, and intensity of magnetic force) has been secured at sea, on the average, about every 200 or 250 miles along the entire route, besides numerous magnetic results having been secured at ports and islands visited.

Owing to the high efficiency reached by Mr. Peters's party and because of the promptness with which the records of observations are transmitted, the complete reduction of the work can be kept almost apace with the observational work. It is confidently hoped that all the results obtained can be put in published form shortly after the termination of the work at San Francisco next May.

To say nothing of the interesting and important scientific results growing out of this work, mention may be made at present of but one result—one of great practical importance to navigational interests. With the aid of the data furnished the United States Hydrographic Office by the Carnegie Institution of Washington, it was possible to issue last spring a new chart of the "Lines of Equal Magnetic

Variation" (Magnetic Declination). It was found that in the Pacific Ocean the charts previously possessed were erroneous along certain well traversed routes by as much as three or five degrees, and that systematically at times. Hence these errors were of sufficient magnitude to be taken into account in practical navigation.

ELIZABETH THOMPSON SCIENCE FUND

THIS fund, which was established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to $26,000. As accumulated income is now available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations *which can not otherwise be provided for,* which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding $300 will be made only under very exceptional circumstances.

Applications for assistance from this fund, in order to receive consideration, *must be accompanied by full information,* especially in regard to the following points: (1) Precise amount required; (2) exact nature of the investigation proposed; (3) conditions under which the research is to be prosecuted; (4) manner in which the appropriation asked for is to be expended.

All applications should be sent at once to the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass.

SCIENTIFIC NOTES AND NEWS

DR. W. W. KEEN has been elected president of the American Philosophical Society, Philadelphia, succeeding Dr. Edgar F. Smith, who declined reelection.

AT the recent meeting of the American Society of Zoologists, Eastern Branch, held at the Sheffield Scientific School of Yale University, the following officers were elected: *President,* Dr. William Morton Wheeler, American Museum of Natural History; *Vice-president,* Professor Herbert S. Jennings, Johns Hopkins University; *Secretary-Treasurer,* Dr. Lorande Loss Woodruff, Yale University; *Member of the Executive Committee,* Professor Gilman A. Drew, University of Maine.

AT the recent Madison meeting of the American Economic Association Professor Simon N. Patten, of the University of Pennsylvania, was elected president, to succeed Professor Jeremiah W. Jenks, of Cornell University.

M. GONNESSIAT, of the Paris Observatory, has been appointed director of the Observatory of Algiers.

PROFESSOR CORNIL, of Paris, having reached the age limit of seventy years, has been retired from the chair of pathological anatomy and histology, which he may be said to have first founded in France.

DR. DAVID HILBERT, of the University of Göttingen, has been made a member of the Bavarian-Maximilian Order for Science and Art.

LORD BRASSEY has been elected a corresponding member of the geographical section of the French Academy of Sciences in succession to the late M. Oudemans.

PROFESSOR RAPHAEL MELDOLA, F.R.S., past president of the Chemical Society, has been elected president of the Society of Dyers and Colorists, in succession to the late Sir W. H. Perkin.

THE University of St. Andrews has resolved to confer the honorary degree of LL.D. upon the following scholars, on February 16: Lord Avebury; Mr. Francis Darwin, president-elect of the British Association; Mr. Philip Norman, treasurer of the Society of Antiquaries; Sir E. J. Poynter, Bart., president of the Royal Academy; Mr. Charles Hercules Read, past president of the Anthropological Institute; and Principal MacAlister, Glasgow.

The University of Cambridge has conferred the honorary degree of M.A. upon Mr. Sidney Herbert Ray, assistant master at St. Olga Street Council Schools, Bethnal Green, in recognition of his study of Oceanic languages.

The Vienna Academy of Sciences has made an appropriation of $300 to Dr. Robert Falta for his work on diabetes.

Professor W. A. Kellerman, of the Ohio State University, is now in the republic of Guatemala prosecuting his fourth mycological expedition to that country, assisted by students H. E. Barber, S. B. Stowe and J. F. Zimmer. The party will collect parasitic fungi and material in related branches of natural history, returning about April 1.

Dr. George A. Dorsey, curator of Anthropology in the Field Museum of Natural History of Chicago since 1897, has begun a long trip in the interests of the museum. He visits first the leading museums on the continent and then proceeds to Ceylon by way of Egypt. In Ceylon he will study the Rock Veddahs, considered the lowest in culture of all the inhabitants of the earth. He then crosses to Southern India and on to Siam, Sumatra and Java. From Java he proceeds to Australia and then to New Zealand where he will study the Maoris. His next objective will be various islands of the Melanesian group. On his way home he will stop at the Philippine Islands to explore some of the little known parts of Mindanao and Mindoro.

The Herbert Baxter Adams prize of $200.00 offered biannually by The American Historical Association for the encouragement of historical research and offered in 1907 for the best unpublished monograph in the field of European history, has been awarded to William Spence Robertson, of Western Reserve University, and Edward B. Krehbiel, of the University of Chicago. The prize is to be divided between them. The prize-winning theses will be published by The American Historical Association both as separate publications and as parts of the annual report of the association. Dr. Robertson's thesis was on "Francisco de Miranda and the Revolutionizing of Spanish America." Professor George L. Burr, of Cornell University, was acting chairman of the committee on award.

The secretary of the Lamarck memorial, adding to his former report, records that he has received contributions from the following institutions and societies: Philadelphia Academy of Sciences, N. Y. Zoological Society, American Paleontologists, American Zoologists, American Naturalists, American Museum of Natural History, Washington Biological Society; and from the following individuals: Messrs. W. S. Marshall, George F. Eaton, Metcalf, Townsend, Hargitt, C. W. Dodge, Davenport, Conklin, Hussakof and Ball.

The funeral of Lord Kelvin at Westminster Abbey, on December 23, was impressive in character. The pall-bearers were: The Lord Rayleigh, O.M., president of the Royal Society; The Right Hon. J. Morley, O.M., secretary of state for India; Sir Archibald Geikie, K.C.B., president of the Geological Society; Professor A. Crum Brown, Royal Society of Edinburgh; The Master of Peterhouse, Cambridge; Sir J. Wolfe Barry, K.C.B., Institution of Civil Engineers; Sir Edward H. Seymour, O.M., admiral of the fleet; M. Gaston Darboux, perpetual secretary of the Academy of Sciences of France; The Lord Strathcona and Mount Royal, high commissioner for Canada; Sir George Darwin, K.C.B., University of Cambridge; Dr. McAlister, principal of the University of Glasgow; Dr. R. T. Glazebrook, Institution of Electrical Engineers.

A memorial meeting in honor of Lord Kelvin was held at the United Engineers Building, New York City, on January 12, under the auspices of the American Institute of Electrical Engineers. Mr. Henry G. Stott presided, and among those who made addresses were Dr. Elihu Thomson, Rear Admiral George W. Melville and Professor E. L. Nichols, of Cornell University.

Professor Boeckh, an eminent medical statistician and emeritus director of the Berlin Statistical Bureau, has died at the age of eighty-three years.

THE fourth lecture in the Harvey Society course was delivered at the New York Academy of Medicine building on Saturday evening, January 11, 1908, by Professor Ernest H. Starling, of the University of London. Subject: "The Chemical Control of the Body."

THE Lees and Raper memorial lecture, 1908, will be delivered in the Town Hall, Oxford, by Mr. William McAdam Eccles, M.S., F.R.C.S., on February 4. Subject: "The Relation of Alcohol to Physical Deterioration and National Efficiency."

AT the request of the New York Physics Club, Professors Crocker and Sever and Mr. Arendt, of the department of electrical engineering of Columbia University, will give to its members a series of demonstrations on electrical engineering, so far as it bears upon high-school physics. These lectures will be free and will be given in the engineering building of Columbia University on Tuesday afternoons from 4 to 5:15 o'clock, February 4 to March 24, inclusive. It is expected that they will be open to all teachers of secondary schools as well as to members of the New York Physics Club.

THE Western Reserve University lecture course now being announced includes lectures upon political, sociological, medical and scientific subjects. Dr. James Elbert Cutler, formerly of the University of Michigan, and now associate professor of sociology upon the newly established Selah Chamberlain Foundation at Western Reserve, opened the course Tuesday evening, January 14, with his lecture, "Lynching as an American Practise." Professor Cutler has made a special study of lynching, and has contributed articles upon the subject to both northern and southern publications. Other lectures of the course are to include "The Results of the Anti-Tuberculosis Movement," by Dr. John H. Lowman, of Western Reserve Medical College, date to be announced later: "The More Recent Developments in Astronomy," by President Charles Sumner Howe, of the Case School of Applied Science, March 3, and "Municipal Home Rule: the Relation of the City and the State," by Dr. Augustus Raymond Hatton, of Western Reserve University, March 17. Dr. Hatton is associate professor of political science upon the M. A. Hanna Foundation. The lectures are free and are to be given in the physical laboratory on the Adelbert College Campus.

THE Sheffield Scientific School of Yale University announces its forty-second annual Sheffield lecture course, to begin January 17, 1908. Following is a list of the lecturers and their subjects, with the dates:

January 17—"Mars as seen from the Andes," by Professor David Todd.

January 24—"Northern Mexico: its Deserts, Plateaus and Canyons," by Dr. Edmund Otis Hovey.

January 31—"Nature Study in relation to protecting and propagating American Game Birds," by Professor Clifton F. Hodge.

February 7—"Personal Experiences in Alaska and the Chilkoot Pass," by Mr. Alfred H. Dunham.

February 14—"Modern Long-span Bridges, with special reference to the Quebec Disaster," by Mr. Frank W. Skinner, C.E.

February 21—"Persian Travels," by Dr. William Lord Smith.

February 28—"Heredity in Man and the Lower Animals," by Dr. Charles B. Davenport.

March 6—"Rare Earth Industries," by Mr. Harlan S. Miner.

March 13—"Silk, Natural and Artificial," by Professor Charles F. Chandler.

March 20—"History and Habits of the Fur Seal," by Mr. Frederic A. Lucas.

THE U. S. Civil Service Commission announces an examination on April 1, 1908, to fill several vacancies in the position of micro-analyst (either sex), at $1,500 per annum, and at lower salaries, depending upon the qualifications shown, in the Bureau of Chemistry, Department of Agriculture.

MR. ENGLEBRIGHT has introduced a bill in the House of Representatives to establish in the Department of the Interior a Bureau of Mines. The bill has been referred to the committee on mines and mining.

A COPY of a decree issued by the provisional governor of Cuba has been transmitted by the Department of State to the Department of Commerce and Labor. It names a commission of fourteen members, headed by Rafael

Fernandez de Castro, president of the Agrarian League of the island, and empowered to prepare a report and submit a draft of a law for the amelioration of agricultural conditions in Cuba.

Consul-General Richard Guenther, of Frankfort, says it is reported that a Hamburg joint stock company has purchased a large tract of land along the mouth of the Elbe at Cuxhaven, where power works are to be erected. The action of the ebb and flow of the tide is to be employed in generating electric energy to be used in factories about to be established. The works will also furnish electric power to the town of Cuxhaven and other towns in the vicinity. The daily capacity of the plant will reach 14,000 horse power.

The French Administration des Postes et Télégraphes is, according to the Paris correspondent of the London *Times*, engaged in making some interesting experiments with a view to the improvement of telephone communication. On an underground cable between Lille and Roubaix a certain number of self-induction coils on the system of Professor Pupin, of Columbia University, have been intercalated. As was found to be the case in America, the results obtained have been excellent, and there is some talk of greatly increasing the use of these coils on a number of other telephone lines.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. Andrew Carnegie will erect a $50,000 building for Bates College for the study of science, providing a similar sum is raised to support the department.

Harvard University has received from the trustees under the will of Miss Harriet N. Lowell the sum of $2,000, this being the first annual payment of a part of the income of her estate in accordance with a provision by which the money will be for surgical research. In addition to this immediate benefit, the university has the remainder of the estate, subject to the life tenancy above mentioned. The university has received from Mr. Francis Skinner $2,500 as his final payment on account of his gift of $5,000 for the purchase of books for the Arnold Arboretum, in memory of his father, Francis Skinner, of the class of 1862.

Columbia University has received for the equipment of the Department of Mining and Metallurgy three gifts of $2,500 each from estate of D. Willis James, Adolph Lewisohn and the Nichols Copper Company.

Steps have been taken by the authorities of the University of Wisconsin to increase the practical value of the instruction in agriculture by establishing a full two-year course to include the maximum amount of scientific and practical work. The present four-year course in agriculture has been revised with view to introducing into the first two years a number of subjects bearing directly upon farming, instead of confining the first years of the course as heretofore to purely scientific work. Graduation from high school or equivalent preparation will be required for entrance to the new two-year course, as well as to the present four-year course. At least six months of practical farm experience will be required for the completion of either of these courses.

According to a decree issued by the ministry of education, ceremonial matriculation is henceforth to be dispensed with in Austrian universities.

Dr. Albert Ross Hill has accepted the presidency of the University of Missouri to succeed President R. H. Jesse. Dr. Hill was dean of the College for Teachers at Missouri until last year when he accepted the deanship of the College of Arts and Sciences at Cornell University.

Dr. E. O. Lovett, professor of mathematics at Princeton University from 1900 to 1905 and since professor of astronomy, has resigned to accept the presidency of the institute established at Houston, Texas, by the late William M. Rice, with an endowment, which after long litigation is said still to amount to over $2,000,000.

Mr. A. T. Stuart has been appointed superintendent of schools in Washington to succeed Dr. William E. Chancellor, who has been dismissed by the Board of Education. The main charge against Dr. Chancellor appears to have been lack of judgment and tact.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JANUARY 24, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

HEREDITY AND ENVIRONIC FORCES[1]

THAT the qualities and forms of living things are the final and net result of the action of environic conditions upon ancestral protoplasm is almost universally agreed upon. Unanimous as may be the acceptance of this all-inclusive generalization, yet when the attempt is made to establish the causal connection between organisms and the forces concerned in their development, an accumulation of facts is encountered which lends itself to widely divergent theoretical explanations.

No gain would result from a citation of these countless theories or from a rehearsal of the evidence claimed for the support of each of them. A proper approach to some of the results to be presented, however, makes necessary a preliminary consideration of some of the basal and recognized relations of the cell, or of the organism to the developing complex of external forces. Foremost among the problems that present themselves in such a review is that of the nature of the so-called adaptations. Underlying the practise and extension of botanical science is the untested assumption that, for example, when a mesophyte is grown as a xerophyte, the modifications of structure which ensue are adaptive and fit the organism for dealing with arid conditions. The size and form of leaves de-

[1] Address of the vice-president and chairman of the Section of Botany, American Association for the Advancement of Science, Chicago meeting, 1907–8.

veloped in such cases is determined by the balance of water supply, conducting capacity of the shoot, and the transpiration rate. The combined action of these factors does lead to the formation of organs in many instances that have the aspect of being of increased fitness and efficiency, but results of the opposite character are encountered. Thus, in my own experiments with *Roripa*, the American watercress, it was seen to bear filiform, dissected leaves when submerged, linear dissected leaves when emersed, but when acclimatized at the Desert Laboratory, developed broadly ovate, almost entire, laminæ.

Etiolation resulting from diminished illumination or total deprivation of light has been supposed to induce adaptive elongation of stems and petioles by which the chlorophyll-bearing tissues were carried past obstacles which cut off the light. Long-continued experimental studies have demonstrated that not half of the species tested exhibit such elongation, a greater number showing thickened organs, and other useless alterations.

Illustrations might be multiplied, and a candid estimate of the alterations undergone by the organs of a plant when it is subjected to unusual conditions of temperature, moisture, food-supply and seasonal change usually fails to reveal anything more than a coincidence of direct response and useful purpose, and it is evident that such coincidences must be subjected to the closest scrutiny before being accepted as adjustments conditioned by suitability.

Turning now to structures and functions of a specialized character, normally heritable and characteristic, it is easy to read into them a fitness not actually present, or not possible of causal induction by the factors to which they are supposed to be an adaptation. Thus but recently the investigations of Lloyd complete the proof that the movements of stomata are not adaptive or regulatory with respect to transpiration. Reams have been written as to the automatic and finely balanced valve-like action of these organs with respect to the conservation of water in the plant, yet it is now known that they open, widen and close in response to other stimuli rather than those arising from the turgidity of leaves and the aridity or humidity of the air. The presence of spines and spiculæ on cacti serve to check the depredations of grazing animals, but it would need a devious logic to conjure up a causal relation between the two. These structures are probably due to aridity, but are not in themselves a useful structure in adaptation to this condition: a dozen species of cacti, devoid of spines altogether, are known which live under the most accentuated desert conditions. Morgan also concludes that the capacity of regeneration has been developed without regard to any directly adaptive action, and this exemplification might be extended indefinitely if space permitted. It is not intended to assert the non-existence of direct useful alterations in the organs of plants, and of the functions they serve: Instances of apparent validity are numerous, particularly in rhythmical activities of all kinds, but the entire matter of causal adaptation is in need of a basal reinvestigation from an entirely new view-point.

This leads to a second problem most readily suggested by the time-worn phrase "inheritance of acquired characters," a conception so vague, so widely inclusive and withal so illy consonant in ordinary usage with the facts, that it will soon be quoted only for its historical importance. If by this phrase is meant that an organism makes adaptive response to its environment by adjustments of functions followed by alterations of structure, and that the continuance of the stimulus and of the response results in heritable and irreversible modifications, we have an idea resting upon inference, and based upon suppositions and circumstantial evidence only, since no satisfactory proof has yet been offered to show that a modified soma might impress its divergent characters upon the germ-plasm.

It seems necessary to repeat and emphasize the assertion that no case exists, in which it has been demonstrated, or proved beyond reasonable doubt, that any fully and continuously heritable change has been induced in a plant by the conditions of cultivation, outside of those due to selection, hybridism and mutation. Individuals may be forced to the limit of their variability by culture, and the effect may endure for a few generations when the inciting causes are removed, but it finally disappears. Thus when a species is acclimatized poleward, it shows a seasonal cycle of lessened length, or instead of annual it becomes biennial, this being a fair example of a direct useful and necessary adaptation and one of the clearest that can be found. A return to lower latitudes is followed by a reversion to the original habit, however, a process which may need two or more generations for its completion. The movement of a species toward the equator may result in a perennial habit, likewise of a temporary character.

While satisfactory proof of direct individual adaptation and its heritability is not at hand, and while many of the most highly specialized adaptations are known to have no causal connection with the external agency concerned, yet the possibilities are not to be ignored. The very vagueness of the subject is a challenge, and it is with the view to testing evidence and obtaining new facts, that the Desert Laboratory has established experimental cultures through a range of a vertical mile, from subtropical arid, to alpine humid climates, in which introductions and exchanges already made have been followed by marked somatic alterations. It remains to be seen whether any of these are adaptive, and whether the changes in question are irreversible or not. A decade will be necessary for any intelligent consideration of even the simpler phases of the subject.

It is now pertinent for us to inquire as to the possible stimulative or formative action which external forces may exert on the germ-plasm independently of the somatic or vegetative body, in the production of heritable alterations.

Experimentation upon the subject has, until recently, been carried on with the idea of producing somatic modifications, which might by repetition, or by profundity of alternation, be impressed on the germ-plasm and thus conveyed to successive generations. Recently, however, Tower has carried his work in the induction of new forms of beetles by climatic and other factors, to a point where he is satisfied that the effect of the external agent is directly upon the germ-plasm, with what remarkable results, as set forth in his notable contribution, you are already doubtless familiar.

My own investigations bearing upon this matter were successful in methods in which the action of the experimental agencies upon the germ-plasm was direct and capable of ready demonstration. As announced in 1905 it was found that the injection of various solutions into ovaries of *Raimannia* was followed by the production of seeds bearing qualities not exhibited by the parent, wholly irreversible, and fully transmissible in successive generations.

Encouraged by this success, a number of reagents were used in the following year with *Œnothera biennis*, a plant which had been under observation for some time, and with which I was so familiar as to be able to recognize alternations readily. Of the various tests with this plant, one, which had been treated with a solution of zinc sulphate, gave seeds one of which produced a plant, known to my associates and myself as "F. 206," which differed so markedly from the parental form as to be recognizable by a novice. This form has been tested to the third generation, transmits all of its characteristics fully, and does not readily hybridize with the parent even when grown so closely in contact with it that the branches interlock.

With this additional success, next nine species in the genera *Opuntia, Cereus, Mentzelia, Argemone, Nicotiana, Eschscholtzia* and *Pentstemon*, which were growing naturally in the vicinity of the Desert Laboratory, were operated upon, using various solutions, inclusive of calcium nitrate, potassium iodide, zinc sulphate, and methyl-blue in various proportions from 1 in 250 to 1–50,000 parts of distilled water. Over a hundred thousand seeds were harvested from the treated ovaries and some were sowed in August, 1907. Most of the species in question develop slowly, and the seeds are difficult to germinate under control. I am not prepared, therefore, to make any definite announcement concerning the results, except to say that among the seedlings of *Cereus* are several which seem far from being typical.

The principal contribution to be made at the present time bears rather upon the mechanics of the action involved by this treatment. The original results were discussed with the assumption that the introduction of reagents into the ovary would be followed by action on the egg. In order to test this matter, solutions of methyl-blue were injected in the same manner as the other substances and examinations were made at various times from a few minutes to a day later, for the purpose of gaining some idea of the mechanical behavior of the fluids. The facts obtained from the great tree cactus, *Cereus giganteus,* will best serve as an illustration.

The ovaries of this plant are inferior and one-celled, the cavity having a capacity of about 2 c.c. The inner layer seems to function especially as a conductive tissue, and from it the concrescent funicular stalks arise, bearing the anatropous ovules to the number of several hundred, the whole offering exceptionally favorable conditions for treatment of the reproductive elements.

The large flowers open early in the morning and attract a variety of small bees and gnats, the former probably being instrumental in effecting pollination. If this is accomplished and the temperature rises to 80° F. the flower closes at the end of the day and falls off a day or two later. At lower temperatures, the flowers may reopen on a second or even a third day. The style is 5 or 6 cm. in length and the pollen tubes must traverse its length within twenty-four hours and probably accomplish it in much shorter time. It was, therefore, thought advisable to make injections between 10 A.M. and 4 P.M. of the day the flowers were open, or perhaps on the previous day.

Generally the needle of a charged syringe was thrust diagonally downward until the tip projected into the central cavity, and the reagent forced in by the pressure of the piston, as much as .5 c.c. being introduced in some instances. The use of this maximum amount would cause a visible enlargement of the ovary, but even in such cases the mucilaginous character of the tissues and the high turgidity would quickly close the wound when the needle was withdrawn. With lesser amounts and using the greatest care in manipulation, the operation was followed by the death and casting away of a proportion of the treated ovaries which amounted to as much as 95 per cent. Similar fatalities resulted in other species and in some all methods of treatment were total failures, the ovaries being aborted within a day after being treated. The plants used during the last two years have been growing in a state of nature on the domain of the Desert Laboratory, and the ripening fruits were subject to the ravages of animals, with the result that the packages of seeds harvested represent but a small fraction of the total number of operations. To this destruction was added the inevitable loss of many of the seedlings. It is needless to say that, having used such a large share of effort upon plants, to which not the slightest imputation of "cultivation" could be attached, precautions of the most rigid sort will be used hereafter.

The coloring matter was injected in the several types of ovaries with various results, according to the anatomical features presented. It will be most profitable to continue the discussion by the citation of results with *Cereus*. In this species the coloring fluid, fairly representing one type of action of the several reagents employed, was absorbed almost entirely by the inner lining wall of the loculicidal cavity. The strong transpiration current quickly conveys the reagent upward to where the walls join and coalesce with the tissues at the base of the style. Here a mass of cells a centimeter in thickness was found to be so thoroughly impregnated with the solution as to be distinctly colored.

The funicular stalks had also taken up a large share and this had been conducted out along the concave flanks and through the conductive tissues as far as a mass of thin-walled cells in the outer part of the inner integument, being still separated from the antipodal cells by several protoplasts. The numerous glandular hairs on the funiculi were also deeply stained, probably by contact with the mass of liquid poured into the cavity. The cells surrounding the micropyle had taken up a noticeable amount, probably in the same manner.

Here then is a set of mechanical conditions under which the pollen tube carrying the generative nuclei can not reach an egg without passing through a deeply impregnated tissue at the base of the pistil, coming in contact with scores of charged cells, then after entering the cavity it touches and adheres to many of the impregnated trichomes of the funiculi, and, lastly, in reaching the egg, it must pass the endostomal cells, also heavily laden with the reagent. In the numerous anatomical examinations made, pollen tubes were found which had become stained before reaching the micropyle. In this species, therefore, any alteration in the normal transmission of hereditary characters might very well be ascribed to effects produced in the chromatin or plasma of generative nuclei of the pollen. In other instances the eggs, or rather the embryo-sac might be more easily acted upon by an injected reagent. It is to be said also that the *Cereus* structures might be affected in a different manner by other reagents, but in all cases the pollen tube would necessarily pass through tissues impregnated with the reagent.

The mechanism of the action of the reagents employed is not capable of ready analysis. It may be readily appreciated, however, that any withdrawal of water, or introduction of substance, would be followed by a disturbance of the balance existing among the various ions in the chromatin and plasma. The slightest disturbance of a protein, or even a modification of the relative rate at which various processes might be proceeding, would account for the profoundest changes in qualities borne by mature plants produced. The modifications, of whatever character they may be, are probably beyond observation by cytological methods.

In addition to these direct effects it is within the range of possibility that the application of the reagents might set in motion the processes resulting in polyembryony, or parthenogenesis: it is to be noted, however, that the facts at hand do not suggest such a happening in the forms already obtained, but in the extension of these experiments to various types of reproduction these things must be taken into account.

While the method described is of interest as having possibilities for our intervention in the evolution of organisms, it becomes much more so if similar results may be expected in a state of nature.

Such a parallelism is to be found in the unusual intensities of the environic factors of light, temperature, moisture, etc., which have been used by Tower in the modifications of *Leptinotarsœ* which he has secured. Here, of course, the entire soma as well as the germ-plasm is subjected to the action of the inciting agent. The various distributional agencies by which seeds are constantly being carried far beyond the limits of the customary range of their various environmental conditions must result in the exposure of developing individuals and mature germ-plasm to unusual intensities which might well be responsible for such results. Thus, a stream takes its rise near the alpine plantation of the Desert Laboratory, and flows out on the desert a few miles away, and a mile lower down. Doubtless hundreds of thousands of seeds are carried to the lowlands each year. Some of these develop into individuals which carry out reproduction. This is usually done in the native habitat, at actual temperatures of the tissues not above 60° or 70° F. Down below, spore formation, reduction divisions and fertilization may ensue in temperatures 40° to 50° higher, a difference capable of being endured by the shoots of some plants, now being tested, and which might well cause irreversible developmental changes. Other factors of the environment may operate in a similar manner. Again, it is to be recalled that the actual formation, or intrusion of active substances in the ovarial tissues, may result from the stings of insects, the mycelia of parasitic fungi, the penetration by foreign pollen, or the egg or pollen may become subject to radium emanations or to X-rays or other forms of radiant energy. Still another possible action is to be accounted for: in hybridization the foreign pollen tubes, carrying the generative nuclei of the pollen parent, may encounter substances in the invaded pistil to which they are not usually subject, with the result that their capacity for transmission of parental characters may be altered, and qualities may thus appear in the progeny which are not active in either parent.

A hypothetical consideration of the known facts as presented by the many species in which mutation has been seen to occur seems to lead to the conclusion that the changes upon which discontinuity of inheritance rests, ensue previous to the reduction divisions in plants. The alterations which take place in my experiments however, follow disturbances not brought to bear upon the germ-plasm until after the second or third division following the reducing divisions and are perhaps separated from this act by a considerable period of time. It will be necessary, therefore, to alter our present conception of mutation, or to conclude that another form of alteration in heredity has been discovered. The former alternative seems possible and preferable. The forms induced may indeed have a cytological basis similar to that which occurs in bud-sports or vegetative mutations, about which but little is known.

The opportunity does not permit an extended and thorough comparison between the results obtained by Tower with beetles and those by myself with plants, but the following points may be noted: The experimentally produced derivatives of beetles diverged from the parental type principally by one main character, with correlated variability in others. The induced forms in plants show many new qualities of fairly equal importance, so far as such things may be estimated, and these might be quite independent of each other. The new forms of beetles crossed readily and were readily swamped by the parental or other types. The new plants do not hybridize freely, if at all, even when grown with branches interlocking with the parental type. The few tests with the derivatives of *Raimannia* in New York and at the Desert Laboratory show it to be less capable of endurance to these climates, both of which are foreign to the parental type, than the parent. The derivatives of *Œnothera biennis* show equal endurance with the parent in the native habitat, and at the Desert Laboratory (2,700 ft.), but exceed it at the montane station (8,000 ft.). The changes produced in beetles are supposed to be a purely stimulative effect in the growth or maturation period of the egg, while those of plants may be due to similar action, or to the direct chemical disturbances produced by the reagents, during the period following the reducing division.

A restatement of the principal protheses of the work in hand upon the relation between environic and other factors and heredity will be profitable in closing. These may be briefly given as follows:

The forms and qualities exhibited by organisms represent the total effect of environment, but it can not be shown that this has been brought about by direct adaptation; many of the most highly specialized and useful structures bear only an indirect relation to the factors to which they bear a useful relation. Neither has it been demonstrated that an individual adjustment made by the soma is impressed upon the germ-plasm, and transmitted unchanged, although the inference is strong that this may be involved in rhythmical functions and perhaps in range of variability.

Various agencies experimentally applied in such manner as to affect the germ-plasm only have caused the origin of forms bearing fully transmissible qualities not presented by the parental type. The new characters have been found to be fully heritable, and the induced forms do not always hybridize with the older types.

The induction of such new forms in plants may be accomplished by reagents applied to the generative nuclei carried by the pollen-tube, and probably by action on the embryo-sac, in the period following reduction division. Mutations have been taken, on hypothetical grounds, to be based on changes occurring previous to these divisions.

The various agencies used in inducing new forms in this manner may have a stimulating effect, or may cause direct disturbances in the chemical balance of the substances in the chromatin and plasma. Similar action may result from unusual intensities of various environmental conditions, or to accidental intrusions on germplasm of many kinds. The alterations in question may well be beyond detection by cytological, or by any direct method of examination.

When the nature of the induced changes is once ascertained, the inductive agents might be applied in such manner as to guide the course of development and thus actually control the evolution of organisms. In so doing, man, the conscious organism, would assume a dominating rôle in the world of organisms and create relations among living things not now existent.

D. T. MacDougal

TENDENCIES IN PATHOLOGY[1]

During the first half of the nineteenth century the science of pathological anatomy was created. Its rise was part of the development in the natural sciences which marked the beginnings of the intellectual expansion of the century, and its growth has continued unbroken up to the present day. Out of the science of anatomical pathology, which stands as the foundation subject of those disturbances in structure and function that constitute disease, there arose other sciences the pursuit of which has served to increase our understanding of the nature of disease. Chief among these are the sciences of general pathology, erected on the foundation laid by the discoveries in physiology, of pathological chemistry, which has grown out of the study by physiologists of the chemical changes connected with the different organic functions, and of the discovery by organic chemists of the nature and constitution of the compounds composing the organic skeleton and produced in the course of organic metabolism, and of bacteriology, that quickening subject, emerging Minerva-like out of the epochal investigations of spontaneous generation and the biology of microscopic plants and animals, which gave to medicine in a few pregnant years an era of discovery in the domain of the causation and the specific treatment of disease unparalleled in all medical history. The resultant of the discoveries in the newer fields of pathological knowledge constitutes the period of etiological pathology which, dating its beginnings from the middle of the last century, is to-day the dominant influence affecting medical thought. It is my wish to present to you briefly, as can only be done in the limits of a short address, certain of the tendencies in the study of pathology to be discovered at the present time.

[1] Address of the vice-president and chairman of Section K, Physiology and Experimental Medicine, American Association for the Advancement of Science, Chicago meeting, 1907.

To compass this broad field superficially even would demand more of your time than would be permissible on this occasion, so great are the activities to-day with which the subjects of general pathology, biological chemistry and bacteriology are being pursued. I have, therefore, adopted a very arbitrary course in the choice of subject-matter to bring before your attention and I have chosen to allude briefly to certain fields of inquiry in general pathology and to deal somewhat more fully with certain newer problems in bacteriology which are commanding at the moment the attention of the best laboratories, and I have left the fascinating field of biological chemistry to be dealt with by a far abler hand than mine.

The causation of disease is manifold, the reaction to abnormal influences is varied. The forces which divert the normal functions and bring disease into being are only in part external, at the time of their operation, to the body. All parasitic plants and animals, which disturb function or alter structure and produce disease, are essentially extrinsic agents of injury and have been introduced from without either during intrauterine life, of which there now exists objective proofs, or later in the period of post-fetal existence. The many causes of occupation diseases, so-called, in which we recognize the introduction into the body chiefly with the inspired air, but also by way of the digestive tract and possibly by way of other mucous surfaces and the skin, of injurious foreign particles, are at present only slightly understood and act not wholly, probably, by increasing susceptibility to bacterial and allied infections, but often through direct chemical and physical malinfluences. A wide-spread interest in the improvement of the physical condition of the race, which has grown out of the social propaganda for bettering the condition of the poor, has produced in many quarters an active inquiry into the pathology of the occupation diseases from which much enlightenment may be confidently expected. But a complete knowledge of these external agencies, when it shall have been acquired, will probably fail to secure to us a full knowledge of the conditions which underlie all disease, since there is a class of diseases, some of very subtile nature, apparently, which result, in part at least, from errors and disturbances of balance in the development of the animal organism or in the correlation of its functions, of which we are at present beginning to appreciate the significance. The remarkable chain of events through which the function of one organ or set of tissues is determined and controlled by the secretion of another organ or set of tissues, as is displayed in the influence of excessive or diminished thyroid secretion on the state of nutrition of the body and functions of its important viscera, and of the metabolic products of fetal tissues upon the hypertrophy and growth and function of the mammary gland, can serve to indicate how dependent is progress in pathology upon knowledge of physiology and chemistry.

Physiology, pathological anatomy and experimental pathology having each contributed a share which the others could not have supplied, are promising to solve some of the problems of arterial hypertension and arterial degeneration in Bright's disease. The peculiar control which the adrenals exercise over the tone of the vascular system can be altered in two ways so as either to depress and relax the circulation or to exalt and increase its tension. The first, a result of ablation or tubercular disease, as in Addison's disease, is clearly of extrinsic origin; but the second, which is associated with certain changes in the gland of an adenomatous character, may not be so. It is this latter condition which has now been found a number of times in cases of sclerosis and atrophy of the kidneys associated with arterial hypertension and degeneration. Recalling the effects of adrenalin in increasing blood pressure, of the degenerations of the aorta produced in rabbits by injections of this drug, and the clinical phenomena in this class of cases of Bright's disease, it seems a natural step to associate the adrenal, the nephritic and arterial disease into one pathological complex. Whether the primary pathological condition is to be discovered in the kidneys and the histological alterations in the adrenals are consequent upon this, as the arterial degenerations are viewed as secondary to the changes in the adrenal, or the order is to be reversed, in which case the changes in the kidneys are to be conceived as following upon those in the arterial system, can only be surmised at the present time. But we may still view this tangible basis of observation and possibly of experiment with hope that in it somewhere may be found the key to the understanding of this complex and vastly important chapter of pathology.

Examples showing the importance of glandular integrity in maintaining a state of health and of disintegrity in producing diseases could, with our present knowledge, be multiplied so as to include most of the glandular organs. Many of these examples would be familiar to you. In some of the best understood examples the number of possible alterations in the glands is two, at least, and the pathological effects are different according as the secretion is diminished or increased in quantity. A notable instance of this kind is found in the relation of the thyroid gland to myxœdema and to Basedow's disease. Still another instance, possibly, has just been mentioned in connection with the adrenal gland. But in the pancreas it seems not improbable that one and the same pathological effect is or can be produced by changes in the islands of Langerhans which make for diminution of secretion, or its increase, with, in the latter case, possibly, a qualitative change in its chemical composition. That is to say, atrophy and degeneration of the islands have now been found so many times in the pancreas of persons succumbing to diabetes mellitus that it would be accepted as a causal condition were it not for the occurrence in a certain number of severe and fatal clinical cases of diabetes of hypertrophy instead of atrophy of the islands. Analysis of the reported cases of diabetes in which the condition of the islands of Langerhans were carefully noted shows that it is in the diabetes of the young especially that the hypertrophied state of the islands is encountered, and the suggestion is a strong one and merits careful consideration whether the islands in these cases may not have been imperfectly developed and have yielded a secretion of such altered and abnormal quality as to have been the cause of the disturbance of the carbohydrate metabolism leading to the fatal diabetes. The conception is unusual, but it is not impossible and is in harmony with the facts so far collected. The mere fact that the pancreas and the islands of Langerhans as a whole are so rarely found even apparently normal in diabetics must be accepted as of great significance in respect to the point as to whether, after all, alterations in the islands are more than accidentally connected with the disease; for our histological methods are still so far from perfect that subtile cellular changes, now only suspected, will surely be discovered in the future.

In comparison with the great advances already achieved in the infectious diseases stands the relatively small progress made in the clearing up of the etiology of the more chronic diseases of the important viscera. The problems of the latter have, until now, except here and there, resisted all effort at their solution. What is chiefly lacking to a fresh and successful endeavor is a suitable and promising method of investigation, and we may well welcome, therefore, an experimental one which aims at a study of important tissues and organs transferred from one animal to another of the same or even of a different species, and the gradual ablation or sudden increase of important organs in order to establish the influences exerted by a new environment on certain organs, or transplanted organs on a new host, or the limit of destruction of tissues with normal and with pathological reactions, or the manner and degree of control capable of being exercised over a greatly augmented activity of different organs. The technical surgical operation involved in this kind of experimentation, on account of the necessity of maintaining unimpaired the circulation of the blood, is great but not impossible of achievement; and the final goal is so important, involving as it does the possibility of substituting sound for diseased organs in human beings, that no effort will or should be spared to reach it.

This method of experiment has, of course, nothing in common with the older one of transplanting minute portions of tissue from one animal to another. In spite of survival of these grafts, for a time, they have yielded very little of an active functioning nature to the new host. By the method of preservation of the circulation through the transplanted organs their functions are maintained and, as a rule, in a perfect manner. Hence it now becomes possible to place sensitive and important viscera under new experimental conditions which may aim to resemble or to reproduce those believed to give rise to common pathological states in man, and to observe the effects over a long period of time. This method, in the hands of Carrel, its chief exponent, has already produced many new and highly important results relating to the blood-vessels, the kidneys, thyroid gland and other organs. It is a matter of no small theoretical and practical significance that arteries can be transplanted successfully from dog to cat, and *vice versa*, and from man to dog, and that keeping extirpated arteries under sterile conditions at refrigerator temperature for twenty or thirty days, or even longer, does not interfere with the results of transplantation; and the histological changes suffered by the transplanted vessels, whether in the same or different species, or made immediately after removal from the body or after several weeks in cold storage, are small in conformity with their perfect function as blood vessels.

The knowledge of the processes of inflammation has already been, and medical and surgical practise may hope to be, assisted by studies of the leucocytes from a physiologico-chemical point of view. The indispensable phagocytic function of the leucocytes—whether directed against micro-parasites or somatic cells worn out by physiological use or destroyed by pathological effects—is now so generally admitted that it seems trite merely to mention the property. But this *living* function of the leucocytes is supplemented by their demonstrated power to yield upon dissolution active proteolytic enzymes of considerable potency capable of attacking native and alien proteid. This enzymotic action can be and often is held in check by certain antienzymes contained normally in the plasma of the blood. Opie, to whom we owe the discovery of the antienzymotic power of the blood-serum, has shown, also, how greatly the issue of an inflammation is affected by the balance between the leucocytes and the serum, and how a purulent inflammation with solution of tissue is the product of collections of leucocytes whose enzymotic power is unrestrained by serum, and that the more superficial and less destructive sero-purulent exudations have the potential enzymotic activity of the leucocytes balanced and checked by the serum. It would appear not to be a long or particularly difficult step from the establishment of these conditions by experiments on animals to their application in human beings in whom the issue of inflammations may be promoted in the direction offering the best hope for the patient.

Until recently, all progress regarding tumors, excepting in their histological structure and place of origin, has been in respect to their surgical treatment. Improvement in operative methods by which local infection of the site of operation and general dissemination of tumor cells have been avoided, and the more complete removal of all tumor-infected tissue accomplished, have increased greatly the number of cures of malignant tumors. We are still ignorant of the cause of tumors, and there is no likelihood that the ignorance will soon be dispelled. But the study of transplantable tumors in mice and rats, chiefly, has already yielded many important facts concerning the biological conditions underlying tumor growth. These small animals, the domesticated races especially, are not infrequently the subject of spontaneous tumors which compass their death. The tumors are, therefore, malignant; in mice they are carcinomata, chiefly, springing from the mammary glands; in rats, sarcomata, chiefly, taking origin from more diverse organs. Many, although not all, of the tumors are transplantable to new individuals of the same species and race, never to animals of another species, and less often to those of another race of a given species.

There is something extremely subtile in the conditions underlying successful transplantation within one race since it may be determined by such minor factors as environment and mere quality of food. A tumor used to growing in Danish white mice may fail utterly to grow in Berlin white mice, and one used to growing in Berlin mice and unable to grow in Norwegian mice, may lose its capacity to grow in Berlin mice transported to Christiania and kept there for a period before inoculation.

Artificial selection of fast-growing strains can modify a slowly-growing into a rapidly-growing tumor and increase the percentage of successful implantations. Once a high degree of power of growth is secured, it can be maintained. The method of selection for virulence is analogous to that for securing virulent strains of bacteria. But the analogy does not go much farther. It may be set down as a rule to which at present the exceptions are insignificant, that the more virulent a tumor is, the less it tends to produce secondary growths at a distance from the primary nodule. Tumors which grow slowly cause, not very infrequently, large secondary growths especially in the lungs; but those which grow rapidly never. Moreover, once the original graft of tumor has begun to grow vigorously, it is almost impossible to implant successfully a second graft. The metastases originate from tumor cells which have entered the circulation and been deposited in the capillaries of the lung. Now, highly virulent tumors, as is to be expected, invade the blood-vessels just as the less virulent tumors do, but in one case the cells at a distance develop into new tumors and in the other they lie dormant. If such a distinction exists in human beings, the subjects of malignant tumors, it has not been made out; but there are great variations in metastases in human cases of tumors, which have never been brought under any law governing tumor growth. My purpose, therefore, in speaking of this peculiar feature of tumor growth in mice is to bring out the fact of the existence of a form of immunity to tumor cells which may be restricted to one part of the body, or be general to the whole body. This immunity Ehrlich called *atrepsy* and he conceives it to be an expression of deprivation of the peculiar foodstuff required for tumor growth. In any body this peculiar nutriment is limited in quantity and hence if cells very highly avid with reference to it are growing actively in any part of the body they may draw all that is available to them and leave none for cells, even of the same nature, which are less avid or away from the focus of its accumulation. The immunities of species, possibly of races also, and the more subtile forms of immunity alluded to, Ehrlich thinks may be atreptic; and for this view there is more or less foundation in facts developed by experiment.

There remain many features of the experimental study of tumors of absorbing interest to the student of tumors in human beings, but they can not be discussed here without extending widely the length of this address. I may, perhaps, allude, before passing to another and quite different topic, to the interesting fact of the occurrence of grades of acquired active immunity in rats and mice that have been inoculated with tumor grafts which have grown but slightly, or which, having grown to a considerable size, later undergo complete absorption. Mice and rats which have recovered spontaneously from tumors can be reinfected with new and more virulent grafts with difficulty or not at all; and recently the interesting fact has been discovered in Ehrlich's laboratory that in such partially immune mice a tumor which was originally adeno-carcinoma tends to revert to adenoma, or from a more heterogeneous to a more homogeneous structure. We see in this observation how fundamentally the state of the host reacts upon the nature of the tumor, just as in the case of increased virulence we saw how greatly the state of the tumor cells reacted on the host. And we can see the operation of this reciprocal interaction of tumor and host in the fundamentally important transformations in types of tumor, from cancer to sarcoma as shown by Ehrlich and Leo Loeb, and from sarcoma to adeno-carcinoma as observed by Jobling and myself, which are part of the recent gains accruing from the experimental study of tumors. Then I might add a word on the outlook for a more efficient therapeutics of tumors, now that tests can be made upon animals under conditions of scientific accuracy of experiment which will permit of the results being interpreted in a strict rather than in an empirical manner. Just as long as every therapeutic advance had to be made upon and with human beings the victims of tumors, just so long was it impossible to approach the subject in a truly scientific way, for just so long was it impossible to secure that control of experimental conditions that alone can make biological experiment accurate and advance logical and not a thing of chance.

I will now ask you to turn with me to a brief discussion of certain topics in bacteriology which are compelling attention at present. Bacteriology in relation to medicine suffered from a period of reaction to its many brilliant achievements and had for a time lingered somewhat in too familiar fields. But new problems, the direct outgrowth of the old acquisitions, are opening up and new lines of work are being laid down, some of which are of such gigantic importance to the larger interests of social hygiene, that many new forces are being brought into operation.

Perhaps the chief single compelling phenomenon is that of the microbe-carrier, who is everywhere coming to be regarded as a serious menace to the health of communities. He is not a new discovery, for, as regards diphtheria, he has been known for more than a decade. But now he has been found to disseminate typhoid fever, dysentery, plague, cholera, influenza, spinal meningitis, and in certain localities a host of protozoan diseases. Moreover, he is not, like the victim of tuberculosis, who is also a microbe-carrier, a sufferer from the disease which he disseminates; he is, as a rule, immune to the microbes in an actual sense and is usually ignorant of the sinister rôle which he plays in life. The period of time during which these pathogenic microbes can exist in the body is very variable, but may be great. In the case of typhoid fever forty-two years have been known to have elapsed since the attack, at the end of which time typhoid bacilli were still being eliminated with the dejecta. Plague bacilli have been present in the sputum seventy-six days after recovery from plague-pneumonia; influenza bacilli have been found in the sputum one year after an attack of influenza; and still other examples of long persistence of pathogenic microbes could be cited.

What is remarkable is that this persistence of pathogenic germs in the body can not be explained on the supposition that they are really outside the body, residing on mucous membranes, and hence not subject to the ordinary forces of destruction which operate in the blood and tissues. The typhoid bacillus increases chiefly in the gall bladder, which is indeed not within the body, strictly speaking; but foci of development may exist in the kidney for many months, infecting the urinary bladder, and in bone and muscle, and they are strictly within the body. A distinction is not readily made between capacity of growth within and on the surface of the body, but evidence exists tending to show that certain tissues may develop immunity to pathogenic bacteria which usually injure them, and certain bacteria develop capacity to survive under conditions which are usually fatal to them.

It is just in this connection that we are learning that bacteriolysis and bactericidal effects do not necessarily go along with spontaneous recovery from and acquired immunity to bacterial diseases. These forces of immunity may be in active operation, so far as tests made outside the body with the blood indicate, at a time that the very bacteria from and against which they have developed may still be surviving in the body. Typhoid bacilli have been cultivated from the blood long after the subsidence of symptoms of typhoid fever and at a time when the titre of serum bacteriolysis was of prodigious height; pneumococci have been detected in the circulating blood of animals actively immunized to the pneumococcus; anthrax bacilli have been grown from the blood of immune and healthy sheep protected by anthrax vaccine, and living virulent tubercle bacilli of the human type have been obtained from the healthy lymphatic glands of calves inoculated with Bovo-vaccine and in consequence already immune to bovine tuberculosis. It is clear, therefore, that the immune state, so far as bacteria are concerned, can be no one-sided phenomenon in which the fact of all importance is the condition of the host, and that of small importance the condition of the invading bacterium. The phenomenon is, indeed, a reciprocal one and must take account of a high degree of capacity for adaptive changes on the part of the parasite as well as on the part of the host.

Many of the diseases due to protozoa show in a more striking way the same facts of mutual adaptation of parasite to host; and this power of survival of the parasites in the healthy body is what makes suppression of diseases transmitted from host to host by blood-sucking insects a matter of such difficult and uncertain achievement. The fact as regards malaria is well known, and this paradoxical condition of immunity and infection is established as true for trypanosomic, piroplasmic and spirillar diseases of man and animals. Koch has drawn attention, in a recent report, to the existence in the blood of healthy natives of the trypanosoma of sleeping-sickness from which the Glossina may readily become infected and made able to carry the disease. It is clear that the future studies in immunity will take into more direct account the changes in the infecting parasite produced by the immune state, and will seek means of their suppression which will leave the host uninjured and weaponed for a more successful resistance to invasion. In this field prediction is hazardous; but it need not excite great surprise if this desideratum should be accomplished through specific drugs suited to the purpose by subtile molecular adaptations, rather than by sera prepared by immunization with the parasites themselves.

The long discussion of the part played in natural and acquired immunity by the blood plasma or serum and the mobile phagocytes has now been settled so as to include both factors. The body fluids and the blood serum chiefly carry, as a result of immunization, dissolved substances which act at one time by neutralizing toxines that are themselves injurious and at another in sensitizing bacteria and other corpuscular bodies so that they may be engulfed by phagocytes which destroy and render them innocuous. The discovery of the opsonins in the normal blood and their increase in states of induced immunity to bacterial and other infections, has added greatly to the clearing up of some of the complicated phenomena of the immune state. That many virulent bacteria—anthrax, chicken cholera, pyocyaneus, staphylococci and streptococci, pneumococci and others—exhibit negative chemotoxis, or are ingested far less by phagocytes than avirulent strains of the same microorganisms, is an old observation, and it is very enlightening to find, as Rosenow has, that virulent strains of pneumococci do not bind opsonin, while avirulent strains do, and extracts prepared from the virulent germs protect avirulent ones from phagocytosis to a greater degree than extracts of the avirulent pneumococci themselves. Cultivation outside the body as saprophytes of parasitic and non-phagocytable pneumococci and other bacteria, tends to alter their relation to the opsonins and to phagocytosis. From which it appears that virulence and negative chemotoxis depend upon certain chemical states of bacteria, determined by the conditions of their existence, and affecting the nature of their metabolic products, among which last are substances that are antagonistic to the functioning of the opsonins. Far as we still are from a clear and full conception of the distinction between virulence and avirulence in bacteria, we must nevertheless welcome this concrete fact as in itself a great gain.

The body infected with bacteria or other pathogenic microorganisms, although it survive the infection, may not be rendered more resistant; it may be rendered more susceptible to reinfection—that is, it may be sensitized to the infecting agent or its poisonous products. The state of hypersensibility, or anaphalaxis, the converse of that of immunity, has been studied with energy and profit during the last two years. Perhaps the best known example is the abnormal reaction developed when an animal infected with tubercle bacilli is injected with the products of the growth of the bacillus. Blood serum contains a substance, or substances, which under suitable conditions develop a reaction of this character. That the human organism reacts more vigorously to second and subsequent injections of horse serum than to the first injection is shown by the reports of many instances in which these stronger effects were noted after administering diphtheria antitoxin. It appears that the reaction of hypersensibility depends for its expression upon the existence in the sensitized body of a substance of the nature of an antibody comparable to, but doubtless differing widely from, the antibodies which are developed during the process of immunization proper to bacterial and other cells. In the case of hypersensitiveness to serum a second injection, in such small animals as the guinea-pig, may result fatally in a few minutes or after several hours; but should it not so result, the animals have been robbed of their sensitive or anaphalactic state and been rendered "immune" to horse serum in the usual sense, or antianaphalactic. These superficial facts suffice, in a way, to indicate that the antibodies governing the anaphalactic state differ from those governing the immune state, and it is, therefore, interesting to learn that they differ further in failing to give the Bordet-Gengou reaction of complement-deviation.

Studies in immunity pursued during the past several years have tended to show that it may be general to the body or more marked in one part than in another. Hence we have to distinguish a state of "general" and a state of "local" immunity; and it would appear, also, that the whole body may be sensitized or that sensitization may be more limited in extent and restricted to certain tissues or locations. Wassermann succeeded in affecting the endothelial cells of the pleura by direct pleural inoculation of typhoid bacilli so as to increase their power to produce antibodies above that of the other tissues of the body, and Noguchi succeeded by localizing a tetanus infection in the subcutaneous tissue of the thigh to make it impossible for tetanus toxin to enter the body from that location while all other avenues of entry were left unaffected. And, as a parallel to these states of immunity, we see in the phenomenon of Arthus that the subcutaneous tissues of the rabbit can by repeated injections of horse serum be sensitized and thus made to react with a degree of vigor and inflammation which may cause their destruction, the rest of the body meanwhile showing no increase of sensitiveness.

The hypersensitiveness of the tubercular state would appear to be localized in tissues far removed from the seat of the infecting tubercle bacilli, and probably every part of the tuberculous organism is in a potential hypersensitive condition. In any case, the ophthalmo-reaction of Calmette and the cuti-reaction of v. Pirquet, both of which are yielding good service in the diagnosis of tuberculosis and taking the place of the more serious general reaction of hypersensitiveness following upon tuberculin injection, show that in the conjunctiva and the skin the cells are sensitized and react rapidly and in a characteristic manner to tuberculinization.

It will be clear to you that in following the diverse reactions of the body to foreign substances, among which parasitic microorganisms play in pathology the chief part, there is gradually being discovered a wide range of phenomena, some desirable and beneficial, some objectionable and injurious, which together constitute the effects of natural disease or of efforts to thwart and overcome it. It will become the particular quest of the immediate future to attempt the unraveling of those biological conditions which underlie one or the other of these, and to secure to the use of medical practise those effects which may be beneficial and to remove from it those which are injurious. Were there still time at hand, I should present to you certain newer facts in protective inoculation with bacteria and of serum therapy which are not without good augury for preventing certain infective diseases of man and animals, and of overcoming them by specific serum therapy once they have developed. And then I should try to interest you in the remarkable progress which has been made, and is being made almost daily, in the discoveries in specific chemical therapeutics which make the control of certain protozoan diseases—trypanosomiases and spirilloses especially—very hopeful for the future. I must, however, not detain you longer from the enjoyment of the interesting scientific program which has been prepared for this hour.

Simon Flexner

CHARLES A. YOUNG

The past five months have brought severe losses to astronomy in the deaths of five of its distinguished men: in Germany, Vogel, of Potsdam; in France, Loewy, of Paris, and Janssen, of Meudon; in this country, Asaph Hall; and now Charles A. Young, who died at Hanover, N. H., on January 3.

There is some consolation, however, in the fact that all of these men had reached advanced years,[1] and had in a measure rounded out their scientific careers, although the three first named were still in active service as directors of large observatories.

Charles Augustus Young was born on

[1] Average age, 75 years.

December 15, 1834, at Hanover, where his grandfather and father successively occupied the chair of natural philosophy in Dartmouth College during the period from 1810 to 1858. He entered college early and graduated with distinction in 1853 as bachelor of arts. During his student days he assisted his father in astronomical observations and accompanied him in 1853 on a trip to Europe to purchase instruments for the Shattuck Observatory, then in course of erection. For two years after graduation he taught the classics at Phillips Academy, pursuing at the same time theological studies at the Andover Seminary. In 1857 he went to Hudson, Ohio, as professor of mathematics and natural philosophy at Western Reserve. During several summer vacations he assisted in the governmental survey of the great lakes. Responding to the call of patriotism in 1862, he was for four months Captain of Company B in the 85th Regiment of Ohio Volunteers, which was largely recruited from students.

In 1866 he returned to Dartmouth as professor of natural philosophy and astronomy, thus continuing the family tradition.

The next few years were stirring times in astrophysical research. The spectroscope was just beginning to be applied in the study of celestial objects, with results of surprising interest. The eclipse of 1868 was made memorable by the discovery by Lockyer and Janssen of the method of observing the solar prominences. In spite of heavy duties as teacher, Young applied himself assiduously to solar research. He observed the eclipse of 1869 at Burlington, Iowa, establishing the fact of the gaseous nature and truly solar origin of the corona. Employing what was for those days a very powerful spectroscope, he quite accurately located the position of the green corona line, which was thereafter known as No. 1,474 on Kirchhoff's map of the solar spectrum. It was not until the eclipse of 1898 that the position of the line was more correctly located, by Professor W. W. Campbell observing in India, and was shown not to be represented by a dark Fraunhofer line. At the eclipse of 1869 Young also looked for, but failed to detect, the reversal of the dark lines at the moment of internal tangency of moon and sun. But he realized his expectations at the Spanish eclipse of the next year, when he discovered the "flash spectrum." He describes it in these words: "The moment the sun is hidden, through the whole length of the spectrum, in the red, the green, the violet, the bright lines flash out by hundreds and thousands, almost startlingly; as suddenly as stars from a bursting rocket head, and as evanescent, for the whole thing is over within two or three seconds."[2] This phenomenon was subsequently observed visually in a more or less satisfactory way by different astronomers at other eclipses, but it was not photographically recorded until 1896, when it was caught by Mr. W. Shackleton at Nova Zembla with the prismatic camera.

In the early seventies Professor Young gave much attention to the spectrum of the chromosphere and to the prominences. Many of his delineations of these have become classics from their reproduction in various works and text-books. He devised an improved form of solar spectroscope which served his purpose very effectively. His assiduity was rewarded by his observation of a number of rather unusual solar phenomena: such as the highest recorded prominences, extraordinary velocities indicated by distorted lines, up to 320 miles per second; violent solar agitation associated with magnetic storms. He was the first to attempt to photograph the prominences and attained a partial success (1870). With the wet plates then neces-

[2] *The Sun*, p. 82.

sarily employed an exposure of four minutes was necessary with the use of the dark blue line of hydrogen (H_γ). This degree of insensitiveness of the films made it undesirable to spend time on such photographs.

In 1876 he made the first use of a grating spectroscope in astronomical work, and measured the rate of rotation of the sun by the displacement of the lines at the east and west limbs.

Professor Young successfully observed the transit of Venus of 1874 at Peking, and went to Russia for the eclipse of 1887, but was prevented from work by clouds. He had clear skies at the eclipse of 1878 at Denver, and in 1900 at Wadesboro, N. C. He also particularly studied the chromospheric lines, and made a list of 190 which he had noted with the spectroscope attached to the Dartmouth nine-inch telescope. The advantage of a high elevation becoming evident, he made an expedition in the summer of 1872 to Wyoming, where with the apparatus taken from Hanover, at an elevation of 8,000 feet, he added another hundred lines to his list. The subsequent increase in these lines, aside from those found in eclipse photographs, has been chiefly due to his own observations at Princeton.

In 1877 he accepted a call to Princeton, where much larger instrumental facilities were offered to him, with less confining teaching duties. He gave, however, much time to the organization and equipment of the students' observatory, making it then probably the best in this country. A powerful spectroscope was provided for the 23-inch equatorial of the Halsted Observatory, and with this he made important observations of the chromosphere and sunspots. He discovered in 1883 that the absorption spectrum of the sunspot umbra may be resolved into "countless and contiguous" dark lines, a difficult observation later amply confirmed by others. With the Halsted refractor he also made micrometric observations of planets and satellites. He carried out an extensive program of observations of the transit of Venus in 1882 at Princeton.

His admirable work "The Sun," of the International Scientific Series, appeared in 1881 and presented in a clear and interesting manner the known facts and theories of solar physics. It includes many of his own interpretations of difficult points and is the authoritative work on the subject. It is characteristic of his modesty that many of his own discoveries (such as that of the reversing layer) are there given without mention of his own name, and would only be recognized as such by those familiar with the circumstances, who could read between the lines, or by those who happened to consult the index. Several editions of this work appeared, and it was translated into several foreign languages. The last, thoroughly revised, edition was published in 1895.

His "General Astronomy," the first of his important series of text-books which have been used by more than a hundred thousand students, was issued in 1888. It represents much more than a mere text for students, and has been widely used as a work of reference. The "Elements of Astronomy" and "Lessons in Astronomy," adapted for more elementary students, were published a little later. The "Manual of Astronomy," comprising most of what was in the General Astronomy, but with more illustrations and with the inclusion of the latest data, was issued in 1902.

The fundamental idea in Professor Young's text-books, popular articles and lectures, was that statements should be accurate as far as they go. He was no special pleader, and in his public utterances always fairly stated both sides of disputed matters, and he avoided controversy in a manner exemplary to younger men. His public lectures were not popular by reason of any eloquence of delivery or of rhetorical skill, but because of their clearness, simplicity and convincing quality of accuracy. As a teacher he was particularly successful; having himself a splendid grasp of the fundamentals of mathematics and physics, he presented his subject logically, with emphasis on the essentials; and his humor enlivened the class room. It is doubtful if any teacher in this country has enlarged the intellectual horizon of a greater number of undergraduates than has he, in his culture courses in astronomy. "Twinkle" will never be forgotten by any of his students.

Professor Young's eminent services in research and education received recognition in numerous academic degrees, membership in and awards from various learned societies.

He had suffered from Bright's disease for a number of years; but by good care had kept himself fairly comfortable. The loss of his wife seven years ago, after forty-four years of a particularly happy married life, came as a crushing blow to him; and to his sorrow was lately added the death, after a year of distressing illness, of his widowed daughter, who made her home with him.

The retirement from his position at Princeton in the summer of 1905 was made the occasion of a grateful recognition by his colleagues, and the appreciation shown by his friends at that time must have been a source of much gratification to him. He then returned to Hanover, where he lived quietly, until he succumbed to a brief attack of pneumonia on January 3. Two days later he was gathered to his fathers in the old cemetery close to the house where he was born.

Edwin B. Frost

Yerkes Observatory,
January 14, 1908

SCIENTIFIC BOOKS

Experimental Zoology. By Thomas Hunt Morgan, Professor of Experimental Zoology in Columbia University. New York, The Macmillan Company. 1907.

In a recent number of Science there appeared an extensive review of this book, which, in the opinion of the writer, does scant justice to an important and valuable work. It is with the thought, therefore, of calling attention to some of the many valuable features of the book that the following supplementary review is written.

Although experimental zoology is one of the youngest of the sciences it has grown so rapidly that it is practically impossible for one not working in this field to keep pace with its development. Until recently there was but one journal devoted to this subject and much of the literature pertaining to it is scattered through publications which are more or less inaccessible. From time to time there is needed in every science, and especially in one not well organized, some general work, which will not only summarize results and bring many scattered observations under one point of view, but which will also awaken interest in the subject and point out the direction of needed research.

Such a book is this of Morgan's—a book which is not only full of information, but which is also illuminating and stimulating. The writer of this notice has made this book the basis of a course of reading for graduate students in zoology with the most satisfactory results. The book discusses in a very concise and direct manner a great range of experimental work in zoology, much of which, it is safe to assume, is relatively unfamiliar to many zoologists. Although these discussions are usually brief, they go straight to the heart of the matter under consideration, and they generally exhibit a critical insight and a breadth of judgment which indicate a thorough acquaintance with the phenomena in question. By the variety and extent of his own experimental work Morgan is probably better fitted than any other man in America to write a general work on experimental zoology.

The book begins with a well-balanced estimate of the relative value of observational and experimental work; it maintains that experiment is the only method by which zoology may be placed upon the same footing with chemistry and physics; it points out the uses and abuses of scientific hypotheses and the necessity of verifying these by experiment; and it concludes that the goal of experimental work is, in the words of Loeb, the control of natural phenomena.

The scope of experimental zoology is so great that it can not be treated as a whole within a volume of ordinary size. The author has therefore omitted from consideration two important fields of study, viz., experimental embryology and the experimental study of regeneration, both of which he has dealt with in other books. The present volume is mainly devoted to those aspects of experimental zoology which have not hitherto received adequate treatment in book form.

The principal topics discussed fall under the following six headings: (1) Experimental Study of Evolution, (2) Experimental Study of Growth, (3) Experimental Studies in Grafting, (4) Experimental Studies of the Influence of the Environment on the Life-cycle, (5) Experimental Studies of the Determination of Sex, (6) Experimental Study of the Secondary Sexual Characters.

Under the first heading are included a large number of topics such as the influence of external conditions in causing changes in the structure of animals, the inherited effects of changes due to environment, the inheritance of acquired characters, experimental hybridizing, the behavior of the germ cells in cross fertilization, inbreeding, the influence of selection, and finally the theory of evolution. These topics are dealt with unequally, the first in particular being very brief, while the last is from its nature rather more speculative than experimental in character. There is everywhere, however, a wealth of reference to works on these topics and many valuable and stimulating suggestions. With the chapters on experimental hybridizing I think it may be said that Morgan first strikes his gait in this book. This subject is treated at much length and in a thorough and admirable manner.

The section of the book on experimental studies on evolution forms rather more than half of the whole work. The remaining sections deal with subjects of a more special character. Under the experimental study of growth, the chapters on the external factors that influence growth, and on growth and regeneration are especially worthy of favorable mention. A single chapter is devoted to experimental studies on grafting, but this chapter is one of the best in the book, and it shows at once the author's intimate and extensive acquaintance with this subject. In the chapters on the experimental studies of the influence of the environment on the life-cycle Morgan has brought together results which are probably less familiar to the average zoologist than are any other topics dealt with in the book. The literature references in these chapters indicate through what a range of publications, many of them relatively inaccessible and but little known, the author has labored in preparing this summary.

The final sections on the determination of sex and on secondary sexual characters deal with some of the most interesting subjects in zoology. The various hypotheses are considered fairly and judicially and the author's own views are set forth in a form which is clear, if not always convincing, and which is sure to stimulate research. And after all this last is perhaps the greatest service which any book can render. In a work which covers so wide a field it is natural that minor faults should occur, but it would be unjust to suppose that it does not also have great merits. Morgan has placed all zoologists under obligation because of this book; it has been received with the highest commendations abroad, and it is a work of which American zoologists may well be proud.

Edwin G. Conklin

The Soil-preferences of Certain Alpine and Subalpine Plants. By M. L. Fernald. Contr. from the Gray Herbarium. Rhodora, September, 1907. 44 pp.

It is refreshing to find, in this study of Fernald, a distinct departure from the hackneyed gathering-up of superficial observations on "plant associations," without any mention of the probable, in many cases abundantly obvious, causes of the geographical grouping of plants. Ecological studies, as often made savor strongly of the "gedankenlose Heusammler" habit animadverted upon by Schleiden over half a century ago, and were apparently only temporarily stopped by Darwin's great work. The soil-conditions accompanying the occurrence of certain plant groupings are usually so superficially set forth that nothing but the old classification into hydrophytes, mesophytes and xerophytes is attempted; in conformity with a hypothesis based upon the arbitrary assumption that moisture is the only controlling factor of plant growth. Adding to this hypothesis the factor of soil-texture, and basing thereon the entire work of soil classification, Whitney and the Bureau of Soils of the United States have built up a one-sided theory, which is in flagrant contradiction to facts observable by any one not under the official afflatus of that head center. Some years ago R. M. Harper, in his studies of the plant geography of the southern Coastal Plain, entered upon the right track so far as observations in the field are concerned; but Fernald has added to the field observations a closer discussion of the exact physico-chemical factors which condition plant distribution, such as I have urged for fifty years past.

In defining his investigations as relating to certain "alpine" plants, Fernald really blurs the nature and importance of his work. Alps are usually rocky and have predominantly *sedentary* soils, that is, soils overlying the rocks from which they have been formed by weathering, without having received admixtures of the decomposition-products of other rocks. Such admixtures may, nevertheless, easily occur locally. Moreover, the fact is that the flora of mountains is often largely paludal on account of their "young" geological surface features, and therefore commonly include wet meadows, ponds and lakelets alongside of cliffs and rocky slopes. The frequent washing-down of the decomposition-products of various rocks on the higher slopes to those lower down, has made the word "alpine flora" a designation referring mainly to temperature-conditions. Fernald himself, however, at once recognizes the distribution of the "subalpine" flora to be almost identical with that of a large portion of the lowlands.

Fernald presents (pp. 158 to 164) lists of 258 plants belonging to the territories of New England and Canada, tabulated so as to show their occurrence, either preferably or exclusively, upon rocks considered respectively as potassic,[1] calcareous and magnesian.

These tables show, in three columns, the plants belonging to soils formed from (supposedly) potassic, calcareous and magnesian rocks, and exhibit the very striking contrasts, as well as some coincidences, in the floras inhabiting the three classes of rocks.

Among the most striking of these is the often-observed poverty of the vegetation on soils derived from exclusively or chiefly magnesian rocks, such as serpentine and talc schist; to which may be added dolomite, which, though consisting more than half of lime carbonate, shows everywhere a more or less depauperated flora, especially when compared with adjacent areas of non-magnesian limestones. Fernald shows how, on the north slope of Mt. Albert, a serpentinous plateau in Gaspé county, by the partial admixture of calcareous and potassic rocks an immediate increase of species and a more luxuriant development take place. A very few plants only are known to prefer purely magnesian soils, everywhere. Among these, Fernald mentions specially, *Cerastium arvense,* whose ash contains the unusual proportion of 19.8 per cent. of MgO.

Fernald promises, by analyses of the ashes of a number of these plants (as well as, it is to be hoped, of corresponding soils) to establish definitely the relations between their plant-food requirements and their rock habitats. As regards the soils, it is evidently of high importance that the analyses should be made by such methods as will show their *permanent* character, and not merely the accidental present

[1] Whether the granites, gneisses and mica schists assumed by Fernald as producing soils rich in potash really do so, is somewhat questionable, and should be verified by analysis.

condition; since the distribution of native plants is a matter of secular or millennial, and not merely of existing conditions. The interpretation of these analyses will require no mere routine consideration of percentages, but must be correlated with the physical composition; inasmuch as a light sandy oil requires much less lime to support a calciphile flora than a heavy clay;[2] and the same is more or less true of other ingredients. It should not be forgotten, however, that quite a large number of plants have long ago been shown to be practically indifferent to the absence or presence of lime.

Again, the paludal or peaty nature of the ground or locality requires consideration. The mere *presence* of a certain proportion of lime may be wholly ineffective in bringing about a calciphile flora if humic acids present produce an acid condition of the soil mass. On the other hand, if a calcareous weathering-product is exposed to continuous leaching, as may easily happen on the summits of hills bearing abundant vegetation, the lime carbonate may be almost wholly leached out, and islands of calcifuge plants will then be found in calciphile territory. The calcareous washings, on the contrary, will impregnate the lower ground, which is always more calcareous than the higher slopes; and so a calciphile flora may, and very commonly does, occur where no obvious source of lime exists in the uplands.

Fernald rightly considers the hornblendic rocks as sources of calcareous soils; yet in the Hawaiian islands the black lavas, which weather into spongy iron ores used as soils, are almost fully leached of the lime that forms so large a proportion of both pyroxene and hornblende, by the abundant rains of the tropics; while the almost identical basalts on the Pacific coast produce calcareous soils, with a uniformly calciphile flora, on account of the deficient rainfall.

It is thus obvious that not only the original soil-forming rocks, but also the climatic conditions and the "lay of the land" must be considered in forecasting the plant-geography of any region. The failure to do this and the physiologically erroneous definition of calcareous soils as "soils that effervesce with acids," has brought about the confusion which appears in the works of Schimper, Contejean and others, as to the causes of plant distribution.

Fernald's paper is provided with copious references to sources of information in relation to the occurrence of rocks and plants, as vouchers for his conclusions. On the other hand, his references to cognate work done in Europe as well as in this country, are somewhat scanty, being probably left for the final publication of his results.

His present conclusions are succinctly set forth in the following quotations from p. 170 of the paper:

After comparing the floras of three areas located not far apart and under identical conditions of exposure and precipitation, he says:

> Precipitation and exposure are, then, of only minor importance in determining the localized distribution of our alpine plants.
>
> In attempting to account for the peculiarities of plant distribution, much stress has of late been laid upon the degree of fineness or coarseness of soils, and their water content. But to those intimate with the occurrence of our alpine plants these factors, again, seem of secondary importance. For instance, *Cystopteris montana* on Mt. Albert grows in equal abundance on the firm and steep amphibolite cliffs and in the deep, fine and (water-) saturated alluvium of mountain streams. *Selaginella selaginoides*, abundant in the wet, mossy bogs of Bonaventure and Gaspé counties, Quebec, is quite as much at home in the well-drained alpine meadows, or in the crevices of either wet or dry rocks; in the latter situation becoming stiffer and more stocky than in deep shade or moisture. *Zygadenus chloranthus* is apparently indifferent whether it is in the crevices of sunbaked rock, on cold cliffs, in river alluvium or on wet bogs. Similarly, many other members of the flora characteristic of the areas classed as group 2 (calciphile) grow in wet or dry, fine or coarse soils.
>
> The distinctive plants of groups 1 and 3 (potassic and magnesian) likewise show a remarkable indifference to the coarseness or fineness, the dryness or saturation of their supporting soils . . . seem equally at home in crevices of sun-baked or

[2] See "Soils," etc., pp. 494–497, 367 ff.

spray-showered rock, on sandy plains, in well-drained alpine meadows and in saturated sphagnum bogs. . . . we are hardly justified in depending upon these (physical) factors to explain the distribution indicated in the preceding tabulation.

In other words, Fernald's observations show that in accordance with the ancient experience of mankind (although contrary to the officially promulgated doctrine), certain chemical soil-conditions are not only equally as potent as, but sometimes prepotent over, even extreme physical conditions, notably in the case of lime; so that without the accompanying study of chemical soil-composition, mere physical analysis gives no definite clew to soil-values, adaptations and peculiarities. It is to be ardently hoped that the broader method of ecological investigation, as exemplified by Fernald's work, will be more generally applied, and so render such work both theoretically and practically more fruitful than it has been in the past. For what is true of wild plants is of necessity true for cultivated ones also.

E. W. Hilgard

Berkeley, Calif.,
Oct. 10, 1907

SOCIETIES AND ACADEMIES

THE OHIO ACADEMY OF SCIENCE

The seventeenth annual meeting of the academy was held at Miami University, Oxford, O., on November 28, 29 and 30, the president of the society, Mr. Charles Dury, of Cincinnati, presiding. On Thursday evening an informal reception took place in Hepburn Hall, where accommodations for members of the academy were generously provided by the university authorities. The sessions on Friday and Saturday were held in Brice Hall.

The address of the president on "Zoological Reminiscences of the Cincinnati 'Zoo,'" occurred at 1:30 p.m. Friday, while in the evening at 7:30 Professor G. W. Hoke discussed "The Nearer East—A Study in Social Geography." Other papers of interest were those by Professor Bruce Fink on "The Status of American Lichenology," Professor S. R. Williams, "A Peculiar Circulatory Modification of *Necturus maculosus*," E. F. McCampbell, "Report on a New Pathogenic Pirosome" (presented by Professor Herbert Osborn in the absence of the speaker).

The following is the complete program:

"A Study of the Origin and Growth of the Egg in *Syncoryne mirabilis*," by Mary D. Mackenzie.

"A Better Method of Preparing Herbarium Specimens," by W. A. Kellerman.

"Compensatory Growth in *Podarke obscura*," by Sergius Morgulis.

"Note on the Development of the Skull in Clupea," by Edward L. Rice.

"Factors determining Cave Habitation as illustrated by the Cave Isopod and its Nearest Outdoor Ally," by A. M. Banta.

"*Symbiotes duryi* n. sp., a New Endomychid from Ohio," by L. B. Walton.

"Notes on the Early Development of Enteropnuesta," by B. M. Davis.

"The Discomycetes of Oxford and Vicinity," by Freda M. Bachman.

"*Wolffia brasilensis* in Ohio," by Robert F. Griggs.

"The Psychology of Speaking," a Scientific Analysis of the Art of Speaking," by John S. Royer.

"The Flora of Cranberry Island, Buckeye Lake," by W. A. Kellerman.

"Reaction of Amphibian Embryos to Tactile Stimuli," by G. E. Coghill.

"The Epibranchial Placodes of Ameiurus," by F. L. Landacre.

"Periodicity of Spirogyra," by W. F. Copeland.

"The Dispersal and Planting of Seeds by Nature's Methods," by W. L. Lazenby.

"The Male Reproductive Organs of *Cimbex americanus* Leach," by H. H. Severin and H. C. Severin.

"A Peculiar Circulatory Modification in *Necturus maculosus*," by S. R. Williams.

"A Migration of *Anosia plexippus* in Ohio," by Herbert Osborn.

"The Variability of Zygospores in *Spirogyra quadrata* formed by Scalariform and by Lateral Conjugation, and its bearing on the Theory of Amphimixis," by L. B. Walton.

"Some Observations concerning the Effects of Freezing on Insect Larvæ," by J. S. Hine.

"The Status of American Lichenology," by Bruce Fink.

"Stains for Embryonic Skeletons," by E. L. Rice.

"A Note on the Occurrence of *Typhlopsylla octactenus* in Ohio," by Herbert Osborn.

"The Development of the Swimming Movement in Amphibian Embryos," by G. E. Coghill.

"Natural History Notes from Hamilton County, Ohio," by Charles Dury.

"Some Rare and Unnamed Mushrooms found in the Cuyahoga Valley" (lantern slides), by G. D. Smith.

"Report on a New Pathogenic Pirosome," by E. F. McCampbell.

"The Marine Biological Survey of the San Diego [California] Region," by B. M. Davis.

"The Development of a Kelp," by R. F. Griggs.

"Regeneration and Inheritance," by Sergius Morgulis.

"The Gold Fish—*Carassius auratus* L.—and its Color," by L. W. Sauer.

"A New Experiment in Ionization," by F. J. Hillig.

"The Lateral Line Organs of Ameiurus," by F. L. Landacre.

"Annual Report on the Ohio State Herbarium for 1907," by W. A. Kellerman and Freda Detmers.

"Notes on Philomycus," by V. Sterki.

"Observations on the Life History and Adaptation of a New Semi-aquatic Aphid, *Aphis aquaticus*," by C. J. Jackson.

"Variation in Temperature and Light Intensity when Growing Plants under Cloth of Different Colors," by W. A. Kellerman and G. W. Hood.

"One Hundred Species of Mushrooms of the Cuyahoga Valley" (lantern slides), by G. D. Smith.

"Some Homologies between the Mouth Parts and Walking Appendages in the Hexapoda," by L. B. Walton.

"Ancient Finger Lakes in Ohio," by G. D. Hubbard.

"A Deposit of Glass Sand at Toboso, Ohio" (lantern slides), by Frank Carney.

"The Origin of Spring Valley Gorge near Granville, Ohio" (lantern slides), by Earl R. Scheffel.

"Extra-morainic Drift in the Baraboo Area, Wisconsin", (lantern slides), by Kirtly F. Mather.

Stratigraphical Studies in Mary Ann Township, Licking County, Ohio:

"Distribution of Formations" (lantern slides), by Frank Carney.

"A Phase of the Sharon" (lantern slides), by William C. Morse.

"Two Notable Landslides," by Geo. D. Hubbard.

"Pleistocene Deposits at Clay Lick, Ohio" (lantern slides), by Kirtly F. Mather.

"A Group of Eskers South of Dayton, Ohio" (lantern slides), by Earl R. Scheffel.

"An Overflow Channel of a Glacial Lake in Yates County, N. Y." (lantern slides), by Frank Carney.

"High Level Terraces in Southeast Ohio," by G. H. Hubbard.

"An Ecological Classification of the Vegetation of Cedar Point," by O. E. Jennings.

The committee on the state natural history survey was enlarged and continued. A committee consisting of the incoming president, secretary and treasurer was appointed to confer with the Indiana Academy of Science relative to the holding of joint meetings periodically by the two societies. It seemed to be the opinion of members of the society that such meetings could profitably be held at intervals of approximately three years in some locality near the border line of the two states.

The society adopted a resolution expressing its sense of loss in the deaths of two members during the past year, Albert Taylor and William Curtis Whitney.

After adopting resolutions expressing the appreciation of the society for the courtesies extended by the faculty and others at Miami University and furthermore thanking Mr. Emerson McMillin, of New York, for his continued interest in the welfare of the academy, the society adjourned. The following officers were elected for the coming year:

President—Professor Frank Carney, Granville, Ohio.

Vice-presidents—Professor J. H. Schaffner, Columbus, Ohio, and Professor F. C. Waite, Cleveland, Ohio.

Secretary—Professor L. B. Walton, Gambier, Ohio.

Treasurer—Professor J. S. Hine, Columbus, Ohio.

Executive Committee—(*ex-officio*) Professor Frank Carney, Granville; Professor L. B. Walton, Gambier; Professor J. S. Hine, Columbus; (elective) Professor Bruce Fink, Oxford; Professor Lynds Jones, Oberlin.

Board of Trustees—Mr. Charles Dury, Cincinnati, Ohio (in place of retiring trustee).

Publication Committee—Professor E. L. Rice (in place of retiring member).

L. B. Walton,
Secretary

THE NEW YORK ACADEMY OF SCIENCES—SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY

AT a meeting of the section held on Monday, October 21, at the American Museum of Natural History, three papers were read.

The Selective Reflection Characteristic of Salts of Carbonic and Other Oxygen Acids: L. B. MORSE.

I. *The Selective Reflection of Carbonates as a Function of the Atomic Weight of the Base.*—Polished plane surfaces of (Mg, Ca, Fe, Mn, Zn, Sr, Ba and Pb) CO_3 were prepared and the ratio of the reflected to the incident radiation was measured at short wave-length intervals between 4 μ and 15 μ. The following are the principal conclusions reached:

1. The reflection curves for all the carbonates examined show between 4 μ and 15 μ three, and only three, bands of abnormal reflection. Abnormal reflection interpreted means a free resonance period of the molecule.

2. The bands fall into three separate and definite spectral regions, which are distinct from the regions where the salts of other acids, so far as known, show reflection maxima.

3. With few exceptions, an increase in the atomic weight of the base causes a shift of all three reflection maxima toward long waves by an amount roughly proportional to the change in atomic weight of the base.

This is shown for the first reflection band by curve *A*, Fig. 1, in which the atomic weights of the bases are plotted as ordinates, and the wave-lengths of the "first" reflection maxima as abscissæ.

II. *The Rôle Played by Oxygen in the Selective Reflection of Carbonates, Nitrates, Sulphates and Silicates.*—Combining with the data on carbonates the scattered observations of other observers on nitrates, sulphates and silicates, the tentative hypothesis has been made that the oxygen atom is the one chiefly responsible for the marked reflection observed.

The wave-lengths of the first reflection bands in $CaCO_3$, KNO_3,[1] $CaSO_4$ and $MgSiO_3$[2] are plotted as abscissæ, curve *b*, Fig. 1, and as ordinates the weights of the acid-forming elements combined with O_3 ($C = 12$, $N = 14$, $\frac{3}{4}S = 24$, and $Si = 28$).

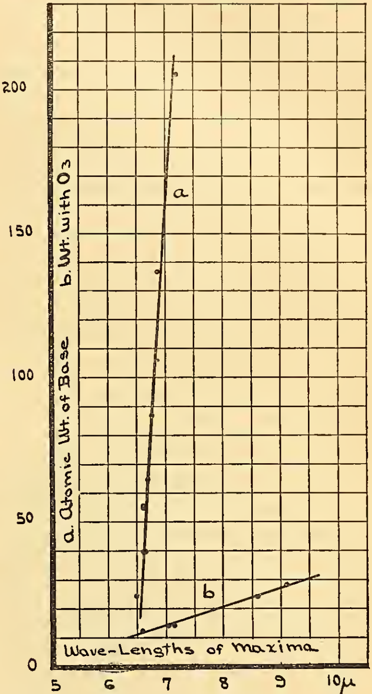

Fig. 1.

The lines drawn show clearly that a small increase in the weight of the acid-forming element produces a much greater displacement of the reflection band than does the same increase in the weight of the base, and this is in full agreement with the chemist's view of the relative strength of the bands existing between the *acid-forming element* and oxygen, and that between the *base* and oxygen.

The results suggest a new and far-reaching method by which it may some time be possible

[1] Two values are plotted for KNO_3 corresponding to the results obtained by two independent observers, Pfund and Coblentz.

[2] If a correction be applied to correct for Mg being lighter than Ca, this would bring the $MgSiO_3$ point even nearer the line drawn.

to express the dynamical relations existing between the separate atoms of a molecule, and thus the present conception of chemical bonds and linkages be given a broader significance.

The paper appears in full in the *Astrophysical Journal* for November, 1907. Addendum, October 30, 1907.

By reducing the results to zero weight of the base and extending the curve b to zero weight of the acid-forming element, the weight with O_3 both in base and as acid-forming element is zero. Thus a wave-length is found which is approximately that found by Ångström for the absorption of ozone.

Also a second absorption band in ozone corresponds to the second carbonate bands, found at a longer wave-length.

This is a very important confirmation of the assumption made viz., that, "the oxygen atom is the one chiefly responsible for the selective reflection observed."

The Decay of Phosphorescence of Gases: C. C. Trowbridge.

The author described a new form of photometer designed for the purpose of measuring the rate of decay of luminosity of a phosphorescent gas. The photometer consists of a track 3.5 meters long, made of two brass rods under tension. On the track an electrically controlled carriage runs which carries the standard light. The standard light can be moved away from a screen placed close to a tube containing the phosphorescent gas to points A, B, C, etc. The illumination on the screen from the standard light is thus directly compared with the luminosity of the gas, and comparisons are made at A, B, C, etc., as the gas fades. Seven readings can be made within ten seconds, giving a variation of from 1/2 to 1/25 the original intensity of the phosphorescent gas. The entire apparatus is operated electrically, time being registered on a chromograph.

By means of this photometer the law of the rate of decay of phosphorescence for gases has been found. In this case, for air at about 0.1 millimeter gas pressure, the expression is the same as that for the decay of phosphorescent solids, or

$$I = \frac{1}{(a + bt)^2}.$$

Plotting the reciprocal of the square roots of the intensities, in the case of one decay of luminous gas, with the corresponding times gives a perfectly straight line. An application of the law to the grading of the light of a body of phosphorescent gas as great in size as a meteor train shows that the light of the self-luminous meteor train can be explained on the assumption that it is a gas phosphorescence, although the train may be visible for thirty minutes. A certain brightening of the sky around the radiant point at the time of meteor showers which has been called the "auroral light" is also explained by the application of the same law. In the latter case it is evident that the feeble phosphorescing of many trains has combined to give a pale glow in the regions of the heavens through which the shower was taking place.

Some Temperature Measurements taken in the Steel Works with the Wanner, Féry and Le Chatelier Pyrometers: W. Campbell.

The author briefly described the instruments used, methods of standardization and application. The temperature readings obtained at the blast furnace were: Metal, 1375° to 1250° C.; slag, 1425° to 1375°. At the Bessemer converter, 1600° C., very hot blow; 1500° C. cool. Average blows 1550° C. The steel was cast at 1500° to 1460° C. At the Open Hearth the furnace temperatures varied from 1550° to 1705° C., the surface of the bath being 1705°. The steel was cast at 1540° to 1460° C. The temperatures of the gas producers varied greatly, one set averaging 650° C., another over 850° C. The most important readings were taken at the Rail Mill, on the finishing temperatures of steel rails. The readings with the Féry pyrometer varied from 1000° to 1070° C., whilst the Wanner averaged 1100° C.

At this meeting Professor D. W. Hering was nominated for vice-president and chairman of the section for 1908, and Professor W. Campbell for secretary.

At a meeting of the section held on Monday, November 18, three papers were presented.

Waves and Rays in Physics: DORIS W. HERING.

The author pointed out the extent to which waves or rays have dominated in explaining the transmission of a disturbance through space, as many as seven different kinds of waves having been employed, and no less than twenty-one different kinds of rays. The most fruitful generalization was Fourier's analysis of wave motion in his "Théorie Analytique de la Chaleur"; the boldest contention was that of Fresnel in advocating transverse vibration to produce waves of light; the most recent and comprehensive generalization was Maxwell's electromagnetic theory of light. The recent great increase in the number and variety of "rays" has been attended by a great deal of charlatanism.

Tool Steel-making in Styria: R. F. BÖHLER.

Reviewed the development of Styrian steel trade from prehistoric and Roman times up to our own days. The paper emphasized a number of special features characteristic of Styrian steel which are so many reasons for its superiority: (1) Crucibles used but once, (2) extreme purity of ores, (3) extensive or exclusive use of charcoal, (4) special skill of workmen in hammer- and heat-treatment.

The works, founded 1446, are now decidedly up-to-date; have pyrometric control; electric melting and hardening furnaces; latest physical testing methods, metallography.

As a consequence extensive use of Styrian steel in the five continents, for tools, rifles, shells, etc., also field guns, motor cars. Hundreds of tons of high-speed steel shipped to the United States yearly.

Electrolysis of Silico-Fluoride Solutions: DR. E. F. KERN.

The author first of all took up the preparation of the electrolytes, current density, etc., and showed numerous specimens including metallic surfaces of lead, nickel, iron, copper and silver deposited from silico-fluoride and other solutions for comparison. The method on a commercial scale for the purification and desilverization of lead is employed at Trail, B. C., and elsewhere.

WILLIAM CAMPBELL,
Secretary

COLUMBIA UNIVERSITY

DISCUSSION AND CORRESPONDENCE

A BRITTLE-STAR NEW TO THE WOODS HOLE REGION

THROUGH the kindness of Mr. George M. Gray, the well-known collector of the Marine Biological Laboratory at Woods Hole, Mass., I am enabled to make an interesting addition to the list of echinoderms known from the Woods Hole region. A single specimen of a brittle-star was dug out of the mud between Ram and Devil's Foot Islands in August, 1907. It was taken to the laboratory alive and in good condition, but in the course of a few hours it shed its disk, leaving only the mouth parts attached to the arms. The disk, as well as the remainder of the animal, was preserved in formalin and the specimen was subsequently sent to me by Mr. Gray for identification. There is little doubt that it is an excellent example of *Amphioplus abdita* (Verrill), a species previously known only from Long Island Sound. It is recorded from near New Haven and from Thimble Islands, by Professor Verrill, and there are specimens in the Museum of Comparative Zoology from Noank, Conn. The Woods Hole specimen measures about 6.5 mm. across the disk, and the arms are between 80 and 90 mm. in length. It differs from Professor Verrill's very complete description, and also from the specimens in the Museum of Comparative Zoology, in three important particulars: (1) the arms are noticeably shorter in proportion to the diameter of the disk; (2) the scales of the disc are coarser and the six primary plates at the center are conspicuous; (3) the color is uniformly gray instead of variegated or yellowish-brown. It is greatly to be hoped that further search will bring to light more specimens at Woods Hole, of this mud-loving species, for it will be interesting to see whether the above-mentioned peculiarities are at all constant. It would also be of great interest to investigate the cause, method and consequence of disk-shedding, a habit known to be frequent in the family to which *Amphioplus* belongs, but concerning which we know almost nothing.

HUBERT LYMAN CLARK

MUSEUM OF COMPARATIVE ZOOLOGY,
November 14, 1907

SPECIAL ARTICLES

THE FOUR INSEPARABLE FACTORS OF EVOLUTION. THEORY OF THEIR DISTINCT AND COMBINED ACTION IN THE TRANSFORMATION OF THE TITANOTHERES, AN EXTINCT FAMILY OF HOOFED ANIMALS IN THE ORDER PERISSODACTYLA [1]

In a recent address entitled "Evolution as it appears to the Paleontologist"[2] I promised a fuller exposition of the law of the four inseparable factors.

During the past six years a very careful analysis of the modes and factors of evolution has been made in connection with my exhaustive study of the Perissodactyl family of Titanotheres, with the following result: all the processes and modes of evolution should be grouped under the *primary* processes of (1) heredity, (2) ontogeny, (3) environment, (4) selection. In this grouping heredity includes solely changes in the germ plasm. Ontogeny includes the somatic expression of heredity, somatic modification and adaptation, as well as the somatic environment of the germ plasm. Environment includes all nature external to the organism. Selection represents all competition, survival or elimination of individuals representing the combined product of heredity, ontogeny and environment. Variation is not included here because it is a *secondary* process.

A survey of the history of evolution theory shows successive waves of opinion or schools holding to the chief or more or less *separate* influence of these processes as factors; for example, environment (Buffon), ontogeny (Lamarck), selection (Darwin), heredity (the modern school). There is a very large element both of truth and of error in the tenets of each of these schools, because while the influence of each of these factors is undeniable, the exclusive influence of either of these factors is never found in nature, and can exist only in the mind of the observer.

The actual state of living nature is that of the *inseparable* and continuous action of these several factors as expressed in the following most fundamental biological law:

The life and evolution of organisms continuously center around the processes which we term heredity, ontogeny, environment, and selection; these have been inseparable and interacting from the beginning; a change introduced or initiated through any one of these factors causes a change in all.

Representing these processes respectively by the capital letters H, O, E, S, life and evolution may be represented by the formula:

$$H \times O \times E \times S.$$

This formula roughly expresses the intimate nexus which exists between all these processes, a nexus which is quite consistent with the fact that each has also its separate part in life and in evolution. The multiplication sign, $\times$, is to be interpreted in the active and passive sense of *influencing and influenced by.* As examples of what is meant by this formula we may cite such principles as the following: (1) that heredity is conditioned by ontogeny and environment; (2) that selection operates on the product of heredity, ontogeny and environment; (3) that ontogeny initiates many changes which are subsequently taken up by heredity; (4) that of the four processes involved in life and evolution heredity is by far the most conservative and stable, among other reasons because it is embodied in a form of matter (germ-plasm) least subject to changing external influences; that ontogeny, on the other hand, is the most unstable.

In contrast to the graphic representations of the original extreme hypothesis of Weismann, in which heredity is represented as a continuous current more or less isolated from ontogeny and environment there may be presented the following diagram.

This diagram brings out the real cause of the difficulties which arise, as illustrated below

[1] Abstract of paper read before the American Society of Zoologists, New Haven, Conn., December 26–28, 1907. This address was first delivered to Columbia students, November 3, 1905, and has been held two years for further consideration, before publication.

[2] Osborn, Henry Fairfield, "Evolution as it appears to the Paleontologist," Science, N. S., Vol. XXVI., No. 674, No. 29, 1907, pp. 744–749. Address before Seventh International Congress of Zoology, Section of Paleozoology, Boston, August, 1907.

(1–4), when we attempt to determine at what point in the chain of processes a new character is set in motion, in course of investigation of the initiation or origin of new characters.

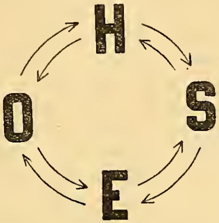

Diagram illustrating the reciprocal influences of heredity, ontogeny, environment and selection. Arrows *across* the circle would represent these relations still more completely.

1. For example, as concerns *heredity,* consider the slow "mutations of Waagen" or the rapid "mutations of De Vries." According to an *internal* theory the point of origin would be expressed by a formula presenting the theory that mutations originate in heredity, namely:

$$H^1\ O\ E\ S.$$

The experiments of MacDougal[3] and others in the New York Botanical Gardens showing that mutations are sometimes set in motion *externally* or through environment, would be represented by the formula:

$$H^2\ O\ E^1\ S.$$

2. Similarly, as concerns *ontogeny,* the theory of the phenomena of "organic or coincident selection" might be represented by the following successive formulæ:

$H\ O^1\ E\ S$ = first or ontogenetic phase.

$H^2\ O^1\ E\ S$ = second phase, or phase of coincidence of heredity with ontogeny.

$H^2\ O^1\ E\ S^3$ = third phase, in which coincident ontogenetic adaptations and hereditary predispositions are selected.

Here again the originating cause may be the environment, in which case the formula should be written E^1, O^2, H^3, S^4. This is a further example of the constant operation of the "inseparable law."

3. The initial influence of *environment* in the origin of new characters (or revival of ancestral characters) has been well illustrated recently in the interesting experiments of Beebe[4] in the New York Zoological Park, in which the eggs of the same mother bird (*Scardafella,* the scaly dove) were subjected to two extremes of environment, all other factors being excluded, with two types of plumage resulting. Here the formula is clearly:

$$H\ O^2\ E^1\ S.$$

4. Finally, as concerns *selection,* while it is admitted that this factor originates nothing, there are periods of intense struggle for existence when selection takes most active part in the perpetuation of certain characters and elimination of others and is thus indirectly initiative.

We are forced to the conclusion that all hypotheses which treat of these four processes as separable in a state of nature are unsound; that all methods of investigation which proceed on such assumption are unsound. At the same time investigation and experiment may proceed to test two working hypotheses: *First, that while inseparable from the others, each process may in certain conditions become an initiative or leading factor; second, that in complex organisms one factor may be initiative in one group of characters while another factor may at the same time be initiative in another group of characters, the inseparable action bringing about a continuously harmonious result.*

Application of this Law to the Titanotheres.—The hypothesis of the simultaneous operation of several factors on different groups of characters could only suggest itself to a paleontologist working upon a very complex organism in which an almost countless number of characters is simultaneously evolving. The analysis of these processes as applied to

[3] MacDougal, "Heredity and the Origin of Species," *The Monist,* January, 1906. Rept. Dept. Bot. Research (extract from fifth Year Book, Carnegie Inst., pp. 119–135), p. 129.

[4] Beebe, C. William, "Geographic Variation in Birds, with Especial Reference to the Effects of Humidity," *Zoologica,* N. Y. Zool. Soc., Sept. 25, 1907, pp. 1–41.

the evolution of the titanotheres is based on thousands of measurements, of the skull and teeth especially, and on comparisons of an exceptionally rich series of specimens in successive geological levels. So far as they have gone they appear to confirm the hypotheses of the separate and combined operation of the four factors on different classes of characters. A few illustrations only may be given of results which will be set forth very fully in the monograph.

1. Heredity appears to dominate the origin of new cuspules in the teeth because they arise in the form of rectigradations, that is, with a slow, definite, and continuous origin, in an adaptive direction and controlled by ancestral affinity. That is, the *same* results appear independently in descendants of the *same* ancestors.

2. Ontogeny rather than heredity appears to be in part an initial factor in fashioning the form of the cranium. We can not regard this as controlled by ancestral affinity, because descendants of the *same* ancestors give rise to *different* results, that is, to extremely divergent broad-skulled and extremely long-skulled forms.

3. Environment, besides its indirect action through heredity and ontogeny, seems to act broadly upon such change as the continuous increase of size, which independently favors the increase in size of the members of four series of titanotheres in contrast to a fifth which is dwarfed in size.

4. Selection (by our definition not an initiative factor), while generally operating on the whole sum of characters or the sum total of the organism, seems in this case to have operated especially on fluctuations in skull breadth or skull length respectively, in relation to the browsing or grazing habit; these congenital fluctuations being connected with ontogeny and organic selection.

The above is a very brief statement of the results of analysis of the evolution processes in general, and of the application of these processes to titanothere evolution in particular. It applies especially to the origin of new characters, with the clear appreciation of the end result that all such characters, or the potentiality of giving rise to them, finally become *germinal* or hereditary.

HENRY FAIRFIELD OSBORN

QUOTATIONS

THE CONCILIUM BIBLIOGRAPHICUM

We learn that at the recent meeting of the International Congress of Zoology held in Boston a committee was formed to raise an adequate endowment fund for the Concilium Bibliographicum. With the one exception of the final settlement of the question of nomenclature—if, indeed, such a settlement be possible—there is no step which the congress could have taken of such importance as this for zoologists in general, nor are there many which could have anything like its economic importance. The literature of zoology is at once the most extensive and the least accessible of all those of the natural sciences. It is estimated that the number of persons engaged in zoological investigations of one kind or another amounts to several thousands, while—to ignore altogether works published independently—there are more than 3,000 periodicals, written in over 20 different languages, which may contain matter of interest for the naturalist. Unfortunately, the difficulty of the situation is made greater by the refusal of most of these journals to limit the matter they publish to any one branch of zoology and also by the importance which claims of "priority" may give to articles that have appeared in the most obscure periodicals. Moreover, it is precisely those papers which, directly or indirectly, are of the greatest economic importance (whether to economic entomology, to the study of fisheries, or to parasitology) that are the hardest for the working zoologist to hear of and to obtain.

The Concilium Bibliographicum was founded in 1896 under the auspices of the International Congress of Zoology. Its offices are situated in Zurich and its staff of librarians and clerks is under the direction of Dr. H. H. Field. The work of the Concilium is to examine as many of the periodicals of the world as are accessible to it, to make abstracts of their contents, and to publish the results of its labors in the form of a card catalogue of zoological literature. Each article is read by a zoologist who determines for what classes of workers the paper is of interest and prepares a brief résumé, noting any new species or genera described. In order to indicate the contents of the articles, the topics met with have been arranged in the form of a comprehensive classification and then numbered, so that each paper is assigned by a numerical symbol to the divisions with which it deals. The reference to each paper is printed on a card and bears the appropriate numbers to designate one of the topics treated in the publication. Where the reviewer finds various matters treated in one paper several different editions of the cards are printed, differing only from one another in the classificatory symbol employed. Thus a given work may be found to contain an account of the occurrence of a white badger in a given country, together with considerations on albinism in general. The paper would emerge from the hands of the reviewer with a symbol for each of these aspects. The indication 11.57 would mean that the paper in question dealt with albinism, and the card would accordingly be sent to subscribers interested in that subject; the symbol 9.74 Meles would mean that the card must go to all subscribers interested in the badger; and a third symbol would designate the country or district in which the animal was found. The naturalist interested in the absence of pigment in animals (albinism) subscribes for that portion of the catalogue which deals with his subject, and receives every two months the new citations of papers on albinism. Some of these may refer to observations made near at hand; but much will relate to foreign publications and might remain unknown save for the agency of the Concilium. The whole series of cards may be subscribed for by an institution, which thus secures a bibliography of zoology since 1896, the value of which, in saving time and ensuring acquaintance with the literature of any branch of the subject, is incalculable. Since it is issued on cards the catalogue is not only always up to date, but has all the references on a given topic together at one point.

Unfortunately, the actual services rendered by the Concilium, great though they have been, have fallen somewhat short of its program. This, however, is entirely due to the limitation of its resources. The organizers of the institute are satisfied that the experimental period has proved beyond question that the program can be fully realized if they be provided with the necessary means. It is to find these means that the committee we have mentioned has been formed. Their success is greatly to be desired, and that, as we have shown, in wider interests than those of zoology alone.—From the London *Times*.

A LETTER RELATING TO THE BIOGRAPHY OF LAMARCK

Professor Joubin, chairman of the Lamarck Memorial Committee, has just sent the American members of this committee a copy of a letter dealing with the biography of Lamarck, written by his son nearly half a century ago. Its materials are timely and I append a translation.

LETTER OF GILLAUME DE LAMARCK, SON OF THE GREAT NATURALIST, WRITTEN JUNE 11, 1865, TO HIS SON EUGÈNE DE LAMARCK, THEN LIEUTENANT ON BOARD THE SLOOP OF WAR "SURPRISE"

My Dear Son:

I have read with pleasure the few lines you sent me taken from a work of which I have never heard. *Histoire naturelle des professeurs du Jardin des Plantes*—this is indeed a singular title. One would have thought it the history of some class or other of animals; one of the most important works of my father is entitled: *Histoire des Animaux sans Vertèbres;* but "The Natural History of the Professors"—that seems to me a little strong.

Be this as it may, the eulogy does exist and it is merited. Moreover, this is not the first that I see. Nevertheless, the name of my father has remained in obscurity. I always feel provoked when I see the statues erected to Georges Cuvier, to de Jussieu, to Géoffroy Saint-Hilaire, or when I see the names of these scientists given to the streets which surround the Jardin des Plantes, when I see the busts of the professors in the galleries of the Natural History Museum, all with the exception of that of my father. But what can one do about it? It does not merely suffice to have the reputation, to have the scientific knowledge, to be a genius, a thing which is very much rarer, but one must still be able to make one's value felt, to push one's self, to extend one's influence and above all things to flatter the great. That talent my father did not have.

In his time there were two men around whom were grouped all of those who aspired to make a name in science. They were Laplace and Cuvier.

Around Laplace were grouped all the geometricians and the physicists; around Cuvier the naturalists. And there was no saving grace to any one outside of these two coteries. It goes without saying that my father belonged to neither. He remained in his corner, making no visits, and receiving only occasional strangers, and the several students whom he installed in his work room and to whom he opened all of his collections. So no one spoke of him; his most remarkable works passed unnoticed. His ideas, which were new, bold, and too advanced for the time when he wrote, contributed, also, perhaps, to keep him in obscurity, if they did not, indeed, give people an opportunity for ridiculing him. I am willing to believe that it will not always be like this.

I have spoken of a reason for the discredit which was cast upon the works of my father; but this was not the only one. There was still another, and even more grave. It was the disgrace brought upon him by the all-powerful master who then ruled.

My father loved to penetrate untrodden fields, he avoided paths too clearly marked out; for him accident was a word empty of meaning; he believed that in nature all things were subject to laws as certain as mathematics; but to discover them one must observe the facts, make comparisons and admit only the explanation which was in concord with all the facts observed. The study of meteorology attracted his attention; he gave himself up to it with the more zeal, since it was a science still in its infancy, a science as he loved them. For a long time people had, indeed, carried out meteorological observations, but these observations no one had been willing to study or to draw from them deductions. My father wished to undertake this task.

There was then in the Ministry of the Interior an intelligent man, a distinguished scientist, Chaptal. M. Chaptal approved of the project of my father. He created for him an office in his ministry and furnished him with correspondents at different points throughout the country. My father wished to keep the public in touch with the progress which he would have made in the study undertaken by him, and to this end published a meteorological year-book in which he had the unfortunate idea of including both memoirs purely scientific and probabilities of the weather to come. This was intended to help along the sale of the work, but it furnished also a weapon for his critics. The astronomers of the Bureau of Longitude, furious to see a naturalist exploit a field which they believed belonged to them, hastened to avail themselves of this weapon; they transformed "probabilities" into "predictions," and upon this ground they made a great outcry. A member of the Institute to play the part of a Mathieu Lansberg! . . . They petitioned the emperor to cause such a scandal to be stopped. The emperor was a member of the Institute and this was not one of the titles of which he was least proud. In a public reception he apostrophized my father sharply on this subject and concluded by telling him that botany should be kept within its proper bounds. ("La botanique! A la bonne heure!") From that time the ministry deprived my father of his office and his correspondents and stopped the publication of the meteorological year-book. Thus it was that the reprimand of a sovereign before whom the entire world trembled succeeded in placing outside of the scientific pale an old man who petitioned no one, who lived retired, and who sought for nothing but the advancement of human knowledge!

Nevertheless, of what nature was this old man? Let us examine his career.

Child, and the last born, of a numerous family, he had been sent to the Jesuits at Amiens and destined to the priesthood. There was no other alternative for noble families. He had to be either priest or soldier. All of the elder ones were soldiers. So my father had to be priest. But it was not his vocation, and when he learned of the death of his father his first words were: "Such being the case, I shall not be a priest." He left the college and returned to his mother, who, not knowing what to do, yielded finally to his wishes and sent him, at the age of fifteen, to the army in Germany, commanded by Marshal de Broglie, to serve as a volunteer. He took with him a letter of recommendation to Colonel de Lastic, who received it with lively dissatisfaction, seeing only an embarrassment in having so young an apprentice to the trade of war. It was then on the eve of a battle of which I have forgotten the unpronounceable name. We were defeated through the fault of the Prince de Soubise, who failed to effect a junction with the marshal, as had been explicitly arranged in a council of war.

The French army had to retire. My father finding himself in command of a company of grenadiers—on account of the death of all of the officers and by virtue of his nobility, fought on in a brilliant action which will be too long to describe, and which earned for him the epaulets of sublieutenant on the field of battle. It was a good commencement for his military career; but peace was made soon afterwards and he had to return to France and begin garrison life. I will not continue; he was forced to sell his grade of lieutenant of infantry on account of a tumor which appeared on his neck.

It was then that he made a complete change in his career. No, I am mistaken: he first remained for a while with his mother at the paternal manor; this was a time of forced inactivity, which one would be glad to drop out of his life. But finally his mother died. He had to sell the estate of Bazantin. There remained to my father only a very meager income. He had to live, he had to make a career. My father went to Paris. He first studied medicine, then abandoned this for botany. This science pleased him, he had a taste for it, he gave himself up to it ardently. One day, as he was walking with other students in the botanical school of the Jardin des Plantes, he laid a wager that he could identify whatever plant was presented him, any one at all, provided they informed him in advance the principal characters which distinguished the fruit (végétaux). He asked, in order to prepare himself, a certain delay, which was granted him, and on the day fixed, in this same school of botany, in the midst of a numerous assembly, the trial took place, succeeded, and the wager was won. Such was the origin of the Flore Française. The means devised by my father consisted in the successive elimination of two opposed characters, which is the method of dichotomy employed to-day in all classifications of natural history. The success of the Flore Française was truly prodigious. It was printed at the expense of the king and opened to my father the gates of the Academy of Sciences.

I pass without comment several other works which he published on botany and which put the seal to his reputation as a botanist. To come to those of his works to which he himself attached the greatest value.

The museum was about to be reorganized. Several new chairs were added to those already existing. The mammals, birds, fishes and reptiles were given to Géoffroy Saint-Hilaire and all of the mass of lower animals were given to my father. No oné, Linné excepted, had then thrown light into the chaos formed by these beings. My father undertook to disentangle them. He established at once the great distinction which divides the animal kingdom into two classes, vertebrate and invertebrate. And the latter class, which up to then had been nearly despised, became of such importance, when my father had brought into it the order which remains there at present, that it has been judged too large to be in the charge of a single professor, and it has been made to-day the object of two different chairs.

It is in his zoological works that the genius of my father had its full scope. To appreciate them properly one should have a knowledge which I do not possess. I can only cite the *Philosophie Zoologique* and the *Histoire des Animaux sans Vertèbres*. These are the two monuments which will appeal to posterity from the coldness of his contemporaries.

Will this appeal ever be heard? I doubt it. Nothing is more difficult to uproot than a preconceived opinion. Men are like sheep; they follow blindly their leader without inquiring the road where he is leading them. They judge rarely by themselves, and find it most convenient to adopt without examination the judgments which time has given them.

It seems that this ingratitude of mankind has been the penalty inflicted upon my father for his neglect of the fulfilment of his duties as head of the family.

I can not deny, indeed, that his conduct in this regard is not reproachless. Undoubtedly it is ideal to devote one's self to science without the slightest regard to worldly ambition or to fortune, but this is the very condition which the interests of the family will not suffer.

My father was three times married—from the first marriage he had six children, from the second two and from the third none.

* * * * * * * *

The conclusion of the letter contains the history of the five sons of the naturalist, only one married, the author of this letter. Of Lamarck's three daughters, the eldest, Rosalie, was his devoted secretary in the days of his blindness.

Bashford Dean,
Treasurer of the American Branch of the Lamarck Memorial Committee
Columbia University,
New York

EDWARD GARDINER GARDINER

Edward Gardiner Gardiner was the son of Edward Gardiner, of Boston, and of Sophia

Harrison Mifflin, of Philadelphia. On his father's side he traced his descent from George Gardiner, who settled in Aquidneck, Rhode Island (the site of the present town of Narragansett), in 1635. On both sides his ancestors had distinguished themselves by services to their respective communities and to their common country. He was born in New York City July 29, 1854, and died in Boston November 4, 1907. He was married April 6, 1895, to Miss Jane Greene Hooper, who, with two children, a boy and girl, survives him.

He was educated at the Boston Latin School and intended, as a matter of course, to enter Harvard, but a trouble with his eyes cut him off for several years from all studies. During this time he made the acquaintance of Professor Alpheus Hyatt, and his association with this distinguished naturalist awoke in him a love of science destined to be lifelong. He assisted Professor Hyatt sorting scientific material in the Museum of Natural History of Boston, and with him made repeated cruises for collection of material as far north as Labrador. His interest in biology and his warm affection for Professor Hyatt led him to pursue his studies at the Massachusetts Institute of Technology, at first as a special student, which was all his eyes made possible. In 1882 he graduated with the degree of Ph.B. and went abroad for two years to carry on his scientific studies. In 1884 he received the degree of Ph.D. from the University of Leipzig, the subject of his thesis being "Beiträge zur Kenntniss des Epitrichiums und der Bildung des Vogelschnabels," published separately and also in *Archiv für Mikroskopische Anatomie,* Vol. XXIV., 1885. Leuckart, for whom he often expressed great admiration, was his principal teacher in Leipzig, but he also attended the lectures of Rauber, Zirkel, Credner, Schenk, Marshall, Fraisse and Chun.

On his return from Leipzig, he entered the laboratory of Professor W. T. Sedgwick in the Massachusetts Institute of Technology and was welcomed as a well-trained zoologist. After a year as graduate student in Professor Sedgwick's laboratory, he was appointed successively assistant and instructor, in which capacities he served from 1885 to 1892. Professor Sedgwick writes that "Gardiner was always a devoted friend of the laboratory and left us because teaching had become irksome to him and interfered greatly with the original work which he hoped and expected to do at Woods Hole."

In 1888 Dr. Gardiner was elected a member of the original board of trustees of the Marine Biological Laboratory, which included also William G. Farlow, Alpheus Hyatt, Susan Minns, Charles S. Minot, William T. Sedgwick and Samuel Wells. Dr. Gardiner, who had consented to enter the board to fill a temporary vacancy, soon withdrew, but it was for a year only, and in 1890 he was again elected a member of the board and served continuously to the time of his death, when he was the only member of the original board remaining on it. He shared in the work of the first session of the laboratory, 1888, and was instructor in 1889, 1890 and 1891. He served as clerk of the corporation from 1895 to 1902 and again from 1906 to the time of his death. He also acted as secretary of the board of trustees from 1896 to 1902 and was again elected to the same office only three months before death deprived the board of his valuable and efficient services.

It is impossible in a brief sketch to even mention the numerous services rendered by Dr. Gardiner, as officer and never-failing friend, to the Marine Biological Laboratory. His long connection with laboratory affairs and intimate knowledge of its history made him one of the most important members of the board of trustees, and his high standing in Boston enabled him to secure valuable assistance for the promotion of the interests of the laboratory.

The board of trustees of the Marine Biological Laboratory record their sorrow at his untimely death, their sense of great loss, and their admiration for the fine sense of honor and loyalty that characterized his life. And they order this record spread upon the minutes of the board of trustees, and recommend that it be published, and that copies be sent to his family, near relatives and friends to express the sympathy of the board in their bereavement.

ORIGINAL PUBLICATIONS OF EDWARD G. GARDINER

"Beiträge zur Kenntniss des Epitrichiums und der Bildung des Vogelschnabels," Inaugural-Dissertation, Leipzig, 1884. Also in *Archiv für Mikroskopische Anatomie*, Bd. XXIV., 1885, pp. 289–338, Taf. XVII.–XVIII.

"Notes on the Structure of the Quills of the Porcupine," *Technology Quarterly*, Vol. I., p. 392, 1889.

"The Origin of Death," *Technology Quarterly*, Vol. IV., p. 178, 1891.

"Weismann and Maupas on the Origin of Death," Biological Lectures delivered at the Marine Biological Laboratory of Woods Hole, Vol. I., Ginn & Co., Boston.

"Early Development of *Polychœrus caudatus*, Mark," *Journal of Morphology*, Vol. XI., No. 1, pp. 155–171, 1895.

"The Growth of the Ovum, Formation of the Polar Bodies and Fertilization in *Polychœrus caudatus*," *Journal of Morphology*, Vol. XV., No. 1, pp. 73–110, Plates 9–12, 1898.

For a number of years prior to his death Dr. Gardiner had been engaged upon a monograph of the *Turbellaria acœla*, which was to have been his principal scientific work, but which was never completed.

SCIENTIFIC NOTES AND NEWS

As we have already announced would be the case, Sir E. Ray Lankester relinquished the directorship of the Natural History Departments of the British Museum on December 31. The trustees have not yet appointed a new director of these departments and it appears to be very uncertain whether they have any intention of doing so. The keepership of the Zoological Department, which was also held by Sir Ray Lankester, likewise remains unfilled.

M. BOURGET, of the Toulouse Observatory, has been appointed director of the Marseilles Observatory, to succeed M. Stephan, who has retired.

THE council of the Institution of Electrical Engineers has elected Lieutenant-Colonel R. E. B. Crompton, C.B., to the presidency of the institution, vacant by the death of Lord Kelvin.

PROFESSOR R. S. LULL, curator in vertebrate paleontology, Peabody Museum, Yale University, was elected president of the American Society of Vertebrate Paleontologists at the meeting in New Haven on December 28.

PROFESSOR MARSTON T. BOGERT, of Columbia University, has been elected president of the Chemists' Club, New York.

THE council of the Geological Society of London has made the following awards: the Wollaston medal to Dr. Paul Groth, professor of mineralogy in the University of Munich; the Murchison medal to Mr. A. C. Seward, professor of botany in the University of Cambridge; the Lyell medal to Mr. R. D. Oldham, formerly of the Geological Survey of India; the Wollaston Fund to Mr. H. H. Thomas, of the Geological Survey of England; the Murchison fund to Miss Ethel G. Skeat, while the Lyell fund is divided between Mr. H. J. Osborne White and Mr. T. F. Sibly for their respective work on the Cretaceous and Carboniferous rocks of England.

THE Liverpool School of Tropical Medicine has decided to confer the Mary Kingsley memorial medal on Mr. Joseph Chamberlain "in recognition of the great work he inaugurated by the establishment of schools of tropical medicine."

MR. MORRIS K. JESUP, president of the American Museum of Natural History, has been made a corresponding honorary member of the Senckenbergische Naturforschende Gesellschaft in appreciation of his gift of the Diplodocus skeleton to the Senckenberg Museum at Frankfurt on the Main, Germany.

DR. EMIL FISCHER and Dr. J. H. van't Hoff, professors of chemistry in the University of Berlin, have been given the honorary degree of doctor of engineering by the Technical Institute at Brunswick.

WE learn from *Nature* that Sir Norman Lockyer has been unanimously elected president and an honorary member of the Penzance Natural History and Antiquarian Society in recognition of his services to the study of the circles and other prehistoric remains in west Cornwall.

M. M. Nyrén, of the Pulkowa Observatory, retired from his office at the end of 1907.

Professor F. B. Crocker, head of the department of electrical engineering in Columbia University, has been appointed secretary of the American section of the international electrotechnical commission, which includes representatives from twelve of the principal countries. This commission has undertaken the universal standardization of electrical machinery and apparatus.

The fifth lecture in the Harvey Society course will be delivered by Professor George W. Crile of the Western Reserve University, at the New York Academy of Medicine building on January 25, at 8:30 p.m. Subject: "Shock." All interested are cordially invited to be present.

Dr. C. P. Steinmetz recently lectured at the University of Illinois, on alternating current railway motors. The meeting was under the auspices of the Urbana Section of the American Institute of Electrical Engineers.

A series of twelve lectures on Nutrition: digestion, metabolism and selection of foods, will be given at Teachers College, Columbia University, beginning on January 13, 1908, and weekly thereafter. The lectures will be given by Dr. William J. Gies, of the College of Physicians and Surgeons, Dr. Henry C. Sherman, of the School of Chemistry and Teachers College, and Miss Anna Barrows, of the department of domestic science, Teachers College.

The deaths are announced of Dr. P. Lachmann, professor of botany at Grenoble at the age of fifty-six years, of Dr. A. W. Krassnow, professor of astronomy and director of the observatory at Warsaw, at the age of forty-one years, and of Dr. H. Giessler, formerly professor of chemistry at Stuttgart Chemical Institute at the age of sixty years.

The U. S. Civil Service Commission announces an examination on February 5–6, to fill vacancies as they may occur in the position of topographic aid, in the Geological Survey, at salaries ranging from $840 to $1,200 per annum, depending upon the experience and ability of the applicant, and in other branches of the service. It also announces an examination on February 5 to fill a vacancy in the position of scientific assistant, $720 per annum, in the Bureau of Fisheries, and vacancies requiring similar qualifications as they may occur.

Senator Dick, of Ohio, introduced in the senate on January 15 a joint resolution to provide for a Mining Technology Branch in the Geological Survey and a bill for the establishment of a Bureau of Mining Technology.

Mr. Smith, of California, has introduced in the house of representatives a bill for the protection of animals, birds and fishes, in the forest reserves in California, which was referred to the committee on the public lands.

The city of Berlin has appropriated $12,500 toward the fund for combating tuberculosis to be named in honor of Dr. Robert Koch. About $40,000 have been subscribed from private sources.

At the examinations recently held in Peking for official degrees men who had studied in American universities were awarded the highest honors. Out of a large number examined, only seven were given the highest degree obtainable, and of these five were graduates of the University of California, while the other two had studied in Japan.

The third meeting of the Commission for the Study of Problems relating to Human Nutrition, appointed by the University of Illinois, was held at the university, Urbana, December 27–28. All the members of the commission were present, including Dr. Theobald Smith, of Harvard; Professor Chittenden, of Yale; Professor Abel, of Johns Hopkins; Professor A. P. Mathews, of the University of Chicago, and Professor Grindley, of the University of Illinois. The commission considered fully the detailed plans at present being used in connection with the nutrition investigations which are being made at the University of Illinois in the study of the influence of cured meats upon the health of man. They also thoroughly inspected the laboratories, the equipment and the houses used for the experiments. The members of the commission visited the nutrition club, taking two meals with the members. The work already done was approved, and arrangements were made for extending in several ways the scope of the investigation now in hand.

AMERICAN geologists who are interested in modern interpretations of Alpine structure will find a valuable series of colored sections in several pamphlets by Professor C. Schmidt, of Basel, as follows: "Bild und Bau der Schweizeralpen," which appeared as a supplement to Vol. XLII. of the Swiss Alpine Club, 1907 (Finckh, Basel, 5 francs), contains, besides a beautifully illustrated text, a small geological map and a remarkable group of sections illustrating the extreme extension now given to the idea of overthrust folds. "Führer zu den Exkursionen der deutschen geologischen Gesellschaft im südlichen Schwarzwald, im Jura und in den Alpen," August 1907, by Schmidt, Buxtorf and Preiswerk (Schweizerbart, Stüttgart, 5 Marks), containing a number of more detailed sections, as well as the same group of general sections. "Ueber die Geologie des Simplongebietes und die Tektonik der Schweizeralpen" (Eclog. geol. helv., IX.), with a number of detailed sections and a general geological map of the Alps between St. Gotthard and Mont Blanc. "Tektonische Demonstrationsbilder" (to be had of the author, 1 franc), with some of the same Alpine sections and several additional sections for the Vosges and the Schwarzwald.

WE learn from the *British Medical Journal* that Mr. Young J. Pentland, of Edinburgh, has relinquished his publishing business in favor of Mr. Henry Frowde, Oxford University Press, and Messrs. Hodder and Stoughton. The copyright volumes transferred include the well-known "Text-book and Manual of Anatomy," by Professor D. J. Cunningham; the "Text-book of Physiology," by Professor Schäfer; the "Manual of Bacteriology," by Professors Muir and Ritchie; the "Manual of Surgery," by Messrs. Thomson and Miles; the "Outlines of Zoology," by Professor J. Arthur Thomson, etc. These works will for the future be published by Mr. Frowde and Messrs. Hodder and Stoughton.

A NEWSPAPER despatch from San Francisco states that with only seven cases of plague reported during the month of December and but three cases remaining under treatment at the isolation hospital, bubonic plague in San Francisco is almost eradicated as a result of the vigorous sanitary campaign conducted during the past four months, by the United States Marine Hospital Service, under the direction of Dr. Rupert Blue, and with the cooperation of the local health authorities. Dr. Blue's staff consists of Dr. W. C. Bucker, his executive officer, and fourteen medical officers from the Marine Hospital Service. Over $200,000 has been expended in a campaign of sanitation and the monthly payroll at present is about $43,000, of which the federal government is paying three fourths. It is estimated that approximately 130,000 rats have been destroyed during the past four months. Thirty-five thousand six hundred and forty-two rats were brought to the laboratory of the health department. Of this number, 11,391 were examined by bacteriologists for plague and 106 found to be infected. The total number of cases reported to date are 136; deaths 73; cured 60, remaining under treatment 3.

CONSUL-GENERAL RICHARD GUENTHER reports that a "Trade Hygienic Institute" is to be established in Frankfort, where all matters appertaining to the health and protection of German factory operatives and the working classes in general are to be studied and taught. He continues: "This institution will be the first of its kind and will have a highly important mission and a great field in which to work. Frankfort has been chosen on account of its being in close proximity to some of the great chemical factories, technical high schools and universities, and the many economic and social-scientific associations abounding in this city and vicinity. The 'Institute for Communal Advancement' in Frankfort, aided by contributions from prominent manufacturers, has raised 100,000 Marks ($23,800) as an endowment for this 'Trade Hygienic Institute.' All the data concerning experiments and experience of physicians and others employed or interested in the care for the working classes, also all reports emanating from official trade inspections, of labor associations, etc., is to be collected by this new institute, where they will be examined by experts and put to good use. Extensive laboratories fitted up with the best of modern appliances will be erected. This enterprise has its source in the belief held by its organization that a central point for this kind of science will greatly benefit the chemical and other industries, and especially the working classes connected therewith."

The College of Agriculture of Cornell University will have a convention of farmers between February 17 and 22. The object of this meeting is to give practical demonstrations of the aims, methods, and results of the work of the college. At the same time will be held the annual meetings of the New York Poultry Society and of the State Agricultural Experimenters' League.

The Bausch & Lomb Optical Company of Rochester, and the Bausch, Lomb, Saegmuller Company of that city, and the Carl Zeiss Optical Works of Jena, Germany, have united their interests, with the expressed purpose of carrying to the highest possible development the production of optical, physical and engineering instruments. The Zeiss works became under Professor Abbe a scientific institution, as well as a commercial firm. They now employ some thirty experts engaged in scientific research, and it will be fortunate if similar methods can be followed in this country.

The United States Geological Survey's annual report on the mineral resources of the United States for 1906 is now ready for distribution. The separate chapters of this volume have been published from time to time as the statistics for the various minerals became available, and these assembled chapters form a book of 1,300 pages, provided with a table of contents, an introduction and an index. The volume comprises 47 separate reports, prepared by 27 authors, covering entirely the mineral production of the country, with descriptions and discussions of the deposits from which the minerals are obtained, reports of imports and exports and many comparisons of home and foreign production, statements of prices and prospects, and notes on the technology of many of the products. In its general features this volume is similar in form and scope to the preceding reports on mineral resources published by the Geological Survey, the series covering altogether a period of twenty-seven years. For twenty-five years of this period the work of gathering these statistics has been in charge of Dr. David T. Day, but the present volume has been prepared in part under the supervision of Mr. Edward W. Parker, who has been for many years Dr. Day's assistant and collaborator. Hereafter Dr. Day will give his attention chiefly to the compilation of reports on petroleum and natural gas, substances concerning which accurate information has been difficult to obtain, and Mr. Parker will have administrative charge of the work of collecting and compiling the various reports and statistics that are published in this annual volume. Since the survey began its work on the mineral statistics of the country the value of the mineral production has increased more than fivefold. From $364,928,298 in 1880 it has risen gradually, with some fluctuations, to $1,902,517,565 in 1906, a sum representing the value of the mineral products in their first marketable condition. The larger producing states contributed to this total in 1906 in the following order and approximate proportions: Pennsylvania, 30 per cent.; Ohio, 11 per cent.; Illinois, 6 per cent.; New York and West Virginia, 4 per cent. each; Montana, Colorado and Michigan, 3.5 per cent. each; Arizona and Missouri, 3 per cent. each; Alabama and California, 2.5 per cent. each. The value of the mineral output of each of these twelve states was more than $50,000,000, and their combined values amount to more than $1,488,000,000.

In his annual report the Secretary of Agriculture says in regard to the new building for the department: "The work on the new building for the department has progressed satisfactorily during the year, and it is hoped to occupy the new quarters within the next month or two. As pointed out in my last report, in considering the question of a building, the imperative need for suitable laboratories to carry on the important investigations of the various bureaus and fireproof space for the library was recognized as paramount. The greater part of the indoor work of the department is conducted in laboratories, hence the absolute necessity for structures that would be well lighted, well ventilated, fireproof, and otherwise well adapted for the purpose. To accomplish these several objects and at the same time to secure opportunities for continued enlargement, the building has been arranged so that extensions could be made in segments as the work required. When the act authorizing the building was passed we could not foresee the rapid growth, by congressional action, of the department. On February 3, 1903, when the work was authorized, there were in Washington 1,100 persons employed in the Department of Agriculture. At the present time there are over 2,100—almost double the number on the date when the appropriation was made. While the original appropriation was so expended as to secure the greatest possible amount of floor space, this floor space is now totally inadequate to care for the increase of almost 100 per cent. in the number of employees. Full arrangements have been worked out for the occupancy of the present segments and the relinquishment of the several buildings for which rent is now being paid. The work will be completed within the appropriation made by Congress."

PROFESSOR J. A. ALLEN makes the following note in a recent *Bulletin of the American Museum of Natural History* on the revision of the nomenclature code by the International Zoological Congress: "As time goes on, the importance of strict adherence to authoritative rules of nomenclature becomes more and more apparent. Hence the world-wide welcome accorded the work of the Nomenclature Commission of the International Zoological Congress, and the increasing cordiality with which its Code of Nomenclature is received. The time is doubtless now ripe for the acceptance on the part of zoologists at large of an International Arbitration Commission on Nomenclature which shall not only provide a code of official rules, but be willing to act as arbiter in difficult and complicated cases where experts may reach different conclusions. To most systematists questions of nomenclature are distasteful, and they would gladly accept the decisions of a properly authorized International Commission rather than fritter away valuable time in attempting to solve nomenclatural riddles. Success in this thankless line of work requires natural aptness for such investigations, coupled with long experience and interest in such work. Nine tenths, if not ninety-nine one hundredths, of those who have occasion to use the technical names of animals, have not the time, the inclination, nor the proper training to deal successfully with such problems. Yet their correct solution is of importance to all. The adoption of uniform rules of nomenclature is essential to stability in nomenclature, but if they contravene well-established principles that have become the basis of modern usage they are not likely to meet with general acceptance. Happily the fundamental rules of nomenclature are few, and for many years have been embodied in all modern codes of nomenclature. Matters of detail are of less importance than unanimity of agreement, which may be easily reached by compromise and the waiving here and there of personal preference on minor points."

UNIVERSITY AND EDUCATIONAL NEWS

FROM a source not yet announced, the Harvard Dental School has received promise of the funds necessary for the erection of a new building. The site which has been chosen is the lot at the corner of Longwood Avenue and Wigglesworth Street, Brookline, adjoining the property on which the buildings of the Medical School stand.

A NEW agricultural building is to be erected for the University of Maine, at a cost of about $35,000.

PRESIDENT EDMUND J. JAMES, of the University of Illinois, has issued a call for a national conference to meet at Urbana, Ill., on February 4 and 5, to discuss the relations of graduate schools of American universities to the preparation of teachers for high schools, colleges and universities.

The National Society for the Promotion of Industrial Education will hold a meeting in Chicago on January 23, 24 and 25. A full program has been arranged. Among the subjects that will be discussed are the apprenticeship system, the trade school, the wage-earners benefit from industrial education, and the ideal of a public school system that aims to benefit all. Among the speakers are Dr. Pritchett, of the Carnegie Foundation, president of the society; President Eliot, of Harvard University, and President Wheeler, of the University of California.

The fourth annual report of the education department of New York State has been transmitted to the legislature. The amount expended for the common schools for the year was $47,077,720, an increase of $1,694,168. There were employed in the public elementary schools during the year 37,280 teachers—3,292 men and 33,988 women. The average annual salary paid was $756.10, an increase of $10.61.

The New York Evening *Post* states that plans for beautifying the surroundings of the Harvard Medical School have been accepted by the Medical School and the Street Department of Boston. Starting from a terminal point in the Fenway near a small lagoon, the new avenue in honor of Louis Pasteur will lead up to the middle of the Medical School quadrangle. This avenue will run through the center of a parkway 120 feet wide. An entrance will be constructed at the junction of the parkway with the quadrangle of the school. The new laboratory on Longwood Avenue, near the Medical School—being built by the Carnegie Institution of Washington for the study of nutrition—will be completed on February 1.

The Baltimore Association for the Promotion of the University Education of Women offers a fellowship of $500 for the year 1908–1909 available for study at an American or European university. Applications must be in the hands of the chairman of the committee, Dr. Mary Sherwood, The Arundel, Baltimore, before March 20.

Mr. E. M. Griffith, the state forester of Wisconsin, will give a course of sixteen lectures on forestry to the students of the University of Wisconsin during the second semester. The lectures are intended for those who expect to manage timber lands or take up forestry as their profession; for students in the agricultural college, to afford information in regard to the management of wood lots; and for students in the college of engineering who are interested in soil reclamation and the protection of stream flow and water powers. The subjects included in the course are the effects of deforestation, conservative lumbering, artificial and natural reforestation, the reservoir system on the headwaters of the Wisconsin, the forest fire problem, taxation of timber lands, forestry for farmers, and forestry legislation.

At a recent meeting of the board of trustees of the Iowa State College Mr. C. A. Scott, of the United States Forest Service, was elected to the chair of forestry, to fill the vacancy caused by the resignation of Professor H. P. Baker, who accepted a position at the Pennsylvania State College. Mr. Scott is a graduate of the Kansas State Agricultural College and a student of the Yale College of Forestry. Mr. Scott has been continuously in the employment of the Forest Service since graduation and during this period of seven years has gradually advanced through all stages of the work from that of student assistant to forest supervisor, which position he resigned to accept the chair of forestry at the Iowa State College.

The corporation of Harvard University has appointed Herbert Leslie Burrell, now professor of clinical surgery, John Homans professor of surgery.

Dr. George T. Jackson has been appointed professor of dermatology in Columbia University to succeed Dr. George H. Fox, who has resigned.

Correction: In the report of the general secretary of the American Association for the Advancement of Science there is an error on page 43. Sections A and D joined with the Chicago section of the American Mathematical Society in the discussion of the teaching of mathematics to engineers, not A and B, as appears in the report.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JANUARY 31, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION A—MATHEMATICS AND ASTRONOMY

THE joint sessions of Sections A and D and the Chicago Section of the American Mathematical Society constituted a most inspiring and far-reaching feature of the meetings of this section. A separate report of these sessions will appear in SCIENCE. The address of the retiring vice-president, Professor Edward Kasner, of Columbia University, was read before a joint meeting of this section and the Chicago Section of the American Mathematical Society. It was entitled "Geometry and Mechanics," and will appear in a later number of SCIENCE. The following twenty-seven papers were read at the separate meetings of Section A.

1. *Observations with the Bruce Spectrograph:* EDWIN B. FROST.
2. *Comments on the Zeiss Stereocomparator and the Spectrocomparator belonging to Yerkes Observatory:* EDWIN B. FROST.
3. *Photographic Phenomena of Comet d 1907 (Daniel):* E. E. BARNARD.
4. *On a Great Bed of Nebulosity in Sagittarius, photographed with the Bruce Telescope of the Yerkes Observatory:* E. E. BARNARD.
5. *Note on the Problem of Three Bodies:* E. O. LOVETT.
6. *The Light Curve of Delta Cephei:* JOEL STEBBINS.
7. *An Application of the Selenium Cell to Astronomical Photometry:* JOEL STEBBINS and F. C. BROWN.
8. *Observations and Explanation of the Phenomena seen at the Disappearances of the Rings of Saturn:* E. E. BARNARD.
9. *On the Twenty-foot Horizontal Solar Spectro-*

graph of the Yerkes Observatory: Edwin B. Frost and Philip Fox.

10. *A Graphic Method for the Determination of the Orbit of a Spectroscopic Binary:* Kurt Laves.
11. *New Tables for the Time of Sight Correction of the Earth's Orbital Motion:* Kurt Laves.
12. *A Generalized Theory of Integral Equations:* W. D. Cairns.
13. *On the Theory of Order, Static and Nascent:* G. B. Halsted.
14. *Singular Points in the Approximate Development of the Perturbative Function:* F. W. Reed.
15. *On a Certain Class of Algebraic Translation-surfaces:* John Eisland.
16. *Matrices not belonging to Groups:* Arthur Ranum.
17. *A Note on Interest on Reserve from Items Computed for the Uniform Report Blank:* C. H. Beckett.
18. *On Asymptotic Isothermic Surfaces:* A. E. Young.
19. *Some Questionable Terms and Definitions used in Elementary Mathematics:* G. A. Miller.
20. *The Photographic Determination of Star-colors and their Relation to Spectral Type:* J. A. Parkhurst and F. C. Jordan.
21. *On the Detection of the Eruptive Prominences on the Solar Disk:* Philip Fox.
22. *An Investigation of the 40-inch Objective at the Yerkes Observatory:* Philip Fox.
23. *The Function of a Color Filter and of Certain Plates in Astronomical Photography:* R. J. Wallace.
24. *The Vertical Cœlostat or "Tower" Telescope of the Mt. Wilson Solar Observatory:* G. E. Hale.
25. *Preliminary Results of a Comparative Study of the Spectra of the Limb and the Center of the Sun:* G. E. Hale and W. S. Adams.
26. *A Simple Method for Reducing Spectrograms:* Frank Schlesinger.
27. *On the Probability of the Near Approach of Two Stars and on Relative Problems in the Sidereal Universe:* F. R. Moulton.

In the absence of their respective authors the papers of Doctors Cairns, Halsted, Lovett and Ranum were read by title, and the paper by Professor Schlesinger was read by Mr. Fox. All the other papers in the above list were read by their authors, and the abstracts which follow bear numbers corresponding to those of the titles in this list.

1. These observations refer to recent work at the Yerkes Observatory on stars having interesting spectra and include some new spectroscopic binaries.

2. In this second paper by Professor Frost he described the satisfactory experience with the instruments mentioned in the title. Although they have been in use for only a few months, their merits appear fully established.

3. This comet became a large one, visible to the naked eye in July and August. With the eye alone, the maximum length of the tail was about 17°, but the photographs showed that it really attained a length of some 25°.

The comet was photographed on every possible occasion with the Bruce photographic telescope of the Yerkes Observatory. Though these pictures showed very rapid changes in the form and general structure of the tail, they did not reveal any new phenomena.

The most interesting feature was a large mass of cometary matter that was thrown off from the head about July 11. Photographs made of the comet by M. Quenessett in France, by the writer at the Yerkes Observatory and by Mr. Duncan at the Lick Observatory on that date showed that this mass, though it was left behind by the comet, partook of its sunward motion, for it drifted slowly towards the sun throughout the period covered by the photographs. Professor Barnard exhibited a number of lantern slides which showed the changes in the tail.

4. In his second paper Professor Barnard gives new nebulous stars and nebulosities shown on photographs made by him in the pure atmosphere of Mt. Wilson in the summer of 1905. He also showed that nebulæ M 17, M 16 and M 8 have wide extensions of feeble nebulosity that greatly

increase their previously known sizes, and he located and described nebulous regions situated in the constellation Sagittarius.

5. In this paper Professor Lovett constructs a problem of three bodies possessing exact transcendental solutions defined by finite equations; these solutions reduce to the Lagrangian solutions of the classic problem of three bodies when the ideal problem assumes the Newtonian form. The paper is a part of an extended memoir which is not ready yet for publication.

6. Professor Stebbins gives the results of a long series of photometric observations of the well-known variable star Delta Cephei. The measures were made with a polarizing photometer attached to a twelve-inch refractor. On each night 96 comparisons of the variable and companion star were taken, the entire series comprising more than 7,000 settings. The observations were combined by the method of overlapping means, and the resulting light curve shows two secondary fluctuations in addition to the main variation in brightness. No complete determination of the variation in radial velocity has been made for this star, and new measures with a modern spectrograph would throw some light upon the conditions that exist in this interesting system.

7. The authors connected a selenium cell as one arm of the ordinary Wheatstone bridge, and an exposure of the cell to light decreased its resistance and caused a deflection of the galvanometer. One observer would point the cell at the moon and make an exposure of ten seconds, while the other observer, situated in a separate room with the remainder of the apparatus, would read the galvanometer. From a series of additional exposures on a standard candle at different distances, the moon's light was determined in terms of candle power at 1 meter. A curve of the variation of moonlight with phase was shown, and from this was derived that the full moon is approximately nine times as bright as the half moon. It was also found that the moon is brighter between first quarter and full than in the corresponding phase after full moon.

Different cells gave discordant values for the candle power of the moon, and it was shown that this must be due to the different color sensibilities of the cells. The relative sensibility for different wavelengths was determined for each cell, and it was found that no two of the cells had the same color curve. In all cases there is a maximum at about λ 7,000, but the two Giltay cells have each another maximum near λ 6,000. It was therefore concluded that selenium cells differ much as do photographic plates as regards color sensibility.

For measures of starlight a special small cell was obtained from Giltay, and by placing this cell in the focus of a 12-inch refractor, it was possible to obtain galvanometer deflections caused by the light from bright stars. Some results of the first night were given, the scale being 5 meters from the galvanometer, and the deflections as follows:

Star	Magnitude	Deflection
Mars		9.0 m.m.
α Tauri	1.0	3.4
α Arietis	2.1	1.3
β Arietis	2.8	0.8
γ Arietis	4.0	visible

These measures were made with a galvanometer which is not very sensitive, and it is hoped that the accuracy of the observations will be considerably increased when a new and more sensitive galvanometer is obtained. If it becomes possible to eliminate the effect of several disturbing factors, especially that of temperature change, there is no doubt that accurate measures of starlight can be made with selenium cells.

8. In July, October and November when there was no direct sunlight shining on the ring the entire ring was distinctly visible with the 40-inch telescope of the Yerkes Observatory.

On July 2 there were two luminous conspicuous masses or condensations visible on the ansæ, both preceding and following. As the visible surface of the ring and the condensations were on the shadow side of the ring where no direct sunlight could fall, the natural conclusion would be that the rings must be self-luminous. But this, from the nature of the constitution of the rings, is shown to be impossible.

The explanation given for this phenomenon is that the sunlight sifts through among the particles composing the rings, and by diffusion, or scattering and reflection, the dark side becomes luminous. Micrometer measures show that the condensations fall on the bright outer portion of the inner bright ring and on its projection near the planet. It is believed that the greater density of this part of the ring makes it more luminous when seen from underneath—just as it appears when the direct sunlight falls on it. In reality what we have seen, therefore, is the surface of the ring seen at a very oblique angle, where it is less than 1″ of arc in width, illuminated by the sunlight percolating through the rings, similar to the sunlit view that we get of the rings, but far more feebly illuminated. That these bright places are not real elevations above the surface of the ring is shown by the fact that they disappeared when the edge of the ring was toward us, at which time they should have been better seen if they were masses on the ring. The eye was simply deceived by their greater brightness, which gave them the appearance of being masses on the ring.

9. Professor Frost gave a description of a solar spectrograph recently mounted in the Snow building of the Yerkes Observatory and explained some preliminary results obtained by means of this instrument.

10. The new method here presented by Professor Laves rests on the geometric properties of the hodographic circle. It shows that from the observed maximum and minimum velocities we can determine K and $Ke \cos \omega$ where K is the radius of the hodographic circle, e the eccentricity of the orbit and ω the longitude of the periastron. By Schwarzschild's proceeding the time of periastron-passage is determined from the course of velocities. The velocity at periastron derived from the same curve furnishes two points in the hodograph of which the one of the two is the periastron. The diameter through this point cuts the chord of central distance $Ke \cos \omega$ in the focus. The values of e and ω are read off by a finely graduated scale.

11. Professor Schlesinger's tables for b and c are based on a previous transformation of the equatorial coordinates α, δ of a star into λ, β, its ecliptical coordinates. The present tables do away with this transformation and furnish at once the right ascension A and declination D of the apex of the earth's motion. The correction x is brought upon the following form:

$$x = V\{\sin\delta \sin D + \cos\delta \cos D \cos(\alpha - A)\}.$$

The quantities $V \sin D$, $V \cos D$ and A are tabulated for every other degree of the circumference. Tables of difference for 1′ change in each one of these tabulated quantities are added to facilitate the calculation. This paper will be published in the *Astrophysical Journal.*

12. The paper by Professor Cairns is devoted to a generalization of the Hilbert theory of a quadratic form in an infinite number of variables. It embodies the results reached in work carried out as part of the requirement for the degree of doctor of philosophy at Göttingen. The investigation arose in seeking to adapt the method

of integral equations to the isoperimetric problem of the calculus of variation.

13. Professor Halsted considered the essence of inherent order, its foundation, genesis, and the uses of inherently ordered series in the attribution of factitious order to primarily unordered assemblages. He also investigated the betweenness relation, both linear and of more than one dimension.

14. The method of approximation developed by Poincaré for obtaining the terms of higher order of the perturbative function depends uniquely upon certain singularities of this function. With suitable numerical assumptions the case of small eccentricities and a small inclination of the orbits is carried out in detail by Dr. Reed, and the results to be found by varying the elements are indicated.

15. The paper by Professor Eisland contains a treatment of all the types of translation-surfaces which are determined by a unicursal quartic in the plane at infinity. The most important result is: To a unicursal quartic with three real double points correspond triply infinite types of translation-surfaces of a particular form. This paper is a continuation of one recently published in the *American Journal of Mathematics* by the same author under the title "On a Certain Class of Algebraic Translation-surfaces." It will appear in the same journal.

16. Dr. Ranum proved the following theorems: If S is a singular matrix not belonging to any group, then if the number of zero roots of its characteristic equation is s, there always exists a positive integer m which does not exceed s, such that S^m belongs to some group. If m is the lowest integer having this property then among the invariant factors of the characteristic determinant of S corresponding to zero roots there is at least one of order m and none of higher order.

17. There is a discrepency between the mathematical theory involved in the fundamental calculations of life, insurance contingencies and the policy contract itself which leaves some latitude and consequent confusion. The object of Professor Beckett's paper was to set forth this discrepancy and to find a solution that can be checked from the other items required to be computed and exhibited in the report of a company.

18. Surfaces characterized by having isothermal asymptotic lines and isothermal lines of curvature Dr. Young has called asymptotic-isothermic. In the present paper he considers special classes of such surfaces and thereby completes along certain lines a paper which he read before the Chicago Section of the American Mathematical Society several months earlier.

19. The term division has two distinct meanings in elementary mathematics. According to one of these it implies the operation of finding an integral quotient and an integral remainder, while according to the other it implies the finding of a number which, multiplied into the divisor, produces the dividend. While only the latter is the inverse of multiplication, yet it is customary to speak of division as an inverse operation without specifying which of the two commonly accepted definitions of the term is meant. A very common definition of multiplication is the performing upon the multiplicand the same operation as that which is performed upon unity to get the multiplier. The vagueness of this definition follows directly from the fact that 4 may be obtained by doubling unity and squaring the result, yet multiplying by 4 does not generally mean doubling the multiplicand and squaring the result. Such vague definitions are contrary to the very essence of mathematics and hence should be avoided.

Especial stress was laid by Professor

Miller upon the fact that dividing by 0 should be banished from elementary mathematics. The so-called indeterminate forms are really meaningless forms and it is questionable whether one should speak of evaluating such a form. As $uv=0$ has not always for its locus the combined loci of $u=0$ and $v=0$ the rule relating to this case should be stated with the necessary restrictions. The fact that the last letters of the alphabet are used both for variables and for unknowns in elementary algebra has led some authors to speak of these two very distinct concepts as if they were identical. This is the more unfortunate since the concept of a variable is continually playing a more fundamental rôle in elementary algebra. This paper will appear in *School Science and Mathematics.*

20. Photographic and visual magnitudes are determined in immediate succession with the 24-inch reflecting telescope; the photographic on ordinary plates, the visual on orthochromatic plates used with a suitable color-filter. The spectral types are obtained with an objective prism used on a 6-inch Zeiss doublet. The difference between the photographic and visual magnitudes, zero for white stars, increases progressively with the intensity of color and with the change in spectral type, giving a measure of color.

The distinctive features of the present work are: (1) The substitution of measures for eye-estimates of star-color, (2) the comparison of measured colors with spectral types.

Star colors ranging from $\frac{1}{2}$ to 5 or more magnitudes are found for types F to N in the Harvard classification. It is proposed to use these color-values as an improved method of stating star-colors. The paper will appear in the *Astrophysical Journal.*

21. In this paper Mr. Fox presents the evidences proving the identity of certain features seen on the calcium spectroheliograms and the eruptive prominences.

22. The objective was tested for zonal and astigmatic errors by Hartmann's method. The astigmatic errors are negligibly small. Hartmann has introduced a criterion for comparing various objectives, which is the mean diameter of the star image from the various investigated zones of the objective upon the mean focal plane expressed in 1/100,000 of the focal length. Data were given for the 40-inch objective of Yerkes Observatory and diagrams were exhibited. This paper will appear in the *Astrophysical Journal.*

23. Mr. Wallace considered the following points: Importance of the method to astronomers in general. Factors governing successful photographic results and the rôle of personality. The requirements and adjustment of filter and plate to the visual refracting telescope, illustrated by color curves of filters, plates and objective, and their combined effect upon the images obtained. Halation, and its influence upon the recording of faint or delicate details.

24. The paper describes a vertical cœlostat telescope recently erected on Mount Wilson. A 12-inch objective, mounted at the summit of a steel tower 65 feet in height, receives the sun's rays from a cœlostat and second mirror and forms an image in a house at the base of the tower. Professor Hale stated that the principal advantages of this instrument, as compared with the Snow telescope, are the better definition of the solar image and the much smaller change of focus during a given exposure of the mirrors to the sun. Photographs of the spectra of sun-spots made in the fourth order of a Littrow spectrograph of 30 feet focal length, mounted in a pit, excavated in the earth underneath the tower, were projected on the screen.

25. Solar spectra, corresponding to

points at the center and near the limb of the sun's disk, were photographed side by side on the same plate with a Littrow or auto-collimating spectrograph of 18 feet focal length, used in conjunction with the Snow telescope of the Mount Wilson Solar Observatory. The third or fourth orders of a 4-inch plane grating, having 14,438 lines to the inch, were employed. For the measurement of line displacements, spectra were photographed at points near the limb lying at opposite ends of a solar diameter, thus permitting the rotational shifts to be eliminated. Some of the more recent work has been done with a Littrow spectrograph of 30 feet focal length, used with the new vertical cœlostat or "tower" telescope of the Solar Observatory. This instrument is of the same focal length as the Snow telescope (60 feet), and thus the diameter of the solar image is about 6.7 inches in each case. The 4-inch grating, when used with the 30-foot spectrograph, gives a scale of 1 mm. = 0.58 Ångströms in the third order and 1 mm. = 0.44 Ångströms in the fourth order. As the Fraunhofer lines are fairly sharp on the photographs, this great scale permits a high degree of precision to be attained in their measurement. Up to the present time, most of the work has been done in the region λ 3,800 — λ 5,800. It is therefore quite possible that the preliminary results given in this paper may not apply below *D* or in the ultra-violet. These results may be summarized as follows:

1. Most of the lines shown by our photographs of spot spectra to be strengthened or weakened in sun-spots, are similarly affected near the limb.

2. Many lines not affected in spots are strengthened or weakened near the limb.

3. Lines due to substances of high atomic weight are, in general, greatly weakened near the limb.

4. Winged lines undergo marked change in appearance, the wings being greatly reduced near the limb.

5. Among the lines considerably strengthened near the limb the most important are due to elements of comparatively low atomic weight. These include the *D* lines of sodium, the *b* lines of magnesium and the blue calcium line at λ 4,227.

6. Most of the lines in the spectrum are slightly widened near the limb.

7. Most of the lines are shifted toward the red, as compared with their position at the center of the sun.

8. These displacements are not due to ascending currents at the center of the sun (which would produce negative displacements of the lines in the solar comparison spectrum), since they have also been measured with the aid of an arc comparison spectrum.

9. The magnitude of the shift varies for different lines of the same element.

10. The strengthened lines, as a rule, seem to show smaller shifts than do the other lines.

11. The spark lines of a given element, as a rule, show larger shifts than do the other lines.

12. In many cases the relative displacements of the lines agree fairly well with those obtained by Humphreys in his laboratory experiments on the effect of pressure on wave-length.

13. The lines of the cyanogen flutings (λ 3,883.5 and λ 4,216.14) are not shifted from their normal positions.

14. The shifts of groups of titanium lines near λ 3,900, λ 4,500 and λ 5,300, and of groups of iron lines near λ 3,800, λ 4,400, λ 4,900 and λ 5,500, show progressive increase toward the red, and seem to indicate that the average pressure shift, for similar lines, is a function of the wave-length.

15. Photographs taken at intermediate points between center and limb indicate that the shifts fall off rapidly, and become very small at a short distance from the limb.

26. In order to obtain radial velocities from star lines that are not present in the comparison spectrum it is customary to use an interpolation formula to express the exact relation between wave-lengths and micrometer readings. These formulæ do not change much from plate to plate if the latter are all taken with the same spectrograph, and whatever differences there may be can be *largely* allowed for by adding to the micrometer readings (R) a linear expression: $a + b \cdot R$. Assuming that this is rigorously the case for short distances on the plate, it is shown that the error of this assumption can amount to a few hundredths of a kilometer per second in the case of plates taken with the Mellon Spectrograph of the Allegheny Observatory. Consequently it is only necessary to interpolate the place of a star line linearly between two comparison lines in order to obtain its displacement. This method has been tried on many plates at the Allegheny Observatory and has been found very convenient. The complete reduction of a plate in this way occupies about ten minutes.

27. The problem of Professor Moulton's paper is to find the possible rôle that the near approaches of the stars to one another may have played in sidereal evolution. The answer to this problem depends upon the extent of the sidereal universe, the number of stars in it, and the character of their motion. The discussion leads to the conclusion that the relatively near approaches of the stars have probably been an important factor in stellar evolution. The paper will be published by the Carnegie Institution.

The general committee elected Professor C. J. Keyser, Columbia University, vice-president and chairman of the Section, and Professor G. A. Miller, University of Illinois, secretary. The Section elected Professor G. B. Halsted, councilor; Professor F. R. Moulton, member of the general committee; Professors E. W. Brown and F. R. Moulton, members of the sectional committee—the former for five years and the latter for four years.

G. A. Miller,
Secretary

University of Illinois

THE AMERICAN MATHEMATICAL SOCIETY

The fourteenth annual meeting of the American Mathematical Society was held at Columbia University on Friday and Saturday, December 27–28, 1907, extending through two sessions on Friday and a session on Saturday morning. The attendance included fifty-three members. President H. S. White occupied the chair, being relieved by Vice-president P. F. Smith at the afternoon session. The following were elected to membership in the society: Mr. Charles Ammerman, McKinley High School, St. Louis, Mo.; Dr. C. S. Atchison, Williams College; Mr. B. H. Camp, Wesleyan University; Professor W. M. Carruth, Hamilton College; Mr. G. R. Clements, Williams College; Professor Julia T. Colpitts, Iowa State College; Professor J. N. Ivey, Tulane University; Professor W. H. Jackson, Haverford College; Mr. W. C. Krathwohl, Columbia University; Professor Murray Macneill, Dalhousie University; Mr. C. N. Moore, Harvard University; Professor Maria M. Roberts, Iowa State College; Mr. E. W. Sheldon, Yale University. Seven applications for membership were received.

In response to the invitation of Professor E. J. Townsend, it was decided to hold the next summer meeting of the society at the University of Illinois. The date will probably be the second week of September. The data of the next annual meeting was fixed as December 29–30.

The membership of the society increased during the past year from 554 to 582, including at present 52 life members. The number of papers presented at all meetings, including those of the Chicago, San Francisco and Southwestern sections, was 166, and the total attendance of members was 396. The treasurer's report shows the gross income for 1907 to be $5,401.28, expenditures, $4,515.26; balance on hand at end of the year, $6,081.82, including $2,-969.40 life membership fund. Sales of the society's publications amounted to $1,534.

Several important changes have occurred during the year in the administrative and editorial offices. Dr. W. S. Dennett retired in February from the treasurer's office, which he had held since 1899, and was succeeded by Professor J. H. Tanner, Professor E. H. Moore, who had served as editor-in-chief of the *Transactions* since its foundation in 1899, has retired, and is succeeded by Professor Maxime Bôcher. At the close of the year Professor Alexander Ziwet retired from the Committee of Publication, of which he had been a most valued member since 1893. The vacancy in the committee was filled by the election of Professor Virgil Snyder.

At the annual election, which closed on Saturday morning, the following officers and other members of the council were chosen:

Vice-presidents—James Harkness, G. A. Miller.

Secretary—F. N. Cole.

Treasurer—J. H. Tanner.

Librarian—D. E. Smith.

Committee of Publication—F. N. Cole, D. E. Smith, Virgil Snyder.

Members of the Council (to serve until December, 1910)—R. E. Allardice, Max Mason, G. D. Olds, M. B. Porter.

The following papers were read at this meeting:

F. L. GRIFFIN: "Certain families of central orbits with a constant apsidal angle."

F. L. GRIFFIN: "On the non-existence of certain types of periodic solutions in the problem of three bodies."

E. O. LOVETT: "On a problem in mechanics, Note II."

E. O. LOVETT: "On a class of periodic solutions in the problem of four bodies."

OSWALD VEBLEN and J. W. YOUNG: "A set of assumptions for projective geometry."

FRANK MORLEY: "The transformation of a Clifford configuration into itself."

R. G. D. RICHARDSON: "Lebesgue improper integrals."

E. W. BROWN: "The motion of the moon relative to a moving plane of reference."

E. W. BROWN: "The development of the infinite determinant."

ARTHUR RANUM: "Groups of singular matrices."

I. G. HARDY: "Curves in a space of n dimensions."

A. B. COBLE: "A reduction of the problem of solving a quintic to Klein's 'problem of the A's' by means of invariant theory."

L. I. HEWES: "The necessary and sufficient condition that an ordinary differential equation shall admit a conformal group."

J. I. HUTCHINSON: "Hermitian forms with zero determinant."

E. B. WILSON: "On the uniform rotation of a homogeneous chain about a vertical axis."

E. B. WILSON: "On the theory of double products and strains in hyperspace."

MAX MASON: "Note on implicit functions."

H. E. HAWKES: "On the equivalence of families of bilinear forms."

G. A. BLISS: "An existence theorem for a partial differential equation of the first order which is non-analytic."

The meeting of the Chicago Section of the society at Chicago, December 30–31, 1907, and January 1, 1908, was especially marked by joint sessions with Sections A and D of the American Association for the Advancement of Science, at which the teaching of mathematics to students of engineering was made the subject of an elaborate discussion participated in by mathematicians and engineers.

The next meeting of the society will be held at Columbia University on Saturday, February 29. The San Francisco Section will meet at Stanford University on the same day.

F. N. Cole,
Secretary

THE AMERICAN PHYSIOLOGICAL SOCIETY

The twentieth annual meeting of the society was held at the University of Chicago, December 31 to January 2, 1907–8. It included joint sessions with the American Society of Biological Chemists and Section K of the American Association for the Advancement of Science. The following scientific papers were presented:

W. H. Howell and W. W. Duke: "Further Communication on the Effect of Vagus Inhibition on the Output of Potassium from the Heart."

O. Folin: "Protein Metabolism in Fasting."

J. J. R. Macleod: "Experimental Glycosuria."

L. B. Mendel: "Further Observations on the Parenteral Utilization of Carbohydrates."

H. D. Haskins: "Preliminary Report of Certain Investigations as to the Nature of Peptones."

A. P. Mathews: "The Spontaneous Oxidation of some Cell Constituents."

Waldemar Koch: "On the Chemical Study of Mental Disorders."

L. B. Stookey and V. Gardner: "Concerning the Pharmacological Action of Potassium Iodide."

H. Gideon Wells: "The Chemistry of Hypernephromas."

J. R. Greer (by invitation): "On the Composition of Normal Lymph from the Neck Lymphatics of the Horse."

Emil Östeberg and Charles G. L. Wolf: "Protein Metabolism in the Dog. The Metabolism with Low Caloric Values of Protein."

J. G. Ryan (by invitation): "The Presence of Glucose in Saliva."

S. J. Meltzer and J. Auer: "The Antagonistic Action of Calcium upon the Inhibitory Effect of Magnesium" (with demonstration).

C. F. Hodge and O. P. Dellinger: "A Comparative Study of the Cilium as a Key to the Structure of Contractile Protoplasm."

C. F. Hodge, D. Gibbs and O. P. Dellinger: "Daily Life of *Amœba proteus*."

J. F. McClendon (by invitation): (1) "The Reaction of *Amœba* to Stimuli of Small Area." (2) "The Effects of Prolonged Centrifugal Force on *Paramœcium*."

R. M. Yerkes: "The Relation of Plasticity to Age in the Dancing Mouse."

B. Brande (by invitation): "The Bacterioagglutinating Action of Lymph under Different Conditions of Lymph Formation."

T. Hughes (by invitation): "The Relative Hemolytic Action of Serum and Lymph under Different Conditions of Lymph Formation."

S. J. Meltzer and D. R. Joseph: "The Effect of Stimulation of the Vagi upon the Onset and Development of Rigor Mortis of the Mammalian Heart."

A. B. Luckhardt (by invitation): "The Osmotic Concentration of the Blood during Anesthesia."

W. T. Porter, W. I. Clark and F. H. Pratt: (1) "On Differences between the Bulbar and Spinal Vasomotor Cells." (2) "The Reactions of Peripheral Vasomotor Areas."

W. T. Porter, R. Richardson and H. K. Marks: (1) "A Comparative Study of Vasomotor Reflexes." (2) "Vasomotor Reflexes after Excessive Hemorrhage."

C. C. Guthrie: "Survival of Tissues and Organs under Perfusion."

A. J. Carlson and W. J. Meek: "On the Mechanism of the Embryonic Heart Rhythm."

S. Hatai: "Comparison of the Nervous System in the Normal Albino Rat with the Nervous System in those Experimentally Stunted."

I. H. Hyde: "A Study of the Respiratory and Cardiac Activities and Blood Pressure in the Skate, following Intravenous Injections of Salt Solutions."

J. Erlanger, J. R. Blackman and E. K. Cullen: "Further Studies on the Physiology of Heart Block in Mammals. Chronic Auriculoventricular Heart Block in the Dog."

G. W. Crile (by invitation): "Observations on the Effect of Excessive Transfusion of Blood."

C. Sihler (by invitation): "The Disputed Points in the Histology of the Submaxillary Gland and their Physiological Importance."

W. B. Cannon: "Some Observations on the Neuro-muscular Mechanism of the Alimentary Tract."

C. W. Edmunds and G. B. Roth: "The Relation of Curara to 'Nerve Ending' and 'Receptive Substance.'"

W. P. Lombard: "Evaporation of Water from the Skin and Air Passages of Men at Rest."

J. R. Murlin and J. H. Huberman: "Observations on the Influence of Carbohydrate on Protein Metabolism."

T. B. Osborne: "Pyrimidine Derivatives in Nucleic Acid."

C. L. Alsberg: "Concerning the Guajac Reaction."

P. B. Hawk: "On the Leucomains of Cod Liver Oil."

A. P. Mathews and R. H. Nicholl: "Ionic Potential and Toxicity."

T. B. Aldrich: "A Preliminary Contribution to the Chemistry of the Infundibular Portion of the Pituitary Gland."

A. J. Carlson, J. R. Greer and F. C. Becht: "Some Points in Lymph Formation."

F. C. Becht (by invitation): "On the Nature of the Heat Paralysis in Nervous Tissues."

F. H. Pike (by invitation): "Studies in the Resuscitation of the Central Nervous System."

F. C. McLean (by invitation): "Further Studies on the Relation of the Oxygen Supply to the Composition of Saliva."

W. J. Meek (by invitation): "The Structure of the Heart Muscle of *Limulus*."

W. S. Hall: "Human Chyle as modified by Diet."

A. Woelfel (by invitation): "An Attempt to Determine the Mechanism of Protein Metabolism in Starvation."

F. S. Lee: "Pseudo-fatigue of the Spinal Cord."

C. D. Snyder (by invitation): "The Temperature Coefficient of Nervous Conduction as Determined on the Ischiadicus of the Frog."

Demonstrations and Exhibition of Physiological Apparatus

G. W. Crile (by invitation): "The Resuscitation of Animals killed by Anesthetics" (with demonstration).

A. J. Carlson, J. R. Greer and F. C. Becht: "The Relation of Organ Activity to Lymph Formation in the Salivary Glands" (with demonstration).

J. Erlanger: "A New Criterion for the Determination of the Systolic blood Pressure with the Sphygmomanometer" (with demonstration).

W. Koch: "Demonstration of an Apparatus for the Extraction of Nerve Tissues."

E. P. Lyon: "Demonstration of a CO_2 apparatus."

W. T. Porter: "An Improved Kymograph."

W. P. Lombard: "Demonstration of a Model showing Effects of Lesions of Heart Valves and 'Compensation' on the Circulation."

W. P. Lombard: "A New Form of Electric Signal."

The following were elected to membership in the society:

Dr. William H. Schultz, University of Missouri, Columbia, Mo.

Dr. Carl J. Wiggers, University of Michigan, Ann Arbor, Mich.

Dr. Joseph L. Miller, Rush Medical College, University of Chicago, Chicago, Ill.

Dr. Albert Woelfel, Physiological Laboratory, University of Chicago, Chicago, Ill.

Dr. Oris P. Dellinger, Clark University, Worcester, Mass.

Dr. Edward B. Meigs, Harvard Medical School, 240 Longwood Ave., Boston, Mass.

Dr. Lawrence J. Henderson, Harvard Medical School, 240 Longwood Ave,, Boston, Mass.

Dr. C. Judson Herrick, University of Chicago, Chicago, Ill.

Dr. George W. Crile, 1021 Prospect Ave., Cleveland, Ohio.

Dr. Robert Banks Gibson, University of Missouri, Columbia, Mo.

Dr. Christian Sihler, 2700 Vestry Ave., Cleveland, Ohio.

Dr. Edgar D. Brown, University of Minnesota, Minneapolis, Minn.

Dr. Charles D. Snyder, 1408 Park Ave., Baltimore, Md.

Dr. Leo Loeb, Medical Department, University of Pennsylvania, Philadelphia, Pa.

Dr. Frank Henry Pike, Physiological Laboratory, University of Chicago, Chicago, Ill.

Dr. John B. Watson, University of Chicago, Chicago, Ill.

Dr. Hugh McGuigan, 4336 Laclede Ave., St. Louis, Mo.

The following distinguished physiologists were elected to honorary membership in the society:

Professor Eduard Pflüger, director of the Physiological Laboratory, Bonn, Germany.

Professor Carl v. Voit, director of the Physiological Institute, Munich, Germany.

Professor Olaf Hammarsten, Upsala, Sweden.

The society adopted the recommendations of the Committee on Protein Nomenclature of the American Physiological Society and the American Society of Biological Chemists and recommended its publication as a joint report. The complete report will be published later in Science.

Appropriate resolutions were passed respecting the late Professor W. O. Atwater, of Wesleyan University, and Professor G. P. Clark, of Syracuse University, both members of the society.

The following officers were elected for the ensuing year:

President—Professor W. H. Howell.

Secretary—Professor Reid Hunt.

Treasurer—Professor W. B. Cannon.

Additional members of the Council—Professors J. J. Abel and G. Lusk.

Forty-five members of the society were in attendance during the meeting.

Lafayette B. Mendel,
Secretary

Sheffield Scientific School,
Yale University,
New Haven, Conn.

WILLIAM SMITH CLARK: HIS PLACE AS A SCIENTIST AND HIS RELATION TO THE DEVELOPMENT OF SCIENTIFIC AGRICULTURE [1]

It is no ordinary occasion of rejoicing or of interest in the progress of technical education which brings us together here to-day, but rather is it an event full of significance and rich in the promise of benefits to that great industry which must ever be recognized as the foundation of all national prosperity. This event has a twofold significance, in that it marks one feature in the celebration of the fortieth anniversary of the foundation of this college; but more particularly that it celebrates the dedication of this dignified and well-equipped building, abundantly suggestive of lofty ideals, persistent endeavor and resolute purpose, to the service of scientific research and to the memory of one whose most cherished plans lay in the domain of botanical science; whose best influence was exerted in behalf of scientific agriculture when that science was yet in its infancy; whose best energies were directed toward laying—strong and sure—the foundations of an institution whose mission he believed it to be to become a leader in agricultural education. These ideals have been largely realized through the influence this college has exercised upon domestic agriculture and the progress of this important branch of industry in far-off oriental lands; and now, through the renewed vigor imparted to it in recent years by a wise policy of practical encouragement, and under the administration of your new president, it would seem as if the coming years were to be rich in the fruits of a widening and deepening influence upon the interests she holds in her keeping.

It is a matter of special gratification that I am privileged to witness the great progress this institution has made since its foundation in 1867, and more particularly the very rapid advances of the last two decades. As one who enjoyed the peculiar friendship which comes through close association in scientific work and the companionship of the teaching profession, it affords me a peculiar sense of satisfaction to be able to participate in the dedication of this building, designed as it is to stand as an exponent of the best scientific ideals, and as a memorial of one who not only exerted a strong influence upon his profession and upon those who were fortunate enough to come under his teaching, but for whom I have always entertained a high personal regard, and to whom I feel indebted for some of the best inspirations of my professional career.

The particular purpose of my presence here to-day is not so much to present you with a biographical sketch of President Clark, as to direct your attention to his relations to the development of botanical science in this country; to show what influ-

[1] An address delivered at the opening of Clark Hall, Massachusetts State College, October 2, 1907.

ences have been associated with his scientific work; and to indicate both the present position of and the future outlook for those special lines of research in which he always manifested a keen interest, and in which he would have taken an active part had circumstances permitted him to continue his useful life. But inasmuch as a clear insight into a man's scientific aptitudes, his capacity for research and his influence upon his chosen profession can be gained only through a knowledge of his temperament, mental attitude and early training, I may be pardoned for reference to some of those personal characteristics which distinguished him among his associates, and which were best revealed to those intimately connected with his scientific work and familiar with his thoughts and aspirations. Through the perspective afforded by time, it becomes possible to gain that just appreciation, and to establish that correct measure of his work, which are possible only when a man's efforts are divested of those less important but often numerous factors which tend to minimize and obscure.

President Clark used to relate with a certain element of justifiable pride, but never in a spirit of boastfulness, that as a boy he always made it a rule to run faster, jump farther and higher, fight harder and swim more strongly, than any of his companions. The determination to excel in whatever he undertook was one of the first of his traits to impress itself upon the stranger. Those who knew him intimately, readily appreciated this side of his character and understood that the dogged persistency with which he pursued any cherished plan, or sought to gain the ascendancy in competition, was an important factor in his career. It carried him through the civil war and the terrible days of the wilderness campaign; it placed this institution on a secure and enduring foundation, which, in spite of its apparent lack of progress for many years, and the periods of despondency which at times come to all healthy organisms, will make it abundantly able to sustain that splendid superstructure of usefulness which seems to lie before it. It carried him to the far-off east, where his memory is firmly enshrined in the hearts of the Japanese, who, to this day, hold his name in the highest esteem as that of one who conferred great benefits upon their country. Throughout his entire career, the force of his living example was of inestimable benefit to his students, and of far greater value than spoken words. These, when uttered, were generally few but full of virile force and significance, and certain to leave a lasting impression. On one occasion he wished to have a number of diagrams to illustrate his lectures on botany, and for this task he selected one of his graduate students to whom such work was entirely new. The unfortunate student was presented with a figure embodying much difficult detail, and was told to reproduce it upon an enlarged scale. Claims of inexperience in such work were not heeded, and the only response to the plea of inability was contained in the very curt command "Do it." Being thus driven to an extremity, and having his pride touched, the student did draw the diagram to the satisfaction of President Clark, and afterwards produced several hundreds of other figures for the same purpose. The phrase "Can not" was entirely unknown to President Clark, but his simple watchword "Do it" seemed to be the slogan guiding him to success in whatever he undertook, as it has since then served to inspire several generations of students in more than one land. An intense enthusiasm characterized his attitude toward everything which he regarded as worthy of his attention, and this spirit successfully bridged many a difficult situation which might have been full of impossibilities for one of a less sanguine temperament.

A keen judge of men, he always surrounded himself with those who could not only execute with ability, but who were able to appreciate and participate in his own enthusiastic efforts. Those who are familiar with the earlier years of this college will readily recall that they were conspicuous for the able men by whom he was supported, all of whom have made their mark in their chosen callings: Stockbridge, than whom none has made a deeper impression upon modern agriculture; Miller and Peabody, profound and careful students of the mathematical sciences; H. J. Clarke, whose name for a brief period shed luster upon this institution through his knowledge of the biological sciences; Goodell, cultured and versatile, and in his later years the able president, well beloved of all who knew him. These were the men who helped to make this institution what it is, whose record is written large in the great book of life, and whose memories will ever be an inspiration to future generations of students. But among this galaxy of able men there was one whose selection for so important a post in the new college was based in part upon student friendship at Göttingen, but more upon a keen appreciation of sterling worth; one whose ability as a scientist continues to shed luster, add renown and lend dignity to this institution; and it is a matter of special congratulation that he is yet with us to participate in this act of tribute to the memory of an old friend—Dr. C. A. Goessmann.

President Clark's professional career was begun in fields quite distinct from those which he cultivated in later years. Under the guidance of Professor Hitchcock, he acquired a great taste for geology, and this, together with a special aptitude for chemistry, led him to choose this branch of science in connection with mineralogy, in which he had gained distinction as a student. It was in pursuit of a further knowledge of these subjects that he went to Göttingen to seek instruction at the hands of eminent German specialists, at a time when it was just becoming fashionable for American students to complete their studies and professional training at German universities. This step was taken at one of the most critical periods in the development of American science, which was then in a state of transition from generalization to specialization. Owing to his keen perception and quick observation, as well as to his ready appreciation of anything which tended in the direction of progress, the experience gained during his residence abroad was of great service in after years. The one great lesson which this period of his life seems to emphasize is the important reciprocal relations of botany and chemistry, and the teachings of his later years always brought into prominence the idea that, for the professional botanist, a thorough groundwork of chemistry is not only essential, but that the more one specializes in botany the wider should be his knowledge of chemistry. At the present day, with our strong tendencies toward narrow specialization, we are in great danger of losing sight of this fundamental fact, and I would impress upon students and teachers the great importance of shaping courses of study in such ways as to secure and maintain a proper balance between these two subjects.

While yet a student at Amherst College, President Clark had followed the usual course in botany as then prescribed by the college curriculum, and although he was not particularly drawn to the subject at that time, he nevertheless pursued it with characteristic zeal and gained proficiency in the methods then in vogue. These were based upon the Linnæan school, which taught the doctrine of the fixity and special creation of species, and regarded purely morphological and taxonomic questions as the chief aim of the science. His keen perception and receptive mind nevertheless enabled him to see, while yet a student in Germany, a very different future for botanical science. This was first brought to his attention on the occasion of a visit in 1850, to the Royal Gardens at Kew, England, then under the able direction of Sir William J. Hooker. He there observed for the first time the enormous resources of plant life, and the extent to which plants are capable of contributing to man's welfare; he there saw in the Victoria regia and in many other rare and striking examples of exotic plants the great possibilities they presented for an extension of man's intellectual and esthetic interests; and in the vast amount of material gathered from all quarters of the globe he recognized the great opportunities for an extension of scientific knowledge along the most attractive and useful lines. He became profoundly impressed with the importance and the far-reaching character of the problems thus presented, and from that time on his thoughts were largely occupied with botanical questions. It was the experience gained at that time which had so marked an influence upon the early plans for the development of this college. This was eventually expressed, among other ways, in the formulation of plans for a botanic garden, unfortunately never realized; in the construction of the Durfee Plant House, and in the building of a botanical museum, both very modest but exceedingly useful efforts to follow the suggestions of the Kew Garden, from which institution the first skilled gardener was obtained. More than this, however, it permitted the formulation of plans upon a broad basis, and an intelligent and far-reaching conception of the true relations in which scientific knowledge must always stand toward scientific agricultural practise.

It is certainly true that an institution such as this must always be prepared to educate a certain number of men in the theory and practise of agriculture, but all modern experience tends to show with increasing force the subordination of such training to that which gives a man a special skill in some one or more of the sciences which may be applied to that industry. No more striking instance of the correctness of this point of view could be obtained than one which was brought to my notice recently, as contained in an address delivered to the West Indian students of McGill University by Sir Daniel Morris, commissioner of agriculture for the West Indies. Sir Daniel has supervision of the agricultural interests of the entire British West Indies, including Honduras, Guiana and other colonies within the continental area. His experience in the agricultural needs of that region has been both wide and prolonged, and the services he has rendered are such as to give his opinion special weight. In directing the attention of his hearers to the useful and lucrative careers which are open to properly-qualified men, and the great influence they may exert in the promotion of agriculture there, he placed special emphasis upon the statement that special knowledge of purely agricultural problems, gained elsewhere, would be useless. What is needed are men specially trained in those sciences such as chemistry, plant pathology, plant physiology and entomology, which may be applied directly to the solution of great problems relating to conditions of soil, diseases of plants, the general question of nutrition and the operation of destructive insects. Through such channels it would be possible for an expert to gain the confidence of the farmer and confer the most lasting benefits upon the agriculture of the region.

It was this point of view which gave to this college its real stability where others have shown so much weakness or have failed in their original purpose, and it is a continued recognition of this relation which will secure for the future the leading rôle which it should occupy and which I feel confident it will always maintain.

The experience of those early years was gained at the most interesting period in the history of botanical science. Darwin, adding the result of his own critical investigations to those of previous observers, had been able to sum up the work of one hundred years and present an intelligent conception of the reproductive processes in the higher plants, together with a knowledge of the relations which insects bear to such processes; both Darwin and Wallace were at that time engaged upon that memorable work which threw such a flood of light upon the origin of species, abolished the old conception of special creations and gave to the world one of its most powerful intellectual impulses; Lawes and Gilbert were deeply engrossed in attempts to solve the nitrogen problem and the broader question of plant nutrition in general; the modern microscope was then in its infancy; microtomes were as yet almost unknown; and the various critical methods of differential staining and other methods in technique which have contributed so much to the advancement of scientific research, were entirely foreign to the knowledge of the so-called microscopist. But among German botanists there was, nevertheless, a movement in progress to cast aside the fetters which for so long a time had bound the science to a purely morphological and taxonomic point of view, and to seek a wider, more attractive and more broadly useful field of investigation in the domain of anatomy and physiology. Many prejudices and preconceived notions had to be overcome, but this was successfully accomplished by Sachs, whose memorable work, published in 1874 and soon translated into English, opened up an entirely new vista and established what has since come to be known as the new school of botanical science. The dogmatism which had for so long a time characterized and dominated scientific thought and teaching rapidly gave way to speculation and freedom of thought, and the way was thus opened for the introduction of those reforms which have followed in such rapid succession during the last thirty years. Hypotheses which were regarded as all-sufficient in 1860 or 1875 have become greatly modified or even abandoned within the last ten years; physiology has assumed a new position and importance and is to-day directing the general course of investigations in whatever department of the subject of botany they may lie; pathology has attained to a position of dignity, attractiveness and importance which not only enlists the energy of the best-trained minds, but appeals with special force because of the great scientific and economic importance of the results which flow from it. The influences which were thus at work during the earlier period of President Clark's professional career were such as to produce a profound impression upon an observing mind, and even those of us who can recall the closing years of this transition period retain a very vivid impression of the powerful stimulus afforded by the alluring prospects presented by the new lines of research, and the opportunity for profitable discovery presented by the new methods.

The trend of thought and the spirit of investigation thus awakened appealed to President Clark with peculiar force and led him to place the new opportunities before his students with successful results, and he may be regarded as one of the first in America to adopt this advanced position. He thus set in motion at this college influences of the greatest importance to the progress of botanical science, which, centering here, later extended to far-away Japan, where such views had not then become known, to various parts of the United States and eventually to Canada. It is a matter of no small moment, and one upon which this institution may well be congratulated, that it was one of the pioneers in giving to the new world correct conceptions of the principles of the new school of botany, in accordance with which it has been possible to realize the great scientific and economic achievements of the last quarter of a century within the domain of that science.

President Clark's claim to scientific recognition rests not so much upon his actual achievements in research as upon his administrative capacity and the intelligent manner in which he stimulated and encouraged investigation on the part of others. As a matter of fact, his only exploit in original botanical work is recorded in the report entitled "The Phenomena of Plant Life." In this paper he undertook to present the results derived from a repetition of Hales's classic experiments, but with greatly improved apparatus of his own devising. This work extended over a period of three years and dealt with a variety of phenomena of great popular interest and much scientific importance. But the portion which claims our special attention is that relating to the movement of sap in trees. To this obscure problem which had claimed the attention of botanists, and had been the subject of more or less profound investigation for three hundred years, he contributed new facts of great value. Although the subject has, of late, received renewed attention, and the resources of greatly improved methods and apparatus have been utilized, the results obtained here in 1874–76 remain unchallenged. Indeed, they afford some of the most reliable data obtainable, and one of the best explanations of the phenomena within the limits of the ground covered. No discussion of the subject can be entered upon without reference to this important work. I desire to emphasize this fact, not only because it indicates the great scientific value of the problems which President Clark was prepared to enter upon, as well as his capacity for their solution, but it serves to make clear his connection with another movement of great significance and far-reaching importance. But before leaving this aspect of our subject, one other item must be added to the scientific work thus indicated, as represented by his successful efforts with respect to the introduction of new or little-known species of Japanese plants. The collections at this college afford abundant evidence of the zeal with which this work was carried out, and the success which attended his efforts.

In 1834 John Bennett Lawes, afterwards Sir John, established at Rothamsted, England, a special station for the investigation of problems relating to the nutrition of plants. This work was suggested by the celebrated investigations of De Saussure, and for a period of nine years it was carried on in a tentative way. But in 1843 it was entered upon on an enlarged scale with improved facilities; and through the cooperation of Dr., afterwards Sir, Henry J. Gilbert the work was carried out on the original lines until the death of the latter brought it under the management of a special trust devised by Sir John Lawes some time before his death. The subsequent establishment of a system of experiment stations throughout Germany, but under government control, gave this movement a powerful impulse which eventually brought it across the Atlantic to our own shores. The example thus set made a deep impression upon the receptive mind of President Clark, and it was one of his cherished plans that such a station should be established here. This hope has been realized, although the fulfilment was not accomplished until several years after his death; though it must be conceded that his scientific observations, together with those of Goessmann and Stockbridge, constituted the real commencement of the Hatch Experiment Station, and gave a powerful impulse to a movement which at that time was hardly more than a suggestion, but which has since resulted in the establishment of similar stations throughout the United States and Canada.

My first recollections of President Clark go back to that early period in the infancy of this college, when technical training in the principles and practise of agriculture was an untried problem; when the young institution was forced to grapple with all the uncertainties of a future which too often received the open and hostile criticism of many otherwise intelligent and progressive citizens. Many were the sore trials and bitter disappointments of those early years, but, fortunately, there was a man at the helm who never wavered in his firm conviction that the agriculture of the future must rest upon a sound basis of scientific knowledge, and who never swerved from what he regarded as a correct policy. To his task he brought not only firm convictions, but an enthusiasm and determination which enlisted the respect and hearty sympathy of all his colleagues, as well as of many influential friends; carried conviction to the wavering and brought success where failure might have been looked for. His critics have been wont to censure him for an enthusiasm which they believed to sometimes carry him beyond the limits of safety, and this may have been true in some instances. Enthusiasm is one of the first requisites of a successful teacher and investigator, and although due conservatism in its exercise is most desirable, an excess is no more to be condemned than undue caution. It was a favorite maxim of President Clark's that a man who never made a mistake was one to be carefully watched. The most successful of men are guilty of errors of judgment which find their justifiable excuse in the great value of their achievements. The over-cautious man who never blunders is thereby characterized by the possession of negative qualities which are rarely, if ever, capable of contributing materially to the general progress and welfare. Boldness of action and resolute decision, promptness of execution, tempered by a cool and accurate judgment, are the qualities which bring success and command the respectful consideration of our fellow men.

As one of those who were intimately associated with President Clark in his work in Japan, and who, from its very inception, was able to gain an intimate knowledge of his purposes, it is proper that I should make some reference to that portion of his career which had to do with a most progressive, intelligent and refined people of great intellectual power. His entire period of service under the Japanese government extended over less than one year, but during that time he laid the foundation of a most successful college of agriculture, which has since outgrown its original purpose and has enlarged its sphere of usefulness to that of a university, of which the college of agriculture remains one of its most important features. Several of the students who commenced their courses of study under the guidance of President Clark have since then studied in the United States, from whose leading universities they have taken higher degrees with distinction. One of these now presides with ability over the destinies of the new university at Sapporo; another is a distinguished professor of botany in the same institution; a third enjoys eminence as one of the most distinguished literary men of Japan, with a high repute as a scholar in foreign lands; while others have won distinction in various callings in their native land.

There is probably no part of President Clark's work which has left so enduring an impression and influence as his participation in the efforts of Japan to introduce the best in our western civilization. His success in this undertaking was based in part upon his appreciation of great public utilities, and in part upon his enthusiasm and ability as a teacher; and it was largely in consequence of the stimulus imparted by him that so many of the students of the Sapporo College sought and won distinction in the domain of science and literature. His administration at Sapporo was governed by the same broad-minded policy and comprehensive views that gave success to the parent institution, and it is one of the most prominent features of both colleges that, in spite of his strong, scientific inclinations, he recognized the importance of a liberal culture combined with ability to meet the practical issues of life. It is this breadth in scientific training, this all-round culture and capacity for work, and ability to deal with every-day problems, that has given to the graduates of both institutions the element of success—they have been trained to the best ideals of useful citizenship.

I should like to enlarge upon the present position of and future outlook for both physiology and pathology in this institution, because of the important historical relation in which President Clark's work stands to both of these very important subjects, but the limitations of the present occasion will not permit me to do so. But I can not avoid a reference, in closing, to the very important connection which must ever exist between the work of this college and the biological sciences. It requires but a moment's reflection to appreciate the enormous values represented by the various agricultural interests directly affected by the operation of disease and the depredations of destructive forms of insect life. For this reason, if for no other, the study of zoology must always find a prominent place in the curricula of institutions dealing with agricultural problems. But when we further reflect that such interests are, after all, secondary to those in which botanical science is concerned, because all forms of animal life are primarily dependent upon plants for their sustenance, it becomes evident that the study of botany, in its many-sided aspects, is of paramount importance, and that it is, after all, the real foundation of scientific agriculture. For this reason it finds a peculiarly appropriate place in our agricultural colleges, and I have for a long time been under the impression that there are no institutions where it may be more profitably cultivated, not only with reference to its direct application to the solution of great economic problems, but with reference to its purely scientific aspects; for, after all, the practical side becomes possible only after the purely scientific side has been dealt with. It is for these reasons that economy is finally gained by securing to botanical departments a competent staff and a thorough equipment in buildings and apparatus; and the fact that this dedication is being held to-day is abundant evidence that the people of Massachusetts appreciate to the full the far-reaching importance of the work to be executed here, under the able direction of Dr. Stone and his assistants.

But I would further point out that nature's processes, although exceedingly certain of fulfilment, are nevertheless exceedingly slow. If it has taken 500,000,000 of years to shape this earth and render it a fit habitation for man, man himself must not be impatient if he is required to spend a few years of arduous toil that he may unlock some of the doors which so carefully guard nature's secrets. Sixty-three years sped on their way from the time when Boussingault first endeavored to ascertain the source of nitrogen in plants, until a satisfactory explanation was reached through our knowledge of the action of root tubercles; and for more than sixty years Lawes and Gilbert sought the solution of plant nutrition without gaining the end in view.

The laws of nature are not kept on draught, as it were, to be drawn in large or small quantity, according to the demand. To present a problem to an investigator and expect an immediate solution, or an immediate practical application, is to be prodigal of a costly equipment, to sacrifice unnecessarily the best and most carefully trained intellectual strength, and to bring discouragement and invite failure. It is, no doubt, true that when a commonwealth has invested a large amount of capital in specially trained men and expensive apparatus, it is reasonable to ask for results, and with this no fault can be found. The danger lies in the fact that sufficient opportunity is not allowed for the careful working out of a problem in all its scientific aspects. Under conditions of haste and undue pressure, the results, if worth anything, are very likely to be incomplete and unsatisfactory, and in too many cases they must be subject to costly revision. I feel disposed at this time to make an appeal to the citizens of this commonwealth to secure to the investigators who will occupy this building, as well as to all others in this college, freedom for the future, from an incubus which, in the history of our experiment stations of the past, has for many years been prolific of disastrous results. I do this because this building should stand as an exponent of the best scientific work and thought, and because I know of no body of men, other than the citizens of Massachusetts, to whom such an appeal may be made with greater assurance of an intelligent hearing, and a fairer prospect that they will apply the remedy, *patience*.

And now to the students of this college, as to those who are to follow you in after years, my best hope is that as you view this building from across the campus, or as you enter its halls for the pursuit of science, you may ever hold it as an inspiration to high ideals, persistent effort and unflinching purpose; and that in whatever walk of life your lot may be cast, you will ever keep before you the example of him whose name it bears, taking up your burden of life in all cheerfulness and hope, and whatever your task may be, with the firm resolve to "Do it."

D. P. Penhallow
McGill University

SCIENTIFIC BOOKS

Memoir and Scientific Correspondence of Sir George Gabriel Stokes. Selected and arranged by Professor J. Larmor, Sec. R.S. Cambridge. The University Press. 1907. Vol. I., pp. 475; Vol. II., pp. 507.

Biographical literature, if one may judge by the notices which have been written of late years, appears to admit of criticism more easily than almost any other form of history which is not written entirely from the point of view of the student. Whenever, as in the present case, the materials are plentiful and easy of access, the reader is almost entirely at the mercy of the writer, so that the latter may, by his method, give what impression he will of the character which he desires to unfold. In any case, it is a difficult matter to settle what is of permanent value in the life of any man who has left his mark on the men of his generation or who has added to the general store of knowledge. The difficulty is not less in the case of a man whose life-work and influence are chiefly recorded in his own publications or in those which he has inspired, and whose thoughts and ideas are chiefly of interest in so far as they have affected his work. Stokes is perhaps a typical example of this class. Whatever value we may feel disposed to place on his ideas in religion, politics or education, there can be no doubt that the subjects of chief interest are his methods of work, his ideas on scientific questions, the way in which he made his influence felt in his chosen line of work, and chiefly, the mental make-up and environment which contributed to his success.

Professor Larmor, in selecting from the materials at his disposal, has kept these principles fully in view. In order to do so, he has broken new ground by showing the form which the biography of a scientific man may take, and the innovation is undoubtedly a success. He has not attempted to write the life himself nor even to give his own ideas of what Stokes has achieved. Indeed, he has, in the two volumes, contributed little else than explanatory details, leaving the memoir and summaries to the chosen few who were most closely associated with Stokes in the various lines of thought which the latter followed. The memoir by Mrs. Laurence Humphrey, the daughter of Sir George Stokes, and appreciations by Professor Liveing, Sir Michael Foster, Sir William Huggins and the Right Rev. Bishop G. F. Browne, serve to give a just idea of the life and character and to avoid the inevitable bias of a single point of view. Nevertheless, we may, perhaps, regret the omission of a summary of Stokes's work from one so well qualified to give an opinion as Professor Larmor.

From the historical side, the life of Stokes may almost be said to be the focus of the scientific activities of the last half century. His position as secretary of the Royal Society for over thirty years and as president for five years, naturally kept him in touch with all that was going on. But even more influential on the men of his day was his unselfish willingness to give his time and thoughts to any one who wished to consult him on a scientific question or to obtain his assistance in the solution of some difficulty. His first opinions on any debatable point were rarely wide of the mark and he would nearly always throw out some suggestion or idea which would enable the recipient to get at the root of the matter. Thus his letters, and these were not few or scanty, show the extent to which scientific progress has been advanced by him. This is perhaps nearly as well shown by the letters which he received. Of these the editor has inserted a larger number than might have been expected, perhaps owing to the materials at his disposal, for Stokes never destroyed any papers, and one may fear that all his correspondents had not been so careful.

In pursuance of the two-fold object—the work and career of Stokes and the scientific history of the latter half of the nineteenth century—Professor Larmor has subordinated the chronological order of the letters to the subjects of which they treat whenever this was necessary. A glance at the dates, everywhere supplied, will always give the former. Thus, in the second volume, there is a series of names under each of which will be found a collection of letters to some one correspondent, usually on a particular subject. Even when Stokes's letters to his correspondent were not available, the replies, with notes furnished by the editor, are sufficient to show what part Stokes had played in the development of the subject. Professor Larmor has also taken much care in the selection of headlines, so that one may rapidly find what is needed by simply turning the pages over.

A few extracts from the excellent memoir of Mrs. Laurence Humphrey will best show how she has contributed those circumstances and ideas which are of chief interest. On page 10:

> He considered that many of the men who worked under him in later years had been much overtrained and that this tended to weaken their minds and diminish their power of originality. He had heard of a machine for stuffing live fowls, to which he likened the process, and sometimes said, "They are stuffed, they won't do anything more, the thinking has been done for them." He considered this to be the reason why some of

those who took very high places in the Mathematical Tripos did so little afterwards.

Again on page 34:

He had two really wicked characteristics, that he would never allow any one to help him with his work, not even permitting invitations to be answered for him, and that he kept every single thing he received by post, even advertisements.

On page 36:

Lord Kelvin's visits were occasions of enjoyment to him, and great were the discussions between them, which anything served to begin; for instance, the eggs were always boiled in an egg-boiler on the table, and Lord Kelvin would wish to boil them by mathematical rule and economy of fuel, with preliminary measurements by the millimeter scale, and so on.

On page 44:

One day especially his silence in the House [of Commons] was remarked. Some scientific question had come up and still he said nothing. When we afterwards asked him why, he answered that he had been prepared to rise, but that another person had obviously wished to speak and had said enough, although he had treated the subject from a different standpoint from that which he should have himself adopted. Only one member beat him in regularity of attendance, Sir Richard Temple, who, however, lived in London.

Amongst the series of letters, one striking omission will be noticed, the absence of any correspondence with Lord Kelvin. We are glad to learn from the preface that these suffice to form a collection by themselves and that it has been decided to publish them separately, with a memorial of the lifelong friendship and collaboration of the writers. Of the numerous scientific matters which are treated in the letters given, it is only possible to mention one or two. In a letter to Sir Henry Roscoe dated February 7, 1862, he gives his share in the history of solar chemistry, which, in view of the oft-repeated rumors that he had really antedated Kirchhoff, must be regarded as settling the question. He adds, "for I never published anything on the subject and if a man's conversations with his friends are to enter into the history of a subject there is pretty nearly an end of attaching any mention or discovery to an individual." As an instance of the gradual development of the theory of waves and heavy ocean swells we may turn to a long series of letters full of details and carefully thought-out ideas.

In conclusion, one must give high praise not only to the editor for the way in which he has done his work in compiling this biography and to those who have assisted him, but also to the Cambridge University Press for a couple of volumes which are issued in a form suitable either for continuous reading or careful consultation.

E. W. B.

Yale University

American Birds. Studied and photographed from life by William Lovell Finley. Illustrated from photographs by Herman T. Bohlman and the author. New York, Charles Scribner's Sons. 1907. Pp. xvi + 256.

In an attractive volume of moderate size Mr. Wm. Lovell Finley describes in popular style the habits of a considerable number of western birds from the rufous humming-bird to the golden eagle. For the pictures, most of which are excellent, we are equally indebted to Mr. Herman T. Bohlman, who has been the author's companion in the field for many years.

We are told in the preface of this book that "each chapter represents a close and continued study with camera and note book at the home of some bird or group of birds—a true life history of each species." All who watch birds on this side of the Mississippi will be glad to see a faithful transcript of their manners on the Pacific slope, and should not be disappointed to find that their behavior is essentially the same wherever found.

The interests of the author seem to have centered in the acquisition of good photographic illustrations, and in this he has succeeded far better than most students who have gone into the field with such a purpose. Among the more noteworthy pictures may be mentioned some of the rufous humming-birds; the Maryland yellow-throat, a common but extremely shy species whose nest and eggs are rarely seen; the nest, eggs, and young of the red-tailed hawk, one of which shows the remains of a big carp, the same fish which the author on that very day saw caught in a distant pond and carried by the old bird to its aerie; white-crowned sparrows; bluebirds perched on a line, and especially the picture of a young bluebird trying to seize food from its parent; warbling vireos feeding their young and standing at inspection, as well as some of the heron and eaglet pictures. Many which were taken on a five-by-seven plate have been trimmed rather too close in order to crowd them on the page, even to the clipping of a bird's wing or tail, or the scamping of its nest. Most of the illustrations are of immature birds or of adults bringing food to their young, whether in or out of the nest; nine only show the feeding process. There are no strictly serial pictures of either growth or activities, which approach biological completeness, in any of the species treated. The editor of a well-known magazine once rejected some pictures of little naked cedarbirds on the ground that they would be "positively objectionable" to a certain class of readers, and possibly the same class of readers would object to illustrations of serial activities. At all events, such pictures would add to the interest and value of any work, and would not injure its sale; so far as nest-life is concerned, they should include: the parent bringing in the food, the pause at the nest which calls forth the initial feeding reaction of the young, placing the food in the throat of the nestling, and watching for the response—which amounts to testing the throats of the young, and giving the food to those which can swallow it—standing at inspection, and cleaning the nest. When both birds come to the nest together they should be shown as a complete family group or unit. It may be added that such completeness should be aimed at, even if it can seldom be attained. Of the so-called "snapping" of isolated scenes in and about the nest a good deal has already been done, and in many cases to little purpose. The photographer should primarily be the student who aims to portray the whole behavior—the serial acts and attitudes of the adult and young. Whoever does this, even in the case of a few species, will make a most noteworthy contribution, whether from the popular or the scientific point of view.

Mr. Finley's twenty-one chapters deal successively with different families or species of birds, and he tells his story in a bright and entertaining manner. Aside from certain mannerisms, and the occasional tendency to pile up and mix his metaphors, the author writes well and effectively. In a single paragraph the rufous hummingbird is likened to "a flying fleck of a rainbow," a "flash from a whirling mirror," a "little shooting star . . . that hummed as well as glowed," to the "glint of real live sunshine," to "a minute ethereal sprite," and to "a mite that possesses the tiniest soul in feathers." In still another paragraph the hummer's flight is "like the rush of a rocket," "a red meteor," but "instead of striking with a burst of flying sparks, he veered just above the bushes with a sound like the lash of a whip drawn softly through the air." Again he "swung back and forth like a comet in his orbit." This puts an unfair strain on the reputation of so small a bird, and we should prefer to eliminate some of the "papas," "mamas," "babies," "bantlings," "marriages" and the like. The author is at his best in the chapters on the larger birds, the hawk, the owl, the crow, the heron and the eagle. These are all very interesting and abound in quotable passages.

Of the temper of the barn owlet he says: "Generally he sat with his chin resting on his chest like a broken-down lawyer. Once, when the photographer was least expecting it, he dropped on to his trousers leg as lightly as a feather, but with the strength and tenacity of a mad bull-pup. The claws sank through to the flesh, and before they could be pried loose they had drawn blood in three places." "In a Heron Village" this vivid picture is found: "When I first climbed in among the nests of a smaller tree with my camera, it sounded as if I were in the midst of a gigantic hen-house. Some of the birds were clucking over their eggs that were soon to be hatched; others were cackling over newly-laid eggs and squawking at being disturbed; others were wrangling and squabbling, so that there was a continual clattering fuss above which one had to yell his loudest to be heard. . . . About me, seemingly almost within reach, I counted thirty-six sets of blue eggs. I was high above the tops of the alders and willows. Set all about below in the background of green were the platforms, each holding several eggs of blue. The trees were dotted in every direction. I counted over four hundred eggs in sight."

The most interesting observations recorded, from the standpoint of the reviewer, are the following: the young of the Vigor's wren were drawn or driven from the nest, when ready for flight, by the male, who would seize all the food which the female brought, until the young were forced to leave. The question of intelligence is not directly raised, but undoubtedly both birds were acting in this case from pure or nearly pure instinct, the female in hunting the prey, and the male in seizing it. We should expect to find intelligence developed in an equal degree in either sex. A bluebird box is mentioned in which one hundred and ten birds were hatched in eight years, and during one season there were three broods of 7, 7 and 5 birds, respectively. In one case, and this is a most interesting observation, two young bluebirds of the first brood followed the male about while the female was incubating her second litter. When the latter hatched the same young began to follow their mother, and they imitated her so well that they not only captured worms, but carried them to the box and fed their brothers and sisters of the second brood. It would be difficult to find a better example of imitation in young birds, having without doubt its base set firmly in instinct. But this suggestion is perhaps even more prosaic than that of the author, who surmises that "Perhaps the two birds of the first brood were girls, and took readily to housework." An oriole is mentioned which mated four times in succession before she was allowed to rear a family, the males having been successively shot by a collector. A western gull was seen to seize a clam, rise with it to a height of thirty feet and drop it on the hard ground. This act was repeated fifteen times before the bird was successful in breaking the shell and getting the soft meat. In parts of the old world gulls are said to resort to certain rocks for the purpose of breaking shellfish, which is by no means incredible. The act is intelligent, and is a good illustration of associative memory. The habit seems to be a rather rare and sporadic one.

In the nest of the golden eagle the author speaks of finding branches of green laurel, which were apparently renewed, when taken away. I have found freshly cut sprays of green hemlock in the nest of the red-tailed hawk, and fresh seaweed is said to be laid upon its mountain of a nest by the osprey. Herring gulls also add green materials to their nests from time to time. I have seen this gull while sitting on her eggs rise up, pull some fresh grass, tuck it under her body, and then settle back upon her eggs again. The "habit" is probably the same in every case, and may represent what I have called the "recrudescence of the building instinct." The fact that the leaf or the spray is fresh and green may attract undue attention.

The author remarks in his preface that "an important and sometimes difficult study of bird-life is to observe accurately and report without false interpretation the habits and actions of the birds." We should rather say that this was the whole matter, and sufficiently difficult at all times. Possibly in a popular work of this kind it would be hardly fair to hold the writer to the letter of his text. However, we note a few cases in which we can not agree with his statements or interpretations. Two paragraphs are devoted to the "heroic" act of a chickadee in clinging to her eggs when her home was invaded. It should be added that the nest-hole of the flicker can be sawn open and the broody bird lifted from her eggs or newly-hatched young with even greater ease and freedom, and all are familiar with the so-called "total depravity" of the setting hen. If we call the bird a hero in the first act, we must dub it a coward in the next, for when the flickers are a week old their parents have become excessively shy. In all such cases we have a common illustration of how the instinct of fear is temporarily blocked or allayed by the stronger parental instinct, namely that of brooding the eggs or young.

The kingfisher's feet are said to be "deformed," and the author remarks: "I am sure a kingfisher would never pretend to walk." To be sure this bird is somewhat of a clodhopper, since he walks upon his whole foot, the proper attitude of a bear or man, and not simply on his toes like most birds, but even the young kingfishers are walkers and during the close of their subterranean life they learn the curious habit of walking backwards.

The paragraph on imitation (V. foot of p. 175) needs considerable revision. How can imitation be regarded as "the strongest factor in the life of the chick from the time it leaves the shell," if by "chick" "nestling" is meant, or how can "nest-building" be ascribed "largely to imitation," or "the lasting impressions in a bird's life" be formed "during the first few weeks of its existence"? Although singing is primarily due to instinct, it may be greatly modified through imitation, but nest-building in all its initial and important stages must be ascribed to instinct alone, and all the acts of young altricious birds show that they are quite incapable of any effective imitation whatever. As to intelligence, we may add that the first trace of it in the nestling is its learning "to know" its parents, in other words learning to limit its feeding reactions to those conditions which count, namely, to the presence or sounds of the old bird. In some cases such a power is partially acquired in two or three days. If young birds in the nest did really imitate so keenly, why do we not see the results of it in the European cuckoo and the cowbird; or must we regard them as bad children upon whom a good education is thrown away by their devoted foster-parents?

The polity of the gull community and nursery is not to be found in Mr. Finley's chapter on this bird, but the subject will repay the most careful study. Gull chicks are said to "show little fear," but we have found them very fearful after the fourth day, and from that time onward their fear seems to increase, unless brought up by hand. "Each mother" gull is said "to recognize her chicks largely by location." On the contrary, we have found by swapping chicks that they discriminate absolutely. One of the fiercest instincts of the herring gull is to defend its preserve and drive off intruders, and many stray and trespassing chicks are thus daily slaughtered in consequence.

Of a tame shrike that would come to call the author speaks in this wise: "His favorite perch was the back of a chair near the window, where he could look out over the slope, and here he would sit for an hour at a time, as if thinking. And how do we know but he was going over many of his hunts and hair-breadth escapes and thinking of the springtime that was coming and the new experiences it would bring?" "I have often wished that I could fathom the thoughts that Jimmy had." This should be compared with a paragraph where the robin, certainly a bird of average intelligence, is dealt with: "I was standing in the back yard watching a robin that came for string to build her nest. I had wrapped a piece several times about a limb to see whether the bird would use any intelligence in unwinding it. I have always been sceptical of some of the stories that have been told of birds reasoning. For example, one writer tells of an oriole that took a piece of cloth and hung it on a thorn so the thread could be pulled out. When the cloth came loose, he said the bird refastened it. Again, he has the bird tying knots in the string to keep the ends from fraying in the wind, or tying the sticks together to make support for the nest. But these are not bird actions: they are evolved out of the fertile brain of the writer." We all recognize the "fertile brain" referred to, about which enough has been said, but if birds really have the power of abstract thought, and therefore of a high degree of intelligence, why should the fancies of the romancer be deemed impossible? What, indeed, are thoughts for—?

In spite of the criticisms of such matters as are here suggested the volume is a fresh contribution to popular ornithology, and is both interesting and informing in an unusual degree.

Francis H. Herrick

SOCIETIES AND ACADEMIES

ORGANIZATION MEETING OF ILLINOIS STATE ACADEMY OF SCIENCE

More than one hundred persons gathered in the senate chamber at Springfield at ten o'clock Saturday morning, December 7, for the purpose of organizing a state academy. The meeting was called to order by A. R. Crook, curator of the State Museum, and U. S. Grant, Northwestern University, was elected chairman.

The opening address by Professor Chamberlin, on "The Advantages of a State Academy of Science" was given in the extemporaneous form and the following outline very imperfectly represents what was said.

Professor Chamberlin introduced his address by conveying the felicitations of the Chicago Academy of Sciences, and sketched some of the salient features of its history of a little more than fifty years, as a means of giving concrete illustration to some of the problems which the new academy must face. Special attention was directed to the radical change in the nature and relations of scientific activity since the oldest academies of the interior were established. In the pioneer days, an almost virgin field was open to naturalists, and enthusiasts in this field constituted the largest factor in the membership of its academies of science during their early stages of development. The results of these pioneer workers were much more fully within the appreciation of all their colleagues and of the intelligent public than are the products of the more highly specialized investigations of to-day. So widely has research deployed in the last fifty years, and so far has it reached into the more recondite phases of each field, that there is now far less community of interest and of intelligent appreciation, even among scientific workers themselves. This fundamental change brings new problems of organization and of adjustment. In like manner, the function of an academy as an avenue of publication has assumed a new aspect. Fifty years ago, an appropriate means of publication was one of the greatest needs which the academies supplied to the pioneer workers, for, aside from these academies, the available opportunities of giving publicity and permanence to scientific results were few and unsatisfactory. As the regional element was dominant in the results of the early naturalists, it was fitting that there should be a local means of publication. To-day, however, the results of research are, in general, more serviceable to scientific workers if they are gathered into the special journals devoted to the several departments of science. While the function of publishing the results of regional investigations still remains and may well continue to be subserved by the regional academies of science, and while certain adaptations of other results may serve an important regional purpose, the question whether an academy should endeavor to be the avenue of miscellaneous publication to the same extent as in the early days is one of the problems that invite the serious consideration of a new academy.

Attention was also directed to the problems presented by the geographic distribution of the centers of scientific activity within the state and by the not altogether felicitous relations of these centers to the capitol of Illinois.

The advantages of a state academy to those who are just entering upon scientific careers, to amateurs dissociated from institutions of research, to trained workers in relative isolation, and to workers in scientific centers, were specifically set forth. The values to be derived from opportunities of reading papers before fellow workers, of submitting results to discussion, of participating in the discussion of others' results, of extending scientific acquaintance, of cooperation, of mutual stimulus to endeavor, of personal education by contact with other workers, were dwelt upon in detail. The value of the academy as a means of disseminating the spirit, the method, and the love of science among the people of the state was especially emphasized. The function of advising relative to legislation on scientific matters was urged as highly important.

The address was closed by an earnest advocacy of the value of the spirit and method of science to the state and nation as an essential element in the solution of its great social, political, and ethical problems. The habit of conscientious search for the precise truth and the systematic control and guidance of opinion and action in accordance with the canons of scientific procedure were urged as means of supreme value in the elevation and purification of the common thought and feeling of our people. More than perhaps anything else, are the intellectual and moral methods of science a protection against current evils and a guarantee of safety in the future.

S. A. Forbes, University of Illinois, gave a history of the formation and existence of former state natural history societies. He called attention to the small number of scientific men in the state at the time when such organizations had their existence; pointed out the difference in present conditions; and showed the promise which there is of an important present and glowing future for the state organization. His address has been printed in Science.

The chair appointed as committee on organization: S. W. Williston, University of Chicago, Wm. A. Noyes, University of Illinois, and C. B. Atwell, Northwestern University. And these three selected to complete the committee of nine called for: T. C. Chamberlin, University of Chicago, S. A. Forbes, University of Illinois, A. R. Crook, State Museum, Fred L. Charles, State Normal School, H. V. Neal, Knox College, and B. B. James, James Millikin University.

At 2 p.m. the committee on organization reported with a constitution. The report was considered item by item and the constitution was adopted. The following officers were elected:

President—Professor T. C. Chamberlin, LL.D., University of Chicago.

Vice-President—Professor Henry Crew, Ph.D., Northwestern University.

Secretary—A. R. Crook, Ph.D., curator State Museum.

Treasurer—Professor J. C. Hessler, Ph.D., James Millikin University.

Dr. H. Foster Bain, state geologist, was appointed a member of publication committee.

The committee on membership consists of: Professor S. A. Forbes, LL.D., University of Illinois, Professor T. W. Galloway, James Millikin University, Professor J. P. Magnusson, Ph.D., Augustana College, Dr. C. H. Smith, Hyde Park High School, Chicago, and Professor B. B. James, James Millikin University.

After the organization was completed ten-minute addresses were given in a symposium on the outlook for young men in science. All of the speakers took an optimistic view of the situation.

W J McGee, as a guest of the occasion, represented the outlook in anthropology. The recognition and financial rewards to the worker in this branch are probably less than in many other branches of science, but the amount of work which remains to build the science into goodly proportions is great.

Dr. Coulter called attention to the many fields which are open to the worker in botany. Rewards are promised to the original worker, to the teacher and to men who would be satisfied with the less attractive, but none the less useful, work of cataloguing the flora of various regions.

Dr. Noyes finds the outlook for workers in chemistry not only attractive scientifically, but financially as well.

Dr. Bain considers the work of investigation and of practical application of geology to be in the main very alluring.

Dr. Crew pointed out the vast amount of investigational work which lies before the physicist, although any one who enters the door of pure physics will find written before the entrance "Leave behind the hope of wealth! All ye who enter here."

Dr. Neal read letters from various leaders in the teaching of zoology in many institutions, showing that the call for workers and investigators in zoology is great, and concluded that zoology offers a most attractive field for men whose ambition is not wealth but a competence.

An informal dinner was enjoyed at six o'clock by about seventy-five persons.

In the evening to an audience of about six hundred, Dr. W J McGee gave his lecture on "Greater Steps in Human Progress."

His address combined in a rare degree such facts as would attract men of the highest scientific attainments and at the same time the more popular audience also. It might be expected that such a title, "Greater Steps in Human Progress," would imply consideration of the remarkable manufacturing and commercial advances which have characterized the last century.

His plan, however, was to note various habits and discoveries of men which indicate evolution from a low physical and mental equipment to the full expansion of man's faculties. Primitive men were unable to open the palm of the hand so as to bring the thumb in the same plane with the fingers. This was shown by the aboriginal Philippine tribes which Dr. McGee assembled at the St. Louis Exposition.

Primitive man is characterized by movements of the hand and arm *toward* the body, whereas his more highly developed descendant directs these movements *from* the body. It is the Anglo-Saxon who has shown this development in the highest degree, and while in other respects prize fighting is indicative of the lower traits, in this one fact, namely, that the motions of the arm in a well-directed blow are from the body of the fighter, the prize fighter's profession indicates high physical development—a real step in progress.

The savage grasps a knife with the blade held towards the body. Civilized man holds the blade from the body. The mistress wishing to judge the mental alertness of a prospective maid servant should hand her a plate and towel noting the motion of the hand as the maid wipes the plate. If the motion of the right hand is clock wise the maid should be considered a promising subject.

At some length Dr. McGee illustrated the fact that the development of "knife sense" is one of the greatest steps in human progress. Primitive men used a rounded stone and had no conception of the value of a sharp edge.

Another one of the great steps, and indeed the chief one, is in the use of fire. Man alone of all created things employs fire. It required long ages for men to learn the use of fire, and this discovery has made possible the great development of the human race, socially, commercially and intellectually.

Finally the faculty of invention is one which has contributed most forcibly and characterized most materially the development of the human race.

The interest which was displayed throughout the meeting, argues well for a successful and useful career for the society.

A. R. Crook,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 195th meeting of the society was held on November 20, 1907, Vice-president Campbell in the chair and thirty-one members present.

Regular Program

The following papers were presented:

Report on the Geological Work of the Third Petroleum Congress: David T. Day.

The congress was called for September 8, in the city of Bucharest, Roumania, but the preceding days were also occupied in a geological excursion through the principal oil field—that of the Prahova Valley.

By means of a preparatory lecture by Professor L. Mrazek, director of the Geological Survey of Roumania, and by his continued guidance on the trip, a particularly good view was obtained of the complicated folding characteristic of the south flank of the Transylvanian Alps, where many well-marked anticlinals are evident, and along the axes of which the oil is chiefly sought (and found). The principal accumulations are closely associated with overthrust faults.

The congress visited principally the Bushtenari field, and had a good view of the geologic structure in passing from Bushtenari to Campina and to Moreni. In the latter field, drilling is made particularly uncertain by a large body of rock salt which takes part in an over-thrust fault, the oil being found close to the under side of the salt. The oil is usually found under great pressure, and gushers are quite common. The oil is usually black, rather ethereal in its odor, and contains both paraffine and asphalt. In many cases, by natural diffusion the asphalt has been lost. The oil is then light in color, and in specific gravity. The oil carries a considerable proportion of members of the benzol series, which, of course, adds to the difficulty of refining.

The scientific work of the congress was divided into three sections—the first section being devoted to geology and oil exploration. Thirty-nine papers were presented in this section, of which twelve were descriptions of petroleum deposits, ten on theories of origin, ten on methods of drilling, and the remainder relating to oil-well management. H. Foster Bain, Ralph Arnold and A. F. Lucas contributed papers in regard to the Illinois, Santa Maria, California and Texas fields, respectively. Much attention was given to the discussion of structural details in the Roumanian fields.

A most important result was pointing out the evident importance of water in filling up the pores of the rock which form covers to the oil pools, and thus prevent the oil from escaping.

Mrazek's insistence on the function of water in driving by capillary action the oils from a diffused condition in shales, and compressing them in relatively small sands, was also of much importance for oil geology.

In regard to theories of origin, Professor Carl Engler replied to the criticisms which have been made against his theory on the animal origin of oil on account of the difference in optical activity between his oil prepared from fish, and natural oils, by showing that destructive distillation of cholesterine gives products similarly optically active to crude petroleum.

The Association of Alunite with Gold at Goldfield, Nevada: F. L. RANSOME.

The alternation of the andesitic and rhyolitic rocks of Goldfield which stands in closest relation to ore deposition has resulted in the removal of nearly all of their lime and magnesia, three fourths of their soda and two thirds of their potash. On the other hand water and sulphuric acid have been added and the iron of the original silicates has been converted to pyrite. The introduction of sulphuric acid is shown in the extensive development of alunite and some kaolinite and diaspore at the expense of the original feldspars.

The solutions which deposited the ores were acid and probably hot. They carried gold, copper, bismuth, antimony, a little arsenic, selenium and tellurium, hydrogen, sulphide, and probably sulphurous and sulphuric acids. Their solvent action on quartz was feeble.

The recognition of alunite as a characteristic constituent of the Goldfield ores and the demonstration of its genetic relation to them establishes a new type—that of alunitic and kaolinitic gold-quartz veins, in the classification of epigenetic deposits based upon the kind of metasomatism effected in the wall rock by the ore-depositing solutions. It is not believed that the Goldfield District is unique in the possession of this type. Other examples are likely to be found among the great number of ore deposits associated with Tertiary volcanism. The constituents removed from the Goldfield rocks are those which are deposited extensively in the production of gold-quartz veins of the sericitic and calcitic type. Consequently conditions are conceivable under which the acid solutions of Goldfield might have ascended through a much thicker series of rocks and given rise to sericitic and calcitic veins.

Finally, the relation of the alunite and kaolinite at Goldfield suggests the possibility of the future discovery of metasomatic veins of the pure alunitic type, without kaolinite.

The Place of the Great Raised Beaches in Geology: H. W. PEARSON.

Mr. Pearson gave the results he had reached in a study of the great raised beaches of Europe and America. Attention was called to the fact that up to the present time too little consideration had been given by geologists to these terraces, which Mr. Pearson believed to be of marine origin. It was shown that if the elevations of beaches, as recorded by various writers who have studied these terraces, were plotted upon one diagram, and consideration given to the apparent difference in relative ages of their ordinates, we should find that,

1. These terraces resolve themselves into several distinct systems.

2. All these terraces are found with rising inclination to the *true north*—the most recent terraces, the upper member of which would have elevation if extended to the pole of about 1,467 feet, disappear, at the equator, into the present sea level. The older and more elevated terraces pass the equator at some considerable distance above the present sea level.

3. The upper terrace of the more recent series, corresponds with the upper surfaces of the so-called glacial lakes, Agassiz, Ohio, Warren, Algonquin, Iroquois, St. Lawrence, Gulf of Winnipeg, etc. It also corresponds with the upper surface of the Lafayette flood, and with the waters of the Champlain and Matanzas submergences. By this correspondence or absolute confluence in beach lines, it was held that complete demonstration was offered as to a similar confluence in all above-named water bodies.

4. The law of inclination found in these terraces is that the rising gradient especially of the younger terraces, increases to the north approximately as the sine of the latitude.

Mention was here made of some of the inferences that would properly follow in case the peculiarities in structure of beach lines as above noted, should be confirmed. For instance, a most logical decision would be that the extraordinary symmetry in these curves offered assurance that no motion of the earth's crust had taken place since the epoch of this elevated sea.

Another assumption might be made, as the mathematicians have shown its competency, that this northern flood may have been caused by a slight shifting of the earth's center of gravity under the effects of a polar ice cap.

Still another inference might be that the great ice dams urged in explanation of the raised beaches were no longer necessary.

The effect of the earth's rotation upon ocean currents was discussed and the matter of deformation of sea level by ocean currents mentioned and attention called to some of the perplexing differences in levels of confluent water bodies thus arising.

Ralph Arnold,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 435th meeting was held December 14, 1907, President Stejneger in the chair.

Dr. M. X. Sullivan read a paper on "Toxic Bodies arising during Plant Metabolism," illustrating it with many photographs.

Many of the products of the life activity of plants have been tested as regards their toxicity to wheat and a number of these substances have been found toxic.

Wheat was grown successively in the same soil until the growth was poor. Investigation of the soil showed that toxic substances had been deposited therein during the growth of the plant. The absolute identity of the substances in plant and soil is yet to be ascertained.

Cowpea was grown in soil until the yield was slight. From this soil was obtained a crystalline body toxic to cowpea. To wheat in the same concentration the substance was beneficial.

The conclusion to be drawn from the paper is that the decrease in yield of plants grown successively on the same soil is due predominantly to substances arising in the metabolism of the plants and exuded from the seedling and roots.

Mr. A. H. Howell read some "Notes on the Migration of Bats," which will be published in the *Proceedings* of the society.

The 436th meeting was the 28th annual meeting for the election of officers. The following were elected for the ensuing year:

President—Leonard Stejneger.

Vice-presidents—T. S. Palmer, W. P. Hay, E. L. Greene, E. W. Nelson.

Recording Secretary—M. C. Marsh.

Corresponding Secretary—W. H. Osgood.

Treasurer—J. W. Gidley.

Councilors—A. D. Hopkins, J. N. Rose, A. K. Fisher, A. B. Baker, David White.

President Stejneger was nominated as a vice-president of the Washington Academy of Sciences.

M. C. MARSH,
Recording Secretary

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

THE fourth regular meeting of the session of 1907–8 was held at the Chemists' Club, 108 West 55th Street, on January 10.

Dr. McMurtrie read a short obituary of the late Peter Townsend Austen who was closely identified with the section since its foundation. Dr. Austen served twice as chairman and contributed much to the society from his vast fund of information and experience in the field of chemistry.

Mr. T. J. Parker described the winter meeting in Chicago, speaking of the elaborate preparations made and the cordial reception extended to visiting chemists, of whom there was a good representation. Mr. Parker also spoke of the business transacted by the council, especially that relating to the publication of a journal of industrial chemistry. This journal together with those now issued would place the American Chemical Society ahead of any society of its kind in the extent of chemical knowledge recorded in its publications.

The following papers were read:

"Drop Weights and the Law of Tate. The Determination of the Molecular Weight in the Liquid State by the Aid of Drop Weights," by J. L. R. Morgan and Reston Stevenson.

"Note on the Precipitation of Zinc as Sulphide," by W. Geo. Waring.

C. M. JOYCE,
Secretary

DISCUSSION AND CORRESPONDENCE

BAPTANODON NOT A "TOOTHLESS" ICHTHYOSAUR

WHILE it may appear to be ungracious to point out the errors of others, especially of those who are valued scientific friends, nevertheless scientific accuracy and the truth of nature sometimes make it necessary to do so.

In the year 1880 Professor O. C. Marsh coined the word *Baptanodon* as the generic name of an ichthyosaurian which in the previous year he had designated as *Sauranodon*, which was preoccupied. Both names indicated the toothless character of the creature for which they stood, and Professor Marsh in his writings maintained the toothless character of *Baptanodon*.

In January, 1905, Dr. Henry Fairfield Osborn published an article in the *Century Magazine* upon ichthyosaurs, in which he speaks of the Jurassic ichthyosaurs included in the genus *Baptanodon* as "belonging to a race which, like certain of the whale tribe, lost their teeth because they had selected for food the softer marine organisms, such as the squids." Elsewhere he speaks of them as "toothless sea-robbers."

In hastily glancing over the pages of the second revised edition of Professor W. B. Scott's "Introduction to Geology," I discover on page 692 the following statement: "*Baptanodon*, found in Wyoming, is an ichthyosaur without teeth, and must have fed upon small and soft marine invertebrates, as do the toothless whales."

As both Professor Osborn and Professor Scott address themselves in their writings to large audiences, and their repetition of the error into which Professor Marsh fell, if backed by their great names, is likely to become very widely accepted, it seems proper for me to call the attention of men of science to the fact that in December, 1902, Mr. C. W. Gilmore in the columns of SCIENCE, N. S., Vol. XVI., pp. 913–914, called attention to the fact that *Baptanodon* was *not* a toothless reptile. Early in the spring of 1904 the Carnegie Museum published a Memoir by Mr. Gilmore entitled "The Osteology of *Baptanodon* Marsh," in which, at page 98, he shows that *Baptanodon*, like the English *Ophthalmosaurus*, is provided with teeth, and figured the teeth, and on page 121 he alludes to the fact that a tooth exists in the jaw of the type of the genus, No. 1,952, preserved in the collections of the Yale Museum, a fact which Professor Marsh had entirely overlooked.

Baptanodon is a misnomer, which, nevertheless, according to the laws of priority, must stand. The "toothless diver" of Marsh was *far from being toothless,* as is shown by the splendid material in the Carnegie Museum, as well as by Professor Marsh's own type specimen.

W. J. Holland

Carnegie Museum,
January 6, 1908

"TROTTING AND PACING, DOMINANT AND RECESSIVE?"

To the Editor of Science: I have noted with interest, in your issue for December 27, on page 908, the communication of Mr. W. Bateson, under the caption "Trotting and Pacing, Dominant and Recessive?" Regarding it I would beg to say that his informants who state that they have "never known a natural trotter produced by two natural pacers," while stating the results of their own experience, have, in that experience, missed, very evidently, a result that is not uncommon in the breeding of harness horses. I have personally known of numerous cases in which the produce from the mating of natural pacers has produced a natural trotter; and, as a matter of direct evidence, may cite a case which has very lately come under my notice.

One of the most celebrated pacing stallions of recent times is Direct Hal. He never lost a race and his record, 2.04¼, made in the first and only season (1902) that he was raced, has never been beaten by a stallion under the same conditions. Direct Hal was a natural pacer. His sire, Direct, was a natural trotter, and was first trained to trot, and given a record of 2.18½ at that gait. He was then taught to pace and given a record of 2.05½ at that gait. He was himself a trotting-bred horse, but the majority of his get have been pacers. The dam of Direct Hal was Bessie Hal, a pacing mare, and pacing bred with the exception of a trotting cross on her dam's side.

One of the most celebrated pacing mares of recent times is Lady of the Manor. She won nearly all her races and also took a record of 2.04¼; which, when made (1899), was the fastest on record for a pacer of her sex. She was by Mambrino King, a trotting horse, with but a remote and attenuated pacing inheritance. Her dam was also a trotting mare, strongly trotting bred and with no near, or, supposedly, influential, pacing blood. Nevertheless, Lady of the Manor was a natural pacer. As she was bred to trot, she was first trained to trot; hobbles and heavy shoes and toe-weights being used to force her to adopt that gait, but the effort was unsuccessful. She was then allowed to pace, with the result above noticed.

After their retirement from racing, these two remarkable pacers were mated, and one of their produce, a filly, foaled in 1905, is now owned by a gentleman of my acquaintance, resident in this city, who has her in training at a farm near here. Both this gentleman and his trainer inform me that this filly is a square trotter, that has, since under their observation, never been seen to pace, either in or out of harness.

This is only one case of a number of similar ones that could be cited.

The whole question of the relation between the trot and the pace is a perplexing one. I have, I may say, devoted many years to its study, during which I have been afforded an embarrassment of riches so far as material for investigation was concerned. During this period I have at various times been of various opinions, which, for the time being, I have believed to be definitely established, but have again and again been unsettled as new evidence, not to be gainsaid, has presented itself. One thing is, however, incontestably true, viz., that pacers are much oftener produced by trotting parents, than trotters by pacing parents. Personally, I much doubt what Mr. Bateson says he has been given to understand —"that the distinction between the natural trotter and the natural pacer is so definite that doutbful cases are exceptional"—and consider the reverse to be, if anything, as probable.

John L. Hervey

INHERITANCE OF FLUCTUATING VARIATIONS

To the Editor of Science: Referring to Dr. Ortmann's interesting article in Science of November 29, I should like to ask him how he accounts for the well-known phenomenon of correlation between parent and offspring in characters subject to normal, or "fluctuating," variation, if such variations are not in fact transmitted.

R. P. BIGELOW
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
BOSTON, MASS.

AGGREGATE MUTATION OF GOSSYPIUM

DR. O. F. COOK, in his official work for the U. S. Department of Agriculture, has observed several instances of abrupt change *en masse* of the distinguishing characters of varieties of cotton, full results of which he is preparing to publish. Some of those transmutations have occurred in connection with geographical transference, and some have not. Central American varieties on being brought to the United States have shown entirely distinct characters of habit and growth in all the plants from and after their first planting. In case of the well-known and long-cultivated upland cotton of the United States, he found all the individual plants of a whole planting to have become thus abruptly changed. The change involved the whole field crop of a planting, and the new crop differed equally from both the parent stock and the plantings of the same stock in other fields in the same season.

Dr. Cook properly regards these transmutations as identical in character with those which I have observed in the tomato and which in several publications I have designated as aggregate mutation. See especially *Popular Science Monthly*, Vol. LXVII., No. 2, June, 1905.

CHARLES A. WHITE

SPECIAL ARTICLES

THE CHROMOSOMES OF ŒNOTHERA

ON account of the general interest which attaches to this subject, it may be well to present some further facts, and also to review briefly our knowledge of the subject as developed up to the present time. The work is being continued upon a large amount of material collected during the summer from a culture which consisted of 1,700 pedigreed individuals, partly from pure races, and partly from guarded crosses. The collections made from each individual were kept separate from all others for examination. My work on the subject was begun on plants grown at Woods Hole, Mass., from seeds of DeVries, in 1905.

In December, 1906,[1] some of this work was reported upon. *O. lata* from a cross was found to have 14 chromosomes as sporophyte number, but quite unexpectedly one of the other plants from what was believed to be pure seeds of *O. lata* × *O. Lamarckiana* were found to contain 20 chromosomes. This result was published in a paper[2] on the abortive pollen development in *O. lata*, but it was discovered by the writer[3] a little later that *O. Lamarckiana* itself had 14 chromosomes. This result was afterwards confirmed by Miss Lutz,[4] and Geerts in a short paper[5] published the same result. After my first announcement of results Miss Lutz germinated seeds of several forms and examined the root-tips of the seedlings, finding[4] about 14 chromosomes in *O. Lamarckiana*, as already stated, but 28 or 29 in *O. gigas*.

I have since reported[6] 14 chromosomes in the *Lamarckiana* plants from *O. lata* × *O. Lamarckiana* as well as in the *O. lata* from this cross, also in *O. rubrinervis* and in *O. nanella;* together with various peculiarities of the reduction mitoses in the pollen mother cells of these forms. One of these interesting features is that sometimes in the heterotypic mitosis one chromosome passes to the wrong pole of the spindle, thus probably introducing

[1] American Association for the Advancement of Science, New York meeting.

[2] "Pollen Development in Hybrids of *Œnothera lata* × *O. Lamarckiana*, and its Relation to Mutation," *Bot. Gazette*, 43: 81–115, 1907.

[3] "Hybridization and Germ Cells of Œnothera Mutants," *Bot. Gazette*, 44: 1–21, 1907.

[4] "A Preliminary Note on the Chromosomes of *Œnothera Lamarckiana* and one of its Mutants, *O. gigas*," SCIENCE, N. S., 26: 151–152, August 2, 1907.

[5] "Über die Zahl der Chromosomen von *Œnothera Lamarckiana*," *Ber. deut. Bot. Gesells.*, 25: 191–195, 1907.

[6] International Zoological Congress, Boston, August 22, 1907.

an irregularity in the chromosome numbers of the next generation. This is especially common in the hybrids. An irregularity of this kind is probably the cause of the 15 chromosomes found by Miss Lutz[7] in one *O. lata* plant. Such irregularities will probably also explain other variations of one or two in the chromosome numbers, including the 20 instead of 21 chromosomes in what I have now shown to be an *O. lata* × *O. gigas* hybrid.

The long-believed tendency to wide variability in the number of chromosomes in root-tips made it important that the count made by Miss Lutz in *O. gigas* should be confirmed. I have recently examined the reduction mitoses in the pollen mother cells of *O. gigas* and also find the number to be 28, the reduced number being 14. The material for this study was obtained from A. C. Life, now of the University of Southern California. It was collected by him at Woods Hole, Mass., in the summer of 1905, from plants growing side by side with those from which my first material was collected.

I have also recently examined material from another plant in the cross which was believed to be pure *O. lata* × *O. Lamarckiana,* but which appeared to have all the characters of *O. gigas* and was found to have 21 chromosomes. This, with other evidence, furnishes definite proof that the cross which was believed to be pure had been partly pollinated with *O. gigas.* The interesting feature about this plant is the manner in which the chromosomes segregate in the heterotypic mitosis.

Almost invariably 10 chromosomes go to one pole of the spindle in the heterotypic mitosis in the pollen mother cell, and 11 chromosomes to the other pole. It is difficult to see how this can be interpreted in harmony with current views of the homology of maternal and paternal chromosomes. For even although we assume that in the reduction of chromosomes in the hybrid the descendants of the 7 *lata* chromosomes in the cross always pair with the descendants of 7 of the 14 *gigas* chromosomes, the remaining 7 *gigas* chromosomes are invariably distributed as though they paired with each other, with the exception, of course, of the unpaired chromosome which (when one is present) may go to either pole of the spindle according to chance. In other words, the chromosomes are invariably distributed as though 10 of them were homologous with the other 10, which is not the case when their origin is considered.

How the *O. lata* × *O. gigas* hybrid, which matures an abundance of pollen, will behave in later generations, is not known. A little thought will show that if the chromosomes always segregate in germ-cell formation in the manner described above, by crossing the hybrid with the parental types and judiciously re-crossing, in later generations plants may be obtained having all sporophyte numbers of chromosomes between 28 and 14, or reduced numbers between 14 and 7; and whenever the sporophyte number was an uneven one the plant would produce two kinds of germ cells, differing by one in their chromosome number. The writer hopes to carry some of these crosses forward in the future, as it is believed that they should throw light on the nature of a chromosome in its relation to somatic characters in heredity.

The early history of the bodies designated heterochromosomes is not yet fully worked out, but they are evidently not directly connected with the chromosomes, although frequently almost identical with them in appearance in the metaphase of the heterotypic mitosis. It is believed that these bodies will be found to be more nearly related to the ordinary nucleoli than to the chromosomes.

Resuming briefly, we may say that *O. Lamarckiana, rubrinervis, nanella,* as well as both the *lata* and *Lamarckiana* types arising from *O. lata* × *O. Lamarckiana,* have 14 chromosomes, with perhaps occasional departures of one from this number. *O. gigas* has 28 chromosomes, and certain plants appearing in the first hybrid generation of *O. lata* × *O. gigas* having almost or quite the identical appearance of *O. gigas* have 21 chromosomes (20 in one plant), the latter segregating equally in reduction, with the ex-

[7] International Zoological Congress, Boston, August 22, 1907.

ception of the unpaired chromosome, which passes to one pole of the spindle.

R. R. Gates

University of Chicago

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

CHANGES OF CLIMATE?

In his recent volume (Vol. II.) on "Ancient Khotan," Dr. M. A. Stein, whose explorations in Chinese Turkestan are well known, points out that it requires constant and persistent effort to keep up the irrigation of the oases in that region. The wind-blown sand and the shifting courses of the silt-laden, snow-fed rivers are always tending to change the course and scope of the irrigation systems. If man relaxes his efforts in the least, the sand and the aridity of the desert replace the fertility of the formerly irrigated oasis. This has happened in many cases within human experience. A swing of the climatic pendulum in this region, towards a drier period, is not thought improbable, but the ordinary physiographic forces at work there are held sufficient to explain the changes of population and of settlements which have been clearly made out.

Again, in the Lake Chad district of Africa, Lieutenant Secker, in northern Nigeria, has lately reported that he found that the natives, by erecting fish-dams on the river Yo, are diverting water which would otherwise flow into the lake. These dams collect large masses of weeds, and lead to the formation of marshland. Lieutenant Secker is of the opinion that this may have something to do with the reported drying-up of Lake Chad.

FOG DENSITIES

The Quarterly Journal of the Royal Meteorological Society for October, 1907, contains a suggestion by J. A. Lovibond, "On a Method and Apparatus for Measuring Fog Densities." The method is based on the power of selective absorption of suitably colored glass. When this has been graded into mechanical scales of equivalent color value, a beam of white light can be progressively absorbed to extinction, and the luminous value of each successive absorption stated in quantitative terms. This analytical power also applies to the color constituents of the beam.

RAIN GAUGES

The Quarterly Journal of the Royal Meteorological Society for October, 1907, also contains a paper, by Dr. H. R. Mill, on "The Best Form of Rain Gauge, with Notes on Other Forms." Dr. Mill strongly recommends the "Snowdon pattern," which is 5 inches in diameter; has a vertical rim to the funnel of 4 inches, and has an inner can and also a bottle.

NOTE

The Annuaire Météorologique of the Royal Observatory of Belgium for 1907 contains a discussion, by A. Lancaster, entitled "L'Humidité de l'Air en Belgique," and an account of balloon ascents in Belgium by J. Vincent.

R. DeC. Ward

Harvard University

THE IOWA LABORATORIES OF ANIMAL BIOLOGY

At the University of Iowa, new laboratories of animal biology have just been put into service under the directorship of Professor Gilbert L. Houser. These laboratories are located in a new and beautiful fire-proof building of thoroughly modern construction—the hall of natural science, erected by the state at an expense of three hundred thousand dollars. With the standard of their new quarters, the laboratories are entirely in keeping, so it is evident that the opening of these laboratories marks an epoch in the scientific facilities of Iowa.

The space devoted to animal biology comprises eleven rooms located in the north wing of the building on the second, the first, and the basement floors. This space is so unified, however, by a small elevator running through the rooms as to make the arrangement much more convenient than if all the space were on one floor.

The laboratories proper occupy the whole of the second floor of the north wing, the large northern exposure giving excellent lighting. This space is chiefly devoted to two large laboratories—the introductory and the advanced, respectively. Each of these laboratories is forty-eight by fifty-three feet in size, and is lighted from three sides by nine very wide windows of plate glass. The heavily paneled ceiling is tinted pure white, and the paneling is supported by a row of beautiful scagliola columns running through the center of the laboratory. The side walls are tinted light buff.

The furniture is all of quartered oak, finished "Early English." Slate is used throughout for the tops of all laboratory tables. The tables assigned to students extend over sixteen feet into the room from the several windows, and their slate tops taper toward a narrow end away from the window, a device which permits each student to obtain unobstructed light for his work. These tables have a new and particularly successful form of electric microscope-lamp for every two students. Outlets for Bunsen burners comprise a part of the fixture at the base of each lamp. An abundance of individual drawer space is provided for each student. Microscope cabinets are ranged conveniently on the wall. And cabinet, drawer, microscope, lock, key—each is stamped with its own number.

The laboratory for introductory courses accommodates fifty-two students at one time; and the number of individual drawers permits the handling of two hundred and eight students in all. The advanced laboratory seats forty-four workers at one time, and the details of the tables here are especially adapted to such courses as require the extensive use of biological reagents. Each of these main laboratories has an adequate quota of general furniture designed for it, including cases for laboratory apparatus, a hood in the corner where reagents may be prepared without tainting the air of the room, and a large aquarium with an abundance of small jets of running water.

SCIENTIFIC NOTES AND NEWS

M. Henri Becquerel has been elected president of the Paris Academy of Sciences, and is succeeded in the vice-presidency by M. Bouchard.

Professor W. W. Campbell, director of the Lick Observatory, and his party have returned from Flint Island, having obtained excellent photographs of the recent total eclipse of the sun.

The Imperial Academy of Sciences of St. Petersburg has elected Professor Sir George Darwin, of Cambridge University, and Professor Charles R. Lanman, of Harvard University, to be corresponding members.

The German Chemical Society has elected as honorary members M. Becquerel, of Paris; Sir William Crookes, of London; Dr. C. von Linde, of Munich; Professor E. Solvay, of Brussels, and Professor J. Thomson, of Copenhagen.

At the general meeting of the Royal Meteorological Society, on January 15, M. Teisserenc de Bort, the distinguished French meteorologist, was presented with the Symons memorial gold medal of the society, and the president, Dr. H. R. Mill, delivered an address on "Map Studies of Rainfall."

M. Baillaud, of the Toulouse Observatory, has been appointed director of the Paris Observatory.

C. E. Moss, D.Sc. (Victoria University), has been appointed curator of the herbarium of Cambridge University.

Dr. William F. M. Goss will be installed as dean of the College of Engineering of the University of Illinois on February 25. In the morning there will be addresses by the president of the university, by representatives of the trustees, of the alumni and of the faculty; followed by the installation address of Dean Goss. In the afternoon there is an inspection of equipment, followed by addresses of visiting engineers. These exercises are to be in connection with the formal opening of the graduate school, which occurs on February 4 and 5.

A dinner in honor of Dr. Rudolf Leonhard, Kaiser Wilhelm professor at Columbia University this year, and Dr. John W. Burgess, Theodore Roosevelt professor at Berlin last year, was given at the Hotel Astor on January 28.

The chiefs of the Six Nations in New York, through the Onondaga tribe, which has been the keeper of the archives throughout the history of the Iroquois Confederacy, have conferred on Director John M. Clarke, of the New York State Museum, the title of Hos-san-na-ga-da, the Keeper of the Name, in recognition of his official custodianship of the Iroquois wampums which were transferred to the state in 1898. The title is to be transmitted in perpetuity with the directorship of the State Museum.

Governor Deneen, of Illinois, has appointed the following commission, authorized by the general assembly to investigate the diseases of occupation in the state and report to the next general assembly: Dr. L. Hektoen, of Chicago; Dr. Alice Hamilton, of Hull House, Chicago; Dr. George W. Webster, of Chicago, president of the State Board of Health, and the secretary of the State Board of Health, Dr. James A. Egan.

The occupation of the Smithsonian seat in the Naples Zoological Station has been approved in behalf of Mr. I. F. Lewis for the month of March of the present year. Mr. Lewis is Bruce fellow in biology at Johns Hopkins University. The seat has further been assigned to Dr. F. M. Andrews, associate professor in botany at the Indiana University, for April and May. Dr. Andrews is now doing research work with Professor Pfeffer at Leipzig, and will devote himself to a problem in plant physiology while at Naples.

Mr. Robert B. Marshall, of the United States Geological Survey, has been appointed to administrative charge of the Topographic Branch of the Survey with the title of chief geographer. Mr. Marshall received his first appointment in the Survey in 1890, and has been connected with it continuously since that date. In 1903 he was given charge of California work, and two years later his district was enlarged to include Oregon. In the reorganization of the Topographic Branch in March, 1907, he was made geographer in charge of the Pacific Division, which comprises California, Oregon, Idaho, Nevada, Utah and Arizona. Mr. Thomas G. Gerdine, who has for a number of years had general supervision of the topographic work in Alaska, has been placed in charge of the Pacific division to succeed Mr. Marshall.

Professor Albert Neisser has returned to his post in Breslau after his long stay at Batavia for research on syphilis in monkeys. He will deliver an address on the present status of the pathology and treatment of syphilis at the approaching German Congress of Internal Medicine at Vienna, opening on April 6.

During the week from January 13 to January 18, Dr. Herman von Schrenk, consulting timber engineer for the Atchison, Topeka and Santa Fé Railroad and supervisor of timber preservation for the Chicago, Rock Island and Pacific Railroad, gave, as in former years, a course of seven lectures at the Forest School of Yale University on the decay of timber and a description of American and European methods and plants for seasoning and preserving wood.

William S. Bigelow, A.B. (Harvard '71), M.D. '74, of Boston, has been appointed Ingersoll lecturer for this year at Harvard University. His subject will be "Immortality as conceived and taught in Buddhism." The date of the lecture has not yet been fixed.

Professor Paul H. Hanus, of Harvard University, addressed the Civic Federation of New England, in Boston, on January 9, on "Industrial Education under State Auspices in Massachusetts."

Professof Leo Loeb, of the laboratory of experimental pathology, University of Pennsylvania, read a paper on "Tissue Growth and Tumor Growth" at a meeting of the American Philosophical Society on January 17.

At the meeting of the Academy of Natural Sciences of Philadelphia, held January 21, Dr. Casey A. Wood, of Chicago, gave the results of his ophthalmoscopic examination of the eyes of birds. The communication was illustrated by beautiful colored lantern views of the arrangement of nerves and blood vessels of the interior of the eyes of birds correlated in a most interesting way with the habits of the several species studied by the speaker in London and elsewhere.

The Royal Institution celebrated on January 17 the centenary of the discovery of the metals of the alkalis by Sir Humphry Davy. An address on this subject was made by Professor T. E. Thorpe.

A meeting in commemoration of the life and work of Lord Kelvin was held by the Philosophical Society, of Washington, at the Hubbard Memorial Hall, on January 18. Addresses were made by Professor Arthur G. Webster, Dr. Robert S. Woodward and Professor Simon Newcomb. Ambassador Brice likewise made some remarks. Dr. L. A. Bauer presided.

The twenty-fifth anniversary of the death of the Russian surgeon Pirogoff has been celebrated by conferring his name on a street and hospital at St. Petersburg and endowing an annual prize for works on surgery. Moscow has also named a street and a hospital in his honor and founded a Pirogoff prize.

Mr. Morris K. Jesup, president of the American Museum of Natural History and of the Chamber of Commerce of New York City, has died at the age of seventy-seven years.

Dr. John Ordronaux, lecturer on medical jurisprudence at Columbia University from 1861 to 1897 and the author of numerous works on medical jurisprudence, has died at his home at Glenhead, L. I., at the age of seventy-seven years.

Dr. Thomas Fillebrown, for many years professor of operative dentistry and oral surgery at the Harvard Dental School, died on January 22, at the age of seventy-one years.

The death is announced of Lieutenant Colonel R. J. L. Ellery, professor of astronomy and late director of the Melbourne Observatory, at the age of eighty years.

The Rev. Lorimer Fison, known for his researches among the aborigines of Australia, died near Melbourne on October 29 at the age of seventy-five years.

Dr. Zulkowski, professor of applied chemistry in the German Technical School at Prague, has died at the age of seventy-four years.

Secretary Root has urged upon congress an appropriation of $50,000 to enable the government of the United States to be represented in the exposition to be opened at Quito on August 10 next, to celebrate the one hundredth anniversary of the independence of Ecuador.

The State Charities Aid Association has received $10,000 from the Russell Sage foundation to organize methods for the prevention of tuberculosis throughout the state of New York.

A joint meeting of the Wisconsin Academy of Sciences, Arts and Letters, the Wisconsin Archeological Society, the Wisconsin Mycological Society, the Wisconsin Natural History Society and the Wisconsin section of the American Chemical Society will be held in Milwaukee—probably in the lecture room of the Public Museum—on Thursday and Friday, February 13 and 14. The plans at present formulated include a session on Thursday evening to which the public will be invited, the program for which will be of general interest. A banquet for the members of all the societies will be held on Friday evening.

An Italian Society for the Study of Tropical Diseases has been founded on the initiative of Professor Angelo Cello, director of the Institute of Hygiene of Rome, Surgeon-Lieutenant-Colonel L. T. Cipollone, of the Italian Navy, and Surgeon-Captain G. Memmo, of the Italian Army.

Owing to the success achieved in the execution of the magnetic survey of the Pacific Ocean, under the auspices of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, it is proposed upon the return of the present vessel (the *Galilee*), to San Francisco next May, to return her to the owners and to undertake the construction of a vessel especially designed and adapted for magnetic work. Such a vessel, it is said, will not only greatly facilitate the observational work by getting rid of the troublesome deviation corrections but will likewise materially reduce the office computations. As soon as this vessel is completed similar work to that of the Pacific Ocean is to be undertaken in the other oceans. With the aid of such a specially adapted vessel and the cooperation already secured by the Department of Terrestrial Magnetism from various countries, it seems reasonably sure now that a general magnetic survey of the globe will be completed within a period of ten to fifteen years.

Number 6 of the Augustana Library Publications has just been issued by Augustana College at Rock Island. It is a Linné Memorial number and the principal paper is by Dr. P. A. Rydberg, curator of the New York Botanical Garden, and is on the subject "Scandinavians who have contributed to the knowledge of the Flora of North America." The author says that his national pride helped him in choosing his subject, and well he might, for on the forty-nine pages of his paper he gives biographical and bibliographical notes on no less than 101 Scandinavian scientists who have contributed to the knowledge of systematic botany of North America, including Greenland, Mexico, the West Indies and Central America. The lists of the writings by the various authors contain 280 titles. One of these works, "Peter Kalm's Travels in North America," is in three volumes and is generally known as one of the best accounts of this country in the early days, and has been published in three languages. In all his writings, the author states, Linné described no less than 2,000 American species of plants. Of Scandinavian American botanists, who are now, or who have been residents in this country, the author enumerates no less than twenty-eight, himself being one of the number. Apparently he is easily foremost, as it appears from the long list of his own papers which has been inserted without the author's intention by the editor. Altogether the paper is a worthy memorial of the two hundredth anniversary of the birth of the illustrious Swede whose life's work gave the first great and world-wide impetus to the study of systematic natural history, and it is particularly fitting that such a memorial paper should be issued by an institution that has been reared by the descendants of the great botanist's countrymen in America.

Mr. H. M. Taylor, formerly tutor of Trinity College and mayor of Cambridge, is trying to promote the provision of scientific books for the blind. He has made a statement in which he says: "The blind who are interested in subjects of a scientific character are very heavily handicapped. An embossed copy of any book occupies a very much larger space than a printed copy of the same book. Lately the British and Foreign Blind Association has published Mr. Charles Smith's 'Elementary Algebra,' the published price of which is 3s. 6d. The embossed edition consists of five 'large royal quarto' volumes, containing in the whole 800 pages. The published price in cloth is 16s. 6d. Books in embossed type are very much needed, I am told, on such subjects as mechanics, physics, astronomy, chemistry, and geology. I hope that I shall not be disappointed in my belief that there are many persons interested in science who would be willing to contribute to a fund which would enable books on such subjects as I have mentioned to be embossed for the use of the blind, and to be sold at a more moderate price."

The Exhibition Committee announces that the Grand Exhibition of Japan will be opened in Tokio on April 1, 1912, and will be closed on October 31 of that year. It will be held on a site covering about 292 acres. All foreign governments and peoples are invited to participate in this exhibition. For foreign exhibits belonging to the five different departments of education, science, machinery, electricity, and manufactured goods, space will be allotted in the exhibition buildings erected by the administration office of the Grand Exhibition of Japan. For exhibits other than those above designated, any nation may erect a separate building at its own expense, which it may also use, if it pleases, for the articles belonging to the five departments mentioned. No charge will be made for space allotted for such building. All articles which shall be imported from foreign countries for the sole purpose of exhibition, and not used for commercial purposes in the country, and all materials for the buildings of foreign governments, or special exhibition buildings and decorations thereof, will be admitted free of duty. It is proposed to make a special arrangement concerning articles which shall be imported from foreign countries for sale at bazaars, or things intended for amusement and shows which are liable to customs duty, and a bill to that effect will be introduced in the next session of the diet. It is also intended to afford special protection to all inventions, designs, models of utility, and trade marks of foreign exhibits, and a bill to that effect will be introduced in the next session of the diet.

UNIVERSITY AND EDUCATIONAL NEWS

According to the daily papers the will of the late Mrs. Lydia Bradley disposes of an estate valued at $3,000,000. Almost the entire property goes to the Bradley Polytechnic of Peoria, Ill., which she established. Mrs. Bradley left only $5,000 to be divided among the children of her brothers and sisters, who, it is said, will institute suit to annul the will.

The Rev. Dr. Henry M. Sanders, who, in 1901, retired from the pastorate of the Madison Avenue Baptist Church, New York, has given $75,000 to Vassar College for the erection of a chemical laboratory. Plans for the building have been accepted, and construction will begin next month. The laboratory is to be of brick with terra cotta facings and in accord with the other buildings of the college. It will be 130 $\times$ 60 feet.

Mr. Andrew Carnegie has given $200,000 to Berea College, subject to an equal amount being given by others. It will be remembered that the Kentucky legislature required the separation of white and colored students, and Berea College has undertaken to establish and maintain two institutions.

Mr. Carnegie, who recently gave $50,000 to Illinois College, at Jacksonville, after $100,000 had been raised as a condition, has now consented to give a further sum of $75,000 on condition that an equal sum be raised.

According to the report of the treasurer of Princeton University, the university received during the last academic year gifts and bequests of the value of nearly a million dollars. This included $200,000 from an anonymous donor towards the biological laboratory, and $116,000, received through the committee of fifty for general purposes.

The trustees of the Western University of Pennsylvania have purchased for $68,000 twelve acres of the Schenley farms property, near the Carnegie Institute and Carnegie Technical Schools, Pittsburg. Plans will be secured for the new buildings, which, when completed, will cost over $1,000,000.

The legislature of Wisconsin has appropriated $30,000 for the establishment of a mining school at Platteville, which is in the zinc and lead mining district of the state.

Former Judge George G. Reynolds, of Brooklyn, has established two scholarships at Wesleyan University, Middletown, Conn., from which he was graduated in 1841. Twenty-five hundred dollars are provided for each.

Mr. H. O. Wills has promised £100,000 towards the endowment of the University for Bristol and the West of England provided a charter be granted within two years.

From the estate of Richard Brown, Youngstown, Ohio, Mount Union College, Alliance, Ohio, has received $30,000 for the endowment of a professorship. The board of trustees at their last meeting, in accordance with the provisions of the bequest, installed such professorship, and named it the Richard Brown professorship of mathematics. Professor Benjamin Franklin Yanney, head of the department of mathematics of the institution since 1894, was elected to the professorship.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, FEBRUARY 7, 1908

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

STUDIES ON FOSSIL FISHES DURING THE YEAR 1907[1]

SINCE the establishment of a merciful Concilium Bibliographicum it is not necessary for us either to wait for generous authors to donate separates, or to ransack files of literature to find the annual doings in each of our fields of inquiry. In the field in which I am especially interested, that of the lowest groups of fossil vertebrates, the Concilium will give you the full *récolte* of references and spare you my list of them—and titles in plenty there are in all the groups of fishes, from primitive sharks to the most complicated teleosts. There are papers systematic on the fossil fishes of California, on new sticklebacks, surgeon fishes, prosturgeons, conodonts—there are papers on the anatomy of fossil fishes, acanthodians and placoderms, and there are not lacking references to the descent of the fishes and to the philosophy of their evolution, as in Eastman's monograph on the fossil fishes of New York, Smith Woodward's address before the Paleontological Society, Patten's continued studies on *Bothriolepis,* and Jaekel's remarks upon the "nest" of placoderms which he has brought to light in the Upper Devonian of Wildungen.

But from all these references we can for the present review only those which bear upon the greater problems.

Our first inquiry, in considering the advances in paleichthyology, is whether the

[1] A portion of the address of the retiring president of the Society of Vertebrate Paleontologists, New Haven, December 27, 1907.

past year has unravelled the problem of the origin of the vertebrata. And I fear that we can, as usual, report nothing better than progress. To our infinite regret there have been forthcoming no new results on the Silurian fishes of Scotland, the clan of Thelodus, Lanarkia, Lanasius. We recall, however, Dr. Patten's splendid work in unearthing fins, tail and other structures of the lowly *Bothriolepis,* and the beautiful models which he demonstrated before the Zoological Congress in Boston. Nevertheless, he has not established, it seems to me, his thesis as to an arthropodial chordate. But he has given us valuable perspective as to the position of this very early "fish": for his studies show clearly how remote a cousin was this form to any type of our known chordates. On evidence which he adduces, such as the position of the anus between the horizontal postero-ventrolateral plates, curious little separately set jaws, which may have operated laterally instead of vertically, and in other regards, we can only conclude that *Bothriolepis* belonged to a terminal group, as far, at least, as our living fishes are concerned. By no stretch of my morphological imagination can I see how this carapaced, hinge-spined, and thread-tailed anomaly could have given birth to a line of our real backboned animals.

Important in this connection is a summary of Hussakof which shows in how many regards the group to which *Bothriolepis* belongs corresponds, as earlier writers believed and as later writers denied, to the group of Arthrodira containing such forms as *Coccosteus, Dinichthys* and *Titanichthys.*

In short, we may be dealing in these groups collectively, which are popularly known as "placoderms," with a great line, a phylum or subphylum, of chordate creatures which preceded the types of modern chordates and which in spite of lines of heroically developed tribes, families, genera and species, died out as the modern chordates came into competitive being. They were, I suggest, chordates in which there were misdirected, or more accurately, unfortunate, evolutional tendencies, affecting structures or correlated combinations of structures. These may well have carried the placoderms along successfully to a certain point, but beyond this basis their morphological restrictions did not permit them to go. Thus these creatures may have been chordates which were defective in the substratum of a gill arch type of mouth and they had not, therefore, laid the necessary foundation for the endofacial complex of the higher animals: I mean that the mouth region of these ancient forms had not the capability of attaining the strengthening support of endoskeletal elements, the greater mobility which gill muscles provided, the greater vascular and nervous supply, the fuller channel for sensory impressions: instead, in those pioneer forms, the mouth apparatus was fashioned on a simpler, more independent and therefore shorter-lived plan. Their jaws were strictly dermal elements, and operated by dermal muscles—all in all a mouth mechanism non-homologous with that of the higher vertebrates.

In the great group of the placoderms known as Arthrodira, including such puzzles as *Dinichthys, Diplognathus, Mylostoma* and *Coccosteus* these jaws seem to have run a gamut of adaptive changes: then followed a period of extermination, for we know to-day of no placoderm—cephalaspid, pterichthyid, coccosteid—which passed an undisputed boundary line into the Carboniferous. The ancient tree died and its branches dropped off. But before its extinction some of its members developed curiously specialized forms and structures, paralleling the characters of modern fishes, as though in a final and supreme "effort" to compete successfully with their fundamentally better equipped rivals.

The recent discoveries of Professor Jaekel have confirmed a prediction—suggestion made nearly a score of years ago—that we should yet find how manifold were the forms of arthrodires during their period of maximum prosperity. He has found in Wildungen, in practically a single spot and in a narrow fossiliferous seam, usually but a few inches thick, no less than twelve genera and fifty species of arthrodires, nearly all of which are new! And paleontologists may well look forward to the publication of his extraordinary results. Here, then, in the uppermost Devonian, close before their extinction, these forms assumed the most varied characters, even bilateral narrowness, in which the form of a swift-swimming teleost was paralleled. I hope, however, that my colleagues will leave this case to parallelism and will not make this creature, the latest and most specialized of the placoderms, the progenitor of teleosts! Dr. Jaekel has, up to the present moment, unhappily, published only an abstract of his results. But they show clearly enough that the forms described are typical arthrodires; and they yield, I believe, no good evidence as to the kinship of these forms to true fishes.[2] Dr. Eastman's recent and careful elaboration of the view (of a score of years ago) that arthrodires are of lung-fish derivation and that a primitive form of the Australian lung-fish (*Ceratodus*) was their progenitor I have already commented upon in Science. On the evidence especially of the flattened dental plates of a late form of arthrodire, *Mylostoma*, he is convinced of a kinship to the modern forms, and he explains the absence of ceratodonts in the pre-Mesozoic on the ground of the fragmentary nature of paleontological evidence. He neglects, however, it seems to me, to take into account what we do know of the Paleozoic lung-fishes, and these documents are both numerous and important, as Dollo, for example, has pointed out. And he has not evaded the morphological pitfall (it seems so to me at least) of attempting to establish homologies between more or less terminal forms of widely different descent. Indeed it is clear that if arthrodires are descended from a primitive ceratodont, their puzzling allies, bothriolepids and cephalaspids must also be closely related to the same ancestor, but this is difficult even to imagine: for who can fancy, as early at least as in the upper silurian, in which all these forms occur, that even then they could be traced back to lung-fishes essentially ceratodont? Furthermore, if I mistake not, Dr. Eastman believes that sharks are the ancestors of lung-fishes, and in this event, how far back into the Urzeit would our paleontological fancy project to find the origin of our modern fishes? The paleontological record is scored, seamed and scanty, we painfully admit, but I am confident that it is not as bad as all this: if the lung-fishes, arthrodira and their anomalous allies came from a ceratodont ancestor we should certainly have found a trace of it somewhere in the stupendously long interval between the upper Silurian and the Mesozoic. We find, on the contrary, that not merely is this creature absent, conspicuously absent, but that its

[2] Thus there is no new light on the presence of fins and girdles: what he regards as the "undoubtedly demonstrable" hip girdle in *Coccosteus* is to certain morphologists, at least, a very doubtful structure; whatever it be, it is rudimentary in Jaekel's new forms. Nor does his explanation carry conviction as to the under jaw of *Pholidosteus* with angular and articular elements. The former is, I believe, the "interlateral" plate well known in the ventral armoring of coccosteids, the latter probably an articular (detached) process of the central plate. The views of Jaekel as to the position of the Arthrodira can not, however, be criticized in detail in the present paper.

kindred, which are present and even abundant, are more and more shark-like in dentition, fins and dermal defenses the further back we go. To maintain in the face of such evidence that a ceratodont existed in the Urzeit would be, it seems to me, as difficult as, for example, to maintain the probable presence of man in the Jurassic.

The puzzles of primitive sharks have been considered several times during the past year, and I think it is quite safe to say on cumulative evidence that "if the earliest true fish could be found, it would almost certainly fall within the subclass Elasmobranchii."[3] From a recent study on the structures of the lowly acanthodians[4] we have reason to believe that they are allied more closely to the more typical sharks. Their dentition was quite shark-like, with (a few) successional rows of teeth, and their fin structures conform more typically to the plan known in cladodonts. In this connection the evolution of their curious finfold type of fin in different members of this group has been indicated lately by Smith Woodward. Of other structural features in acanthodians we know even details, *e. g.*, in sensory canals and ear structures. As vertebrate morphologists some of us wish we could believe that the acanthodians, earliest of sharks, had a great number of gill slits, but for the present we shall have to content ourselves with the typical selachian number, five: we wish also that we could feel assured that the mandibular arch in acanthodians was segmented dorsally after the fashion of a typical gill arch, as Reis and Jaekel have shown in the Permian *Acanthodes bronni*, but unhappily certain earlier genera (the lower Devonian *Ischnacanthus gracilis, Cheiracanthus murchisoni*) do not have this interesting subdivision of the palatoquadrate, and it may well be, therefore, that in later forms the subdivision is due to fossilization, the cartilage subdividing, owing to weakness from nutrient vessels, etc., at certain definite spots.

An up-to-date classification of the selachians by Tate Regan should here be mentioned[5] which gives interesting notes as to the evolution of the sharks and considers the paleontological evidence.

The chimæroids have been made the subject of comparative study during the past year,[6] and from an examination of their fossils, anatomy and embryology the conclusion is reached that they are to be classed not as ancestral sharks, but rather as a group highly divergent from some early shark stem. The few undeniably primitive features which they possess are heirlooms from some Paleozoic selachian ancestor—features which modern sharks have not as well conserved owing, among other causes, to the elaboration of hylostylism. The nearest living kin of the chimæroids are probably cestraciont sharks.

Important in this connection is the discovery that our pre-Permian "chimæroids," *i. e.*, those antedating menaspids, may have to go by the board. Jaekel's discovery of associated remains of *Rhamphodus*, as Dollo points out,[7] makes it probable that all ptyctodonts, hitherto classed as chimæroids, are in reality highly modified arthrodires!

Our knowledge of the descent of lung-fishes has not progressed perceptibly during the past year—*i. e.*, if we admit that the Arthrodira and early lung-fishes are not related, the view which we have main-

[3] Smith Woodward, "Natural Science," Vol. VI., p. 38.

[4] Dean, "Notes on Acanthodian Sharks," *Am. Jour. of Anatomy*, Vol. VII., pp. 209–226.

[5] Regan, *Pro. Zool. Soc. London*, 1906, pp. 722–758.

[6] Dean, "Chimæroid Fishes and their Development," Monograph 34, Carnegie Institution, Washington, D. C.

[7] *Bull. Soc. Belge de Geol.*, 1907, pp. 97–108.

tained above. Nor has the year seen any notable advances in our philosophical knowledge of the ganoids. Their fin structure alone has been considered critically,[8] and in this discussion the evolution of the "effective fins" shows the relations of ganoids and teleosts.

Nor has the great group of Teleosts yielded far-reaching results during the past year. The paper of Woodward above cited recapitulates the teleostean fins and skeleton from the standpoint of evolutional philosophy. And, in a matter of detail, Hussakof has described a form of surgeon fish which serves to connect the balistids with the teuthids. On the purely systematic side work has been active, but this phase of research our time will not permit us to treat.

Finally, as to the evolutional philosophy which the study of fossil fishes has touched upon, we can only say that orthogenesis keeps presenting itself with significant persistency. There has, however, been no attempt up to the present time to collect these results systematically—and herein lies a harvest for the reflective worker. We should, on the other hand, mention the vast materials unearthed by Jaekel at Wildungen, for in them he maintains, rightly or wrongly, the appearance of an "explosive" or mutational origin of species.

Bashford Dean

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION G—BOTANY

Section G of the American Association for the Advancement of Science met during the past convocation week at Chicago, all of the sessions, except the vice-presidential address by Dr. D. T. MacDougal, being held in the Botany Building of the University of Chicago. Three sessions were held for the reading of papers, and all meetings were held in conjunction with the Botanical Society of America, so that in no case were two botanical meetings held simultaneously. The attendance varied from one hundred to one hundred and fifty, and over one hundred professional botanists from outside Chicago were present at the meetings. The sessions were presided over by the vice-president of the section, Professor Charles E. Bessey; in the absence of the secretary, Professor Francis E. Lloyd, Dr. Henry C. Cowles acted as secretary *pro tem.*

The following officers were chosen:

Vice-president—Professor H. M. Richards, Columbia University.

Secretary (five years)—Dr. Henry C. Cowles, University of Chicago.

Member of the Council—Dr. F. E. Clements, University of Minnesota.

Member of the Sectional Committee (five years)—Professor R. A. Harper, University of Wisconsin; (one year, vice Professor Charles E. Bessey, resigned)—Dr. J. M. Greenman, Field Museum of Natural History, Chicago.

Member of the General Committee—Professor M. B. Thomas, Wabash College.

The following resolutions were adopted, in memory of Professor Lucien M. Underwood:

Whereas: By the lamented death of Dr. Lucien Marcus Underwood, late professor of botany in Columbia University, science has suffered a severe loss and the American Association for the Advancement of Science, particularly the Botanical Section, an active and esteemed member, be it

Resolved, That this society place on record its recognition of his fruitful labors along his chosen lines in the field of scientific research and instruction and its keen appreciation of the stimulating influence of his personal character and scholarly attainments.

The vice-presidential address of Dr. D. T. MacDougal has been published in full in Science. Abstracts of the technical papers presented follow:

[8] A. S. Woodward, *op. cit.*, pp. 276–278.

The Past Season's Experiments with Anthracnose-resistant Clover: S. M. Bain and S. H. Essary. (Read by title.)

Some New Cases of Mendelian Inheritance: George H. Shull.

The common garden sunflower exists in two forms with respect to branching. One of these has a single large head borne on an unbranched stem, the other has a number of strong branches which ascend strongly till they reach nearly the same height as the central axis. The branching is shown to be a Mendelian character, dominating completely over the simple-stemmed type. The garden sunflower differs from the wild *Helianthus annuus* in the color of the disk, the former having a yellow disk, the latter a deep purple disk. The disk color likewise constitutes a Mendelian pair with the purple disk dominating the yellow.

In *Lychnis dioica,* purple and white flowers are shown by a large series of crosses to be a Mendelian pair with purple dominant over white. A large number of families of the composition $DR \times R$ showed a range of variation in the number of purple-flowered offspring from 30 per cent. to 65 per cent. in the different families, and when these percentages were seriated they presented a nearly normal variation curve, showing that the assumption that the unlike gametes unite according to the laws of chance is correct. The usual statement that 50 per cent. purple is to be expected in such cases is inaccurate, for according to the law of chance the 50 per cent. ratio can be properly expected only when the number of observations is infinite. When a normal curve is formed with the mean approximating 50 per cent. within the limits of probable error every proper expectation has been fulfilled.

Both *Helianthus annuus* and *Lychnis dioica* are incapable of self-fertilization, and the occurrence of these cases of typical Mendelian inheritance shows that self-fertilization bears no relation to this type of inheritance, though it was first discovered in a self-fertilizing species.

In *Verbascum blattaria,* two forms occur, one with bright yellow flowers, the other with pale, cream-colored flowers, almost white. These forms constitute a Mendelian pair with the yellow dominant over the pale-flowered form. This differs from the behavior of yellow flower color in *Matthiola* (stocks) and *Polemonium,* in which the white has been shown by Bateson and Correns to be dominant over yellow. The yellow of *Verbascum* proves to be a sap color, while that of *Matthiola* and probably that of *Polemonium* also are a plastid color thus showing that Bateson's classification of the color of *Matthiola* on this basis is probably fundamentally correct.

The Prairie Grass Formation of Southeastern South Dakota: Leroy H. Harvey.

The formation is a part of the Ponca Prairie District of Pound and Clements. Its composition is transitional between the mesophytic eastern and xerophytic western prairies. These two groups of elements during post-glacial migration entered from two distinct centers of migration; the former from the southeast by the Missouri Valley route and the latter from the southwest. The prairie is preglacial in origin and is descended from the climatic prairie of Tertiary times which arose in response to reduced precipitation caused by the upheaval of the Rockies at the close of the Cretaceous.

The floral activity of the formation at Yankton, South Dakota, may be recorded in the following five aspects: prevernal, April 1 to about April 25—six species; vernal, May 3 to about May 31—twenty-eight species; estival, June 1 to about July 7—twenty-one species; serotinal, July 7 to about August 7—thirteen species; autumnal, August 7 to about September 21—twenty-two species. The prairie elements show a marked grouping into layers which correspond with the floral aspects. Overtopped by the autumnal, the sublayers are successively those of the serotinal, estival, vernal and prevernal. There is a marked distinction in the chresard of base, slope and crest in the prevernal, which becomes less marked in the subsequent aspects, approaching equality in the autumnal. As a result the floral covering shows a corresponding difference upon base, slope and crest in earlier aspects; the influence of position gradually declines, the floral covering presenting a striking similarity over the entire formation in the autumnal.

New or Noteworthy Peronosporales: Guy W. Wilson.

In the course of a monographic study of the Peronosporales several problems in specific limitations have arisen, some of which have been solved and are discussed. To these notes are added the description of two new species of *Albugo* and notes on the distribution of *Phytophthora thalictri* and *Peronospora floerkeae*, both of which are rare species.

Both *Albugo trianthera* and *A. cladothricis* were described from Las Cruces, New Mexico, the former occurring on *Trianthera*, the latter on *Cladothrix*. Both are rather closely related to *A. bliti*, but are distinguishable by conidial characters. The oospore of *A. triantheræ* is also quite characteristic, while that of *A. cladothricis* is unknown. Of the four other species discussed, *Peronospora cyparissiæ, P. rumicis* and *P. hyoscyami* are to be dropped from the list of American species, the first being a mistaken determination of *P. euphorbiæ*, while the other two represent European species with American cognates. *P. rumicis* becomes *P. polygoni* and *P. hyoscyami* becomes *P. nicotianæ,* a species heretofore reported only from South America. *P. arborescens* must also be added to our flora, having been collected in Colorado on *Argemone,* but erroneously reported under the name of *P. corydalis.*

Notes on Cleistogamy of Grasses: Agnes Chase.

I. The genus *Triplasis* is found to produce late in the season cleistogamous spikelets in small panicles wholly or partly included in the sheaths; specimens of *T. purpurea* (Walt.) Chapman, collected in October, 1907, show a second form of cleistogene, larger than the others, solitary and sessile at the base of the prophyllum.

II. *Amphicarpon amphicarpon* (Pursh) Nash was collected in October, 1907, with perfect grains in the aerial spikelets as well as in the subterranean cleistogamous ones.

Mutations of Rudbeckia hirta: W. J. Beal.

Dr. W. J. Beal, of Michigan Agricultural College, during the past five years has selected from many thousands of plants, certain peculiar forms, sports or mutations, flowers of some of which he exhibited:

1. A specimen with wide ray flowers, the head four inches across.

2. A large head of flowers with the base of each ray dark purple.

3. A large head with fourteen ray flowers, each quilled or narrow for one fourth inch at the base.

4. A head in which all the rays were tubular or quilled.

5. A head with rays very light yellow.

6. The rays twisted.

7. A very small head with rays about one fourth inch in length.

8. One with center of head green instead of purple.

Plant Zones of the Mountain Lakes in Northern Colorado: FRANCIS RAMALEY and W. W. ROBBINS.

In the Rocky Mountain region of northern Colorado, the lakes of the subalpine and alpine districts are of the morainal type, while those of the montane zone are chiefly meander lakes. Around these lakes zonation is well developed in cases where there is an accumulation of silt.

In a typical morainal lake studied by the writers, there is a *Carex* zone surrounded by a *Salix-Betula* zone. Among the more prominent plants in the former zone are *Dodecatheon* and *Clementsia* besides various grasses and sedges. Mosses occur here also, chiefly *Polytrichum, Mnium* and *Sphagnum.* In the *Salix-Betula* zone there are such plants as *Elephantella, Pedicularis* and a few orchids. This zone is surrounded by a coniferous forest.

A meander lake at about 9,000 feet altitude, showed four zones: (1) *Carex;* (2) *Salix-Betula;* (3) *Dasiphora;* (4) *Campanula.* Still another meander lake (altitude 8,000 feet) had three zones: (1) *Carex;* (2) *Thermopsis;* (3) *Campanula.* Back of these zones in this particular case there is a belt of grassland before the coniferous forest is reached.

Lakes above timber line show no zonation. In all lakes of the montane and subalpine districts, pond weeds occur and yellow pond lilies in many. There is an entire absence of cattail and bulrush vegetation.

It is worthy of note that in general the pondside plants have come down from higher altitudes and the plants of dry situations have come up from lower altitudes. In other words, the mountain mesophytes are largely boreal forms while the xerophytes show austral affinities.

Rock-ridge Vegetation of Northern Colorado: FRANCIS RAMALEY and W. W. ROBBINS.

The sedimentary rock ridges in northern Colorado have a striking appearance due to the considerable dip of the strata and the numerous faults and folds. Sharp escarpments, deep gulches and irregular erosion lines make the country rough and rugged.

A remarkable scrub formation of mountain mahogany (*Cercocarpus parvifolius*) occurs on these ridges, being generally quite dense where there is little soil and frequently stopping as an abrupt line near the foot of a hill or ridge.

At the line of contact between the granites and the conglomerates there is usually a broad lateral valley with rather fine-grained compact soil. This supports a grassland formation with no trees or shrubs. The granite hills to the west have a scattered covering of pines, various shrubs, grasses and perennial herbs. East of the lateral valley are the sedimentary rock ridges with their dense scrub of mountain mahogany and a few scattered pines. In the deep gulches, Douglas spruces and deciduous mesophytic shrubs occur just as in the canyons of the granite foothills.

The rock ridges with much lime in their composition show a very open formation of *Cercocarpus,* the shrubs being often eight or ten feet apart, but on the sandstone the plants make a close stand very difficult to climb through. *Cercocarpus* grows only on a dry, rocky substratum and is replaced by grassland where there is more soil and moisture, while its place is taken by mesophytic shrubs, trees and grasses in moist shaded situations where there is an accumulation of humus.

A careful study was made of one square mile of territory at the contact of the granites and sedimentaries. This territory was mapped and the vegetation charted so that the more striking differences between granite hills, lateral valley and rock ridges could be seen.

A Preliminary Account of Studies in the Variability of a Unit Character in Œnothera: R. R. Gates.

The most striking character distinguishing the mutant *O. rubrinervis* from its parent *O. Lamarckiana,* is the conspicuous red color present on the petioles and mid veins of the leaves and on the sepals and young fruits of the former. The variability of this red color pattern in the sepals of *O. rubrinervis* has been the main object of study. Painted types of individual buds were used as standards of classes in cataloguing the variability. The variation in the extent of the red on the sepals is definite, forming a reduction series, the color receding from the margin of the sepals and in extreme reduction appearing only as a series of spots along the sides of the median ridge of each sepal, or rarely being wholly absent. By examination of all the flowers of a plant, the mode of the individual may be obtained, and this is found to vary in different individuals. One extreme variant in a culture of 1,000 *O. rubrinervis* plants showed a great increase of the red pigment, which covered not only the whole sepal (including the median ridge, which is otherwise always green) but also the hypanthium. Whether this extreme form will breed true, and how it will behave in a cross, is to be determined later.

The buds of *Œnothera Lamarckiana,* when attacked by a certain insect, produce red pigment as in *O. rubrinervis,* showing that the capacity for pigment production under certain circumstances is present in *O. Lamarckiana* and not that it is confined to certain germ cells only in which it originates suddenly as a new or additional unit character. These and other facts of variation are not in accord with the DeVriesian conception of unit characters in mutation, but may be better explained on another basis.

In all, 1,460 buds from 104 individuals were examined in this preliminary study. A more extensive study of color variations in *Œnothera* is to be made.

Mine Fungi: Perley Spaulding. (Read by title.)

The Loco Investigation: C. Dwight Marsh. (Publication reserved.)

Crystal Formation in Cultures of Penicillium: Arthur W. Dox. (Presented by Charles Thom.)

In cultures of different species of *Penicillium* upon Cohn's medium, the formation of peculiar crystals was noticed. Crystals were formed only by those organisms which gradually changed the reaction of the medium from acid to alkaline. Chemical analysis showed them to be magnesium ammonium phosphate with six molecules of water. This substance has heretofore been obtained only by precipitation and in microscopic crystals, whereas the crystals formed in Cohn's solution were often two centimeters in length. The finest crystals were obtained when the culture was carefully maintained at a uniform temperature. This work suggests a possible application of mold cultures to the formation of other substances in crystals, particularly those substances that are soluble in acid but insoluble in neutral solutions.

Embryo-sac Development and Embryology of Symplocarpus fœtidus: C. O. Rosendahl.

The inflorescences of *Symplocarpus fœtidus* are borne as lateral branches in the axils of the leaves on the upright, monopodial rhizome. They develop very slowly and the rudiments of the flowers are distinguishable eighteen to twenty months before the time of blossoming. The ovules are formed during the late summer and fall months of the year previous to blossoming. In nearly all cases the ovary is one-chambered, with but one ovule in each chamber. This is orthotropous and pendant from the upper part of the cavity. Occasionally two chambers are found with one or more ovules in each.

A single archesporial cell is differentiated, which becomes the spore-mother cell. This, by two successive divisions, gives rise to four megaspores. In most cases the two megaspores toward the chalaza end lie in the long axis of the ovule, while the two toward the micropylar end lie transversely. All four spores germinate, the innermost one giving rise to the embryo-sac, the others breaking down.

The first divisions of the oospore are transverse and a row of three to four cells is built up before anticlinal walls appear.

In the development of the endosperm a period of free cell formation is followed by the appearance of cell walls whereby a tissue is built up throughout the embryo-sac. It grows rapidly and soon begins to encroach upon the inner and outer integuments and finally begins to push back into the basal tissue of the ovule.

The antipodal cells give rise to a tissue made up of a considerable number of cells with greatly enlarged nuclei.

The proembryo undergoes rapid changes, at first becoming club-shaped and later on pyriform or ovoid. A short suspensor made up of several rows of cells is formed. Upon one side of the embryo, near the suspensor, a small depression appears which deepens into a groove. On the axial side of this groove the leaves and plumule are differentiated. The axes of the plumule and the radicle form a somewhat acute angle with each other, the one being bent back upon the other.

During the differentiation and development of these structures, the protocorm has completely devoured the endosperm and all traces of the integuments have disappeared. The only ovular tissue left is a small remnant on one side of the naked, nearly spherical embryo.

Regeneration in Root-tips of Vicia and Phaseolus: C. H. Shattuck.

This paper gives the results of the writer's recent experimental work at the University of Chicago. The important points developed by this study are as follows: (1) The lysigenous breaking down of the plerome cells above the point of wounding; (2) the fusion, at certain levels, of young cells from opposite sides of a split root-tip in the region of the pericycle; (3) the disrupting of these tissues at lower levels, thus giving rise to two distinct roots; (4) the complete restoration of the circular form of the root by means of a radial meristem in which the ordinary transverse orientation of the cell plate becomes longitudinal; (5) the encircling of stems by a whorl of new roots when spirally cut through the pericycle; (6) that the root orients itself geotropically, not because the vegetative point has reached a particular stage, but always because of the appearance of statolithic starch and fails to regenerate if this does not appear.

Notes on Gymnosporangium macropus: F. D. Heald.

Gymnosporangium macropus has been considered an annual, but the investigations carried on by the author in Nebraska have shown that two years is required for the "cedar apples" to reach maturity. Young "cedar apples" can be found nearly a month before the rust spots on the apple leaves have matured any æcidiospores. The unusual prevalence of "cedar apples" in Nebraska is due to the extensive use of the cedar as an ornamental tree and for orchard wind breaks with the planting of varieties of apples especially susceptible to the disease. During the past season, æcidiospores were found in viable condition during July, August, September and until October 22, and it was shown that spores from this period produce no evident infection until the spring of the next year when growth is resumed and the young "cedar apples" become visible.

The Bud-Rot of Carnations: F. D. Heald.

The bud-rot of carnations is a new disease which has only been prevalent in Nebraska and a number of other states during the past few years. The disease has been proved by the writer to be due to a definite species of fungus, *Sporotrichum anthophilum* Peck, which has associated with it a new species of mite, *Pediculoides dianthophilus* Wolcott, as a constant accompaniment.

The disease affects the buds in various stages of maturity aud produces a rotting of the petals and other flower parts, at least the parts enclosed by the calyx, thus interfering with the normal opening of the flower. The disease has therefore been termed the "bud-rot" of the carnation.

A Principle of Elementary Laboratory Teaching for Culture Students: Charles H. Shaw.

Biological laboratory teaching in general comes far short of accomplishing the results expected. On the average the student develops relatively little of that interest in the subject and power of observation which are the chief reasons for the existence of such courses.

A teacher is likely to find himself able to stimulate a greater degree of interest and effort in part of the lessons than in others. This fact is of primary importance. Laboratory courses should be made up of those lessons in which the teacher finds himself able to bring the class to its maximum of independent effort, leaving to lecture and demonstration the task of keeping the course logically connected and rounded out.

A sort of corollary to the above seems to be that courses are to be modified in the direction of physiology. To reach the desired end it may in some cases even be necessary to omit certain standard topics of morphology. In all cases the goal must be kept clearly in view and any needful sacrifice made without limitation.

The Influence of the Form of Carbon upon the Morphology of Penicillium Cultures: Charles Thom.

Cultures of eleven species of *Penicillium* are presented to illustrate the wide difference in morphology produced by changing the source of carbon in synthetic culture media. For comparison the species are exhibited upon potato-agar, then upon synthetic agar in which carbon is presented: (1) as granulated sugar (sucrose), (2) lactose, (3) glycerine, (4) alcohol, (5) tartaric acid. Repeated cultures have shown that the form of carbon presented produces very marked differences in metabolism, in morphology and in the changes induced by cultures upon the substratum—*i. e.*, formation of pigments, crystals, etc. These cultures emphasize the importance of exact definitions of substrata or culture media in describing saprophytes of this genus.

Plant Succession in Eastern Colorado: H. L. Shantz.

Climatic and soil factors of the plant habitat. Plant succession on areas which have been broken and deserted for from one to twenty-two years. Chief stages of the succession. Conditions which hasten or retard the succession. Succession under natural conditions.

The Influence of Wind upon the Distribution of Plants in Iowa and Adjoining Territory: B. Shimek.

Winds tend to produce xerophytic conditions, and their effect in conjunction with topography and drainage, upon the vegetation of the state of Iowa, is discussed. The possibility of forest (mesophytic), as well as xerophytic areas within the state is explained on this basis.

Some Apple Leaf-spot Fungi: Carl P. Hartley.

The finding of eighteen apple leaf-spot fungi in West Virginia is recorded, the commonest ones being *Coniothyrium pirina, Coryneum foliicolum, Sphæropsis malorum,* and an undetermined species. The two first named were grown artificially. Inoculation work with both the *Coniothyrium* and the *Coryneum* indicated that they were not capable of causing serious leaf disease. Both fungi were found on wood, the former apparently wintering on dead twigs.

On the Occurrence of Pith Spots in the Wood of the Soft Maple: Hermann von Schrenk. (Read by title.)

Observations on Change of Sex in Carica papaya: M. J. Iorns. (Read by title.)

Studies in the Genus Gymnosporangium: Frank D. Kern.

This paper gives a brief statement of the problems encountered by those who began the systematic study of the genus *Gymnosporangium* in this country, with an abstract summary of the published results. The data left by past workers was chaotic and insufficient, but by selecting new diagnostic characters and by studying in detail many specimens from all parts of the United States the difficulties have been overcome. For the purpose of bringing together the data in such a manner as to be of material assistance in the determination of specimens, a key involving the characters of the telia is presented. Notes are given explanatory of changes in nomenclature, extensions of range, etc. It has been found necessary to describe three new forms.

Vernal Aspect of the Chaparral Formation of California: Pehr Olsson-Seffer. (Read by title.)

Periodicity in Spirogyra: W. F. Copeland.

The object of this paper is to mention some results of investigation bearing upon the seasonal or periodic activities of *Spirogyra*. The work was continued for twenty-two months in the laboratory and in the field. Indoor work was in ordinary biological laboratories, where over seven hundred aquaria were used. Outdoor study was limited to forty ponds within a distance of twelve miles. At least thirteen species were kept under observation. The period of maximum abundance corresponded exactly with the period of maximum conjugation. The vegetative filaments disappeared at the same time as the conjugating filaments. When a species was in fruit out of doors, it was also in fruit in the laboratory. Experiments and observations seemed to indicate that *Spirogyra* is not a perennial plant; that its activities are limited to a few weeks, or months at most; and that the vegetative and conjugating activities are conditions resulting not so much from external as from internal environment.

Types of Some Rocky Mountain Willows: Carleton R. Ball. (Read by title.)

Dry Rot of Corn and its Causes: James T. Barrett.

Diseases of ear corn which have been called "dry rot" have been found, upon investigation, to be caused by several species of fungi. The one which has been the most destructive the past two seasons and to which 85 to 90 per cent. of the rot was due is a species of *Diplodia,* very probably *D. maydis.*

When an early infection takes place this fungus causes a premature ripening and shriveling of the ear, which usually remains in an upright position with tightly clinging and dark-colored husks. Later infections which produce various degrees of rot in the ear may or may not present the symptoms mentioned above; in fact, in many cases the disease is not detected until the husk has been removed. The seasonal infections are started by conidia blown from the old rotten ears and the one- or two-year-old stalks left standing in the field.

A form of disease which is not uncommon this season and due to a species of *Fusarium* is recognized in that it is usually more localized than that caused by *Diplodia* affecting the ears in patches. The fungus produces dense masses of mycelium both on the diseased areas of the corn and in pure culture. Microconidia are usually found in abundance, while macroconidia are rare.

A third form of the rot noticed for the first time this season is very characteristic in that infection, with few exceptions, takes place at the tip of the ear and the mycelium soon develops a deep pink color. The fungus thus far has proven to be sterile. The effect on the corn is much the same as that produced by the later infections of *Diplodia.*

Other forms of rot have been found to be due to other species of *Fusarium,* and one to one or more species of bacilli.

From data collected from fifty or more counties in Illinois in 1906, it is estimated that more than 15,000,000 bushels of corn having a value of $5,400,000 were destroyed by rot.

The Relation of "Conjugation" and "Nuclear Migration" in the Rusts: E. W. Olive.

The seemingly conflicting results obtained by Blackman and Christman in their investigations of the sexual phenomena in the *Cæoma* type of rusts are to some extent brought into harmony by certain new and supplementary facts recorded in the present paper.

In the several species of *Cæoma* rusts studied by the writer, fertilization was found to be accomplished, much as Christman maintains, through the absorption of a portion of the walls of two essentially similar gametes. The fusion process may begin, however, through a very small conjugation pore, so that as the one protoplast moves through the narrow opening to fuse with the adjoining gamete, the nucleus may thus sometimes be stretched out or constricted, in this condition presenting an appearance quite similar to that which Blackman has termed "nuclear migration." Such an instance is regarded simply as a case of conjugation between two cells in which the connecting pore is as yet small. The writer observed instances in which a Blackman type of conjugation, as it may be termed, through a narrow pore, occurred side by side with a Christman type of fusion, through a broad pore. The essential feature of the process is therefore regarded as the equal participation of two morphologically equivalent cells to form the binucleated "fusion cell."

But although the conclusions of Christman are thus in greater part confirmed, several observations made in connection with the sexual fusions point to the important conclusion that the two gametes differ somewhat in time of development. The observations on which this conclusion is based are as follows: (1) In the *Cæoma* forms the first hyphæ to push up under the epidermis mass themselves often more or less regularly upright and parallel and then proceed to cut off sterile cells at their tips. The sterile tips push up against the epidermal cells and soon degenerate. A more or less prolonged period of vegetation appears thus to intervene before the conjugations begin. (2) Generally only one of the two conjugating gametes bears such a sterile tip while the other shows no such differentiation. (3) The gamete which bears the degenerating tip cell often appears to be placed somewhat above the other, thus suggesting that the earlier hyphæ fuse, not among themselves, but with other hyphæ which push up later from below. Such a differentiation in time of development does not involve, in the writer's opinion, a morphological differentiation; the lower gamete is therefore not to be regarded as a "vegetative cell." The sterile cell, according to these views, is not an abortive, functionless trichogyne, as proposed by Blackman's theory, but merely a "buffer cell," a degenerate gametophytic cell, morphologically similar to the functional gametes. This of course leaves the so-called spermatia still unexplained.

The Relationships of the Æcidium-cup Type of Rust: E. W. Olive.

The recent work of Blackman and Christman has solved to a great extent the problems which concern the origin of the diffuse *Cæoma* type of rust. But the more complicated, compacted cup fructification apparently needs further explanation. This is rendered evident by the recent discovery in a number of species of large, irregularly-shaped, multinucleated cells, which appear to arise from the stimulated growth which follows the sexual fusion. Sometimes several such multinucleated cells may be seen at the base of the æcidium cup. In some of these instances they undoubtedly originate as detached buds or branches from a single, central growth; in still other cases, more than one fusion apparently takes place and more than one center of growth thus results. It is quite probable that these large, multinucleated cells may prove to be similar to the archicarps of DeBary, Massee and Richards. The basal cells which form the origin of the rows of æcidiospores arise as the ultimate branches of the multinucleated cells.

The æcidium-cup type of rust is thus derived from a deep-seated, more or less limited, mass of cells; and the peridium arises as an enclosing layer, apparently in consequence of the deep-seated character of the fructification, as well as from its more or less centrifugal growth. The fructifying organs of the diffuse *Cæoma* type are, on the other hand, more or less superficially placed, and no peridium is formed in this instance. Many sexual cell fusions, in most instances probably one for every spore-row, occur in this kind of rust; whereas in the æcidium cup but few sexual fusions apparently take place.

The simpler *Cæoma* type sometimes shows in its course of development a phenomenon which, in my opinion, points to the conditions in which the more complicated æcidium-cup fructification probably had its origin. Following the sexual fusion, the two nuclei thus brought together begin rapidly to divide by conjugate division. Sometimes nuclear division thus goes on more rapidly than cell division; so that as a result several nuclei (as many as six have been observed) come to lie in the one large fusion cell. It is quite conceivable that a still further development of such a multinucleated fusion cell, coupled with the partial suppression of other neighboring cell fusions, especially in the case of a deep-lying *Cæoma*, might give rise to the cup-shaped type of æcidium, with its enveloping peridium. This idea is made the basis of the conclusion that the complicated æcidium-cup fructification might be thus directly derived from certain of the

Cæoma-like rusts, and so to be regarded as the last of the evolutionary series of this group of fungi. While there may be some slight resemblances of the æcidium cup in its development to certain Ascomycetes, the regular occurrence of conjugate nuclei in the rust form, as well as the additional wide differences in the spore mother cells of the two groups of organisms, precludes, in my opinion, the idea of any close relationship between the two, as has been assumed by Blackman.

Are Canned Goods Sterile? T. J. Burrill.

The canning process depends for its efficiency and safety upon the exclusion of living bacteria; sometimes by defects in the cans or in the process failure occurs. Do cans apparently sound ever contain living bacteria? Several investigators have reported affirmatively, but mistakes are hard to avoid and the reported results can not be considered conclusive.

For this investigation a new method was adopted, believed to be more likely to reach the truth, but in this there are shown to be some growths—eleven out of two thousand six hundred and one cultures or 0.42 per cent. There is every reason to believe these are contaminations in spite of the care taken to prevent them. In one case there were two positive cultures, from one can; otherwise only one tube out of seventeen from a can showed growth.

Conclusion: cans which "keep" are sterile.

Henry C. Cowles,
Secretary pro tem.

University of Chicago

THE ENTOMOLOGICAL SOCIETY OF AMERICA

The third meeting of the Entomological Society of America was held at the University of Chicago, December 30 and 31, 1907, in affiliation with the American Association for the Advancement of Science, and other societies. About one hundred were in attendance, coming from as widely remote localities as Maine and California, Ottawa and Louisiana.

On Monday sessions were held for the reading of papers. On Monday evening the annual address was given before the society by Professor Herbert Osborn, of the Ohio State University, his subject being "The Habits of Insects as a Factor in Classification." The address was followed by a most enjoyable smoker, at which the members of the society and their friends were the guests of the Entomological Section of the Chicago Academy of Sciences.

At the annual business meeting on Tuesday, December 31, the following officers were elected:

President—Dr. William Morton Wheeler.

First Vice-president—Dr. John B. Smith.

Second Vice-president—Rev. Professor C. J. S. Bethune.

Secretary-Treasurer—J. Chester Bradley.

Additional Members of the Executive Committee—Dr. James G. Needham, Professor V. S. Kellogg, Professor Herbert Osborn, Professor J. H. Comstock, Dr. P. P. Calvert, Mr. F. M. Webster.

Standing Committee on Nomenclature—(to serve three years) Dr. H. T. Fernald, (to serve two years) Professor T. D. A. Cockerell, (to serve one year) Dr. E. P. Felt.

Committee on Nomenclature.—Dr. Fernald moved, seconded by Dr. Smith:

1. That the Entomological Society of America hereby endorses the Code of Nomenclature adopted by the International Zoological Congress as the code which should be used by the members of the society so far as it can be applied.

2. That cases not covered by this code which may be presented to the society for consideration, be referred to a standing Committee on Nomenclature, to consist of three members, one member of which shall be elected each year for a term of three years, and the opinion of this committee on cases referred to them, shall be reported to the society at the first annual meeting subsequent to their reference to the committee.

Mr. Bradley moved to amend by striking out the second clause, because entomology should not be treated as distinct from zoology in general, and because the Commission on Nomenclature established by the International Congress of Zoology is the sufficient and proper body before which to bring such question for decision.

Dr. Fernald stated that the reports of the Commission on Nomenclature of the International Congress of Zoology are greatly delayed by the fact that the congress meets only once in three years, and by the rule that a question must be presented at least a year before the meeting at which it is to be considered. It was not the intention of the mover that the committee should act in opposition to or independently from the Commission on Nomenclature, but that it should be instrumental in voicing the needs of entomology before that body, which should be the final court of reference.

With that explanation, the amendment was withdrawn and motion passed.

Publication of a Journal.—Perhaps the most important act of the meeting was embodied in the following resolutions adopted by the executive committee and confirmed by the society:

1. That the society undertake a publication to be called *Annals of the Entomological Society of America*, to be issued in quarterly fascicles.

2. That it include only papers of importance or marked merit, and that each be issued and bound separately as well as in fascicles, so that each paper may be sold separately.

3. That proceedings of the meetings be included either at the beginning or end of each volume and form one separate, which is to be sent to all members of the society.

4. That a subscription price of one dollar in addition to the membership fee be charged members for the annals and that the subscription price to non-members, libraries, etc., be $3.

5. That an editorial board be selected by the executive committee and that this board shall select one of its members as managing editor, who, with his associates, shall be responsible for the selection of material to be published.

6. That if possible some one living in a suitable location and who can undertake the work of managing editor for a series of years, be selected for this position.

7. That details not covered in this report are to be determined by the editorial board.

8. That actual publication under the provisions of this report be inaugurated as soon as possible.

It will be seen from the above that all members will receive the number containing the full proceedings of the meetings free, and upon payment of one dollar the entire annals; while the regular subscription price to non-members will be $3.

A resolution was passed limiting the number of fellows for the present to ten per cent. of the membership.

The meeting then adjourned, to meet next December in Baltimore.

During the sessions the executive committee elected the following fellows: Justus Watson Folsom, William Joseph Holland, Clarence Preston Gillette, Lawrence Bruner, Mark Vernon Slingerland, Henry Clinton Fall, Charles Lester Marlatt.

J. Chester Bradley,
Secretary

SCIENTIFIC BOOKS

Practical Physiography. Harold Wellman Fairbanks, Ph.D. Pp. xxvii + 542; 403 figs., including 9 colored maps. Boston, Allyn & Bacon. 1906.

The author of this new text-book of physiography points out the fact that the evolution of better methods of teaching justifies the addition of new texts to those already in use, and in his own production makes certain departures from the usual methods with the purpose of effecting desirable improvements. Questions and exercises are distributed throughout the text, in order to make the volume a combination of text-book and field and laboratory guide. The illustrations are largely from photographs, on the ground that "they appeal with much more force to pupils of high school age than do diagrams or sketches." When diagrams are considered necessary, the student is asked to construct them. The printed illustrations are good, and have an added interest from the fact that most of them are from the author's own negatives. The press work is excellent, and the appearance of the volume is very attractive.

The book is divided into two parts, the first supposed to deal with physiographic processes in general, and the second with physiographic features of the United States, although this scheme is not closely followed. In Part I. are considered such subjects as the general features of the earth's surface; the effect of the "interior or building-up forces" and the "exterior or tearing-down forces" on the surface of the earth; the composition of the earth; and the work of underground waters. In Part II. we find a discussion of the plains, mountains, valleys, rivers, lakes and shore lines of the United States, the climate of the United States and the subjects of forestry and irrigation, as well as a general treatment of the ocean and the air.

As a source of good illustrations and much interesting information, the book is of distinct value. While appreciating the book's many good points, the writer of this review is impelled to point out what seem to him some serious defects.

It may be doubted whether any considerable number of teachers of physiography will agree with the author that photographs can advantageously replace good diagrams. The absence of such diagrams detracts from the value of the present book. Both diagrammatic and photographic illustrations are needed in the ideal text. It is impossible to secure photographs of many things which require illustration; as, for example, the relation of structure to topography in different types of mountains. To depend upon the student for the preparation of such diagrams does not seem desirable.

The lack of system in the selection and presentation of subject-matter throughout the book constitutes, in the opinion of the reviewer, another serious defect. Physiographic descriptions are frequently encumbered with a large mass of geological details, interesting in themselves, but having little or no relation to surface forms. Two whole chapters are devoted to The Composition of the Earth. The conditions of ore deposition, and the methods of mining are of importance to students of economic geology and mining engineering; but it may be doubted whether it is expedient to burden a text-book of physiography with matter so irrelevant. The consideration of stream action, instead of being systematically presented in one place, is scattered through several chapters, especially chapters IV., The Exterior or Tearing-down Forces; VII., The Sculpturing of the Land, and XIV., Valleys and Canyons. In Part I., General Physiographic Processes, we look in vain for any discussion of such general topics as ocean tides and currents, movements of the air, formation and classification of clouds, the origin of storms, etc. But we find two chapters on these general subjects included in Part II., under the title, The Physiography of the United States. Sand dunes and glacial accumulations are treated in chapter XII., Mountains of the United States. Barrier beaches and lagoons are in part treated under Basins and Lakes of the United States, in part under The Geography of Coast Lines.

The author follows, to a limited extent, the newer method of physiographic treatment in which land forms are considered in their relation to stages of development in the geographic cycle. Such treatment is largely confined to a single chapter, where the "geographic cycle," "new topography," "mature topography" and "old topography" are briefly considered. Elsewhere in the book we find little application of this newer method, although, in the opinion of the reviewer, it is essentially important in a modern text on physiography.

When we examine the details of subject-matter we find a number of statements which many teachers of physiography would consider open to criticism. The full-bodied, subdued forms of the maturely dissected White Mountains of New Hampshire are cited as examples of "old mountains." It is implied in several places (*e. g.*, page 34) that fresh lava is always rough and old lava smooth. The implication that young mountains are those which are still being uplifted and that old mountains are those in which the uplifting process has ceased (pp. 6, 126) might mislead the student, inasmuch as uplift might be going on in a young, a mature or even an old mountain range; while uplift might have entirely ceased in a young mountain range. The stages of mountain development are not directly concerned with constructional forces, but depend wholly upon the amount of dissection accomplished by destructional forces.

If the author's statements are correctly interpreted, it would seem that the stage of development of the land form and the stage of stream development are often confused. On page 132, after describing a region where the streams "dash swiftly through narrow canyons" and where "rapids and waterfalls mark their courses," it is stated that "the topography has now reached its *mature* stage." It is true that the land form in question may have reached maturity, but the description suggests that the streams are very young. Figure 98 represents the head of King's River in the Sierra Nevada, and is given as an example of "topography in early maturity." The mountains are mature, but the valley appears to be young. Figure 99, Trinity River in the Klamath Mountains, and figure 100, a canyon near Phœnix, Arizona, are likewise cited as examples of "mature topography," although both show features generally regarded as characteristic of youth, and both are referred to as "canyons."

The discussion of drainage patterns on pages 142–151 is confusing, because the author uses the terminology of recent students of river action, but does not follow their interpretations. The definition given of subsequent streams is not the definition generally accepted by physiographers, and the origin of subsequent streams as understood by them is nowhere referred to. The figure representing subsequent streams is misleading inasmuch as none of the streams can be regarded as subsequent, with the very doubtful exception of a few of the smallest branches. The request that the student distinguish between the consequent and subsequent streams of the folded Appalachians may lead to error, for the streams (Delaware, Susquehanna, etc.), which according to the implication of the text are to be considered consequent, are believed by those most familiar with the rivers of the region, to belong to a different class. The statement that "the tributary streams are, however, weaker than the rock structure and have adapted themselves to it," and that stream channels are "slowly shifted to correspond to the differences in the rocks" suggests that the streams, tributaries and all, are ready made, let down upon diverse rock structures, and then bodily shifted to follow the softer rocks as far as possible. The student is here given an interpretation of the methods of drainage adjustments quite different from that generally advanced to account for the relations existing between longitudinal and transverse valleys. One is surprised to find in a modern text-book the statement that when subsequent streams "encounter a broad stratum or dike of resistant rock, they turn and follow along the softer beds by the side of the main stratum until a narrow or weak spot is found in it, and then they turn and cross" (p. 145). Such an explanation is obsolete.

On page 190 we find the statement that "Plains of accumulation are distinguished by perfectly even surfaces, often many miles in extent. Volcanic plains and plains of erosion are often undulating." Maturely dissected plains and plateaus have no place in this classification, and the undulating surfaces of young plains of accumulation are not recognized. The Appalachian Plateau is not even mentioned in the discussion of plains and plateaus of the United States; nor under mountains formed by erosion, where other dissected plateaus are classed. But under Rivers of the United States, we find a brief reference to the "maturely dissected" Appalachian Plateau (p. 347). The region from the head of the Gulf of California eastward into Texas is described under Marine Plains (p. 193), where it is stated that "the waves and currents which built up these plains so long ago distributed the sediments as evenly as a floor. The mountain peaks rise like islands from this floor." The alluvial origin of extensive areas of the intermontane plains, the relations of the plains to each other and to the mountain ranges, and the many other complications in the topography of the region, do not find a place in this description. The account of the Great Plains (pp. 212–215) leads the student to believe that the surface is a gently undulating peneplain surface with a little gravel strewn over it near the base of the Rocky Mountains; and that the eastern slope of the Rocky Mountains west of Colorado Springs is formed by the up-folded layers which underlie the plains. ("The steep slope of the eastern face of the mountains marks the point where the strata, which underneath the plains are nearly flat, have been sharply folded"—p. 214.)

The reviewer's experience as a teacher leads him to conclude that students profit more from a statement of both sides of a question concerning the answer to which some doubt might reasonably be entertained, than from a definite settlement of the question according to the author's best opinion. Some teachers would prefer to omit the consideration of such questions altogether. Teachers having either conviction will doubt the wisdom of such statements as that on page 255, where it is confidently asserted regarding a low mountain fold in Washington, that "the movement undoubtedly stopped long ago, and will never result in a greater elevation." In a reference to that problematic ring or crater known as Coon Butte, Arizona, we read: "This iron [meteoric iron found about the crater] was thought by those who found it to be fragments of an enormous meteorite which had struck the earth with such force as to bury itself deeply where the crater stands. The iron, indeed, proved to have belonged to a meteorite that by mere chance had fallen by the crater and really had nothing to do with it" (p. 268). The student would not realize, from this statement, that the meteoric origin of the crater is still maintained by competent geologists.

The author's discussion of glacial erosion includes the following statements: "It is even thought by some that the rounded canyons in glaciated areas, including the fiord canyons of Norway and Alaska, are in their essential features the work of glaciers; but there is much more reason in the view that they were made by running water, and that their flooded mouths have resulted from a subsidence of the land." "As a usual thing, the trunk stream in a given basin will deepen its channel more rapidly than its tributaries, so that the latter will for a long time enter the main canyon or valley by a rapid or waterfall. It is also true that a large glacier will erode its bed more than a small one, and this fact has given rise to the view held by some geographers that hanging valleys in glaciated regions are the result of differential action of ice streams of unequal size. From the fact that similar valleys exist in non-glaciated regions, however, it seems more reasonable to believe that the main features of hanging valleys result from stream erosion previous to glaciation" (pp. 314–316). It is to be feared that the student will here be misled as to the real reason why some geographers believe hanging valleys and fiords in glaciated regions are due to glaciation; also that he will not appreciate the very limited occurrence of hanging valleys in non-glaciated regions, or the special conditions under which they occur in such regions. He will later have to learn that, except in certain young valleys, tributaries as a usual thing enter the main stream at accordant levels, as announced by Playfair many years ago. It is interesting to note that the example of a hanging valley ascribed by the author to normal stream action (p. 330), is that of Bridal Veil Creek where it enters the Yosemite Valley; an example taken from a *glaciated* region, and believed by many to be due to glacial over-deepening of the main valley.

The antecedent origin of the course of the Green River through the Uinta Mountains is set forth without question (p. 362), notwithstanding the doubt long entertained regarding the correctness of that interpretation. The popular misapplication of the term "tidal wave" to a wave produced by an earthquake shock is adopted on page 434, without any explanation; confusion is made easy because tides are treated in the same connection. The relation of the two high tides is stated in the following words: "It (the water) is heaped up on the side nearest the moon, because there the pull of the latter is strongest; while a corresponding rise in the water takes place upon the side farthest away, where the pull is weakest" (p. 436). While literally true, the statement is likely to mislead the student who does not notice the sudden change from "because" in the first part of the sentence, to "where" in the second part. The reason for the existence of two waves is not referred to.

Throughout the volume one sees abundant evidence of the author's extended field experience and untiring industry in collecting illustrations of physiographic features. While the book is, in its present condition, of value to teachers, for general school use the subject-matter will require, possibly in another edition, more carefully considered and systematic treatment.

D. W. Johnson

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Experimental Zoology, Vol. V., No. 1 (November, 1907), contains the following papers: "Determination of Sex in *Hydatina senta*," by David Day Whitney. "A New Explanation of the Mechanics of Mitosis," by Arthur B. Lamb. It is suggested that the characteristic configuration of the chromatin substance in dividing cells may be due to a synchronous pulsation or oscillation of the astral centers and it is shown that this explanation presents certain unique advantages as contrasted with previous explanations. "The Reactions of Planarians to Light," by H. E. Walter. The action of light upon planarians is a function of its intensity, which, under certain conditions, is emphasized by the direction of the light. The orientation and phototaxis of planarians is more consistently explained by the theory of tropisms than by the theory of trial and error. The evolution of the photoreceptive apparatus of planarians stands at such a low stage of differentiation that the light environment of these worms is of slight importance to them.

At the recent Chicago meeting of the Association of Economic Entomologists a stock company was organized for the purpose of publishing a *Journal of Economic Entomology*. This bimonthly publication is devoted to economic entomology in its widest aspects. The first number will appear in February. It has a board of editors and advisory board composed of well-known investigators. E. P. Felt, state entomologist, Albany, N. Y., is editor; A. F. Burgess, secretary of the Association of Economic Entomologists, Washington, D. C., associate editor, and E. D. Sanderson, business manager. On the advisory board are Dr. S. A. Forbes, Illinois; Dr. James Fletcher, Canada; Dr. L. O. Howard, Washingtcn; Dr. H. T. Fernald, Massachusetts; Professor Herbert Osborn, and Professor H. A. Morgan, Tennessee.

SOCIETIES AND ACADEMIES

THE TORREY BOTANICAL CLUB

The regular meeting of the club for December 10, 1907, was held at the American Museum of Natural History at 8:30 P.M., with President Rusby in the chair and fourteen persons present. In the absence of the secretary, Mr. Charles L. Pollard was appointed acting secretary. The minutes of the last preceding meeting were read and approved.

The following scientific program was presented:

Dictionaries and their Relation to Biology: Charles Louis Pollard.

The speaker referred to the fact that a large part of the increment in our language in recent years has consisted of scientific terms, including new Latin classificatory names, biological descriptive words and phrases, and vernacular names. In spite of this there is a very general lack of interest among working scientists in the average dictionary, and it is not the indispensable reference book which it should be. The reasons for this are to be sought in the attitude of the publishers toward the style of definitions, the effort to avoid undue technicality often resulting in scientific inaccuracy. Obsolete words and meanings are frequently given too great prominence and are not properly differentiated from those in current usage. There is also a tendency to magnify the importance of so-called popular names, many of which are coined by the writers of manuals and are not used elsewhere.

The general discussion which followed brought out the fact that the dictionary, in spite of its defects, contains much information difficult to obtain from other sources, but that it is very generally at variance with usage among botanists in the matter of pronunciation.

Notes on the Pine Barrens of Long Island: Roland M. Harper.

The flora of the pine barrens of Long Island has received little attention from botanists, chiefly because it consists of comparatively few and widely distributed species. A list of 46 Long Island pine-barren plants was published by Dr. Britton in 1880, and copied by at least three subsequent writers, but even yet the aspects of the vegetation have scarcely been described, or any photographs of it published in botanical literature.

The pine barrens are chiefly confined to the southern half of Suffolk County, and are very well developed in the uninhabited portions of the towns of Babylon and Islip. The area covered by them is very flat, with a soil of coarse sandy loam. The vegetation is of two types, dry pine barrens and swamps, the former being by far the most extensive. In the dry pine barrens the trees are nearly all *Pinus rigida,* and there is a dense undergrowth consisting mostly of *Quercus ilicifolia* and *Q. prinoides,* two to six feet tall. The commonest herbs are *Pteridium aquilinum, Ionactis, Cracca, Baptisia, Dasystoma,* etc. The effects of fire are everywhere visible.

In the swamps the flora is somewhat richer than in the dry pine barrens. *Acer rubrum, Nyssa, Clethra, Alnus, Myrica, Ilex, Osmunda* and *Dulichium* are characteristic. Ericaceæ and allied families are well represented.

Nearly all the species in these pine barrens are quite widely distributed in the glaciated region, or on the coastal plain, or both. Many also occur in the mountains, from New Jersey to Georgia. The vegetation is very similar to that of some parts of the pine barrens of New Jersey, from all accounts, but the flora is considerably less diversified.

The paper was illustrated by photographs, and will be published in the January, 1908, number of *Torreya.*

Charles Louis Pollard,
Secretary pro tem.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 409th meeting was held December 3, 1907. The president read the program for the coming academic year of the Paris School of Anthropology, and exhibited a photograph by A. Frič of a band of professional Indian-hunters still employed in South Brazil. Several of the men-hunters show wounds, while in their midst is a small group of captured Indian women and children.

Professor W. H. Holmes gave an account of the prehistoric sites in Arizona and New Mexico recently set apart for preservation as public monuments. They are great pueblos in Chaco Canyon, New Mexico; Inscription Rock near Zuñi, New Mexico, bearing autograph inscriptions of early Spanish explorers; and Montezuma Castle on the Rio Verde, Arizona. Professor Holmes was followed by Mr. Edgar L. Hewett, who presented many interesting details regarding Chaco Canyon pueblos and the cliff ruins of the Mesa Verde. Illustrations of these ruins were shown, and a prolonged discussion engaged in by Messrs. Lamb, Koher, Robinson and Hewett.

Dr. Hrdlicka demonstrated the right humerus of an adult orang showing perfect healing after a complete oblique fracture at the middle of the shaft, just below the attachment of the deltoid. The bone was somewhat shortened, but there was little displacement, leaving the animal with a very serviceable limb. The bone is from a wild orang collected in Sumatra for the U. S. National Museum by Dr. W. L. Abbott. In view of the arboreal habits of the orang, the location of the fracture in the right arm, and the time needed for a strong union of the fragments, the healing effected is truly remarkable. The case arouses much speculation as to the behavior of the animal under such conditions, and it seems certain that the injured arm was given a prolonged rest. Discussed by Professor Holmes and Drs. Lamb, Baker and Kober.

Dr. I. M. Casanowicz exhibited specimens of ancient textiles in the U. S. National Museum. They are from Panopolis and Antinopolis in Egypt, are of linen, cotton, wool, and rarely silk, and date from the third to the seventh century, A.D. They are decorated usually in geometric designs with wool of various colors in tapestry stitch.

At the meeting of December 17, 1907, native cotton raised by the Hopi of Oraibi, Arizona, was exhibited by the secretary, who said that the seed of this cotton is similar to that found in ancient graves in northeastern Arizona. The Hopi use this cotton for cord and textiles devoted to ceremonial purposes.

The paper of the evening was by Major James Albert Clark, of the Bureau of Immigration, on "The Effects of Immigration on the Ethnic or Race Composition of our Population." Major Clark held that the pessimistic view that the country will be injured by the immigration is baseless; on the contrary, it is made by immigration. Teutonic, said Major Clark, will always be the backbone of the nation, and though 25,318,067 foreigners have come in since 1820, this number has not smothered the basic population. He discussed the various characteristics and prejudices of the racial elements which make up the American nation, and concludes that the alchemy of assimilation is forming the greatest nation the world has ever held. The address was discussed by McGee, Robinson, Hrdlicka and others, and a vote of thanks was tendered Major Clark for his illuminating treatment of his subject.

Walter Hough,
General Secretary

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION

The eightieth regular meeting of the section was held in the amphitheater of the Chemistry Building of the Harvard Medical School, on December 20, at 8 o'clock P.M., President Frank G. Stantial in the chair. About eighty members and friends were present. The paper of the evening was by Dr. William F. Boos, of the Laboratory of Physiological Chemistry, of the Massachusetts General Hospital, who addressed the section upon "Ptomaïns and Toxins." Two classes of poisonous substances have been distinguished as occurring in the flesh of animals: (*a*) Bodies formed as the result of putrefaction, and (*b*) substances resulting from the invasion of the body by pathogenic bacteria. This distinction is being abandoned because there is really no essential difference between the two classes. Most of the substances isolated from putrid animal matter are harmless, but one, *sepsin*, is very poisonous. The term "ptomaïns" was first applied to many substances in putrefying animal matter, but most of these are non-toxic. On this account the term toxin was introduced for poisonous ptomaïns.

Toxins are classified as: (1) Ectotoxins, which are dissolved in the culture fluid, and when injected subcutaneously, produce anti-toxins, which render the subject immune. The toxins of diphtheria and tetanus are of this class; (2) endotoxins, which are part of the body-substance of the bacteria, and which do not produce true anti-toxin when injected into the blood, but which yield precipitating and agglutinating agents like the opsonins of Wright. The toxin of tuberculosis illustrates this class.

Meat poisoning cases frequently occur due to toxic substances, which produce symptoms resembling alkaloidal poisoning. Thus, the toxin from infected sausages produces symptoms much like those of atropin poisoning, and has therefore been called "ptomatropin."

The only toxin which has been isolated in the pure state is "sepsin." It has been prepared from putrid yeast and putrid blood. Twenty mgms. of the sulphate killed a large dog in a few hours. The symptoms and effects are very similar to those of arsenic poisoning. By heating to 60° C., for an hour, sepsin is changed to cadaverine and rendered innocuous.

Poisoning from spoiled meat is due to sepsin; but thorough cooking changes sepsin into cadaverine. It has often been noticed in cases of epidemics, that only those who ate the smoked or lightly cooked meats were poisoned. But in ordinary cooking processes, the interior portions of the meat or fish may not reach a temperature sufficiently high to destroy the poison if present.

As regards low temperatures and cold storage effects, the bacteria may remain alive at zero temperatures and below, and even continue to multiply as long as the medium is liquid. But if meat is stored at temperatures low enough to produce a solidly frozen substratum it will keep indefinitely since there can be no bacterial growth or activity in ice. Fowls have been found perfectly good after four years storage at —10° F. But the public prejudice against cold storage products leads the market men to thaw the birds or meat before placing them on sale. This thawing is done by soaking in cold water, and as fresh water is not used for each piece, the water becomes foul, and well preserved material becomes infected. Unsold birds or meat, after thawing and hanging in the air for longer or shorter time, are frequently returned to cold storage and re-frozen to keep until the market demands them. Such re-refrigerated stock always shows marked deterioration. By purchasing original frozen stock, and allowing it to thaw slowly in the air, the consumer can insure himself perfectly good material at practically no risk of toxic poisons. Soaking frozen stock is always to be condemned.

In the lengthy discussion it was brought out that pure sepsin always shows the same degree of toxicity, no matter how prepared. When combined with albumen, certain animal and vegetable poisons appear to act more quickly than do their pure toxins. This is true particularly of ophiotoxin or snake venom. Meats and fowl should be placed in cold storage at once after killing, to insure long keeping. But for economical reasons, the animal heat is allowed to dissipate before putting the meat in the cold room. Meats that are "high," have already begun to decompose, but their habitual use appears to render the consumer more or less immune to the effect of toxins. In support of this theory successful experiments have been made to immunize animals against sepsin.

Following the discussion, a vote of thanks to the speaker, and to the faculty of the Harvard Medical school for the courtesies extended to the section, was passed. The members were then shown through the laboratories and inspected the equipment of the Chemical Building.

FRANK H. THORP,
Secretary

DISCUSSION AND CORRESPONDENCE

TOWER'S EVOLUTION IN LEPTINOTARSA

IN SCIENCE for July 19, 1907, Professor T. D. A. Cockerell gives a very appreciative review of Tower's investigation of evolution in chrysomelid beetles of the genus *Leptinotarsa,* and incidentally points out some defects. Professor Tower's work is of such scope that it seems desirable to call attention to certain errors and shortcomings which it contains. Above all one misses a clear presentation of the facts upon which the work is built up and which alone can give it standing among scientists. The value of the evolutionary discussion, which makes up the bulk of the work, must rest upon the accurate presentation of data and if these data are weak the deductions can not hold. It is my purpose herewith to point out such statements touching upon the biology and systematic aspect of these beetles as seem to me to call for criticism. Even a slight acquaintance with the literature of the subject would have saved Professor Tower from errors which are surprising in a man who claims to have devoted eleven years to his subject.

On page 1 is a tabulation of genera and species of Chrysomelini, abstracted from the "Biologia Centrali Americana." Although this purports to include the forms found in "America north of the Isthmus of Panama" the species found to the north of the Mexican boundary, with the exception of a few species of *Leptinotarsa,* are omitted. Thus several additional genera, and a large number of species, should be included in such a consideration. It is stated that of the 13 genera enumerated all but *Phædon* are peculiar to America, while in fact *Plagiodera* and *Melasoma* are likewise circumpolar. To these circumpolar genera must be added *Timarcha, Entomoscelis, Prasocuris, Chrysomela, Gastroidea, Gonioctena* and *Phyllodecta.* Professor Tower states that "with the exception of *Phædon*, all of these genera are closely allied." In fact, *Plagiodera* and *Melasoma* fall into a well-marked group with *Phædon*.

On page 2 Professor Tower states that three species of *Leptinotarsa* are found in the United States. The following species are known to occur north of Mexico: *decem-lineata* Say, *juncta* Germ., *texana* Schaeff. (*defecta* Linell, not Stål), *defecta* Stål, *lineolata* Stål, *dahlbomi* Stål, *haldemani* Rog., *rubiginosa* Rog.

Tower states that the life histories of *Leptinotarsa* are almost entirely undescribed; those of the following species have been published: *cacica* Stål, *behrensi* Harold, *undecim-lineata* Stål, *decem-lineata* Say, *texana* Schaeffer, *juncta* Germar, *calceata* Stål, *lineolata* Stål.

The list of the species of *Leptinotarsa* is simply garbled from the "Biologia" without reference to any other sources. Stål's classic work on the group is not even cited in the bibliography! The following two species are altogether omitted: *peninsularis* Horn and *multilineata* Stål. Most likely this last is the "*intermedia*" proposed by Tower, but not described. Under *L. defecta* at least two species are confused; quite probably the quoted record from Yucatan applies to still another species. *Leptinotarsa modesta* Jacoby = *L. behrensi* Harold, as Professor Tower might have discovered by more careful consultation of his one source of information—the "Biologia." No attempt is made to settle the status of doubtful species. Thus *L. violacesceus* Stål and *L. libatrix* Suffrian occur in the same localities and appear to be forms of one species. Tower visited these localities and collected these forms and a little attention should have settled this point. *Leptinotarsa puncticollis* Jacoby is merely a color-variant of *L. behrensi*.

Of Tower's five new species there is no descriptive matter whatever. Of four of them a single elytron is figured—however, no specific characters are shown in these figures. More useful for future identification will be the larvæ which are figured in three cases. Professor Tower asserts that the specific distinctions lie mainly in the colors of the beetles in life, and which disappear after death; he, however, studiously avoids any statement of what these color-differences are. And what are we to think, then, when on page 238 we read that *L. oblonga* is dimorphic and has a red and yellow form! In truth, several of the forms which Professor Tower enumerates as species are invalidated by the evidence which he presents in the body of the work. Thus *L. melanothorax*, if Professor Tower's observations are correct, can in no sense be termed a species; it does not exist independently in nature and is merely a color-variant of *L. multitæniata*.

While there is no direct statement to that effect, one is led to infer that the elytral pattern is of the greatest importance for specific differentiation. Yet the figures, if the forms are correctly associated, directly contradict this view. It remains to be proven, however, that such forms as appear under the same name in plate 14, Figs. 38 and 39, and in plate 23, Figs. 20 and 21, really belong together. On page 77 it is stated that the subcostal stripes are the least variable part of the elytral pattern; in *L. juncta* the two subcostal stripes present the most striking variation in that they are either independent, except at their extreme ends, or fused throughout, forming one heavy black stripe.

Plate 14, Fig. 35, shows a variation of *L. undecim-lineata* with the outer stripe wanting, but this form is omitted from the table of variation on page 78.

With Tower's seven varieties of *Leptinotarsa decem-lineata* matters stand even worse. Two of them are figured; of the rest there is nothing whatever to indicate their nature—unless one accepts the names themselves as aids to the imagination. Some of these forms are stated to show a number of characters which are specific; it would certainly be of interest to learn what these distinctive characters are. To give his work standing, Professor Tower must publish satisfactory descriptions of these forms. Furthermore, he should deposit series of all his species in a public museum, such as the National Museum, where they would be accessible to students and their preservation and authenticity guaranteed.

Plate 16, Fig. 9, represents *L. tortusa* Tower, a "variety" of *decem-lineata;* it appears to be a sport such as is sometimes produced by malformation or slight injury to the pupa. Such oddities of color-pattern, and much more striking ones, produced in such manner, are of frequent occurrence in the Coccinellidæ.

The statements regarding the distribution of *Leptinotarsa* on page 3 are at variance with those in the table on page 1.

But it is when we come to the discussion of *L. decem-lineata,* and the book may almost be said to be a treatise on this one species, that the superficiality of the author becomes most apparent. *L. multitæniata,* which occupies central Mexico, is stated to have extended its range to the northward along with its food plant, *Solanum rostratum,* in the wake of the Spanish conquerors in their progress northward. In its new habitat (northern Mexico and Texas) it was transformed into the form *"intermedia."* The introduction and dispersal of *Solanum rostratum* into northern Mexico along the lines of early Spanish travel, and its spread from there farther north by the bison, are discussed at great length. *L. intermedia* of northern Mexico, after it reached the eastern slopes of our Rockies, was transformed into *decem-lineata.*

The whole argument turns upon the hypothetical dispersal of *Solanum rostratum* and the assumption that this plant is the original food plant of *L. decem-lineata.* We are virtually asked to believe that since the days of the Spanish conquest *L. multitæniata* has produced the two species *intermedia* and *decem-lineata.* Professor Cockerell has made the claim that in New Mexico *Solanum eleagnifolium* is the normal food plant of *L. decem-lineata.* As Dr. Chittenden has pointed out to me, the species of *Leptinotarsa* will feed upon various species of *Solanum,* preferring the more succulent ones.

On page 24 we learn that "the original distribution of *decem-lineata* was on the eastern slope of the Rocky Mountains northward to the Canadian boundary, eastward into western Kansas and Nebraska, and southward into Texas and New Mexico. In this habitat it was found by Say in 1823. Then, as now, it was probably sparsely distributed over the area, feeding upon *Solanum rostratum.*" It would be interesting to know from what sources Professor Tower obtained all this information regarding the original habitat and food plant of the species. After the original description of the species by Say, we find the remark: "This species seems to be not uncommon on the Upper Missouri, where it was obtained by Mr. Nuttall and by myself. The variety I found on the Arkansas." The variety in question, in which "the two outer intermediate lines are united at base and tip" is undoubtedly *L. juncta;* therefore the original habitat record is from the upper Missouri only, and certainly very little was added to our knowledge of the beetle until the time when it became of economic interest.

The eastward spread of the beetle and the factors that controlled it are presented in detail. Beginning with p. 44, the effect of the wind on the dispersal of *L. decem-lineata* during its progress eastward is discussed. On page 47 it is stated that the prevailing southerly winds greatly retarded the southward progress of the beetle. The scarcity of its favorite food plant in the south is much more likely to have been a barrier to its progress. The facilities for dispersal offered by the boat traffic on the Mississippi and its tributaries (see p. 30) would more than offset the influence of the unfavorable prevailing winds.

Tower states that the species of *Leptinotarsa* are double-brooded. This point, it seems to me, needs further investigation. My own experience with species of many genera of Chrysomelidæ has shown that they are all single-brooded and that the newly developed beetles do not become sexually mature until the following season. I have had no experience with *Leptinotarsa,* but abundant data which show that such closely related genera as *Calligrapha, Lina* and *Gastroidea* are only single-brooded. Such a physiological difference in alternating generations, of quick sexual maturity in one brood and of a long period of sexual inactivity in the other, would be most remarkable. The seeming double-broodedness of *L. decem-lineata* may be due to the difference in the time of emergence from hibernation of different individuals. We have no exact data regarding this point in *L. decem-lineata,* but some very pertinent ones on the boll-weevil which elucidate this subject. In Bulletin 51 of the Bureau of Entomology, p. 108, it is shown that the boll-weevil continued to emerge from hibernation during a period of more than two months (March 18–May 26). It is only reasonable to suppose that there would be an equal irregularity in the time of copulation, oviposition and larval development—amply sufficient to account for the two apparent broods.

Leptinotarsa juncta is taken up on page 49, and its retreat before *decem-lineata* discussed. The original distribution of *juncta,* as given in the text and on the accompanying map, is incorrect. Originally the species extended along the Atlantic as far north as the New England states and west of the Alleghenies at least northward into Ohio. As to the present distribution, I know of its recent occurrence at Richmond, Va., New Richmond, O., and St. Louis, Mo. The observation of Professor Quaintance that *juncta* and *decem-lineata* "hybridize freely in nature, although the eggs that are laid are not fertile," is ingeniously turned to account.

"The full explanation of the extinction of *juncta* is to be found in the fact that the two species cross freely in nature, and that this natural crossing has resulted in a most interesting and peculiar case of prepotency in one species and of submergence in the other." In other words, according to Tower, *L. juncta* in crossing with *decem-lineata* has been eliminated through Mendel's law. Does Tower realize that *juncta* has a number of specific characters and that these can not all be "recessive"—at least not according to the usual interpretation of the Mendelian law? In fact, *juncta* continues to exist as a distinct species, even upon the same plant with *decem-lineata.* Furthermore, Tower states (p. 20) that his *L. oblongata* and *L. multitæniata* Stål occur together upon the same food plant but do not interbreed. The same statement is made with reference to *L. multitæniata* and *L. rubicunda* Tower. These three forms appear to be much more nearly related to each other than are *L. decem-lineata* and *L. juncta* and it is unreasonable to believe that the last two interbreed freely while the first three do not. A similar case to that of these two species of *Leptinotarsa* is that of the crowding out of *Pieris oleracea* by *Pieris rapæ. Pieris oleracea* still persists in the mountainous parts of New England, where it is found associated with *P. rapæ,* and it would be going far afield to invoke the "recessive" principle of Mendel's law to explain its disappearance from its former territory. In the Chrysomelidæ the crossing of closely related species is quite common when the two forms occur upon the same food plant. I have observed it repeatedly in *Gastroidea polygoni* and *G. cyanea,* but I am not aware that such crossing has had any appreciable effect upon either species.

In the chapter on the habits and instincts of *Leptinotarsa* we find, on page 236, the following statement: "the eggs, although they may be fully formed and fertilized, are not laid, but are retained in the passages of the female reproductive organs until they are resorbed, or, as more frequently happens, until the female dies." As the process of egg fertilization in insects is generally understood, the seminal fluid is deposited in the receptaculum seminis and the eggs are only fertilized when they pass this organ during oviposition.

The statement, on page 260, that all the species of *Leptinotarsa* feed upon Solanaceæ is certainly incorrect; this may be true of the *lineata* group, but it is certainly not for the whole genus.

Chapter III., which deals largely with the physiology of color-pattern production, is the most scholarly part of the work, and most interesting and instructive. It is, however, in great part a repetition of the previously published investigations of the author.

Many pages of the book are taken up with tables which look very impressive. As the figures are, however, for the most part only in averages, and there is nothing to show how extensive or complete are the data back of them, they are not convincing. Thus in the table of data on page 237 relating to oviposition, the maximum, minimum and average for any given species may be made up of more or less complete observations on two beetles or on a thousand; at all events, new observations will change the figures. Data on the oviposition of *L. decem-lineata* which Mr. A. A. Girault is about to publish will change the aspect of this table very materially.

It goes without saying that there is much excellent material in Professor's Tower's work. The observations on habits are most interesting. A point well worth the attention of experimental biologists is that tropical species, being less subject to fluctuating conditions than those of more northerly regions, respond more readily to change of environment.

The work, along with other Carnegie publications, suffers very materially through the absence of an index.

Frederick Knab

Washington, D. C.

SPECIAL ARTICLES

AGE OF A COOLING GLOBE IN WHICH THE INITIAL TEMPERATURE INCREASES DIRECTLY AS THE DISTANCE FROM THE SURFACE

Kelvin's famous and epoch-making paper on the secular cooling of the earth was published in 1862.[1] His problem was to find the time which would elapse before a globe completely solid from center to surface and having throughout a certain uniform initial temperature would cool so far as to reduce the surface gradient of temperature to any given value. He assumed an initial temperature of 3,900° C., a diffusivity of 0.01178 in c.g.s. units and a final surface gradient of 1° C. in 27.76 m. or 1° F. in 50.6 feet. These data discussed by one of Fourier's theorems give for the age of the earth 98×10^6 years. Kelvin, however, expressly directed attention to the fact that the effect of temperature in modifying diffusivities is almost unknown, and that the original distribution of temperature is uncertain. He also referred to the great differences in the surface gradient of temperature, which varies with the locality, as he stated, from 1° F. in 15 feet to 1° F. in 110 feet. He, therefore, allowed very wide limits in his estimate and placed the age between 20 million and 400 million years.

In 1893 Clarence King made a very important contribution to the subject[2] by introducing the criterion of tidal stability. Mr. Barus determined for him the melting point of diabase in terms of depth. If in any hypothetical earth consisting solely of diabase the temperature in any couche were to exceed the melting point of diabase, then tidal instability would set in, the crust would break down and chaos would reign for the time being. In a real earth the same result would follow provided the couche were in a region where diabase or equally fusible rocks are to be expected. Excluding such cases, King found that the age of the earth could not exceed 24 million years when Kelvin's values for diffusivity and surface gradient are assumed. He also found that the corresponding initial temperature of such a globe would be 1,950° C.

Kelvin's last paper on a cooling earth[3] was read in 1897 and he there stated that after having worked out the problem of conduction of heat outwards from the earth by an elaborate method, he was not led to differ much from Clarence King's estimate. This he adopted as the most probable age and reduced his limits to between 20×10^6 and 40×10^6 years.

While King's earth is tidally stable, I confess that his solution of the problem seems to me to be fatally defective. He himself gives a temperature curve for the same earth at an age of 15 million years and this earth shows a couche at a temperature above the melting point of diabase, this layer extending from a depth of 34 miles below the surface to 66 miles. According to Laplace's law of densities these two levels correspond respectively to densities of 2.85 and 2.93, and it seems certain that the material must consist chiefly of basaltic rocks. Thus the 15-million-year

[1] *Trans. R. S. Edinburgh*, reprinted in Thomson & Tait, "Natural Philosophy," Pt. II., p. 468.

[2] *Am. Jour. Sci.*, Vol. 45, 1893, p. 1.

[3] *Trans. Victoria Institute*, Vol. 31, 1899, p. 11.

earth would be unstable and this instability would only just disappear at 24 million years. I am obliged to conclude that if an earth could cool in this way—if the crust could be prevented from breaking—the 24-million-year earth would only just have reached the "consistentior status" or the epoch of solidity.

The real earth, however, has been in a condition of tidal stability at least since the beginning of the Cambrian. For the strata are full of ripple marks, sands and pebbles rearranged by tidal currents, beach footprints and similar evidence of tides. Now oceanic tides would not exist upon a tidally unstable earth and therefore the consistentior status occurred long ago. It was the remoteness of this epoch which Kelvin attempted to calculate.

King gives data for only one earth which is satisfactory from this point of view. It had an initial temperature of 1,230° C. and reached a surface gradient of 1° F. in 50.6 feet in 10 million years. It was solid almost from the beginning. But apart from the excessive brevity of the age, it seems to me that this earth must likewise be rejected. The temperature was insufficient to melt even diabase a few miles below the surface, much less andesites and rhyolites, while there is a mass of well-known evidence that the earth has been fluid at least to depths of many miles from its growing surface. This is shown by the general dependence of gravity on latitude, the nearly spheroidal shape of the earth, the oblateness of the interior layers of equal density and the fact demonstrated by Kelvin,[4] Roche[5] and Wiechert[6] that a nucleus of constant high density (approximately the density of iron) surrounded by a shell of much smaller density (near 3), will satisfy the observations on precession, ratio of surface density to mean density and the ellipticity of sea level.

Considering the materials of which the earth is composed and the high pressures which must have existed at some distance from the surface at any stage of the earth's growth, it seems clear that very high temperatures must have prevailed within its mass, while for the reasons stated above tidal instability at any epoch since the ocean came into existence, is inadmissible. Hence the hypothesis of a constant initial temperature will not satisfy the conditions.

The question thus arises whether the initial temperature may be supposed to have been graduated in such a manner as to satisfy known conditions. I believe that this question may be answered affirmatively. Our great master in geophysics himself contemplated a very different distribution of temperature from the uniformity assumed in his equations. The earth, he said, "did in all probability become solid at its melting temperature all through or all through the outer layer"; "convective equilibrium of temperature must have been approximately fulfilled until solidification commenced" and "the temperature of solidification will, at great depths, because of the great pressure there, be higher than at the surface if the fluid contracts . . . in becoming solid."

If the initial temperature at the consistentior status increased with distance from the surface, it was probably according to some complex law, intimately related to that of convective equilibrium, but the thickness of the shell which has been sensibly affected by cooling is very small. At a distance of 80 miles below the surface the temperature is probably now very near 99 per cent. of what it was at the consistentior status. Hence if a layer double this thickness is considered, the conditions which prevailed in the remainder of the earth are of no consequence. The inner part, with a radius of say 3,840 miles, may have been originally at the temperature of ice or of the electric arc; it may conduct heat as well as silver or as ill as magnesia; in any case the influence on the outer surface would be insensible even after scores of millions of years. Now, though the temperature at the consistentior status did vary with distance from the surface according to a highly complex law, it is altogether probable that for so short a distance as 2 per cent.

[4] "Natural Philosophy," Pt. II., p. 420. This article also appeared in the first edition of the "Natural Philosophy," 1867.

[5] *Mém. Acad. Montpellier*, 1882.

[6] *Göttingen Nachrichten*, 1897, p. 221.

of the radius this law may be adequately represented by a straight line, the chord of an arc whose curvature is small. It would be comparable with, though not identical with, the superficial portion of Mr. Barus's nearly rectilinear curve representing the melting point of diabase as a function of depth. Hence it will be sufficient to assume that the initial temperature increased in simple proportion to distance from the surface.

It is easy to modify the Fourier equation employed by Kelvin to meet this condition. This equation is, strictly speaking, that of an infinite solid divided by a plane, on one side of which, at the initial instant, the temperature has one uniform value, while on the other side it has another uniform value. In other words, in Kelvin's problem the curvature of the earth is neglected because the phenomena are so superficial.

The equation used by Kelvin of course satisfies Fourier's law of the conduction of heat, viz.,

$$\frac{dv}{dt} = \kappa \frac{d^2v}{dx^2},$$

where v is temperature, t time, x distance from the dividing plane and κ diffusivity assumed to be constant. It follows that

$$\kappa \frac{d^2v}{dx^2} = -\frac{xV\varepsilon^{-x^2/4\kappa t}}{2t\sqrt{\pi\kappa t}},$$

and this integrated once gives

$$\frac{dv}{dx} = \frac{V}{\sqrt{\pi\kappa t}} \cdot \varepsilon^{-x^2/4\kappa t} + c. \qquad (1)$$

Here V is half the difference of the two initial temperatures at an infinitesimal distance from the dividing plane and c is a constant temperature gradient. In Kelvin's solution c is zero and the temperature on each side of the divisional plane is uniform. A second integration gives

$$v - v_0 = V \cdot \frac{2}{\sqrt{\pi}} \int_0^{x/2\sqrt{\kappa t}} \varepsilon^{-z^2} dz + cx. \qquad (2)$$

When $t = 0$, x being positive

$$v - v_0 = V + cx, \qquad (3)$$

while for negative x

$$v - v_0 = -V - cx.$$

This last equation represents the initial distribution of temperature in the hypothetical solid replacing outer space in the problem of a cooling earth. In these equations v_0 is the temperature in the dividing plane itself while V is the temperature at an infinitesimal distance from the plane at the initial instant. It is convenient to write $v - v_0 = E$ so that E is the excess of temperature of any point in the solid over the temperature in the limiting plane. For the present problem then

$$E = V + cx$$

represents the initial distribution of temperature in the earth.

If appropriate values of the constants can be found, equations (1) and (2) can be computed for any desired age and this computation is an easy task because the value of the definite integral in (2) has been tabulated by various mathematicians, the most complete table being by Mr. James Burgess and printed in 1900.[7]

Kelvin employed a diffusivity, κ, of 400, using the British foot and the year as units. In c.g.s. units this would be 0.01178. This value was obtained from experiments on the trap rock of Calton Hill, the sand of an experimental garden and the sandstone of Craigleith quarry, all at Edinburgh. Different weights were given to these observations, but how is not explained. Now, in considering the diffusivity of the earth it does not seem to me that the ragged pellicle of detrital matter on its surface need be considered. Over large areas it is absent and in most places the sedimentary rocks are saturated with water, so that their own intrinsic diffusivity is a minor feature of the flow of heat. The great bulk of the rocks in the shell affected by cooling are massive and at least comparable with the trap of Calton Hill, which is chiefly composed of Carboniferous basalt and andesite. The conductivity of this rock was observed by Forbes and Thomson (Kelvin) for no less than eighteen years, the thermal capacity was determined by Regnault, so that the value of the diffusivity, 0.00786, is undoubtedly very accurate. It does not stand alone. A com-

[7] *Trans. R. S. Edinburgh*, Vol. 39, 1900, p. 257.

mittee of the British Association,[8] Herschel and Lebour, reported for whin and traps $\kappa = .0067$, and for serpentine from .00594 to .0073, while Ayrton and Perry got for porphyritic trachyte .0103. I do not think a better choice can be made than the Calton Hill trap, and its diffusivity with the meter and year as units is the value which will be assumed here, *i. e.*, $\kappa = 24.8037$.

That κ varies with temperature and with pressure is probable. That in iron it decreases with increasing temperature is known and analogy would point to the conclusion that it should increase with pressure. Possibly diffusivity is simply related to density and for the same or similar rocks tends in the earth to a nearly constant value. At present it seems unavoidable in this problem to regard it as constant.

The outer portion of the earth is composed of various rocks which are believed to be arranged roughly in the order of density. If so the peridotites underlie the basaltic rocks, while the andesites and rhyolites overlie them. These latter are less fusible than diabase. How deep the level lies which would answer to the upper surface of the basaltic rocks can not be told with certainty. The best that can be done is to assume that Laplace's law of density is valid for a few score miles from the surface and to consider roughly the effects of heat and pressure. In this way I have reached the conclusion that at about 40 miles, or 0.01 times the radius, where the density should be 2.86, the temperature perhaps 1,300° C. and the pressure 17,400 atmospheres, basaltic rocks may begin to appear in place. A pressure of 13 or 14 atmospheres per degree centigrade is probably of the order of magnitude needful to preserve constancy of volume in a heated solid, while at atmospheric pressures the densities of basaltic rocks are from 2.85 to 3.10, with minor exceptions. I shall assume, therefore, that the outer crust to a depth of 40 miles is less fusible than basalt.

The line representing the melting point of diabase in terms of depth as determined by Mr. Barus may be taken as rectilinear for depths up to a hundred miles and is then represented by what I may call the diabase line,

$$y = 1170° + \frac{430}{.01r}x,$$

where r is the radius of the earth, and according to the results of the last paragraph the original temperature distribution in the globe must be such that only the layer of rock within 40 miles of the surface was heated to a higher point than that at which diabase would melt. Thus V being the original surface temperature and u the original temperature at distance x,

$$u = V + \frac{1600 - V}{.01r}x,$$

and this line, intersecting the diabase line at $.01r$ or 63,710 meters, must be the asymptote of the temperature excess curve.

It is easy to perceive that whatever values of the constants and the age are chosen, the temperature curve will have one and only one tangent which is parallel to the diabase line. Of course the point of tangency is that at which the curve approaches the melting point of diabase most closely or at which the additional temperature which would be required to melt diabase is a minimum. It is at this level of tangency that any access of temperature due to the dissipation of mechanical energy or to other causes is most likely to produce fusion at depths where the rock is diabasic. If the constants are assumed at any value and the courses of the curves are considered for various periods of time, it is easily seen that the point of nearest approach to the diabase line sinks to greater depths as time elapses.

Now, strains must exist in the earth at all times. They may be and are partially relieved by rupture and by solid flow, but most completely by fusion. Thus in an earth the cooling of which is represented by (2) such strains as may be incident to upheaval and subsidence and to orogeny will probably be most completely relieved at the slowly sinking surface of easiest fusion.

Messrs. Tittmann and Hayford have recently discussed the whole body of geodetic data for the United States and have shown that the deflections of the vertical are best

[8] Brit. Assoc. Ad. Sci., 1881.

accounted for by the hypothesis that isostatic compensation is uniformly distributed and is complete at a depth of 140 kilometers or 71 miles from the surface.[9]

I, therefore, adopt the hypothesis that the tangent of the temperature curve, or equation (1), is parallel to the diabase line at 140 kilometers from the surface.

V is the value of the original temperature excess of the earth at its surface over the temperature of the atmosphere in contact with it. As was pointed out above, this must have been high enough to fuse rocks more refractory than diabase and was probably about equal to the temperature of the hottest eruptions which now reach the surface of the earth. It seems to me that 1,300° is a reasonable estimate. This is considerably below the melting point of pure iron and lower than the blast furnace, but above the melting point of copper (1,065°), which lavas are known to fuse, and of Barus's diabase (1,170°). So far as I know, no precise determinations have yet been made of the temperatures at which lavas issue from their vents, though the new optical method should make good observations possible.

To take advantage of the level of isostatic compensation x in equation (1) may be put at 140,000 meters, and dv/dx at the gradient of the diabase line, or $430°/.01r$. Then with $\kappa = .00786$ and

$$c = \frac{1600° - V}{.01r} = \frac{1600° - V}{63710}$$

it follows that

$$\frac{1}{V} = \frac{1}{1170°}\left\{1 - \frac{7217.2}{\sqrt{t}\,\varepsilon^{\frac{130.99 \times 10^6}{t}}}\right\}.$$

Although V should be about 1,300° and t might be computed as dependent variable, the form of this expression makes it easiest to assume values of t and then compute corresponding values of V and c. When these are known for any given age the corresponding value of the surface temperature gradient is

$$\left(\frac{dv}{dx}\right)_0 = \frac{V}{\sqrt{\pi\kappa t}} + c.$$

[9] Rep. to 15th general conference of the International Geodetic Assoc., Washington, 1906.

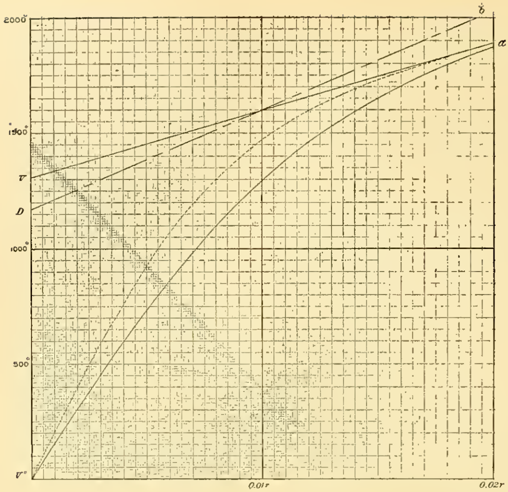
Carrying out this process I get the following table of related values:

A	30.	50.	55.	60.	65.	100.
V	1190.°	1264.	1286.	1307.	1329.	1453.
c	0.00644	0.00527	0.00493	0.00459	0.00426	0.00231
$1/c$	155.^{m}	190.	203.	218.	235.	433.
G°C.	32.^{m}2	39.2	40.7	42.2	43.6	53.3
G°F.	58.′7	71.4	74.2	76.9	79.5	97.1

A is the age in millions of years; V is the initial surface temperature; c is the initial gradient of internal temperature and $1/c$ gives this gradient in terms of meters per degree centigrade. G° C. is the final surface gradient in terms of meters per degree centigrade and G° F. is the same gradient in terms of feet per degree Fahrenheit.

In all of these earths the upper surface of the diabase couche is supposed to be at one one-hundredth of the radius from the surface, or 63,710 meters. All of the excess of temperature curves have tangents parallel to the diabase line at a depth of 140,000 meters.

Of the six earths computed the one whose initial temperature comes nearest to 1,300° C. is that of the 60-million-year earth, and it is the one which appears to me most probable. The most evident objection to it is the low surface gradient of 1° F. in 77 feet, while Kelvin took 1° F. in 50.6 feet and King stated that in 1893 the last published value as reduced from all available data by the British Association committee is 64 feet per degree Fahrenheit. King himself considered 75 feet a maximum. To me, however, it does not seem that an average value is what is required. In discussing the cooling of the earth disturbing causes must be eliminated as far as possible. Now several causes must contribute more or less to raise the temperature of rocks near the surface; for example, thermal springs, volcanic heat, the dissipation of mechanical energy by faulting or solid flow, the liberation of heat in the decomposition of minerals and radioactivity. So far as I know, the only cause which can lead to a deceptively low gradient in rocks of a given type is abnormally high diffusivity. Furthermore, to include gradients observed in sedimentary rocks seems to me to complicate the problem unnecessarily. The gradients which should



serve as a guide are those in massive rocks, especially the nearly anhydrous basaltic, andesitic and rhyolitic massives. All cases where there are local evidences of heat due to thermal springs, etc., should be excluded, and when for a normal rock the gradient is unusually high, it should be considered as suspicious. In short, for the present problem the lower gradients in massive rocks are those most likely to give a correct value of the earth's age. So far as I can judge, the gradient of 1° F. in 77 feet is not much, if at all, too low from this point of view.

The accompanying diagram represents the temperature excess curve for the 60-million-year earth as a full line. It is asymptotic to the line *Va* and involves no tidal instability. A dotted curve in the diagram shows the temperature of the same earth when 30 million years of age. At that time the level of easiest fusion, or the eutectic level, was much nearer the surface than 140 kilometers in fact at about 86 kilometers, and the increment of temperature needful to produce fusion at the eutectic level was smaller, only some 80° instead of 140° C. At no stage of the life of this earth was there tidal instability. Only in the earliest stages did the curve cross the diabase line *Db*, and that only at less than 40 miles from the surface, where by hypothesis the rocks are andesites or rhyolites and less fusible than diabase. On the other hand, the temperature of the globe at great depths is high, 2,000° being reached within a hundred miles of the surface.

Perhaps the least satisfactory of the assumptions made in this discussion is that the layer of rocks less fusible than diabase is 40 miles in thickness. To obtain an idea of the importance of an error in this assumption I have computed the gradient, assuming the refractory layer to be only 30 miles thick in the 60×10^6 year earth, the other data remaining unchanged. This calculation gives 1° F. in 79.2 feet, so that the effect of even a very large error in estimating the thickness of the refractory layer is not great.

In the course of time it should be possible to obtain better values of the constants than I have employed. I urge a careful revision of surface temperature gradients in the sense of the remarks in a preceding paragraph, accurate determinations of the temperature of lava as it flows from the vents, and above all the study of the thermal diffusivity of massive rocks. Mr. Barus's investigation of diabase was most fruitful pioneer work and afforded the starting point for improvements which ought now to be applied to a revision of his results.

Notwithstanding the inadequacy of the data, I can not but believe that the 60-million-year earth here discussed is a fair approximation to the truth and that with better data this age will not be changed by more than perhaps 5 million years. It is in good accord with geological estimates from denudation and sedimentation, with the age of the ocean as inferred from the sodium content and with the age of the moon as computed by Sir Geo. Darwin. Finally, as I shall show elsewhere, it indicates that the part played by radioactivity in the heating of the earth is a subordinate one. George F. Becker

U. S. Geological Survey,
Washington, D. C.,
January, 1908

QUOTATIONS

THE GREAT BEQUEST TO TRINITY COLLEGE

By the death without issue of Lady Pearce, who survived her husband, the late Sir William George Pearce, by less than two months, Trinity College, Cambridge, becomes immediately entitled, as we have recently recorded, to the large property in which she had a life interest. It does not often happen that the way is cleared for the owner of the remainder interest with such dramatic rapidity as in this instance. Nor does it often happen that so substantial a sum comes into the hands of any college or educational institution in this country. The total value of this bequest to Trinity College is probably considerably more than £400,000, but taken only at that figure the benefaction is an extremely handsome one. Trinity, as the most distinguished college in the two universities, is in every way worthy of this piece of good fortune, though there are doubtless many less prosperous colleges that may be pardoned for regarding it with somewhat envious eyes, and for quoting the hard saying, "to him that hath shall be given." Trinity will undoubtedly know how to make good use of the money for educational purposes; still, it may be regretted that, in view of the poverty of the university as distinguished from the colleges, some part at least of this large sum was not placed at its disposal. There are statutory provisions in force, both at Oxford and at Cambridge, whereby each college contributes a certain portion of its revenues either to some specific purpose, such as the payment of a professor's stipend, or to a common university fund to be applied to university purposes in general. Under these provisions, the university will, we presume, take its appointed toll of the Pearce benefaction to Trinity. But it is not otherwise a beneficiary. Yet in 1896 the total revenue of the university amounted to only £62,000 odd—only £844 of which was not specially appropriated—whereas in 1907 the gross annual revenue of Trinity was over £76,000.

A few comparative figures will serve to emphasize this contrast. Trinity already possesses the largest revenues of any college in the university, its gross income amounting, as stated above, to over £76,000 out of an aggregate total of £316,000 odd enjoyed by all the colleges. No doubt its outgoings and responsibilities are proportionate to this large income; but the new benefaction, probably amounting, as we have said, to considerably more than £400,000, may perhaps be taken as equivalent to an additional net income of £15,000 annually. There are no fewer than eleven out of the seventeen colleges at Cambridge of which the respective gross annual incomes amount to less than this, ranging from Magdalene with only £4,782 a year to Christ's with £14,371 a year; while a twelfth, Clare, only just exceeds it, having a gross annual income of £15,104. These figures are not cited invidiously. Their sole purpose is to show that Trinity is now about to enjoy an additional income, free of all charges, which is more than equivalent to the gross annual incomes respectively enjoyed by more than two thirds of the colleges at Cambridge. On the other hand, it is certain that at this juncture the needs and deserts of the university as such are far greater than those of any college. For more than ten years past the Cambridge University Association has been laboriously collecting funds for the reendowment of the university and its adequate equipment to meet the educational and academic needs of the modern time. Some four years ago, on the occasion of the opening by his majesty the king of four new university buildings, the erection of which was largely promoted by this association, we published three articles by a special correspondent in which it was shown that the needs of the university, all more or less urgent and yet evaluated at a strictly moderate estimate, could not be satisfied by anything much less than a capital sum of a million and a half. It was also pointed out that the buildings of the University of Strassburg had cost nearly a million; that the state endowment of the University of Berlin was nearly £170,000 a year; that private effort had endowed the universities and colleges of the United States with more than £40,000,000 in a few years; and that in two years alone the funds obtained from this source had amounted to nearly £7,000,000. Yet at that time the Cambridge University Association had only succeeded in collecting some £71,000 in the course of seven years, a sum less than the gross annual income of Trinity by more than the gross annual income of Magdalene, and only about a sixth of the stupendous windfall which has now fallen, unsolicited and unexpected—though we are far from saying undeservedly—into the lap of Trinity.—The London *Times*.

THE GEORGE WASHINGTON UNIVERSITY

At the meeting of the Board of Trustees, held on January 8, 1908, certain recommendations of President Needham, affecting the educational work of the university, were adopted.

1. The courses of instruction in the Department of Arts and Sciences were put in charge of two general faculties; namely, the Faculty of Graduate Studies and the Faculty of Undergraduate Studies. The latter faculty is composed of all professors, assistant-professors and instructors who carry on instruction in the several undergraduate colleges and divisions.

2. In Columbian College, the B.S. degree was discontinued, and the requirements for the B.A. degree were changed so that it might cover the courses formerly embraced by both B.S. and B.A. English, mathematics and a foreign language (Latin, French or German) are specified as the required studies, constituting 9 out of 15 points for entrance, and 9 out of 60 points for the attainment of the B.A. degree.

3. In the Law Department beginning with the next academic year the requirements for the LL.B. degree are increased to fourteen hours per week, the full day work beginning at 9 o'clock in the morning. Beginning with the academic year 1909–1910, the requirements for admission to this course are two years of college work or its equivalent, with the provision that students who have not the required college work may be admitted as special students and if they obtain a record of B or better, they may be recommended for the degree. There has been established in this department for half-day students, a course of ten hours per week, covering three years, to be given between the hours of 4:30 and 6:30, and for the full course of thirty hours the degree of B.L. will be given. A four-year course of twelve hours a week will be open to students who received the B.L. degree and such students as complete the fourth year course and meet the requirements for admission and graduation will be entitled to the degree of LL.B.

4. In the Department of Medicine, beginning with the session of 1909–10, the requirements for admission will be two years of college work or its equivalent.

WILLIAM STRATFORD

Professor William Stratford, for forty-one years a member of the teaching staff of the New York City College, died on January 24. He was born at Newtown, L. I., in 1844, graduated at the City College in 1865, and took the degrees of M.D. and Ph.D. at New

York University. He became tutor in natural history in the City College in 1866, under Professor John C. Draper, whom he succeeded in 1886, as head of the department. He was a well-known member of the scientific organizations of New York, and was a recognized expert in biological microscopy, devising new combinations in the mathematics of lenses and conducting important experiments in the early days of photomicrography. In his work in the City College he introduced laboratory methods and developed its museum, enriching it with the fruits of several paleontological excursions to the Rockies. He is best known, however, as the teacher and devoted friend of those whose interests in natural history led them to carry their studies beyond the door of their classroom, and he was generous, even to a fault, in giving them his time, means, books, apparatus—all that he had. Not a few of his pupils became prominent in New York as physicians and as biologists. B. D.

MORRIS K. JESUP

In the death of Morris K. Jesup, science in America has lost one of its wisest supporters and most liberal benefactors. Mr. Jesup's name has been closely associated in our minds with the American Museum of Natural History, and it is true that during his presidency of twenty-seven years his chief interests have been centered there, but his enthusiasm in the cause of education and of science reached far beyond the bounds of the City of New York; in fact, it is doubtful if there has ever lived in America or any other country a man trained originally for business who developed more universal sympathies and interests. The most northerly promontory of the Arctic bears his name; he was instrumental in exploration of the extreme south; as president of the Syrian College at Beirut his influence has been felt through the orient, and expeditions, made possible through his generosity, have investigated many scientific problems in the west.

There were two grandly distinctive features of his administration of the American Museum. First, his desire to popularize science through the arrangement and exhibition of collections in such a simple and attractive manner as to come within the reach and intelligence of all; second, to make the museum a center for research and an agency for the exploration of unknown fields. It may be said without reserve that he was as full of enthusiasm for, and faith in the cause of pure research as he was in that of popular education. During 1907, the last year of his administration, and with his sanction, the museum spent at least $80,000 for strictly scientific work. It is important to make this statement because the extent of the activities of the museum in the field of pure science is not so widely known as it should be.

Two years ago the trustees of the museum invited Mr. Jesup to celebrate the twenty-fifth anniversary of his presidency of the institution. A loving cup beautifully designed in gold was presented to him, with inscriptions and symbols in allusion to those branches of science in which he had taken special interest. On one face of the cup reference was made to the forestry of North America; on another, his interest in vertebrate paleontology was indicated and his gift of the Cope collection of fishes, amphibians and reptiles was mentioned; on the third face was a design symbolizing the work of the Jesup North Pacific expeditions, the last and greatest of the enterprises toward which his efforts were directed. Two years have elapsed since this memorable meeting, at which the three surviving founders of the museum, J. Pierpont Morgan, Joseph H. Choate and Mr. Jesup, were present.

It is not possible to review or summarize here all the different directions in which Mr. Jesup was led by his keen sense of the duties of citizenship. He was a man who had a strong civic pride; he believed in American ideas and in American men, and was ever willing to sacrifice his own interests to those of the community. He was an idealist, an optimist, and keenly patriotic. He was sanguine, determined, forceful, trustful, appreciative and even affectionate toward those closely associated with him. Many of his acts of kindness will never be known, because hundreds of his deeds were on the principle of not letting the left hand know what the right hand doeth. As a merchant and banker he was successful, and the culmination of his business career was reached when he was elected to the presidency of the Chamber of Commerce. Through his activity this stately association of the merchants of New York was provided with its present magnificent building. This reminds us of another aspect of Mr. Jesup's life—his desire that science and commerce should both be set amidst appropriate and dignified surroundings.

During the past year, because of failing strength, Mr. Jesup has not been able to take an active part in the management of the museum, but its welfare has been one of the chief subjects of his thought and its progress one of the chief sources of happiness to him during the long suffering days and weeks of his illness. Born at Westport, Connecticut, June 21, 1830, he passed away in New York City on January 22, 1908. His death has been followed by rare testimonials of admiration and appreciation.

H. F. O.

SCIENTIFIC NOTES AND NEWS

Professor Reginald W. Brock, professor of geology in the School of Mining, Kingston, has been appointed director of the Geological Survey of Canada.

Dr. Arthur Newsholme has been appointed medical officer to the London Local Government Board on the retirement from that office of Mr. W. H. Power, C.B., F.R.S.

Mr. R. H. Lock, fellow of Gonville and Caius College, Cambridge University, has been appointed an assistant director at the Royal Botanic Gardens at Peradenyia, in Ceylon, a post which, at the instance of the director, Dr. Willis, has been created for him by the Colonial Office.

Dr. Theodore W. Richards, professor of chemistry at Harvard University, has been elected a foreign member of the Academy of Sciences at Stockholm.

Dr. Feodor Cernyshev, St. Petersburg, has been elected a foreign correspondent of the Geological Society of London.

Mr. C. O. Waterhouse has been elected president of the British Entomological Society.

The senior students in mining at the Pennsylvania State College have presented to Professor M. E. Wadsworth, dean of the schools of mines and metallurgy, a silver loving cup on the occasion of his sixtieth birthday.

Professor J. Paul Goode, of the University of Chicago, will spend the next six months at Washington in order to use the geographical works in the congressional library.

Dr. W. W. Beman, professor of mathematics at the University of Michigan, has been granted leave of absence for the coming academic year, which he will spend abroad.

Mr. R. S. Williams, assistant curator of the New York Botanical Garden, has gone to the Isthmus of Panama to make collections for the garden. He expects to return in May.

The *Koonya* has returned to Wellington, N. Z., after having towed the *Nimrod,* Lieutenant Shackleton's ship, with the British Antarctic Expedition on board, 1,500 miles to within a mile of the ice.

We learn from the London *Times* that the Aéro Club of France gave a banquet on January 16 to Mr. Henry Farman in honor of his feat in winning the prize offered by the club for the first flight of one kilometer with a machine heavier than air. The chairman, in proposing the toast of the guest of the evening, recalled the history of the conquest of the air. The Comte de la Vaux then presented the gold medal of the Aéro Club to Mr. Farman, who also received two other gold medals, one from Messrs. Voisin, the builders of his aeroplane, and the other from M. Frank Reichel, as well as a bronze by Barrias, presented by M. Robert Esnault-Pettrie, of the Académie des Sports. M. Le Vasseur was presented with a medal in enamel by Messrs. Voisin. Speeches were then made by M. Henry Deutsch, Baron de Zuylen, M. Archdeacon, Prince Roland Bonaparte and Mr. Henry Farman, after which MM. Deutsch and Archdeacon each handed a cheque for 25,000 f. to Mr. Farman.

The prize of £50 from the Gordon Wigan fund, Cambridge University, for an investigation in chemistry was awarded in the year 1907 to F. Buckney, of Sidney Sussex College, for his essay entitled "A Study of some quinquevalent cyclic nitrogen compounds."

Mr. Bailey Willis, of the United States Geological Survey, will give a series of six lectures at the University of Illinois from February 10 to 15. Most of these lectures will deal with the past and present geography of North America. In one Mr. Willis will give an account of his recent geological experiences in China.

Professor Rollin D. Salisbury, University of Chicago, and Dr. H. Foster Bain, state geologist of Illinois, will give special lectures in geology at the University of Wisconsin during the present year.

The sixth lecture in the Harvey Society course will be given by Professor Joseph Jastrow, University of Wisconsin, at the New York Academy of Medicine building, on Saturday evening, February 8, at 8:30 p.m. Subject, "Subconsciousness."

The experiment of Foucault, originally performed in the Panthéon at Paris in 1851 to prove the rotation of our earth, will be repeated twice publicly at Columbia University in St. Paul's Chapel. The apparatus includes a pendulum, 91 feet long, of which the weight is a cannon ball weighing 140 pounds, the whole suspended within the chapel dome. The time required by this great pendulum to complete a swing is six seconds. Two half-hour lectures in explanation of the experiment will be given as follows: February 7, Dr. S. Alfred Mitchell, at 3 p.m., and February 12, Professor Jacoby, at 4:30 p.m. Visitors will be admitted to see the swinging pendulum until 5:30 p.m. on both days.

A bill has been introduced in the senate by Senator Teller, for the erection of a memorial to John Wesley Powell, director of the Bureau of American Ethnology and the U. S. Geological Survey.

A life-size bronze bust of the late Professor von Bergmann was presented last month, as we learn from the *Journal of the American Medical Association,* to the clinic, the scene of his surgical triumphs, by his former pupils, many of whom now occupy prominent positions in other clinics. The bust stands beside those of Gräfe, Dieffenbach and Langenbeck. Professor Bier, the present chief of the clinic, and Professor Sonnenburg delivered addresses.

Services in honor of the late Nicholas Senn were held in the Fine Arts building, Chicago, on February 2, under the auspices of Rush Medical College, Northwestern University Medical School, College of Physicians and Surgeons, Chicago Medical Society, Chicago Surgical Association and the Nicholas Senn Club. President Edmund Janes James, of the University of Illinois, was chairman, and the speakers were: Dr. Frank Billings, dean of Rush Medical College, "Nicholas Senn as a Teacher"; Dr. Arthur R. Edwards, dean of Northwestern University Medical School, "Nicholas Senn as a Scientist"; Dr. William E. Quine, dean of the College of Physicians and Surgeons, "Nicholas Senn as a Man"; Dr. Henry B. Favill, president of the Chicago Medical Society, "Nicholas Senn as a Physician"; Dr. Albert J. Ochsner, president of the Chicago Surgical Association, "Nicholas Senn as a Surgeon," and Dr. Daniel R. Brower, president of the Nicholas Senn Club, "Nicholas Senn as a Traveler."

Mr. Charles Abbott Davis, curator of natural history at the Roger Williams Park Museum, Providence, died, on January 29, at the age of thirty-nine years.

Captain Jules Bailly, osteologist at McGill University, known for his work in osteology and natural history, died, on January 29, at the age of seventy-seven years.

Dr. A. Williams Wilkinson, a chemist in New York City, known for his inventions in connection with illuminating gas, has died at the age of seventy-five years.

Dr. H. G. Knaggs, a British medical man, known for his contributions to entomology, died, on January 16, in his seventy-sixth year.

Mr. John Macfarlane Gray, the well-known British engineer, died, in Edinburgh on January 14, in his seventy-sixth year.

There will be civil service examinations on March 4 and 5 as follows: Statistician in the Geological Survey, three vacancies at salaries from $1,200 to $1,800; assistant geologist, qualified in petrology, at $75 a month, a temporary position, but qualifying for promotion; aid in the Bureau of Standards, at a salary of $600; executive assistants in the Bureau of Plant Industry, at salaries ranging from $1,600 to $2,000, there being at present vacancies in connection with tobacco investigation and in the office of the cerealist; and food and drug inspectors, at salaries from $1,000 to $1,800 in the Bureau of Chemistry, Department of Agriculture.

By the will of the late Morris K. Jesup an endowment fund of $1,000,000 is given to the American Museum of Natural History, of which he had been president since 1882. The provision of the will relating to the museum is as follows:

I give and bequeath to the American Museum of Natural History in the city of New York $1,000,000, to constitute a permanent fund, the principal to be invested and kept invested, and the income to be applied and apportioned to the general purposes of the museum, other than alterations, additions, repairs or erection of buildings, the purchase of land, or the payment of salaries, or for labor or for services of any kind ordinarily considered under the item of maintenance. I wish to explain that I have bequeathed this sum of $1,000,000 to the American Museum of Natural History and that I have made for it the other bequests and provisions contained in my will because of the fact that I have been identified with the museum from its act of incorporation to the present time. I have been its president since 1882. Since that time I have devoted a great part of my life, my thoughts, and my attention to its interests. I believe it to be to-day one of the most effective agencies which exist in the city of New York for furnishing education, innocent amusement, and instruction to the people. It can be immensely increased in its usefulness by increasing its powers. The city of New York under its contract with the museum is to provide buildings and to maintain them, but the buildings must be filled with specimens. This means that for this purpose the necessary amount must come from individual donors. It is in order that the means for this purpose may be helped, as the museum must grow in additional buildings by the city, that I make for the museum the bequests and provisions contained in my will, relying upon the trustees of the museum to do their share by looking after the investment of the funds, the use of its income, and by carefully watching over and wisely planning for the best interests of this great institution.

The anthropological collections made by Mr. Henry G. Bryant among the Esquimaux, have been presented by him to the University of Pennsylvania.

Professor Hirschberg has informed the authorities that his will presents his valuable collection of ophthalmologic works to the Berlin Royal Library with an endowment of about $4,000, the income of which is to be applied for subscriptions to the current periodicals on ophthalmology and optics.

In its recent report to the government the Swedish Commission for the Prevention of Tuberculosis recommends the gradual establishment of 4,600 sanatoria at a total expense of 10,810,000 crowns. It is proposed that the expenses of patients shall be paid by the municipalities.

A conference of the district engineers of the water resources branch of the United States Geological Survey was held at the office of the Survey in Washington during the week ending January 25. Those present were: W. B. Clapp, of Los Angeles, Cal., in charge of the California district; J. C. Stevens, of Portland, Ore., whose district includes Oregon and Washington; Robert Follansbee, of Washington, D. C., in charge of the district covering Montana, North Dakota and a portion of northern Wyoming; W. B. Freeman, of Denver, Colo., supervising work in Colorado, Nebraska, Oklahoma, New Mexico and southern Wyoming; E. C. LaRue, of Salt Lake City, whose district is Utah, Idaho and Nevada; H. K. Barrows, of Boston, in charge of the New England district and New York; M. R. Hall, of Atlanta, Ga., in charge of the work in the South Atlantic and Gulf States; and J. C. Hoyt, assistant chief hydrographer, who supervises from the Washington office the work in the Middle Atlantic States. Other engineers present were C. C. Covert and F. W. Henshaw, of the Washington office, recently engaged in stream measurements in Alaska in cooperation with the survey's Division of Alaskan Mineral Resources; R. H. Bolster and W. G. Steward, also of the home office; F. W. Hanna, of the U. S. Reclamation Service; and Sydney K. Clapp, of the Board of Additional Water Supply for New York City. The meeting was presided over by the chief hydrographer, Mr. Marshall O. Leighton. The subjects under discussion included methods of work, instruments and equipment, scientific studies, storage and evaporation investigations, cost-keeping systems, and publicity and cooperation work. Special addresses were made by the director of the survey, George Otis Smith, and by Dr. G. K. Gilbert, who explained in detail the methods of investigation of what is known as the "débris problem" of California rivers, now in progress at the hydrologic laboratory of the survey, at Berkeley, Cal.

The London *Times* states that in a recent German patent a method is described for producing artificially certain mineral species, such as olivine, zircon, beryll, and spinelle, in a definitely crystalline form. This consists in dissolving their constituent oxides in appropriate proportions in molten sodium or potassium metaborate. The temperature of the fused mixture is then raised to 1,300° C., when the alkali metaborate volatilizes, leaving the artificial mineral in the form of crystals. In addition to obtaining products corresponding with the naturally occurring minerals, other compounds having no mineralogical counterparts may be produced by this method. A nickel chrome spinelle, NiO, Cr_2O_3, prepared from its constituent oxides, was obtained in the form of small green crystals. It is well known that the mineral species corundum occurs in the form of very variously colored stones ranging from colorless sapphire to brown and opaque corundum. Between these extremes one meets with sapphires tinted in yellow, green, blue, red, and intermediate hues, and it is generally supposed that these various colors are due to the presence of compounds of iron, manganese, chromium, titanium, or other foreign elements. In the *Comptes rendus de l'Académie des Sciences* F. Bordas describes experiments in which the color of these gems is caused to change by exposing the stones to the action of a very radioactive specimen of radium bromide. In these circumstances a blue sapphire assumes successively green, light yellow, and dark yellow tints, whilst a red sapphire develops in succession shades of violet, blue, green and yellow. These experiments justify the belief that the distinctive colors of these precious stones are not due to the presence of any particular oxides. The variation always occurs in the above sense from red to yellow, and it seems likely that the topaz represents the last term in this transformation. Moreover it seems probable that these gems are found in regions where the surrounding soil has a certain degree of radioactivity. This idea receives support from the fact that the yellow sapphires are the commonest, although yellow and blue sapphires frequently occur together. The gems which have been thus artificially colored are not radioactive; they do not become luminescent in the dark under the influence of radium bromide, but they retain their color on heating.

Nature states that an addition to the exhibition galleries of the British Museum (Natural History) has been made in the shape of a copy of a water-color drawing made about 1585 by John White, containing the earliest known representation of the American king-crab, *Limulus polyphemus*. John White, who was one of the first settlers in Virginia, of which he was for some time governor, served as lieutenant to Sir Walter Raleigh. In three volumes of drawings by him preserved in the department of prints and drawings in the British Museum, many of the delineations of natural objects are of great beauty, and show a fidelity to nature rare at the period. The drawing in which the king-crab is depicted was engraved, with some modifications, for de Bry's "America" ("Grands Voyages," Part I., pl. 13) in 1590. In the engraving the king-crab is, however, shown in somewhat greater detail, thus suggesting that the engraver had an actual specimen or another drawing from which to copy.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. Lawrence introduced in the House of Representatives on January 27 a bill to create a commission to investigate and report to congress as to the advisability of the establishment of a Pan-American University. It was referred to the committee on education.

The regents of the University of Michigan have appropriated $275,000 for the new chemical building, which will be erected as soon as possible on the north side of the campus. It will consist of four stories and a central court, being built on the same plan as the new medical building.

According to the *Journal of the American Medical Association* the contract for the building of the new Richardson Memorial Building, Tulane University, has been let. The new building is to cost about $200,000 and will be three stories and a basement in height. The basement will contain workrooms for minor surgery, original research and toilet and storage rooms; the first floor will have a large lecture room and physiologic and pharmacologic laboratories, and also the administration offices; the second floor will contain pathologic, bacteriologic and histologic laboratories, private laboratories for the professors and research rooms; the third floor will contain the dissecting room, anatomical museum and laboratories for the curator of the museum and the professor of anatomy, research rooms and also a large lecture room. The building is expected to be ready in October next.

The last legislature of Pennsylvania appropriated $50,000 for the School of Mines and Metallurgy of the Pennsylvania State College, of which sum $20,000 were for further extension of its buildings and $30,000 for its maintenance. The buildings, as planned and partly built and occupied, contain over 60,000 square feet of floor space. The buildings contain laboratories and lecture rooms, for the instruction in crystallography, mineralogy, petrography, geology, mining geology, metallography, metallurgy, assaying, ore dressing, coal washing, mining, etc. Among the recent appointments are these: Clarence P. Linville, assistant professor of metallurgy; Frank A. Dalburg, instructor in mining and metallurgy; Lloyd B. Smith, instructor in mineralogy and geology, and Howard I. Smith, instructor in mineralogy and metallurgy.

The trustees of Boston College, an institution in charge of the Jesuits, have acquired thirty-three acres of land near the Chestnut Hill Reservoir in Boston, for a new site for the college. The site is said to be one of the finest in New England for educational purposes. It has been suggested that the initial plan should contemplate the erection of a recitation building, an administration building, two science buildings, a gymnasium, a library and a college theater. Work is to begin at once.

The sum of $50,000 has been collected for Illinois College at Jacksonville, Ill., which makes available the $50,000 offered on this condition by Mr. Andrew Carnegie.

New four-year courses in chemistry designed to train analytical chemists, industrial chemists, agricultural and soil chemists, sanitary and food chemists, and physiological chemists have just been arranged by the faculty of the University of Wisconsin.

The Harvard Faculty of Art and Sciences has passed the following resolution:

> At the last meeting of the faculty of arts and sciences it was voted to send to the president and fellows of Harvard College, the committee on athletic sports, and to each college represented in the Association of Colleges of New England, the following expression of opinion: "That in the opinion of this faculty the number of intercollegiate contests should be largely reduced."

Dr. G. M. Stratton, professor of experimental psychology and director of the Psychological Laboratory at the Johns Hopkins University, has accepted the chair in psychology in the University of California.

Professor Jungfleisch has been called to the chair of chemistry in the Collège de France, vacant through the death of M. Berthelot.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, FEBRUARY 14, 1908

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SOME OF THE PRESENT-DAY PROBLEMS OF BIOLOGICAL CHEMISTRY *

DURING the past few decades there has been gradually developing in the biological world a clearer recognition of the importance of a study of function, coupled with a fuller appreciation of the great diversity of the processes characteristic of life. It has come to be the fashion for naturalists—who up to comparatively recent times were content mainly to study form and structure—to turn their attention to observation of function, to learn how and why certain things are accomplished. Each decade has witnessed a broadening of the point of view; in botany, zoology, paleontology and geology new methods of investigation have been gradually applied, new relationships have been established, and the study of life, past and present, has taken on a new and broader significance. The Mendelian law and the present theories of genetics; the facts of modern cytology and the theories of heredity consequent thereto; the present-day experiments in breeding and variation with the conclusions to be drawn therefrom; the modern methods and theories of physiology in general; are the natural outcome of a progressive scientific activity where the study of function has come to occupy a prominent position and where the experi-

* Address of the president of the American Society of Biological Chemists and chairman of the Biological Section of the American Chemical Society, at the joint meeting in Chicago, January 1, 1908.

mental method is being largely applied in biology as in the physical sciences.

The historical and descriptive study of biology has been gradually giving place to experiment. The zoologist is no longer content with systematic work, with the naming and classifying of species and genera, but he seeks to understand the chemical and physical changes that occur in growth, development, old age, death, etc.; or, in other words, he would know the cause or causes of these phenomena. He would understand the reason for things that occur during life, and with that end in view he turns to the experimental method, just as in physics and chemistry experimental or analytical study is made use of in the solving of problems that pertain to these sciences.

In botany, attention is being more and more directed to the study of plant physiology, with its chemical and physical problems. It is not enough to know that some species of fungi, for example, become black at a certain stage of their growth, but we need the explanation of the cause. The enzyme is to be detected and isolated, and the substance or substances upon which it acts identified. So, too, the many phenomena connected with the growth, nutrition and pathology of plants interest us, but knowledge of what is actually occurring can only be had by application of chemical methods. Systemic study of plants and animals will always be important, but if we are to have adequate explanation of the hundred and one phenomena characteristic of living forms we must turn our attention to experimental methods, as is being so largely done at the present time throughout the biological world, with due regard also to possible chemical transformations and reactions, that may be symbolical of broader changes in function and structure.

Descriptive embryology may tell us much regarding development, may show us the many different stages through which the egg, after fertilization, passes on its way to the full-fledged organism, but we gain thereby little or no insight into the causes that are operating to accomplish the ultimate end. We may well conjecture that in fertilization the spermatozoon brings in some chemical elements that constitute the exciting cause of cell division. Assuming such to be the case, we may ask whether it is a ferment substance of the ordinary enzyme type, or whether substances of a totally different character are involved. The answer to this question, however, does not concern us now; but that such a question is pertinent clearly suggests how the cause of cell cleavage may possibly be sought for in chemical or physico-chemical reactions incited by the admixture of germ and sperm substance.

It is well understood to-day that all the phenomena of life are to be explained on the basis of chemical and physical laws, and it is partly because of a clear recognition of this fact that biological chemistry has finally attained the eminence it has now reached as a division of biology; a branch of study that promises much in the ultimate explanation of many of the most intricate of the present-day problems of life. There is another reason why biological chemistry has shown such remarkable development during the past decades, and that is because of the direct aid it has furnished, and still promises to furnish, to physiology and to both experimental and practical medicine. Physiology as an independent science, having to do with the study of function, has grown in keeping with the increasing demand for wider knowledge of the processes of life, and this has led quite naturally to a broader recognition of the importance of the chemical side of physiology, since the physical side has been found inadequate to explain all the varied phenomena of living organisms. As a result, physiological chemistry has developed by leaps and bounds, until to-day special laboratories and journals devoted to this subject are to be found on all sides.

Again, in bacteriology, and in medicine in general, the applications of chemistry are so numerous and so fruitful in results that it is no longer necessary to defend the position of physiological or biological chemistry as a leading factor in the development of knowledge in these subjects. Sooner or later, in almost every problem that presents itself, we are brought face to face with some form of chemical reaction, or some chemical substance, upon which hinges the explanation of the phenomenon in question. Under the broad term of biological chemistry, we are dealing with a subject which, directly and indirectly, concerns itself with the chemical processes of living organisms, and as these are as many and varied as the organisms themselves, it is plain to see that the field is broad and one beset with many difficulties.

The very breadth of our field makes it clear that there will be diversity of opinion regarding the relative importance of the present-day problems in our science. To one man, quite naturally, a certain line of investigation will appeal most strongly, while to another a totally different set of problems will be suggested as the more important and promising. To one, questions of chemical structure and their bearing upon the processes of metabolism will prove most attractive; to another, questions of physico-chemical nature in their relationship to physiological processes in general will appeal most strongly; while to a third, the chemical dynamics or kinetics of physiological processes, the action of inorganic salts and their respective ions upon protoplasmic activity, etc., will seem the more promising field of work. In this latter field, we all recognize the great value of the results obtained in the laboratories here at Chicago, with equal recognition of the broad influence which the theories and conclusions drawn therefrom by Loeb, Mathews and others, have had upon the development and progress of this branch of our science.

Understanding fully the natural tendency of chemists and physiologists to differ somewhat in their estimate of the relative value of the different subjects calling for investigation, we may still, I think, readily select for discussion a certain number of problems in biological chemistry which we shall all recognize as being preeminently important to-day, and the settlement of which would go far toward giving a clearer understanding of many of the functions of the body. Among these problems stands out with startling distinctness the question of the chemical constitution of protein material. To the chemical mind interested in biological matters there is no problem that can overshadow this one in importance. As the basis of cell protoplasm of all kinds, protein stands forth as the one substance or class of substances absolutely essential for life. It is the chemical nucleus or pivot around which revolves a multitude of reactions characteristic of biological phenomena. In all the metabolic processes of animals and plants protein in some form plays a conspicuous part, and its many katabolic or decomposition products testify both to its complexity of structure and to the great diversity of reactions that may accompany its disintegration.

Nowhere is there to be found a better illustration of the physiological power which may reside in a certain definite grouping of elements than is seen in the case of protein. Gelatin, which resembles albumin in its superficial reactions and which contains approximately the same amount of nitrogen, is, as we know, quite incapable of taking the place of albumin in supplying the needs of the body for protein food. Yet, gelatin yields on decomposition many of the disintegration products furnished by albumin. Still, there are differences in the character and proportion of the cleavage products which, while not sufficiently marked to modify the ordinary protein color reactions, etc., are enough to indicate a difference in chemical structure, and owing to this difference in structure gelatin is quite unable to repair the waste of tissue in body metabolism. To every one at all familiar with protein chemistry the recent advances in knowledge of the hydrolytic cleavage products of this class of substances are more or less known. All proteins by appropriate methods of disintegration break down into a number of monoamino and diamino acids. Thirty years ago these hydrolytic cleavage products were represented mainly by leucine, tyrosine, aspartic and glutaminic acid; but now, as a result of efforts in many quarters, the number of such decomposition products has risen to at least seventeen. The significance of this statement is apparent when we remember that these cleavage products represent the building stones which make up the finished structure of the protein molecule, and if the time ever comes when we know all of these building stones, we shall then without doubt be able to construct or synthesize this most important substance.

Some of the most careful and painstaking work on the hydrolysis of proteins has been done in our own country by Dr. Thomas B. Osborne and his co-workers at New Haven. Examination of the results reported reveals several very important facts. Take, for example, some of the latest data afforded as in the hydrolysis of phaseolin,[1] the globulin of the kidney bean, formerly called legumin. Here, sixteen different cleavage products were identified and determined. The method of hydrolysis and the methods of separating the different amino acids were carried out by persons skilled by long practise and under the best of conditions, yet the percentage of total cleavage products determined amounted to only 54.27. Again, in the hydrolysis of excelsin,[2] the characteristic globulin of the Brazil-nut, the total yield of cleavage products was 61.09 per cent. Finally, in the hydrolysis of hordein,[3] the alcohol-soluble protein of barley, 71.32 per cent. of cleavage products was separated. In other words, by the best methods available and in the hands of skilled workers trained to take advantage of all the knowledge available, chemists are able at present to separate and identify only 54 to 71 per cent. of the total yield of cleavage products which results from the hydrolysis of protein. This undoubtedly means that there are still some building stones in the protein molecule with which as yet we are unfamiliar.

It needs no argument to convince any one that here lies a most important field of work; here is a problem the solution of which gives promise of rich reward, both to the chemist and to the physiologist. Of course, it is possible that the seventeen cleavage products referred to represent all the different types that are formed by hydrolysis and that the apparent deficiency is due simply to inadequate methods of separation. This, however, is not very probable, and it is to be noted in this connection that the results reported by Abderhalden and his co-workers in Germany are

[1] *American Journal of Physiology*, Vol. XVIII., p. 295, 1907.

[2] *Ibid.*, Vol. XIX., p. 53, 1907.

[3] *Ibid.*, Vol. XIX., p. 117, 1907.

not radically different from those obtained by Osborne and others. Far more probable is it that there are still undiscovered a number of component parts of the protein molecule, knowledge of which must be obtained before we can hope to arrive at a synthesis of protein. Physiologists have long sought this goal. It means so much in the unraveling of many intricate problems in protein metabolism, in nutrition in general, in intracellular reactions and particularly those which bear upon the changes incidental to fertilization and cell division.

To how great degree the large variety of proteins of both animal and vegetable tissues have chemical and physiological individuality has long been an unsettled question. There is plenty of physiological evidence that the circulating proteins contained in the blood and lymph of different species of animals are unlike each other in some respects at least. Blood serum from one species introduced into the circulation of another species causes marked disturbance and even a fatal result. Animal proteins are plainly different in some respects from those of vegetable origin, while the latter derived from different sources vary greatly among themselves. We can readily conceive of individual proteins playing quite different parts in the nutrition of man and of animals when taken as food. There may be radical and logical differences in the nutritive value of animal as compared with vegetable proteins, although at present we have no positive proof of such differences. Arguments for or against vegetarianism, which are now based primarily upon questions of sentiment, may in time rest upon a solid foundation of fact. Such observations as have been made bearing upon the constitution of proteins are beginning to have special significance because of the radical differences in chemical make-up shown by the individual proteins studied. Take, for example, phaseolin from the kidney bean. This protein, as shown by both Osborne and Abderhalden, yields about 15 per cent. of glutaminic acid, 4 per cent. of lysine, 2.5 per cent. of proline, 5 per cent. of arginine, etc. Excelsin from the Brazil-nut, on the other hand, yields by hydrolysis 16 per cent. of arginine, 13 per cent. of glutaminic acid, 1.6 per cent. of lysine and 3.6 per cent. of proline; while the hordein of barley yields no lysine whatever, but furnishes 36 per cent. of glutaminic acid and nearly 14 per cent. of proline.

Such differences as these must have some significance; they certainly indicate a totally different assortment of building stones in the finished structure, and it is fair to presume that they carry with them some influence upon the physiological behavior of the proteins when the latter are taken as foods. The gliadin of wheat yields by hydrolysis about 37 per cent. of glutaminic acid, while the casein of cow's milk yields only 11 per cent. Here is indicated a radical difference in structure between the protein of animal origin and that derived from the plant kingdom. We can not say, however, that vegetable proteins are characterized by a high content of glutaminic acid, for while it may be true of both gliadin and hordein, it is not the case with phaseolin or excelsin, both of which yield only a little more glutaminic acid than animal casein. Plainly, we have here a problem not to be overlooked, and in these days of specialized vegetable foods we may justly expect an adequate explanation of the physiological significance to be attached to these chemical differences in structure. The gliadin of wheat, the zein of corn meal and the hordein of barley are all three alcohol-soluble proteins. This solubility in warm alcohol might well serve to place these proteins in a group by themselves, but they plainly are unlike chemically in some respects at least. There is harmony in the fact that all three yield no lysine by hydrolysis, but zein yields only 11 per cent. of glutaminic acid, while the other two furnish over 30 per cent. of this amino acid. Further, gliadin and hordein yield only about 2 per cent. of tyrosine, while zein furnishes 10 per cent. of this substance. To any one familiar with the known relationship between chemical constitution and physiological action as demonstrated in the study of drugs, the question as to what these differences in chemical constitution signify in the physiological action of three food proteins so closely related otherwise must be a pertinent one.

The present-day conception of the protein molecule is that it is a complex of different amino acids variously joined together. By energetic hydrolysis of the protein the latter is naturally broken apart into simple fragments represented by the monoamino and diamino acids. When the hydrolysis is carefully conducted as by a weak solution of trypsin, various proteoses result as the primary products, *i. e.*, high molecular polypeptides, which by further action of the enzymes may be successively broken down into simpler polypeptides, such as tetra-, tri- and dipeptides. Fischer and Abderhalden[4] a few years ago obtained a polypeptide in the pancreatic proteolysis of several proteins which was characterized by being composed solely of glycocoll, proline and phenylalanine. More recently Osborne and Clapp[5] obtained in the hydrolysis of gliadin what appeared to be a crystalline dipeptide composed of proline and phenylalanine. Further, Fischer and Abderhalden[6] have just described several dipeptides obtained in the partial hydrolysis of proteins; notably, glycocoll and l-tyrosine from silk, glycocoll and l-leucine from elastin and l-leucyl-d-glutaminic acid from gliadin; all characteristic dipeptides. In these results we see suggested the possibility of a primary cleavage of proteins into dissimilar polypeptides and dipeptides with distinct chemical make-up. If such reactions as these do occur, under the influence, for example, of pepsin or trypsin proteolysis, or even through the agency of the duodenal enzyme erepsin, then it is certainly reasonable to consider whether the individual proteoses or polypeptides formed during gastric and pancreatic digestion may not be endowed with different physiological properties. It raises the question whether in the digestion of protein in the gastro-intestinal tract by the enzymes naturally present there a kind of selective cleavage may not occur, in which the various amino acids contained in the protein are split off in special combinations representative of particular lines of attraction or union. Further, a tendency toward the formation of di- and polypeptides having a definite composition, assuming it to exist, may furnish a clue to the way in which the synthesis of protein may be accomplished. Obviously, however, there remains to be discovered first the nature of the 29–46 per cent. of the protein not yet represented by known decomposition products.

The well-known lability of the protein molecule accounts for the ease with which it undergoes hydrolysis, but it is, I think, quite plain that the ordinary cleavage of protein is not the result of a promiscuous breaking down of the molecule. On the contrary, there is satisfactory evidence that certain of the building stones are easily split off, while others are separated with greater difficulty and still others remain combined in large groups or masses,

[4] *Zeitschrift für physiologischen Chemie*, Band XXXIX., p. 81, 1903.

[5] *American Journal of Physiology*, Vol. XVIII., p. 123, 1907.

[6] *Zentralblatt für Physiologie*, No. 15, p. 472, 1907.

thereby suggesting different degrees of attraction or union. Thus, it has been recently shown by Abderhalden and Voegtlin[7] that in the digestion of edestin by activated pancreatic juice certain of the amino acids are rapidly freed from their combinations, while others are liberated much more slowly; tyrosine, for example, was wholly free in two days' time, while glutaminic acid even at the end of sixteen days was split off only to the extent of two thirds of the amount present in the edestin molecule. The same has been found true in the pancreatic digestion of casein; tyrosine is rapidly and completely split off, glutaminic acid, on the other hand, very gradually. Thus, with casein and activated pancreatic juice the full amount of tyrosine contained in the protein was liberated in three days, while, as a rule, glutaminic acid could be obtained free only to the extent of 60–80 per cent. of the amount present and then only after three weeks of continued proteolysis. It is thought, though by no means settled, that alanine, valine, leucine, etc., behave exactly like glutaminic acid, while phenylalanine, proline and glycocoll do not admit of being freed from their combinations at all by the hydrolytic action of pancreatic juice. In other words, we see suggested here different degrees of attraction, different lines of combination among the many units entering into the construction of the protein molecule, which are well worthy of careful consideration, since they may have both chemical and physiological significance. It is no exaggeration to say that every additional fact bearing upon the nature and combinations of the chemical units present in the protein molecule promises to be of the greatest help in unraveling the many complexities now confronting us in our understanding of the nature of this most important substance.

[7] *Zeitschrift für physiologischen Chemie*, Band XXXV., p. 315, 1907.

Any consideration of protein cleavage as a physiological process naturally brings into the foreground enzymatic action in general, which is rapidly becoming recognized as the most important method of chemical change occurring in living organisms. We need go back only a few years when practically our knowledge of enzymatic action as it occurred in man and the higher animals was limited to the transformations of starch, protein and fat by the digestive juices of the gastro-intestinal tract, and in plants to the alteration of starch through diastase. But to-day what a change has come over our understanding of enzymolysis and how widespread the varied processes now included under this term! The bio-chemical reactions which are produced through the agency of the many enzymes so widely distributed in nature are not only numerous, but exceedingly varied in character, and we are practically justified in the assumption that the great majority of the intra- and extra-cellular chemical changes taking place in living organisms are the result of enzyme action. The old-time distinction between ferment action and the so-called vital action of living cells no longer carries weight. As is now well known, not hydrolysis merely, but oxidation, deamidization and a whole host of well-defined chemical changes, such, for example, as are characteristic of the different types of intermediary metabolism in the higher animals, are due to intra- and extra-cellular enzymes, formed, it is true, through the constructive power of living cells, but acting as simple chemical or physico-chemical agents and capable of producing their transformations whether in contact with the cells where they are formed or merely dissolved in suitable extracts free from tissue elements. Not only do these statements hold for the ordinary changes of tissue metabolism in animals and plants, but in that more or less hidden world of microorganisms so potent for good and evil, tangible enzymes are likewise responsible for many, if not all, of the chemical reactions by which the life and activity of the organisms are manifested. New enzymes and new forms of chemical change are constantly being discovered and as a result new light is being thrown upon many phases of tissue metabolism and the processes connected therewith.

Note, for example, the group of unique enzymes concerned in the transformations of nucleoproteins; enzymes which are widely distributed among different species of animals, in different organs and tissues, and which are truly unique in the character of the chemical changes they are capable of producing. Thus, we have nuclease, which splits off or liberates the purines from the nucleic acid complex; adenase and guanase, deamidizing enzymes which are able, by hydrolysis with liberation of ammonia, to form the oxypurines hypoxanthine and xanthine from the aminopurines adenine and guanine; xantho-oxidase, which by oxidation transforms the oxypurines to uric acid; and lastly, a uricolytic enzyme which is able to accomplish the destruction of uric acid with formation of allantoin as one of the intermediary products. Observe how these successive steps in the formation of uric acid from a nucleoprotein are accomplished by specific enzymes, each one of a distinct type and limited in its action to the one transformation. Further, it has been found by several observers that these characteristic enzymes are not common to all active tissues; different organisms show unlike equipment in this respect, thus indicating, as a recent writer has expressed it, that there are "noteworthy variations in the purine metabolism of different species."[8] Consider also arginase which has the power of effecting the hydrolysis of arginine, with production of urea and ornithine; an enzyme present in the liver, kidneys, thymus, intestinal mucous membrane and other tissues, as well as in yeast. Here is an enzyme, according to Dakin,[9] which is adapted for the exclusive hydrolysis apparently of dextro-arginine or of other substances containing the dextro-arginine grouping, and, as in the case of glucosides and sugars, the relation of the enzyme to the substrate is so intimately and finely adjusted that many other substances structurally similar to arginine are incapable of hydrolysis by arginase. Note likewise the newly discovered enzymes creatinase and creatininase,[10] the former of which is apparently able to transform creatin into creatinin, while the latter is said to decompose creatinin, presumably into methyl glycocoll and urea.

Truly, we have in the action of these peculiar enzymes a striking illustration of how in intermediary tissue metabolism successive chemical transformations may be accomplished in orderly fashion, while at the same time there is suggested the probable existence of many other specialized enzymes capable of inciting chemical reactions of equal interest. Is there not possible gain to be had in a broader, more comprehensive study of the intracellular enzymes of animal tissues? Doubtless in each species of animal there are peculiarities of metabolism which are truly specific; probably also there are specific enzymes, the presence and action of which are the determining factors in the special line of

[8] Mendel and Mitchell, *American Journal of Physiology*, Vol. XX., p. 100, 1907.

[9] *Journal of Biological Chemistry*, Vol. III., p. 435, 1907.

[10] *Zeitschrift für physiologischen Chemie*, Band LII., p. 1, 1907.

metabolism occurring. Here is a field of work the cultivation of which promises results of the greatest value, while at the same time broadly applicable. Take, for example, the processes of growth as studied in the earlier stages of embryonic life upwards. What is the character of the processes by which the young organism is able to carry forward its rapid development? What the nature of the chemical changes in the construction and destruction of tissues constantly taking place during growth, where of necessity cell nucleoproteins are conspicuous elements? These questions can not be definitely answered at present, but some work carried on in our laboratory[11] at New Haven has indicated quite clearly the presence of certain specific enzymes early in embryonic life, while others common to the same organs in the full-grown animal are wholly wanting. Thus, it has been found in embryo pigs that the liver contains adenase, but no guanase; the latter enzyme, however, is present in the viscera of the embryo. Further, nuclease is present in the liver of the embryo, indicating that in the embryonic stage of this animal autolytic changes can take place in the liver; *i. e.*, a liberation of aminopurines from the nucleoproteins of the forming hepatic cells, while any adenine set free can be transformed by the deamidizing enzyme adenase into the oxypurine hypoxanthine. Likewise, any guanine liberated can by action of the guanase contained in the embryo viscera be transformed into xanthine. Here, however, reactions of this sort apparently stop in the embryo, at least of this particular species. The xantho-oxidase and the uricolytic enzyme are not present in the embryo, though quite abundant after birth. In other words, in the embryonic, growing organism, oxidative and katabolic enzymes which are obviously concerned in the gradual destruction of the purine part of the nucleic acid complex are wholly wanting; while those enzymes which have to do simply with transformation and alteration of the purines, thereby leading perhaps to the construction of added nuclein complexes, are conspicuous. Here, we see chemical evidence clearly substantiating our conception of the character of the transformations taking place in embryonic tissue; in the embryo, synthetical, constructive processes must naturally predominate, and the chemical mechanism present at that stage of development is designed solely to meet the requirements of synthesis and broad constructive power. Later on, however, when the embryo passes into an independent existence, those enzymes which have to do with katabolism gradually appear, and assume their function side by side with the enzymes primarily concerned in construction.

[11] "Chemical Studies on Growth," Mendel and Mitchell, *American Journal of Physiology*, Vol. XX., p. 115, 1907.

Problems of this character naturally lead us on to a consideration of the chemical aspects of fertilization, cell division, and the relative significance of the cytoplasm and karyoplasm of the egg and sperm cells in heredity, etc. As is well known, the head of the spermatozoon is essentially a cell nucleus, and like other nuclei is composed mainly of nucleoproteins; viz., compounds of nucleic acid with protein material of a more or less basic character. The only substance to be noted in addition is a small admixture of an organic iron compound known as karyogen. The nucleoproteins of the spermatozoon nucleus differ, however, from the corresponding substances present in the somatic cell nuclei in that the protein part of the molecule is made up mainly of some peculiar form of protein such as protamine, which Kossel has defined as the simplest type of protein material known.

These protamines, of which salmine, clupeine, scombrine and sturine are types, are composed chiefly of diamino acids. Thus, as Kossel and Dakin[12] have shown, salmine contains 89.2 per cent. of its nitrogen as arginine, 4.3 per cent. as proline, 3.25 per cent. as serine, and 16.5 per cent. as valine; a total of 98.4 per cent. Similarly, scombrine contains 88.82 of its nitrogen as arginine, 3.8 per cent. as proline, and 6.8 per cent. as alanine; a total of 99.42 per cent. Sturine, on the other hand, differs from the two preceding protamines in that in addition to arginine it contains fairly large amounts of histidine and lysine. From these statements it is plain to see that the basic character of protamines with their large content of diamino acids is much more marked than that of ordinary proteins, such as are found in somatic nucleoproteins. In some species of fishes, the spermatozoon nucleus contains in place of protamine a histone, as the basic substance joined to the nucleic acid. The significant point in this statement is that the histones as a class contain less (about 31–38 per cent.) of their total nitrogen in the form of diamino acids (arginine, lysine and histidine), while the majority of the protamines have 84–89 per cent. of their total nitrogen in this form. Obviously, therefore, the basic portion of the nucleoprotein is subject to decided variation in the sperm of different species of animals, although all are alike in being made up in large measure of diamino acids.

The nucleic acids present in the spermatozoon, as in the nuclei of somatic cells, are composed of a condensed phosphoric acid to which are joined the purine bases adenine and guanine, the pyrimidine derivatives thymine and probably cytosine, with pentose and hexose groups in addition thereto. As expressed by Burian,[13] the two purine bases are joined directly to the phosphorus of the condensed phosphoric acid, so that in all probability a phosphoric acid amide-like combination results. The thymine and cytosine are presumably joined with carbohydrate groups, the latter being in turn bound with the phosphoric acid skeleton after the fashion of an ester. Regarding the cytosine, it is not yet clear whether this substance is a primary component of nucleic acid or a secondary decomposition product of the purine bases. In any event, we have in the sperm nucleic acid a complex substance containing phosphorus in the form of phosphoric acid, nitrogen in the form of purine bases and pyramidine derivatives, together with carbohydrate in the form of pentose and hexose groups. In the sperm nucleus, this acid is combined with a protein, such as protamine, and according to the analyses of Miescher the head of the ripe spermatozoon of the salmon is composed of about 95 per cent. of a neutral salt of salmine nucleate. These are important facts, since they show us something as to the nature of the chemical complex which constitutes the active part of the spermatozoon, and which of necessity plays an important rôle in the synthetical and constructive processes connected with fertilization of the egg and with the later processes of cell division. The dominance of the diamino acids in the protein part of the nucleoprotein (as in salmine) and the corresponding dominance of purine (and pyrimidine) nitrogen in the acid part of the nucleoprotein must impress us as significant when it is remembered that this material is of necessity concerned in the construction of cell, and later, of tissue protoplasm. In making these statements, I have no desire to minimize in any degree the value of other

[12] *Zeitschrift für physiologischen Chemie*, Band 40, p. 565; Band 41, p. 407, and Band 44, p. 342.

[13] "Chemie der Spermatozoen," II., *Ergebnisse der Physiologie*, Band 5, p. 803, 1906.

lines of work—such, for example, as have been carried on so successfully in this university—notably the influence of changing conditions in temperature, oxygen, proportion and nature of inorganic salts, etc., as determining factors in fertilization and cell division. Still, the striking peculiarities in chemical structure just referred to constantly confront us and call for some logical explanation.

It has been one of the accepted doctrines of physiology in the past that in the animal body the protein of tissue protoplasm is the result of a simple transformation of the food protein; digestion in the gastro-intestinal tract leads to the formation of proteoses and peptones, which after absorption are reconverted into such proteins as are adapted to the needs of individual organs and tissues. Latterly, however, this view has been steadily losing ground. The discovery of the enzyme erepsine in the intestine of man and the higher animals, together with its well-established power of quickly breaking down peptones into crystalline fragments, among which the diamino acids stand out conspicuously, has raised the question whether in the intestine prior to absorption food protein is not more or less completely disintegrated with formation among other fragments, of arginine, lysine and histidine, out of which in the liver or elsewhere specific proteins are manufactured *de novo* to meet the needs of the individual organism. There are many grounds for attaching considerable weight to this view, although the question is by no means settled. The facts, however, point clearly to the probability that in digestion the food protein is more or less broken down into amino acids and very simple peptides, and if the organism is to derive advantage from these nitrogenous fragments for the manufacture of protein to make good tissue waste, then synthesis must be the rule. Further, it is easy to see how by such a method of procedure the animal body is able to construct by a proper selection of these fragments the specific proteins needed by different types or species of organisms; far more easily, indeed, than if the changes undergone by the varying food proteins during digestion are limited to such slight transformations as are involved in peptonization, etc. Assuming this view to be correct, we see a close analogy between the construction of body protein in ordinary nutritive processes and the synthesis of protein in those phases of growth and development associated with fertilization and cell division. In both cases, diamino acids, notably arginine, lysine and histidine, are conspicuous elements, but it is to be noted that in the spermatozoon nucleus the protein part of the nucleoprotein is characterized by great simplicity of structure and with a dominance of diamino acids, notably conspicuous in the protamines, less so in the histones. As constrasted with the proteins of somatic cell nucleoproteins, the difference is very striking and must have some significance. The latter are relatively very complex; a complexity which shows itself in a far larger number of building stones, monoamino acids, etc., with a corresponding diminution in the proportion of diamino acids, such as arginine. We can well conceive that in fertilization and the subsequent nuclear changes which precede rapid cell division there must be some inciting element, some conditions prevailing other than those which characterize the somatic cells, and it would seen justifiable to ask if this peculiar chemical structure of the spermatozoon protein, with its high content of diamino acids, may not be in some measure responsible for the characteristic reactions that accompany and follow fertilization. It is certainly a conspicuous fact that the sperm nucleus of many species of animals contains the same kind of nucleic acid as is found in the nucleoproteins of many somatic cells. Here, there is no noticeable difference in chemical structure, but in the protein part of the nucleoprotein the difference, as has been pointed out, is most striking. Hence, it seems reasonable to suppose that some special function attaches to this peculiar structure of the protein present in the nucleoprotein of the spermatozoon nucleus, although it must be granted that at present there are no facts available to support any theory.

We can not avoid attaching considerable significance to this marked chemical difference in the composition of the cytoplasm and karyoplasm of the sperm cell, any more than we can overlook the striking peculiarity of structure in this particular type of cell, in which the nucleus completely overshadows the cell body. We may well ask why the cytoplasm, composed as it is of a highly complicated mixture of different materials, should be so dominated by a nuclear substance composed almost entirely of a nucleoprotein, the basic portion of which is made up of the simplest type of protein known, with its large percentage of diamino acids? The egg cell, on the other hand, is composed in large measure of cytoplasm, and further, the nucleus of this type of cell has a chemical structure radically different from that of the karyoplasm of the spermatozoon, since such nucleoprotein as it contains is widely variant in chemical make-up from the forms present in the sperm nucleus. It is not strange, therefore, that Miescher and others for a time considered protamine nucleate as the important factor in the process of fertilization. Various lines of experiment have apparently demonstrated, however, that such is not the case; still the problem remains, and there must be some explanation to account for these striking chemical differences in the make-up of the karyoplasm in the two types of cells. The chemist and the cytologist are alike unable to find any adequate explanation for the reactions that occur in the commingling of sperm and germ cells. Extracts of various kinds made from the spermatozoon, which might take up some one or more chemical substances as yet unrecognized, have been so far inoperative in inducing fertilization. There can be no question, however, that many of the problems connected with fertilization, cell division, heredity, etc., are bound up in the chemical constitution of the different components of the sperm and germ cells. Chemical activity of some sort is unquestionably incited by the sperm cell, and we may well believe with Loeb[14] "that the direct and essential effect of the spermatozoon and the methods of artificial parthenogenesis is the starting of a definite chemical process," although we are wholly in the dark as to the exact nature of the reactions involved. It might be conjectured that the spermatozoon serves to introduce a positive catalyzer into the egg cell and thereby starts or accelerates synthetical processes by which the egg is made to develop, with consequent transformation of a portion of the cell protoplasm into the specific nuclein or chromatin substance of the nucleus. Experiment along these lines, however, has failed to give any proof of a positive catalyzer being carried into the egg (Loeb).

There may be legitimate differences of opinion as to the relative importance of the nucleic acid and of the protamine base; of their relative significance in the transference of racial and family characteristics, for example. Loeb, however, has said "that the nucleic acid is of more importance for heredity than protamines and histones." This may be so, although the evidence for such a view is not thoroughly

[14] "The Dynamics of Living Matter," 1906, p. 178.

convincing. However, this is not the time to enter into detailed discussion regarding such questions, as the chemical evidence is altogether unsatisfactory and fragmentary. We must rest content at present with the few suggestions already put forward, understanding that our object at this moment is merely to emphasize the need of broader and more exact knowledge in a field of investigation where chemical processes are undoubtedly of paramount importance. The problems involved are many, and future advance is to be looked for from chemists as well as from workers in the fields of morphology and cytology.

Students of heredity are inclined to believe, on the basis of Mendel's experiments on hybridization, etc., that each individual characteristic of a species is represented by a definite determinant in the germ cell. As Loeb has expressed it, "this determinant may be a definite chemical compound. The transition or mutation from one form into another is therefore only possible through the addition or disappearance of one or more of the characteristics or determinants." Look where we will and such suggestions as these are ever before us. We may recognize to the fullest degree the value of the work which has been done, and is still being carried forward so successfully, on the chemical dynamics of physiological processes and the important bearing which the results thereby obtained have upon the problems we are now discussing, yet there is still before us the unanswered question what are these specific determinants that are the carriers of heredity? If their individuality is bound up, as may well be believed, in the chemical structure of the protoplasm, what is the nature of the groups involved? What the character of the ions that are instrumental by their presence or absence in determining processes that are so fundamental in the perpetuation of species or in the production of modifications? Biological chemists may well work with enthusiasm on such a subject, and while it may be that one person's thoughts, for example, will lead him to a study of organic structure, another may be led with equal force to investigate the influence of positive and negative electrons on protoplasmic activity, each equally impressed with the value of his work in its possible bearing on the solution of the problem. Indeed, there is, I think, perfect assurance that both lines of work are called for if there is to be found positive answers for the many questions constantly arising relative to the subject of heredity and the transmission of specific characteristics. The problem is indeed intricate, or so appears at present, and we can only hope for success by following up every line of approach that presents itself.

The topics on which I have ventured to touch in this brief presentation are a small fraction only of those which will arise in the minds of most biological chemists in thinking of our present-day problems. The number is indeed legion. Problems of many kinds confront us of varying degrees of importance, and on their solution depends our rate of progress. The spirit of investigation is abroad and it is our duty, as it should be our pleasure, to exhibit all possible zeal in advancing knowledge of bio-chemical processes. Opportunities in this country have greatly increased of late. The time was, and only a few years ago, when it was a rarity to find a laboratory of physiological chemistry attached to a university. Now, such laboratories are to be seen on all sides, and men of power are being trained to carry on investigation in this attractive and promising field of work. Further, the great research institutions recently established, The Carnegie Institution of Washington, The Rockefeller Institute for

Medical Research at New York, various public health laboratories, the laboratories for research connected with many of the more progressive hospitals and asylums of the country, and last, but by no means least, the agricultural experiment stations with their increased funds, all offer opportunities for progressive work which, if properly taken advantage of, promise results of great importance in the development of a more exact and broader knowledge of the chemical processes of life. To the chemist and physiologist there is nothing to be desired more than an increase in the activity of research; research guided by intelligence and knowledge, coupled with an interest which knows no discouragement.

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THE AMERICAN SOCIETY OF VERTEBRATE PALEONTOLOGY

The society held its seventh annual meeting at Yale University, New Haven, Conn., December 25, 26 and 27, the following papers being presented and business enacted.

Dr. G. R. Wieland discussed the extermination of green turtles and whales, showing that while the whaling industry had been prosecuted fully a thousand years, in which time some $272,000,000 worth of oil and bone had been obtained, the total number of whales killed was under one million; but the destruction of this relatively small number is fast exterminating these marine mammals. After an animated discussion the society adopted the following resolution:

Resolved, That the American Society of Vertebrate Paleontologists will aid in every way practicable those measures, legislative, international and local, which will prevent the now immanent destruction of the great marine vertebrates, especially whales, manatees, seals and green or other turtles, on the coasts of the United States and on the high seas.

Dr. F. B. Loomis described a fauna of vertebrates (*Portheus, Ichthyodectes, Saurocephalus, Pachyrhizodus, Empo,* etc.) found in the upper black shales making the divide between the Cheyenne River and Hat Creek, Wyo. This fauna being typical of the Niobrara indicated that the upper beds of the so-called Ft. Pierre of that region are Niobrara, and what is beneath would be Niobrara and Ft. Benton.

Dr. W. J. Sinclair showed that the material of the Washakie was practically all volcanic ash, probably distributed by wind and streams.

Dr. G. F. Eaton discussed the skull of *Pteranodon*, showing that the basal portion was peculiar in the development of the parasphenoid, and unique in the possession of diagonal rods running from the base of the parasphenoid to the transpalatines. The origin of the crest was partly attributed to the great development of grasping muscles (connected with the supposed piscatorial habit of feeding) and was compared with incipient crests in the fish eating birds *Plotus* and *Phalocrocorax*. The striking similarity of the pelvis to that of birds was pointed out.

Professor Joseph Barrell read a paper in which evidence was given showing the widespread development of flood plain deposits in the Old Red Sandstones basins and the presence of a fluviatile piscine fauna. The climate was genial and subject to recurrent seasons of dryness. The footprints of the earlier amphibia often show also an association with fluviatile deposits and an adaptation to even semiarid climates. In the discussion of various factors tending to bring about the evolution of the Amphibia the influence of recurrent seasons of dryness upon a fluviatile fauna appeared to be by far the most powerful. In conclusion the origin of hibernation was discussed and the probable relations of early amphibia and reptilia.

Dr. Wieland exhibited the skeleton of the giant turtle *Achelon*, pointing out the points of morphological importance, and the affinities of the Protostegidæ.

Professor Bashford's presidential address on the "Findings in Fossil Fishes, 1906–1907" appeared in Science on February 14.

Dr. Hussakof presented a model of a restoration of *Dinichthys*, which emphasized the great head and relatively small body and tail, suggesting a bottom-living fish. He also showed illustrations and specimens giving the exact detail as to the location of the fish-bearing beds in the Devonian of Canada.

Dr. C. R. Eastman announced the discovery of a new species of *Cœlacanthus*, the earliest yet found in this country, and represented by a nearly complete individual, in the basal portion of the Kinderhook limestone of Iowa. The accompanying invertebrate fauna is regarded by Dr. Stuart Weller as a survival of late Devonian times, and its marked Devonian aspect has also been commented on by Professor S. Calvin. The specialized character of the new American form indicates that the ancestors of the group are to be sought in rocks possibly as old as the Lower Devonian, where their remains have hitherto escaped notice. A description of the new form will be found in the *Journal of Geology*.

Professor R. S. Lull presented a comparative study of the musculature of the chameleon and a chelonian, together with the muscle depressions on the skull of *Triceratops*, the main muscles of the latter were ascertained—those of the jaws and of the neck region. The frill or crest seems to have had its incipient function in providing space for attachment of the great temporal muscles of mastication. A second function, that of providing leverage for the wielding of the head, with its great armament of horns, and a final function of protection of the neck, were ascertained. The crest is quite similar to the casque of the chameleon, both morphologically and in function, while the male of the living *Chameleo owenii* from Fernando Po resembles *Triceratops* still further in the development of three horns. Convergence toward the turtles is shown in the beak and the false roofing of the skull above the brain case, culminating in the turtle *Meiolania* of the Tertiary of Lord Howe Island, which also bore horns on the skull.

Professor Lull's second paper considered the migrations of the elephants, first from the ancestral home in the Fayûm of Egypt, and later to and from the great center of proboscidian evolution in India. The American elephants have been the result of successive migrations, one genus only, *Dibelodon*, having reached South America by way of the Isthmus of Panama.

Professor H. F. Osborn discussed "Dolicocephaly and Brachycephaly in Titanotheres," showing that while lengthening or shortening might take place uniformly as if the skull were stretched, still it was more generally to be attributed to local lengthening or shortening of a special part as the face or brain case. On Friday at 5 P.M. Professor Osborn gave an illustrated lecture on his trip into the Fayûm, this being before both the zoologists and paleontologists.

Professor E. C. Case had a paper on the "Permian Glaciation and Distribution of Permian Reptiles" presented; in which he brought out the uniform character of the fauna of Africa, South America and India, and its entire lack of affinity with the North American Pelycosauria. During the Permian glaciation of the southern hemisphere, its reptile fauna was driven northward, surviving in some unknown locality; later after the glaciation it returned to the southern land mass, there to develop its high variation and specialization. Probably during its exile the mammalian stem arose. The North American Pelycosauria (though having a common ancestry in pre-Permian times) never came in contact with the southern Anomodontia, and played their rôle independently.

Dr. W. D. Matthew described a new four-horned pelycosaur from the Permian of Texas; also a mole from the Lower Miocene of South Dakota.

Mr. Walter Granger, summarizing his studies on the American Hyracotheres, showed that the generic term *Eohippus* covered all the Wasatch, Wind River and Huferno Basin species of the family; *Orohippus* all the Bridger forms; and *Epihippus* all the Uinta forms. He also demonstrated that on premolar 3 of the upper jaw, the last cusp to develop was the anterior-internal, while on premolar 4 it was the posterior-internal which developed last. This striking divergence in the phylogeny of two adjacent teeth causes a demand for much further study, before the history of the various teeth can be summarily treated.

Mr. Harold Cook described a new hornless acerotherine rhinoceros from the Lower Miocene of Nebraska.

Dr. F. B. Loomis discussed the fauna of the Lower Miocene of Nebraska, describing a new *Parahippus,* a hornless rhinoceros (*Acerotherium*) and two new Dicerotheres. A review of the fauna and consideration of the nature of the sedimentation led him to advocate an eolian origin for the beds. The last session of the meeting was devoted to museum methods, the discussion being led by Mr. A. Herrman, Dr. Matthew and Professor Chas. Schuchert.

At the business session the following officers were elected for 1908:

President—Professor R. S. Lull, of Yale.

Secretary-treasurer—Dr. W. D. Matthew, of the American Museum.

Executive Committee—Dr. C. R. Eastman, of Peabody Museum; Mr. O. A. Peterson, of Carnegie Museum; Professor Wm. Patten, of Dartmouth College.

F. B. Loomis,
Secretary

THE NEW EDUCATION IN CHINA

That most popular simile of schoolboy compositions, of Juno springing full-armed from the head of Jupiter, may be applied to the new education in China. From the Chinese government the new education came forth by imperial edict. The edict and the consequent commands and directions present a fully articulated scheme of education.

Four grades of education were made: (1) The primary school, of five years; (2) the common school, of four years; (3) the middle school, of five years; (4) the provincial college, of at least two years, and for some students one; (5) the Imperial University, at Peking, of such a length as may be desired.

Such a course, in its whole duration, covering from sixteen to twenty years, represents a most impressive endeavor to introduce the western system of education into the Middle Kingdom.

The system is indeed western, but it is western colored by Japanese influences. The martial conqueror of China has become her teacher in things intellectual, and more willing has China become to receive her conqueror as a teacher since this teacher has become the conqueror also of Russia. The rapid advancement of Japan to a place among the great nations gives to her example and teachings a peculiar impressiveness. Japan in turn, it may be added, found in Germany and America her intellectual and pedagogical models.

The Avon to the Severn flows, the Severn to the sea;
And Wycliffe's dust must spread abroad, wide as the waters be.

The content of this prolonged course is quite as significant of the modern touch as is its length. Throughout the nine years of the primary and the common school Chinese is the chief subject, representing ten hours a week. Writing covers six hours the first year, but diminishes, becoming only two hours in the ninth. Arithmetic begins with three hours, but increases to four at the close of the course. History and geography begin in the fourth year, each subject being allowed two years, but in the sixth year the allowance of time granted to history is increased one hour, In each year of the four of the common school some science is taught two hours a week, and drawing one. Throughout the whole period two hours are given to ethics and three hours to physical drill.

A similar scheme of equal elaborateness is prescribed in the middle school of five years. In this whole period, Chinese is still studied for six hours. English is introduced, being allowed also six hours; mathematics is continued for four hours, including algebra, geometry and trigonometry as well as arithmetic. Drawing and ethics are also continued, each having one hour, and physical drill still has its former allowance of three hours. Both foreign and Chinese history is studied in the first two years four hours, and in the last three years three hours a week. Such are the "constants" of this higher school course. In addition the "variables" are significant. For four years geography commands two hours a week. For three years four hours a week are given to sciences in which chemistry and physics fittingly occupy a leading place, and allied with them are physiology and hygiene, physical geography, geology and mineralogy. But the sciences are not suffered entirely to exclude literary studies, for political economy and law are studies of two hours a week each for the last year of the long course.

The student who has completed these three schools, the primary, the common and the middle, covering in all no less than fourteen years, has reached the age of at least twenty—the age of the ordinary sophomore in the American college. On reaching this stage he may pass on to the college of his province. He may enter the normal school, preparing himself to be a teacher to his countrymen, in a course covering either one year or three years. This school includes such subjects as would be found in a good American normal school. Or, this graduate of a middle school may desire, probably does, to become an official. In this case he enters a special school. The prospectus of one of these schools—that at Ningpo—says:

> To teach the modern methods of law and government, especially as they are related to those of China, and laying emphasis on the study of Japanese law and methods of government. Resident students must, previous to their entrance, have taken a Chinese degree, or be graduates of a middle school. The course extends over two years and the students who have been successful in their examinations will receive certificates, and will then be recommended by the prefect to the governor for official appointment, or for further study in Peking.
>
> The course of study includes commercial law, theory of government, international law, penal law, judicial law, army organization, Japanese and a little English.

Such, in bare and bald outline, is the educational system which China has adopted. As a system, comprehending the chief subjects of modern learning, it deserves and receives the highest commendation. The government merits great praise for laying such foundations under most serious difficulties.

Schools to teach these studies have been established throughout the empire. Some of the schoolhouses are large and impressive structures. Thousands of these schools are now trying to educate hundreds of thousands of Chinese boys and girls. The spectacle is one of the mightiest triumphs of education and of government ever known, despite all the haltings and failures to which the undertaking is subjected.

In carrying out the system the making of text-books has become an important factor. Text-books have been produced in enormous quantity and one great variety. Many of them are translations of English or Japanese text-books. In some of them the Japanese influence is strong. Of them all, perhaps none are more important than the Chinese National Readers. The series contains readings on subjects of all sorts—scientific, historical, ethical. It may be added that these books frequently argue against superstition and idolatry. One who knows them has said that they contain nothing which opposes Christianity. But besides this series are numerous others, especially in the sciences. History is also well represented.

But more important than the system of education or the text-book is the teacher. The old Chinese teacher does not easily lend himself to the new order. He is by nature conservative. He clings to the old methods. He is himself so wedded to the old that he confesses to a sort of intellectual awkwardness when he tries to use the new learning and methods. He keeps himself, in his fear of making mistakes, closely to his text-book. He still emphasizes the value of memory. He himself is not a thinker, and he is not inclined to adopt methods which quicken thinking in his students. Modern pedagogy is to him so new a science and art that either he has little appreciation of its worth, or, if he is able to appreciate, he is not able to use it with facility and efficiency.

The teacher, the text-book and the course of study are all designed for the advantage of the student. The Chinese student has a mind strong and virile. The mental quality is akin to the physical. But his mind, like the feet of his sisters, has been fettered by ages of unreasoning limitations. The education of his forefathers has been either no education at all, or, if it has existed, it has been unreasoning and irrational. He himself in his newly-found freedom feels himself strange: he sees trees as men walking. But gradually he is finding himself. His conception of education is rather of a vocation than of culture. The vocation may take on somewhat of a materialistic basis and color. He desires those physical advantages which education is supposed to create. "What are you going to do?" asked a teacher of a graduate—an able man—of Nan Yang College. "Commerce," was the answer. "And why commerce?" persisted the questioner. "Is it for the sake of enriching yourself or helping your country?" The reply indicated that the purpose was not altogether altruistic.

The inspiring motives of the casting off of the old education and the adoption of the new are manifold. The immediate occasion is, undoubtedly, the failure of the Boxer movement of 1900. The entrance of the allied forces into Peking in the summer of that year was the entrance of intellectual light quite as much as of armies. The government became aware, as perhaps never before, that there was a world outside of China, and superior in at least some respects to China.

Connected with this occasion is the rise of Japan into a place as a world power. China saw and was moved. She saw, moreover, correctly—that the rise of Japan was due in part at least to education. China, therefore, determined to adopt similar means and methods. She went about the business of education. Japanese methods, text-books, she adopted. She imported Japanese teachers. She sent thousands, even tens of thousands, of her young men to Japan, to Tokyo, to Waseda University and other schools. Her old rival, and her conqueror, became her teacher.

A third cause of the educational advancement lies in the force of the progressive men of China. The character of Chang Chih-Tang—one of the two greatest Chinese—and his writing, as, for instance, his book, "China's Only Hope," represent a mighty influence. Against hard odds and good fighters do the progressive leaders contend. Chang Chih-Tang himself has described them in his book:

> The anti-reformers may be roughly divided into three classes:
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> First, the conservatives, who are stuck in the mud of antiquity. The mischief wrought by these obstructionists may be readily perceived.
>
> Second, the slow bellies of Chinese officialdom, who in case of reform would be compelled to bestir themselves, and who would be held responsible for the outlay of money and men necessary for the changes. The secret machinations of these befuddled, indolent, slippery nepotists thwart all schemes of reform. They give out that it is not "convenient," and in order to cloak their evil deeds rehearse the old story, the usual evasive drivel about "old custom." And if we attempt to discover what this precious old custom in the matter of education and government is, there will be remonstrances on all sides. Old custom is a bugaboo, a password to lying and deceit. How can any one believe it?
>
> Third, the hypercritics.

But against such forces the reform party has won, and is still winning; though no prophet would intimate how long it will prove to be victorious.

But, above all, the missionary and Christian forces of the Middle Kingdom represent a permanent cause of her interest in education. Christianity has not been in China for three hundred years, or for a hundred years with special power, for nothing. Christianity is far more than a religion. It is an education. The church and the schoolhouse historically stand side by side. The priest is also a teacher. Protestant Christianity has for the last hundred years in its missionary propagandism given special heed to education. Such a force operating for generations, even in a most conservative society, could not fail to effect results of comprehensive and also of definite significance.

Under the influence of these four occasions and motives, not to mention others, China has entered into the work of education. She has come to realize that the work is more complex and more difficult than it seemed five years ago. She undertook the tremendous task without proper forethought. It was a leap in the dark. But the leap was taken and the consequences of taking it she must, for better or for worse, endure. What are some of the peculiar difficulties which are now besetting the pathway of education in China I shall discuss in some detail. For these difficulties are formidable and unique.

SPECIAL DIFFICULTIES OF THE NEW EDUCATION IN CHINA

One's heart goes out in great interest to the educationists of China. For the difficulties which beset them are very serious. I doubt if in the history of the world difficulties more serious have beset those whose duty it is to establish and to promote a system of education.

One difficulty lies in the necessary doubt regarding the sincerity and earnestness of the Chinese government in its endeavor to foster the education of its people. The government may be honest in the desire to educate; it may not be. Even if the desire be real as far as it goes, doubt also arises respecting the earnestness and fullness of this desire. The edicts abolishing the old system of examinations followed not long after the cataclysm of the summer of 1900. This break seemed one of the inevitable results of that catastrophe. This and other consequences could not be avoided by the court, however conservative were the governmental tendencies. With these results were naturally united the necessity of giving to China such a system of education as had seemed to lift the rest of the world into civilization. But with it China did not enter with that spirit which moved the German people after their Napoleonic distresses into education both university and common. The Germans were inspired by most personal and national ambitions; and the result is read in the history of the University of Berlin. The Chinese were primarily moved from without; the degree of cooperation which the outside influence found in the Chinese heart was and still is a matter of grave doubt. This element of doubt in the sincerity and earnestness of the Chinese heart in promoting public education is a chief difficulty which the educationists meet. It is not a stone wall, which can be struck down; it is a malaria which represents conditions that can be dealt with only by indirection.

A second difficulty is the constant change of the educational purposes of "the authorities" and also of the less constant change of these authorities themselves. Shall the provincial colleges be literary or scientific institutions? If scientific, shall they train agriculturists, or mechanical, or civil, or electrical, engineers? In the course of a few years these different purposes may be imposed upon the teachers of a college by their official superiors—superiors who are superiors in only the official sense. Such changes are disastrous. No less disastrous are the changes wrought in the transfer of governing powers from one official board to another. At one time Nang Yang College, at Shanghai, for instance, may be under the charge of the Board of Agriculture, and at another under the charge of the Board of Communications—Post and Telegraphic. At one time a college may have a president who serves as the source of immediate authority, at another it may have no president, but be governed by a council. The changes, too, in the viceroys of the different provinces may fundamentally affect the fortunes of a college. One viceroy esteems education and promotes it; his successor may despise it and seek to limit its progress. All these conditions throw doubt into that most important part of college administration—the budget. Such instability is most trying and perplexing to the heart and the mind of the educationists of China.

Another difficulty lies in the divorce which has for many centuries existed in China between the scholar and the man of affairs. The scholar, be it always remembered, has from the early time held a high place in Chinese society. The learned man has been esteemed, and learning honored. The learning has, however, been an end in itself. The scholar has filled his mind with the paragraphs and the sentiments of the old moralists. Such stuffing has given him pleasure. That his knowledge should be of any worth or benefit to humanity has been quite foreign to his thought. Most egoistic has he been; and the community has been content to let him be egoistic. But modern education has for its primary note service. It is in purpose, method and content altruistic. If it promotes scholarship and makes scholars, it looks beyond the accumulation of knowledge to the worth which this wealth may prove to be to humanity. It is the introduction of this altrusitic ideal which the teachers of many Chinese schools find of great difficulty.

Allied to this specific course is a general condition, out of which possibly the cause to a degree springs. I allude to the doubt which pervades at least some orders of Chinese society regarding the real worth of human character. Is man, the ordinary man, worth educating? Is it well for man to seek to lift man by education? Once a coolie, why should not a coolie he always remain? Is not education disquieting to the individual and disturbing to society? Is it not better for man to be half blind and content than to see plainly and be discontented? Such questioning is in the air at Peking, Wauchang and Shanghai. It serves, if not to cut the name of education, at least to dull its enthusiasms.

But the severest difficulty found in the progress of Chinese education lies in the lack of a sufficient number of good teachers. The government, provincial and national, went into the work of education as a sort of leap into the dark. It adopted and created the material forms and forces of education, which are evident and impressive enough. It built schoolhouses, large and long and high. In not a few capitals the schoolhouses are the most impressive structures. But the government failed to take proper account of the fact that, if it is easy to build a schoolhouse, it is hard to get a teacher. Teachers can not be made in a year as can a schoolhouse. The government did not put the cart of the school before the horse of the teacher, for though there was the cart there was no horse. Teachers in a sense are grown; and growth, unlike manufacturing, takes much time. Therefore, while there were and are schoolhouses, and also pupils, in abundance, too great abundance in a sense, there was and is a dearth of teachers. The gun was made and mounted, but there was no gunner to fire it. In such a dearth incompetency flourishes. But the dearth was and is so great that the number of even incompetent teachers proves to be insufficient. Some schoolhouses are, therefore, houses without schools, and other schoolhouses are only half occupied. In such a condition Japan would even now be plunged, had she not established normal schools—and some excellent ones, too—for training teachers. This need of Japan President Eliot pointed out a generation ago. China has normal schools, but they are new, and they, too, lack proper teachers. The fact is that China went into this great work of the education of a quarter of the population of the globe without proper prevision or provision. The mission schools and colleges, such as St. Johns, at Shanghai, and the North China Union College, near Peking, are implored by the government officials to send teachers to the government schools, but these colleges and others like them, in many cases, can not, simply because the supply is inadequate.

It may be said that the dearth of good teachers in the government schools of China should prove to be an impressive fact to the American man who is graduating at his college. Teachers of English and of the sciences are specially needed. Many motives, selfward and altruistic, would urge him to go to China on graduation. He can earn twice as much money as a teacher in China as he can at home. He can gather up into his manhood experiences, new, diverse, moving and enriching. Whether he can do more good than at home is a personal question, in which a stranger should not meddle. But, if meeting responsive minds, eager and by nature strong, which are to become makers of other minds, represents an opportunity for doing much good, certainly the Chinese government schools represent a very rich opportunity.

These difficulties which I thus outline are very general and constant. The teachers now on the ground are dealing with them as best they may. Both foreign teachers and native are laboring together to overcome what obstacles they can not remove, and to remove all that can be removed. The problem is hard. The quantitative relation is significant. To educate four hundred millions is a problem unlike educating forty millions—as in Japan. In their endeavors the present teachers of China deserve sympathy. To condemn the inadequacy of Chinese education—and it is inadequate—means ignorance of the conditions. Sympathy should be given by the teachers of the world to their professional brethren in China, and reenforcements, too. For these reenforcements the Chinese government is loudly calling.

Charles F. Thwing
Western Reserve University

SCIENTIFIC BOOKS

A Text-book of Physiology for Medical Students and Physicians. By William H. Howell, Ph.D., M.D., LL.D. Second edition. Philadelphia and London, W. B. Saunders Co. 1907.

"Economy," wrote Burke, "consists not in saving, but in selection." This principle Professor Howell has applied in writing his text-book of physiology. Instead of attempting to condense the great mass of fact and theory which constitutes the body of present-day physiology, he has chosen subjects which have seemed to him most desirable for the man with medical interests to know. And these subjects he has presented with simplicity and lucidity. The result of this method has been the production of a treatise which states with a fair degree of completeness the facts and theories of many important phases of physiology, while other phases are wholly eliminated. The method permits the writer to avoid the bleak statements of fact which characterize attempts at too great condensation, and allows a variety and discursiveness, at times into the historical development, at times into the practical bearings of the subject, which are entertaining. This text-book has already been used two years by medical students, and they report to their instructors, "Howell is interesting reading."

The first exception which might be made to a text-book based on the principle of elimination rather than condensation is that the writer may emphasize his special interests and may eliminate subjects which seem important to others. Fortunately Professor Howell's extensive experience as a teacher and investigator in different medical schools has served him well. This experience, together with the fact that in all the larger medical schools in which the laboratory method is an important feature of physiological training the subjects taught do not greatly vary, has led to a selection of material which would be generally admitted as desirable for students of medicine to know, and to the elimination of little that is at present medically important.

The first section of the volume deals with the physiology of muscle and nerve—the fundamental tissues for most of the systems which follow. The second section on the physiology of the central nervous system is concerned with the governing agent of the muscular structures already studied. A discussion of the physiology of sleep in this section is an unusual and commendable chapter in a physiological text-book. Treatment of the special senses as the recipients of stimuli for the central nervous system is taken up in section three. Blood and lymph are next considered as a preliminary to section five which is devoted to the organs of circulation. The discussion of the physiology of respiration in section six, and digestion and secretion in section seven presents further application of the fundamental activities studied in the earlier chapters. In all these general subjects the chemical side of the physiological activities has received due recognition. This is also true of the treatment in section eight of nutrition, and heat production and regulation. The formal exposition closes with an excellent account of the physiology of reproduction. An appendix, however, gives a brief description of proteins and their classification, and a clear statement of some of the facts and principles of physical chemistry in their application to physiological processes. The large array of original illustrations is a pleasing feature of the volume.

In this second edition a number of small errors which crept into the first edition have been corrected, and additions have been made with the object of keeping the book abreast of the times. As far as possible, however, these additions have been counter-balanced by the elimination of material which could be spared, and the volume, therefore, remains of practically the same size as in the first edition.

At this time when physiological facts and methods are becoming more generally recognized for their importance in experimental pathology and surgery it is highly gratifying that so excellent a treatise as Professor Howell's can be placed in the hands of students who are to become the future investigators and practitioners of scientific medicine. So few text-books are written now-a-days by men who are themselves active in research that the spirit of research rarely is expressed in them. This book, however, is an exception to the rule. Professor Howell has not hesitated to bring before his readers phases of physiology in which the conclusions are not yet settled; the student is thus made to see that there are live issues in the determination of which he may himself engage. Other evidence of the hand of the scholar in this book is the presence of numerous references to the original sources. This feature, likewise, is so unusual in the conventional text-book that it is worth noting and commending as admirable. By these methods the student may be led to take no secondary account as final authority, but to base his judgment on the weighing of first evidence. It is a real pleasure to find these scholarly qualities in an American text-book widely used by American students.

Walter B. Cannon

The Microscopy of Technical Products. By Dr. T. F. Hanausek, Director of the Gymnasium at Krems on the Danube; Member of Various Imperial Commissions and Learned Societies; formerly Professor of Natural History at Vienna, Analyst of the Government Food Laboratory at Vienna, etc. Revised by the author and translated by Andrew L. Winton, Ph.D., Chief of the Chicago Food and Drug Laboratory, Bureau of Chemistry, U. S. Department of Agriculture; formerly in charge of the Analytical Laboratory of the Connecticut Agricultural Experiment Station, with the collaboration of Kate G. Barber, Ph.D., Microscopist of the Connecticut Agricultural Experiment Station. With 276 illustrations. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1907. Cloth, $5.00.

With the development and application of scientific methods in all lines of industry and with the increasing use of the microscope in the analysis of various raw and manufactured products, the need for books dealing with its application in this field is being felt in this country as well as abroad, and we in this country are highly indebted to Dr. Winton for making available first the valuable work of Moeller on food products and now the work by Hanausek on technical products.

As stated in the preface, Hanausek's work is intended on the one hand as a text-book for the "student entering the field of technical microscopy," the requirements being that he shall possess a general knowledge of the natural sciences, particularly the morphology and histology of organisms, and shall also be familiar with the principles of chemistry; and on the other hand, as an aid in the solution of practical problems. Thus, as stated by the translator, the book "is unique in that it teaches the microscopic identification of technical products and at the same time the fundamental principles of vegetable histology and the histology of certain animal materials" as well.

The author's reputation as a teacher, investigator and technical expert, and the translator's ability and experience as an analyst, assure at once the high character of the work and bespeak for it a wide use in this country.

The book covers some 471 pages, and is divided into two parts. Part I. includes three chapters and deals with the microscope, microscopic accessories and micro-technique. Part II. embraces nine chapters, and treats of the microscopy of the most important types of technical raw materials under the following heads: (1) Starch and Inulin; (2) Vegetable Fibers, including hairs, the fibers of monocotyledonous and dicotyledonous stems, and the microscopic examination of paper; (3) Animal Hairs, Silk and Silk Substitutes, Mineral Fibers, and Microscopic Examination of Textile

Fabrics; (4) Wood of Dicotyledons and Gymnosperms, Monocotyledonous Stems, Subterranean Organs, Barks, and Practical Examples; (5) Leaves of Different Varieties of Sumach; (6) Pyrethrum or Insect Powder; (7) Technical Fruits and Seeds, Oil Cakes, Myrobalans, Ivory Nut; (8) True Bones, Teeth, Horn, Tortoise-shell and Whalebone; (9) Micro-chemical Analysis.

The reviewer is using both the work on "The Microscopy of Vegetable Foods" and on "The Microscopy of Technical Products" in the laboratory, and finds them very helpful. Pure botanists would do well to have these books in their laboratories where plant histology is considered, as there is no doubt but that much of the work on the anatomy of plants has been developed by the investigators in technical histology.

Henry Kraemer

Philadelphia College of Pharmacy

Archiv für Optik; Internationales Organ für Experimentelle, Theoretische und Technische Optik. Erster Band; Erstes Heft, Oktober, 1907. Herausgegeben von Dr. Alexander Gleichen, Kaiserl. Regierungsrat in Berlin, unter Mitwirkung von (some twenty astronomers, physicists and optical specialists). Verlag von Veit und Comp. in Leipzig, Preis des Bandes. 20 Mark.

The establishment of an international journal in any important field of scientific activity is nowadays a decided step toward that internationalism in science and that pure human cooperation which are earnestly desired by the best and brightest people of all lands. Astronomy has for two centuries led the way in this genuine internationalism, but many other sciences are now enlisting under the same standard.

As a general rule the journal of international scope should be published in the country which may naturally be expected to contribute most efficiently to its pages. A fine type of such a publication is the *Astrophysical Journal* published in America, where astrophysical science flourishes most luxuriantly. It has, however, received the hearty support of men of science in all lands. Its pages are enriched by the world's best thought in the great field of astrophysics.

The *Archiv für Optik,* as an international organ, ought naturally to be published in Germany. In many respects German thought has led in theoretical optics, and the German hand executed some of the finest experimental and technical results in all optics. To-day no great general treatises in technical optics exist outside the German language. It is also peculiarly fitting that the same international cooperation should be given the *Archiv für Optik* that has in the collateral field been accorded the *Astrophysical Journal.*

Dr. Alexander Gleichen, if we may judge from the theoretical thoroughness and practical tone of his writings, is well equipped to guide so difficult and important an undertaking as a world-journal in general optics. His "Lehrbuch der Geometrischen Optik," Leipzig und Berlin, 1902, has an international reputation. His "Vorlesungen über Photographische Optik," Leipzig, 1905, is indispensable to technical students in optics, and his "Leitfaden der Practischen Optik," Leipzig, 1906, is an excellent introduction to the fundamental theory necessary in optical practise.

The first number of the *Archiv* contains "Tatsachen und Fiktionen in der Lehre von der Optischen Abbildung," by Allvar Gullstrand, of Upsala; "Über ein neue Verfahren der Körpervermessung," by C. Pulfrich, of Jena; and "Patentschutz für Optische Systeme," and "Zum Gedächtnis von Siefried Czapski," by Dr. Gleichen. Then follow trenchant reviews of eighteen current articles on physical optics; of two on astronomical and meteorological optics; of one on medical and biological optics; and of one on technical optics. Dr. Lummer's new volume on optics receives detailed notice; and a complete list of optical articles read before various scientific academies is presented. F. Plehn makes a valuable contribution to the history of optics by reviewing Kepler's "Paralipomena ad Vitellionem seu Astronomiae pars optica." Then follow interesting selections from scientific societies, namely, Max Wolf "On the

Milky Way," and Sigmund Exner on "Acuteness of Vision of Various Animals." The new German optical patents and instrumental designs are reviewed. The optical ateliers and their novelties receive a page of attention. Mention of new books and personal notices close the number.

The far-reaching significance of the appearance of this international journal on optics should be promptly appreciated. Glancing over the achievements of America's men of science in the field of optics during the last quarter of a century, and calling to mind the present manifold American activity in all kinds of optical enterprise, it seems that many interesting contributions ought to be made to this journal from the land of Alvan Clark, Henry Draper, J. Willard Gibbs, Henry A. Rowland, James Keeler, Samuel P. Langley and D. B. Brace.

The *Archiv für Optik* will, of necessity, be at the command of every American student and worker in optical fields. And the deeper interest in theoretical and practical optics to be awakened by this special journal will find concrete expression in more powerful optical instruments, largely of American design and manufacture, and in their manifold and ever-multiplying scientific uses.

M. B. S.

SCIENTIFIC JOURNALS AND ARTICLES

In the December number of *The American Naturalist* the editor, Professor Frederic T. Lewis, of the Harvard Medical School, says: "*The American Naturalist* now completes its forty-first volume. With the development of the natural sciences in this country, in which it has had an important part, many technical journals have appeared; but these have not deprived the *Naturalist* of its special field. Although dispensing with its early subtitle—A Popular Illustrated Magazine of Natural History—it has always aimed to present in readable form an account of the progress of natural history, together with original articles on such animals, plants, and geological formations as are of general interest. In accomplishing this without the usual endowment or support of any scientific society, the journal has depended upon its owners and the public for financial support, and upon the unpaid work of editors and contributors for its success. Messrs. Ginn & Company have decided to discontinue as publishers with the completion of this, their tenth volume. It is thought that to justify the work now being expended upon the journal, it should have a wider circulation and more generous support. The means of accomplishing this are being discussed, and the owners will be glad to receive practical suggestions from those interested." It has now been arranged that the *Naturalist* will in the future be published by The Science Press, and business communications should be addressed to Sub-station 84, New York City. Editorial communications should be addressed to the Editor of the American Naturalist, Garrison, N. Y.

The Museums Journal of Great Britain for December, 1907, contains a brief article by H. C. Bumpus, on "The New Museum at Frankfurt" which is commended, among other things, for the ample provision made for laboratories, and for a staff to use them. Huntly Carter tells "How to Promote the Use of Museums by an Institute of Museums." In spite of many good points this article strikes one as rather unpractical and to imply a willingness on the part of the public to study the workings and uses of museums that the same public is very far from possessing. Among other notes is an item to the effect that work has begun on a new wing for the National Gallery.

The Zoological Society Bulletin for January opens with an article by C. William Beebe on "New Rare Birds in the Zoological Park." Notable among these are the lammergeier, the hyacinthine macaw and the touracous. The park now contains 2,400 birds representing 520 species, perhaps the largest collection of living birds in the world. The principal article is by Elwin R. Sanborn on "The National Bison Herd," an account of the transportation of the herd of fifteen bison, presented by the Zoological Society to the national government, from New York to the Wichita range; the article is admirably illustrated. Mr. Ditmars records the reception of a toad, *Scaphiopus hammondi,* said to have been exhumed from limestone, at a depth of 150 feet, at Butte, Montana. As limestone is notable for caves and fissures there is nothing impossible in the specimen having lived out of sight long enough for the color pattern to have faded. It has now lived in a porcelain jar for eight months without feeding. But a rattlesnake has been known to exist seventeen months without eating and snails from three to eleven years. We trust that the future record of this toad will be carefully kept.

The American Museum Journal for January is a paleontological number. W. D. Matthew describes the recently mounted skeleton of "Allosaurus, a Carnivorous Dinosaur," and "The New Ichthyosaurus," this last one of the rare instances in which the shape of the paddles, tail and dorsal fin of this marine reptile are clearly shown. Walter Granger gives "A Preliminary Notice of the Fayûm Collection," which secured some 600 specimens of fossil vertebrates, and there are notes on ethnological material from the Congo, and the Bismarck Archipelago.

The Museum News of the Brooklyn Institute for January has articles on "Zuni Basketry," "Arctic Foxes" and the "Tree Frog and Protective Coloration."

The Bulletin of the Charleston Museum for December is mainly devoted to the "History of the Museum" subsequent to 1850, although it notes the preparation of the first loan, or traveling exhibit, devoted to illustrating the iron and steel industry.

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 437th meeting was held January 11, 1908, President Stejneger in the chair.

The first paper, by Mr. E. W. Nelson, of the Biological Survey, on the "Distribution of Plant and Animal Life in Lower California," was in the form of a lecture illustrated by many lantern slides during which he gave a brief resumé of his recent expedition to the Peninsula of Lower California. The peninsula, which is about 800 miles long and from 30 to 100 miles wide, was traversed its entire length and crossed eight times from one side to the other. The country proved to be mainly a mountainous desert subject to prolonged periods of drought during which no rain falls for several successive seasons. As a result surface water is very scarce.

The most interesting feature of this region is its plant life, as it has probably developed the most remarkable desert flora of the world. On the other hand, the bird and mammal life is very closely related to that of southern California. The birds and mammals in most cases are either the same as, or merely geographic races of, the Californian species. As would be expected, the greatest amount of differentiation has taken place in the mountains near the extreme southern end of the peninsula. Only about half a dozen birds and a single mammal, a species of mouse (*Oryzomys*), are derived from the opposite mainland of Mexico. These species all live near the southern end of the peninsula.

The second paper, by Dr. D. T. MacDougal, was a lantern slide lecture devoted in large part to "Changes in the Delta of the Colorado River."

During a visit to the lower part of the delta of the Colorado River in March, 1905, a great volume of flood water was seen to be leaving the main channel and making its way southeastwardly to the gulf through the Santa Clara Slough, and the prediction was hazarded that a shift of the cutting action of the water might send the principal current to the sea in this way (*Bull. Amer. Geog. Society,* January, 1906).

Shortly after that observation was made, the entire stream was diverted into the Salton Basin for a time, leaving the bed of the river bare for more than a hundred miles. With the restoration of recent conditions the Colorado resumed its way to the Gulf, but in the meantime, such erosion and formation of bars had taken place in the section affected by the tides below the "Colony mesa," that the main current flowed through the Santa Clara Slough, if reports from three different sources are to be credited.

The consequences of this change are somewhat momentous. The main mouth of the river was formerly twenty or thirty miles farther north of the new débouchure, and with the converging shores of the gulf, gave conditions which with the spring tides at thirty to forty feet, produced a marked bore, being felt many miles upstream, both in the Colorado and Hardy. The new channel reaches sea-level by a much more gradual descent and hence without the strong current favorable to developing the bore.

The new mouth will become the center of a new series of mud flats which fringe the shores already for a distance of fifty miles, The deposition of silt will operate to close the eastern channel between Montague Island and the mainland, which has long since ceased to be navigable and will soon afford material which will be piled by the tides in the deeper channel to the westward with the final result of filling it more or less completely.

The new eastern channel is one probably not previously occupied by the river in its present condition, and the change adds to the delta the triangular area enclosed by the old channel below the "Colony mesa" to the gulf, and the new channel, inclusive of expanses of mud flats and a range of gravel dunes or hillocks which find their culmination at the extreme northern end of the triangle immediately below where the new channel takes off from the old one.

In addition to increasing the area of the delta, serious disturbance of the plants and animals over an area of several hundred square miles may ensue. In a large part of it the composition of the flora will be totally altered.

M. C. Marsh,
Recording Secretary

THE TORREY BOTANICAL CLUB

The first stated meeting for 1908 was held on January 14, 1908, at the American Museum of Natural History at 8:15 P.M. Vice-president Edward S. Burgess presided. The attendance was fourteen.

This being the annual business meeting of the club, the chairman called for the reports of officers for 1907. Reports of the secretary, treasurer, editor and corresponding secretary were read, accepted and placed on file.

The secretary reported that fourteen regular meetings had been held during the year, with a total attendance of 306, as against 219 in 1906, and an average attendance of 21.8, as against 16.8 last year. A total of 37 formal papers was presented before the club, distributed according to subject-matter as follows: taxonomy, 5; physiology, 6; morphology, 4; ecology, 7; regional botany, 5; exploration, 2; lantern lectures, 4; miscellaneous, 4. In addition to these were numerous informal notes and exhibitions of specimens.

The editor reported the publication of one number of the *Memoirs,* of 47 pages, and the issuance of the *Bulletin* and of *Torreya* as usual. The need of an adequate index to the *Bulletin* from volume one to thirty, inclusive, was strongly emphasized.

On behalf of the committee on the local flora, the chairman, Dr. Britton, urged the need of increased activity, and emphasized the desirability of preparing a special work on the flora of New York City and vicinity. At present no such work exists.

Election of officers for the year 1908 resulted in the election of the following ticket:

President—Henry Hurd Rusby.

Vice-presidents—Edward Sandford Burgess and John Hendley Barnhart.

Secretary—C. Stuart Gager.

Treasurer—William Mansfield.

Editor—Marshall Avery Howe.

Associate Editors—John Hendley Barnhart, Jean Broadhurst, Philip Dowell, Alexander William Evans, Tracy Eliot Hazen, William Alphonso Murrill, Charles Louis Pollard and Herbert Maule Richards.

C. Stuart Gager,
Secretary

DISCUSSION AND CORRESPONDENCE

THE TEMPERATURE OF THE SUN

Professor Schaeberle's measurement of the effect of concentrated solar radiation in the melting of platinum and other metals[1] is a valuable addition to previous experiments of this sort. Indeed, it may be doubted whether the measurement has ever been made before

[1] Science, December 20, 1907, p. 877.

with a mirror of so great concentrating power, which at the same time has possessed so perfect a figure.

The energy received from the sun can not be determined from the data given without further addition of a time-factor, and estimates of the mass of material heated, and of the accompanying losses of heat. As a simple experiment in static equilibrium of temperature, however, this knowledge is not necessary.

It is doubtful whether radiation formulæ obtained from measures through a limited range of temperature for solid bodies, composed of complex molecules, are applicable to solar conditions at the photospheric level, where it is improbable that any molecules remain undissociated. Extrapolations from Stefan's law of the proportionality of total radiation from a black body to the fourth power of the absolute temperature, are therefore not certainly applicable to the problem, even though the law has been verified through a range of some hundreds of degrees. But, on the other hand, Newton's law, which is only an approximation for a very limited range of temperature, and which becomes entirely erroneous when we pass to wider variations, is even less trustworthy.

If the exposed body were at the center of a perfectly reflecting, hemispherical mirror, it would receive as much heat as if it were transported to the sun's surface, neglecting the loss by atmospheric absorption. At the focus of such a mirror, since the radiation received or lost is proportional to the solid angle filled by the mirror, or by the portion of the sphere outside the mirror, respectively, the body would receive more solar radiation than from the actual mirror, subtending 29°, in the proportion, versin 90°: versin 14°.5 = 31.3 : 1.

At the same time, the angle through which loss of radiation from the heated body takes place, having been diminished in the ratio, 1.968 : 1, the total radiant effect would be altered in the ratio, $1 : 1.968 \times 31.3 = 1 : 61.6$. Accepting the estimate of losses by absorption, this ratio is to be further multiplied by 2.14, giving 1 : 131.8. With the estimated temperature of 2,000° C. from solar rays with an 18-inch aperture, we get, if the sun radiates as a full radiator and Stefan's law holds, effective solar temperature $= t_0 = (2{,}000^4 \times 131.8)^{\frac{1}{4}} = 6{,}776°$. This is a minimum value, because the sun does not radiate as a body at a single definite temperature, but as a complex radiator, since, even if the photosphere behave like an absolutely "black," or full radiator, the atmospheric layers above the photosphere, which are at a lower temperature and which add their own radiations, can not be perfect radiators, because they would then be perfect absorbers also, and would completely absorb and shut off the radiation from the photosphere itself, becoming a new photosphere in turn.

We may presume that quite a notable amount of radiation comes from these cooler and imperfectly radiating layers, enough, at any rate, to cause the maximum in the spectral energy-curve to move from the position corresponding to the photospheric temperature to one appropriate to a body of lower temperature, through the addition of a disproportionate amount of radiation of longer wave-length.

To produce a given amount of radiation from an imperfect radiator requires a higher temperature in inverse proportion to the coefficient of relative emissive power. Scheiner has noted this in his treatise on the "Radiation and Temperature of the Sun," and has estimated that it may be necessary to almost double the temperature which would be obtained on the supposition that the sun is a perfect radiator.

The complexity of the solar radiating layer prevents the strict application of Paschen's law connecting the wave-length of maximum radiation and the absolute temperature, to the problem of solar temperature; but there is now sufficient agreement in the different modes of computing the solar temperature to indicate that it is between 6,000° and 7,000°, or else that there is a marked change in the law of radiation at solar temperatures, a possibility which has been suggested by Professor Bigelow.[2]

It does not seem demonstrable that the effective solar temperature is as great as 66,-

[2] *Monthly Weather Review*, December, 1902, p. 561.

000° C., the value assigned by Professor Schaeberle; but neither is it demonstrable that the temperatures assigned by Stefan's law are correct; and nothing but the existence of certain coincidences in values given by different methods, coincidences which are possibly fallacious, can be said to favor the supposition that the effective temperature is as low as 7,000°.

Since about nineteen twentieths of photospheric radiations of wave-length $0.3\,\mu$ are absorbed by the sun's atmosphere, and of rays of wave-length $0.4\,\mu$ barely a fifth get through, the form of the spectral energy-curve is so much changed near the maximum that the position of this important point in the curve of photospheric radiation, restored by application of corrections for the absorption by the atmospheres of sun and earth, becomes uncertain; but the photosphere can not have a temperature as great as 60,000°, nor even one of 10,000°, without requiring serious changes in the constants of radiation in the formulæ accepted to-day, or in the assumptions tacitly made as to the emissive power of the solar substances. The latter may very likely be in error, and it would be interesting to have measures of the relative emissive powers at very high temperatures of all substances which can give continuous spectra at those temperatures.

Frank W. Very

Westwood, Mass.

THE FAUNA OF RUSSIAN RIVER, CALIFORNIA, AND ITS RELATION TO THAT OF THE SACRAMENTO

Following an article in a recent number of Science[1] on certain "Physiographic Changes bearing on the Faunal Relationships of the Russian and Sacramento Rivers, California," a note on the fish faunas of these basins may be of interest. The writer of the present paper has seen no account of the fishes of the Russian River, and therefore must rely entirely on his own observations for the following statements.

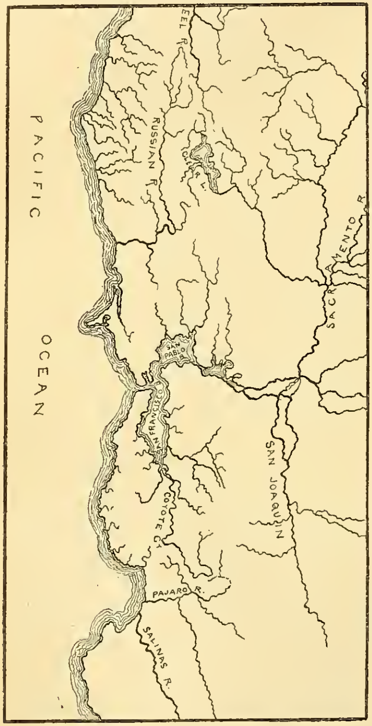
The Russian River has, so far as known, twelve species of indigenous fishes. They are: *Entosphenus tridentatus, Catostomus occidentalis, Mylopharodon conocephalus, Ptychocheilus grandis, Rutilus symmetricus, Oncorhynchus tschawytscha, Salmo irideus, Gasterosteus cataphractus, Cottus asper, Cottus gulosus, Cottus aleuticus* and *Hysterocarpus traski*. Of these, *E. tridentatus, O. tschawytscha* and *S. irideus* are anadromous forms, while *G. cataphractus, C. asper, C. gulosus* and *C. aleuticus* are able to withstand salt water and are consequently to be ignored in a study of the faunal relationships of rivers. The other species are strictly fluvial. The above-named species also occur in the Sacramento River. A large series of specimens from each basin, examined some years ago by the writer, presented no structural differences whatever. They were as near alike as fishes collected from the same stream.

It may here be noted, for those not familiar with the geography of the region, that the Russian River occupies a basin lying mostly in the mountainous region to the westward of the great valley drained by the Sacramento. Its general course is southward until it reaches a point about 35 miles to the north of San Pablo Bay, when it turns abruptly west and, flowing through a deep canyon, reaches the ocean. It is therefore completely isolated from the Sacramento. The headwaters of numerous small tributaries of both rivers rise in close proximity in the high mountains which divide their basins. It is in this mountainous divide that Holway has found evidence of a transfer of a part of a tributary from the Russian River to the Sacramento, which probably carried along with it a representation of the Russian River fauna.

That such a movement as Holway records could have any effect on the faunal relationships of the two basins seems highly improbable, as the Sacramento, a vastly larger and probably older system, not only contains all the fluvial species known from the Russian River, but also others not there represented. The zoological evidence, such as it is, indicates that the Russian River fauna was derived from the Sacramento, and not that any portion of the fauna of the latter was obtained from the Russian River.

[1] Holway, Ruliff S., Science, September 20, 1907.

Since the two systems are widely isolated, one can explain the identity of their faunas in so far as it exists, only by the assumption that an intermingling of their waters occurred at some past time. Several years ago attention was directed to a probable connection between



Map of the Russian River basin and parts of the Sacramento and neighboring rivers.

these basins, no reference being made at the time to their faunas. Lawson[2] in 1894 made a statement to the effect that at one time the Russian River, instead of turning abruptly westward to the ocean, continued its southward course through an uninterrupted valley to the region now occupied by San Pablo Bay. It would thus have established a main channel connection with the Sacramento, the union being perfect in case of a slight elevation of the coast which probably prevailed at that time. In this connection it should be emphasized that whatever may have been the agency for bringing about a passage between the two systems, it was apparently not able to transfer a complete representation of the Sacramento fauna to the Russian River. There are among the Sacramento fishes a considerable number of species not known in the Russian River, of which may be mentioned *Orthodon microlepidotus, Lavinea exilicauda, Pogonichthys macrolepidotus* and *Leuciscus crassicauda,* all strictly fluvial. Concerning these species two facts should be noted as having a possible bearing on the method by which the Russian River received its fish fauna: (1) they are indigenous to certain small streams which flow into San Francisco Bay[3] and they have also found their way from thence southward[4] into certain small coastal streams, where they are now abundantly able to maintain themselves; (2) they are such forms as inhabit the lower courses of the rivers, seemingly preferring the warmer, deeper and more quiet waters of the main channel. Now, if the Russian River received its fauna from the Sacramento through a main channel connection, as may be inferred from Lawson's statement, we should expect to find among its species the same channel fishes as inhabit the Sacramento and the smaller streams flowing into San Francisco Bay. They are absent, however. That they were once introduced and have since become extinct seems scarcely probable, since they are now living in the small streams referred to, under conditions apparently similar to those prevailing in the Rus-

[2] Lawson, Andrew C., "The Geomorphogeny of the Coast of Northern California," *Bull. Dept. Geol. Univ. of Cal.*, I., p. 269.

[3] Snyder, J. O., "Notes on the Fishes of the Streams flowing into San Francisco Bay, California," Rept. Com. Fish., Dept. Com. and Labor, 1904, p. 327.

[4] Branner, J. C., "A Drainage Peculiarity of the Santa Clara Valley Affecting Fresh-water Faunas," *Jour. Geol.*, XV., No. 1.

sian River. Should a part of the upper course of a tributary have been transferred from one system to the other, it would have carried with it only such forms as it harbored, thus introducing to the recipient basin a comparatively limited fauna. This condition is apparently what we find in the Russian River system. Its fauna is like that of the upper courses of the streams tributary to the Sacramento which flow from the western side of the great valley, the channel forms common to the main river being absent.

It is fair to conclude that the fish fauna of the Russian River was probably derived from the Sacramento system, and a study of the species offers the suggestion that the intermingling of their waters, by which the species were introduced, was not affected by a main-channel connection, but rather by a process of stream-robbing something like that described by Holway, only that the transfer was in the opposite direction. J. O. Snyder

THE MOTH-PROOFING OF WOOLENS

When living in Swatow, China, my house, like all dwellings within the tropics, was infested with various kinds of insects. In experimenting with diverse substances with a view to self-protection against insect pests, I found that alum was a perfect preventive of the ravages of moths among woolens.

It is well known that the female clothes-moth deposits her eggs in woolen goods, and that the worm-like larvæ hatched from these eggs subsist upon the wool until they attain the general form of the adult moth. The Chinese, who are the great practical economists of the world, do not ordinarily wear woolen garments. They are well protected from cold by an interlayer of raw cotton between the lining and the surface fabric of their winter apparel, which is often made from very light-weight silk or linen. Nevertheless, the clothes-moth is ubiquitous in China, and undisturbed woolens are soon riddled by its developing progeny.

I gave the alum a severe test by immersing picture-cords made wholly of wool, in a saturated solution for several hours, and afterward using the cords to suspend framed pictures. These cords, numbering a score or more, sustained heavy pictures for over three years, without showing sign of weakness.

A basket of soft worsteds, that I had used in testing the Chinese for color-blindness by the Seebeck and Holmgren method, were likewise treated with alum, and left uncovered and undisturbed for more than a year without attack from moths. The colors of these worsteds, although diverse and delicate, were not altered by the soaking in alum water.

Woolen shawls and other articles were fortified against moths in the same way, and remained intact for several years.

The alum does not evaporate, and is therefore permanently effective in unwashed fabrics.

There is apparently no reason why wools used in manufacturing cloth, rugs and carpets should not be so treated with alum as to become moth-proof. Crude alum is inexpensive and probably one pound of it in four quarts of water would make a solution of sufficient strength for the practical result aimed at. The commercial value of woolen goods would be enhanced by this process, and "the house beautiful" would be more easily kept.

Holland, writing of these troublesome immigrants from the old world, says ("Moths," p. 426) that the depredations of clothes-moths cost the citizens of the United States annually a sum of money which is enough in amount at the present time to pay the interest on the national debt. Adele M. Fielde

Seattle, Wash.,
November 22, 1907

PINK KATYDIDS.

To the Editor of Science: Referring to your page 639 (Vol. XXVI.), I have captured pink katydids at East Hampton, L. I., probably on four to six different occasions in the last twenty years. One year—I should say in the seventies—I had three at one time. No one there had ever seen any—although no professional entomologist was in town. I also found one at South Lyme, Conn., in the summer of 1906. All that I have ever found were a bright shell pink. I did not note the sex of any of my specimens, which were all liberated after showing them to curious friends.

J. Stanford Brown

SPECIAL ARTICLES

RIGHT-HANDEDNESS AND PERIPHERAL VISION

Of right-handedness, three facts seem to be fairly well established: it is hereditary, it develops by a method of trial and error in the seventh month of life, it is due to some as yet unknown ascendency of the left hemisphere of the brain. That it is inheritable points to its origin as a congenital variation. That it develops in the seventh month of life points to its dependence upon the ripening of some bodily structure. The precise manner in which it is dependent upon the left hemisphere has never been satisfactorily explained. In fact, the very pertinent question whether the ascendency of the left hemisphere rests in the sensory or motor areas has, seemingly, never been raised. Reflection will show that the initial difference must be sensory and not motor. If the reflex act concept of the manner of working of the nervous system is correct, and if, as a consequence of that concept, currents of innervation flow only from afferent to efferent neurones, always in the "forward direction," it follows that the ascendency of the left hemisphere must, in the first instance, exist in the sensory neurones. For, the contraction of muscles of the right arm is merely a consequence of the discharge of nerve cells in the left motor cortex. But, the discharge of these cells is, again, a consequence, merely, of the discharge of sensory cells which are situated either in the sensory cortex or, possibly, in the periphery. If this reasoning is sound, it follows that where there is motor bilateral asymmetry there must first be sensory bilateral asymmetry.

Experiments[1] carried out during the past year, on the comparative sizes of objects which are seen in indirect vision, brought to light the fact that a marked difference in the perception of size exists between the right and left halves of the retinæ of the two eyes. The experiments were made with a perimeter. The objects compared were the orbits described by two black spots which were borne upon the peripheries of two slowly moving white cardboard discs. The spots were attached to movable radii so that the orbit of the apparently larger disc could be reduced until it equaled, subjectively, the orbit of the smaller. In this way, quantitative measurements were made for four meridians, vertical, horizontal and two oblique, and for three parallels of latitude, 10°, 20° and 25°, of the visual field. The observations were either (*a*) peripheral comparisons, in which the discs were situated in the periphery of the field of vision, upon some one of the four meridians, on opposite sides of the fixation point or (*b*) foveal-peripheral comparisons, in which one disc covered the fixation point and the other occupied some position in the periphery. The results of both (*a*) and (*b*) follow. (i.) The discs on the upper vertical, right-upper oblique, right horizontal and right-lower oblique meridians appear larger than similar discs symmetrically placed on opposite sides of the fixation point or at the fixation point. (ii.) This result is constant for *both* eyes. (iii.) The enlargement is greatest at 25° from the fixation point and least at 10°. (iv.) The enlargement is greater in the right-upper field than in the right-lower field. When it was seen that objects in the right half of the field of vision are imaged upon the left corresponding halves of the retinæ and that these halves of the combined eye are connected with the left occipital hemisphere, it was suggested that the illusion of size might be reversed with left-handed persons, who are, presumably, right-hemisphered. To test this point, crude observations were made with small clay discs and larger cardboard discs, placed upon a table, about 12 cm. apart, in front of the observer. The observer looked with one eye at a time, from a height of about 75 cm., at the middle point between the discs and compared, in indirect vision, their size. 183 observations were made. To 100 persons, the right disc appeared larger to both eyes. To 45 persons, the left disc appeared larger to both eyes. These results, as unequivocal, are the only ones that need be

[1] For a full report on these experiments, see a forthcoming article in *The Psychological Review*.

cited here. Of the 100 persons to whom the right disc appeared larger, 76 were right-handed, 8 ambidextrous, 16 left-handed. Of the 45 persons to whom the left disc appeared larger, 15 were right-handed, 3 ambidextrous, 27 left-handed. These results can not be considered final; but, they do seem to indicate a tendency to a relationship between the peripheral perception of size and right- and left-handedness.

Granted that such a difference in the perception of size does certainly exist between the central and peripheral parts of the retina, the sensory motive, so to call it, which in the discussion of the part played by the left hemisphere, seemed necessary to initiate right-handed movements, would be furnished. Objects situated in the right half of the field of vision of a left-hemisphered infant would, by appearing larger, attract its attention. The eyeballs would then turn, reflexly, to receive the attractive object on the fovea. Eye movements would, probably, lead to head movements, and head movements to arm movements. Just the reverse of this would happen with a right-hemisphered infant. The fact that the predominant use of the right hand is developed by trial and error, is against the assumption that there is a "natural prepotency in the paths to discharge into the right arm." If it were merely reflex, there would be no period of uncertainty in which both arms are used. A fact which supports the view suggested here is that the time (seven months) at which a pronounced right-handedness developed in Baldwin's[1] child was but little later than the time (five months) at which Raehlmann[2] found that an object was recognized when its image fell on the periphery of the retina.

H. C. Stevens

Seattle, Washington

[1] "Mental Development, Methods and Processes," p. 64.

[2] Cited, without reference to the original, by Schaefer, "Text-book of Physiology," Vol. II., p. 759.

TERTIARY DEPOSITS OF NORTHEASTERN MEXICO

The work done in the Tertiary deposits along the Rio Grande border of Texas by Dr. R. A. F. Penrose, Jr., and myself, and described in the First Annual Report of the Geological Survey of Texas and in a later paper entitled "Geology of Southwestern Texas," has been extended southward during the past year by Professor W. F. Cummins as far as the Conchas River.

He finds that the same general divisions which we have described in Texas are easily recognizable for this entire distance of more than one hundred miles, but also finds that, while a large number of the familiar forms of the Texas fossils are found in the various divisions, there are others which were not recognized there. Among these is the occurrence of a *Venericardia*, which Dr. Dall states is allied to *potapacœnsis* of the Maryland Eocene, in beds that are stratigraphically the continuation of the Marine stage of the Texas section. A number of other new forms were also found, which have not as yet been studied.

The beds of the Fayette stage which are exposed on the Rio Grande between Carrizo and Roma extend southward to Mendez on the Conchas and are characterized by the large *Ostrea alabamiensis* var. *contracta* Conrad and other forms.

The beds of the Frio stage which overlie the Fayette here, as farther north, are better exposed in this region than in Texas and carry a very distinctive fauna. Some of the forms collected at San Fernando on the Conchas River were examined by Dr. Dall, who writes that they comprise *Pecten, Arca, Clementia*, etc., and are with little doubt Oligocene. This series of beds, which Professor Cummins calls the San Fernando, was traced by him to the extreme southern limit of the Tertiary, some forty miles south of the mouth of the Soto Marina River.

Very few fossils were found in the Frio deposits in Texas and such as were determinable seemed to warrant its reference to the Eocene, but Professor Cummins's later discoveries show this to be incorrect and in place of being of Lower Claiborne age, it should be placed with the Oligocene.

E. T. Dumble

ANOPHEL. BREEDING IN SEA WATER

The leading article in the *Atti Della Società per gli Studi della Malaria* for 1907 is by Dr. W. T. de Vogel, of Samarang, Dutch East Indies, and is entitled "Anophelines in Sea Water."

Dr. Vogel shows that the investigations of several Italian workers have negatived the idea that *Anopheles* can multiply in sea water and that they have shown that the maximum proportion of sodium chloride in the water which *Anopheles* can stand is 1.87 per cent. according to Perrone, and 1.75 per cent. according to Vivante. Dr. Vogel, having made some elaborate studies in regard to malaria at Samarang, found as early as 1902 that *Anopheles* was breeding in a certain pool containing 2.8 per cent. of chloride of sodium. Later he verified these results in several interesting cases. One of these was the case of the island of Onrust, a small coral island situated two thousand meters from the mainland, and which contains no fresh water whatever. The distance from the mainland is such that even if *Anopheles* were brought from the mainland by winds they would not be numerous enough to cause much trouble. At the same time a marine station established on the island was suppressed on account of the ravages of malaria among the workmen.

He studied also the conditions in the Karimon Islands, a little archipelago in the Java Sea sixty-five kilometers from the coast. The first colonists in this archipelago were convicts and were sent there to cut down the forests of rhizopores. There were no buildings, and the convicts were forced to sleep on the earth. The mortality was between two and three thousand in two years. Later one of the officers—a man named Michalofski, a plain man but full of good sense—succeeded in putting a stop to the excessive mortality with the simple means at his disposal, by drying the sea-water pools, completely removing a part of the forest, and raising the ground on which the men slept. The success which followed these measures leads Dr. Vogel to suppose that the mortality had been caused by malaria, and this supposition is all the more probable since malaria is to-day rife among the population of the islands. He himself has visited the islands and found much malaria present. The islands themselves are principally flat, planted with cocoanut palms and surrounded by deep water, and again, at a distance of five hundred or a thousand yards from the coast, by a coral reef.

There is on the island of Grand Marimon only a single permanent source of fresh water which has only one restricted outlet; so that during the dry season there is no mingling of fresh water with sea water, and there exist during the dry season many pools of dead sea water, peopled with *Anopheles* larvæ, containing not less than three per cent. of sodium chloride, and which then must be considered as concentrated sea water.

Continuing his researches at Samarang, Dr. Vogel found other pools of water inhabited by *Anopheles* larvæ, in proximity to the sea. One of these places had a surface of 20 to 30 square meters and a depth of from 10 to 30 centimeters. It was connected with a pool of sea water by a bamboo pipe crossing the dike. The pool is thus invaded by seaweeds, but the fish can not enter. These places swarm with *Anopheles* larvæ, while *Culex* larvæ are not found there. In this pool the percentage of sodium chloride is about 2.88, while in the water of the neighboring swamps it varies between 2.44 and 2.76.

Other instances are given with careful descriptions and the author finally draws the following conclusions:

1. There are species of *Anopheles* which can live very well in sea water.

2. These mosquitoes lay eggs which develop even in sea water which has been evaporated to half its original quantity.

3. These larvæ in the gradually evaporating pools of sea water can stand an evaporation of the water to one third of its bulk, but do not appear to transform to adults if the concentration be greater than this.

4. The larvæ coming from eggs laid in sea water of high concentration can accomplish their entire metamorphoses in almost the normal time. This is true even when the water has such concentration that the development of larvæ originally hatching in un-

concentrated sea water would be retarded by this salt water.

Not only are these observations of great interest as bearing upon the health of certain seacoasts, but they have an important bearing in possibly explaining the cases of malaria observed upon sailing vessels that have not made port for months, since it indicates the possibility that *Anopheles* may breed in the bilge-water of such vessels. In such cases it is only necessary that one of the sailors should have gametes in his blood in order to start an epidemic of malaria aboard the vessel. The bad reputation which the coral islands of farther India have is explained by Doctor Vogel's observations, since so many cases of malaria are observed along the coast during the dry season when all the rivers and fresh-water streams are dried up.

The proposed destruction of *Anopheles* by the introduction of sea water seems not to be rational.

Good tidal ponds exercise a favorable influence upon the malarial death rate, but when these are infected, or even where the water is permitted to form isolated stagnant pools, the mortality from malaria reaches a high figure, as has been observed at Samarang. Villages near the sea, in the middle of tidal pools have had during a period of ten years an average mortality of from 1 to 4 per cent. each year. In villages further away from the sea, where the ponds have been abandoned or neglected and the sea water is, therefore, isolated, there is a mortality which varies from 8 to 10 per cent. each year. The pools in these regions during the dry season have a proportion of sea salt equal to that of the ocean from which they get their water. In this dry season the death rate is greatest, and this is exclusively due to the sea water ponds.

The great mortality is surely due to malaria, since almost without exception the cases of pernicious malaria or hæmoglobinuria which are treated at Samarang come from the south border of tidal pools. A quarter of Samarang called Zeestrand was inhabited by well-to-do citizens of the city who had good health, although surrounded by pools. Then, on account of the banking up of the coast, these pools were left further from the sea, and the inhabitants were forced to quit the quarter because the death rate from malaria reached terrible proportions. The empty houses of this quarter still bear witness to past grandeur. The mortality of the indigenous population which still remains there has been on the average during the last ten years 9.7 per cent. per year.

L. O. Howard

SCIENTIFIC NOTES AND NEWS

Dr. Henry Fairfield Osborn, one of the vice-presidents of the American Museum of Natural History and curator of vertebrate paleontology, has been elected president of the museum to succeed the late Morris K. Jesup.

The University of Pennsylvania will confer the degree of doctor of laws on Mr. G. K. Gilbert, of the U. S. Geological Survey, on February 22. The annual university day address will be made by the Hon. Joseph H. Choate.

Professor Robert Helmert, director of the Goedetic Institute at Potsdam, has been elected a corresponding member of the St. Petersburg Academy of Sciences.

Lord Avebury has been elected president of the Royal Microscopical Society, and will deliver an address on seeds, with especial reference to British plants, at the March meeting.

The Association of American Geographers held its fourth annual meeting at Chicago during convocation week. The sessions lasted three days, including one joint session with Section E of the American Association. Forty-four papers were presented, this being the largest number yet offered at any meeting. Since the death of the society's president, Dr. Angelo Heilprin, the duties of this office have devolved upon the first vice-president, Professor Ralph S. Tarr. Officers elected for the coming year are G. K. Gilbert, president; R. D. Salisbury, first vice-president; Ellen C. Semple, second vice-president; A. P. Brigham, secretary; N. M. Fenneman, treasurer; R. S. Tarr, member of council. It was all but formally decided to hold the next annual meeting at New Haven.

Professor D. C. Jackson, of the Massachusetts Institute of Technology, has been retained by the Massachusetts Highway Commission, to make a report regarding the telephone situation with special reference to the practicability of a reduction in rates and a higher efficiency of service.

Professor R. C. McCrea, associate director of the New York School of Philanthropy, has been appointed by the trustees of Columbia University to make a preliminary study of humane societies and instruction in humanity, in view of the recent endowment of $100,000 to establish a chair in this subject.

The Rev. J. B. McClellan, M.A., has resigned the principalship of the Royal Agricultural College, Cirencester, after more than a quarter of a century's service.

The British secretary of state for the colonies has sent Dr. W. J. Simpson, professor of hygiene at King's College, London, and lecturer in tropical hygiene at the London School of Tropical Medicine, to the Gold Coast to assist in combating the present outbreak of bubonic plague at Accra.

Dr. W. S. Bruce, of the Scottish Oceanographical Laboratory, has received information from Buenos Aires to the effect that the ship *Austral* was getting ready to go south. Mr. Davis, of the Argentine Meteorological Office, will probably have another meteorological and magnetic station set up on Wandel Island for the coming year.

Under the auspices of the Sigma Xi scientific society of the University of Kansas, Professor Russell H. Chittenden, director of the Sheffield Scientific School of Yale University, will deliver two popular lectures at the University on February 17 and 18.

Dr. Lucien I. Blake, formerly professor of physics in the University of Kansas, will give a course of lectures upon electrical subjects before the students in electrical engineering at the university, during the last week in February. Aside from the technical lectures, Mr. Blake will deliver three popular lectures for the general public.

Arrangements have been made by the American Society of Naturalists to celebrate the one hundredth anniversary of Charles Darwin, in cooperation with the American Association for the Advancement of Science, on the occasion of their meetings in Baltimore in 1908. The Society of Naturalists will be represented on the Committee of Arrangements by the president, the secretary and several members.

A bust of A. Kekulé, eminent for his work at Bonn on organic chemistry, has been presented to the Worcester Polytechnic Institute by Dr. George D. Moore, formerly assistant professor of chemistry, and has been placed in one of the museums of the chemical department.

Mr. James Wallace Pinchot, who took an active interest in art and science, especially in forestry, and made liberal contributions for their support, died in Washington on February 6, at the age of seventy-six years.

Mr. Richard Hinckley Allen, of Chatham, N. J., died on January 14 at Northampton, Mass. Mr. Allen will be remembered as the author of "Star Names and their Meanings," a work of wide and scholarly research, and lasting value. Mr. Allen was a member of the American Association for the Advancement of Science and of the Astronomical Society of the Pacific, and the National Geographical Society.

Sir Thomas McCall Anderson, regius professor of medicine in the University of Glasgow, and an authority on diseases of the skin, died on January 25 at the age of seventy-one years.

Professor James Bell Pettigrew, M.D., LL.D., Chandos professor of anatomy and medicine in the University of St. Andrews, died on January 30 at the age of seventy-three years. He was the author of numerous contributions to medicine and other scientific subjects, being the author of a book on "Animal Locomotion" and of various papers concerned with flying machines.

Dr. Adolf Paalzow, formerly professor of physics in the Technological Institute at Charlottenburg, has died at the age of eighty-four years.

We regret also to record the death, at the age of seventy-seven years, of Professor Vaclav K. Zengler, the Bohemian physicist and meteorologist, and of Dr. Chapot Prévost, professor of histology in Rio Janeiro.

The following letter from the University of London, signed by Lord Rosebery, chancellor; W. J. Collins, vice-chancellor; Edward H. Busk, chairman of convocation, and Arthur W. Rücker, principal, has been sent to the vice-chancellor and principal of the University of Glasgow:

We are desired by the senate of the University of London, who met yesterday [January 22] for the first time after the Christmas vacation, to tender to you, and through you to the University of Glasgow at large, an expression of our sincere sympathy in the loss which you have suffered by the death of your chancellor. Lord Kelvin's researches into the operations of nature and his contributions to the sum of human knowledge, by which the work of all the universities of the civilized world has been so notably advanced, have given additional luster to the illustrious name of the University of Glasgow. It must ever remain to you a source of the proudest satisfaction that a career nobly and beneficently devoted to the welfare of humanity was throughout associated with the body over which he was presiding when the world lost him. We are proud to remember on this occasion that Lord Kelvin was one of the only two men, outside the circle of royalty, upon whom the University of London has ever conferred an honorary degree.

At a meeting of the American Ethnological Society the following resolutions were adopted:

Whereas: The American Ethnological Society has suffered a severe loss by the death of Morris K. Jesup, its honorary president, its former president, and one of its honored members; and

Whereas: Through his wide sympathies and active cooperation, he has advanced the well-being of his fellow-citizens and the interests of science and art, and has placed the science of anthropology under lasting obligations by his generous support of the anthropological work of the American Museum of Natural History, by his maintenance of researches bearing upon anthropological problems, and by enlisting the interests of others in similar work; and

Whereas: He organized and maintained, partly alone, partly in cooperation with his friends, researches in Mexico, Central and South America, among the Indians of our western states, on the Pacific coasts of America and Asia, in Siberia, and in southeastern Asia, and gave liberally to these enterprises, not only of his wealth, but also of his wide experience and wise counsel: therefore be it

Resolved, That the American Ethnological Society wishes to express the sense of the great loss it has sustained by the death of one whose services to the science of anthropology will long live in the records of the researches that were undertaken at his instance.

Resolved, That a copy of these resolutions be sent to the family of the deceased.

The Sheffield Scientific School, Yale University, has subscribed for a research room at the Marine Biological Laboratory, Woods Hole, Mass. It is expected that this will be an annual contribution, which will insure one research room for the use of some member of the biological staff.

A joint resolution presented to the House of Representatives by Mr. Mann, authorizing the presentation of the statue of Washington, now located in the capitol grounds, to the Smithsonian Institution, has been referred to the committee on the library.

The permanent endowment fund of the American Museum of Natural History has been increased by a gift of $10,000 from Mrs. J. B. Trevor, and by the payment of a bequest of $25,000 from the estate of William P. Davis, Esq. H. W. Seton-Karr, Esq., of Wimbledon, England, has presented to the department of archeology seventy-one specimens of paleolithic implements collected by him in the districts of Poondi and Cazeepet, Madras Presidency, India. These implements are of red argillaceous sandstone and were washed out of Pleistocene alluvial deposits containing quartzite boulders. The department has received from Mr. Alanson Skinner a series of specimens collected for the museum last year in Ontario, Livingston and Erie counties, New York, from sites formerly occupied by the Seneca and Neutral Indians of Iroquoian stock.

The Brazilian government has voted funds for the establishment of an experimental pathological institute at Manguinhos, intended for the study of the parasitic and infectious diseases of man, animals and plants, and for the preparation of serums.

The foundation stone of an institute for the teaching of the history of medicine in connection with the University of Vienna will, says the *British Medical Journal,* shortly be laid. The state has promised a subvention, and the medical pr fession has contributed with a generous hand. In the institute there will be a museum containing collections of all sorts of things relating to medical history—portraits, books, instruments, apparatus, etc. One section of this will be devoted to a collection showing the development of the healing art in Austria. The establishment of the institute is due to the untiring efforts of Professors Neuburger and von Töply, both of whom have won deserved fame as medical antiquarians.

In October, 1891, Thomas George Hodgkins, of Setauket, New York, made a donation to the Smithsonian Institution, the income from a part of which was to be devoted to "the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man." In the furtherance of the donor's wishes, the Smithsonian Institution has from time to time offered prizes, awarded medals, made grants for investigations and issued publications. In connection with the approaching International Congress on Tuberculosis, which will be held in Washington, September 21 to October 12, 1908, a prize of $1,500 is offered for the best treatise that may be submitted to that Congress "On the Relation of Atmospheric Air to Tuberculosis." The treatises may be written in English, French, German, Spanish or Italian. They will be examined and the prize awarded by a committee appointed by the Secretary of the Smithsonian Institution in conjunction with the officers of the International Congress on Tuberculosis. The right is reserved to award no prize if in the judgment of the committee no contribution is offered of sufficient merit to warrant such action. The Smithsonian Institution reserves the right to publish the treatise to which the prize is awarded.

Professor H. McE. Knower, Secretary of the American Society of Naturalists, has sent the following resolution, adopted by the council of the society, advocating a biological survey of the Panama Canal zone:

Realizing that the work in the Panama Canal is changing biological conditions in Panama and that the completion of the Canal will enable the fresh-water faunæ of the two slopes to mingle freely and that many marine animals will succeed in passing the completed Canal, the American Society of Naturalists urges upon the President and Congress to make provision for a biological survey of the Panama Canal zone.

Since the conditions will be permanently changed as soon as the Canal is completed and the work can not be satisfactorily done after the completion of the canal, there is great urgency that provision for the work be made at once.

Resolved, That the secretary be instructed to send copies of this resolution to the President, the Vice-President, the Speaker of the House and the Secretary of the Smithsonian Institution.

Nature says: "Last spring Dr. J. Elberts, the German geologist, conducted an expedition to investigate further the fossiliferous deposits of the Bengawan River, near Trinil, in Java, rendered famous by the discovery of *Pithecanthropus erectus* by Dr. Eugene Dubois in 1891–2. Although extensive collections were made and fresh forms discovered, no trace of *Pithecanthropus* was found; but, according to the correspondent of the *Pall Mall Gazette* (January 17), Dr. Elberts found roughly fashioned implements of bone, "a fireplace, and the remains of extinct animals, from which he became convinced that the ape-man must have existed at a remoter period." Unfortunately, this statement is so vague that nothing can be accepted until more information comes to hand. The implication is that some beings made fires and cooked animals, now extinct, before the gravel beds were deposited which contain *Pithecanthropus* and other extinct forms. In the province of Madium a fireplace was discovered 20 feet below the surface containing stone arrow-heads and fragments of pottery, broken and partly burned bones, and charred teeth of a fossil buffalo, together with the bones of deer, pigs, and a fossil elephant (*Stegodon*); some of these bones had been split open in order to extract the marrow. Dr. Elberts computes that these people lived 20,000 years ago, but, as the correspondent of the *Pall Mall Gazette* does not give the data upon which this estimation is based, this date must await the publication of all the facts. It is evident that we may congratulate our German colleagues on having discovered remains of early inhabitants of Java who were apparently in their "Neolithic" stage of culture. It is to be hoped that when the finds are published in full it will be possible to learn what manner of men they were. We understand that the expedition is now in south Sumatra, where fossil plants will also be collected, in the hope of determining whether Sumatra had an Ice age."

On January 21, Lord Lister was enrolled as an Honorary Burgess of the City of Glasgow. According to the account in the *British Medical Journal* the lord provost, Sir William Bilsland, who presided at the ceremony, recalled Lord Lister's connection with the city while professor of surgery at the university and visiting surgeon at the royal infirmary. It was at Glasgow that he achieved worldwide distinction as a scientist and a surgeon by his discovery which had saved thousands of lives and greatly lessened human suffering. It had been well said that Lord Lister's work marked a new epoch in modern surgery, and his name would have an imperishable place alongside the greatest in his profession and among the noblest benefactors of humanity. Professor Sir Hector Cameron accepted on behalf of Lord Lister, who was unable to be present, the casket containing the burgess ticket, and read from him a letter recalling his connection with the University and the city, in the course of which he said: "Having in due time been elected by the managers of the Royal Infirmary as surgeon to that institution, I experienced uniform consideration at their hands when applying to the treatment of wounds the great truth which had been recently revealed by the illustrious Pasteur regarding the nature of fermentative changes in organic substances. That truth, though it seemed to me to shine clear as daylight from Pasteur's writings, was for many years not generally recognized, and thus it was my privilege to witness in my own practise, as the application of the principle became gradually improved, the revelation of pathological truths of fundamental importance and a revolution in practical surgery, and I look upon the years spent in your city as the happiest period in my life. The old infirmary is now giving place to more commodious buildings; and, great as must necessarily be the expense in this undertaking, I do not doubt that the proverbial liberality of Glasgow will prove fully equal to the occasion."

During the last year hydrologists of the U. S. Geological Survey have been making a study of the quality of the water of Lehigh River. The chief purpose of this work is to determine the nature and extent of the variations in the character of the water at different seasons of the year and its suitability for use by manufactories and for domestic purposes. At the same time the studies made show what minerals are dissolved from the soils of the Lehigh Valley and the quantity of each. Samples of the river water have been collected from day to day at South Bethlehem and shipped to the survey's laboratory at Washington, D. C., where chemists have submitted it to critical analysis. These studies are still unfinished, but many conclusions regarding the stream have been reached. It is shown, for example, that each year about 270,000 tons of dissolved minerals are carried past South Bethlehem. Of this quantity 10.2 per cent. is silica, the chief constituent of sand and of most rocks; more than 15 per cent. is calcium, washed into the stream as sulphate and carbonate of lime; nearly 6 per cent. is magnesium; nearly 8 per cent. is sodium, one of the constituents of common salt; only 1 per cent. is iron. The grand total of the minerals borne by the stream is made up of the metals named, carried in combination as sulphates, carbonates, chlorides and nitrates. The sulphate compounds are the chief constituents, amounting to about 116,000 tons a year; the carbonates are next in rank, aggregating about 86,000 tons a year.

The report of the commissioner of patents for the fiscal year ending June 30, 1907, has been issued. According to the abstract in the *Electrical World,* there was filed a total of 66,795 applications, including 56,514 for mechanical patents; 816 for designs; 192 for reissues; 7,869 for registration of trade-marks; 982 for registration of labels and 422 for registration of prints. In addition to these applications, there were filed 1,900 caveats. There were issued 33,644 mechanical patents; 529 design patents; 165 reissues; and there were registered 8,798 trade-marks, 660 labels and 325 prints. The number of patents which expired was 25,322, while 4,707 letters patent were withheld for non-payment of the final fees; 14,565 applications were allowed, and awaiting the payment of the final fees. The total receipts of the office from all sources amounted to $1,859,592.89 for the fiscal year, of which there were expended $1,584,489.70, including $932,665.59 for salaries, leaving a surplus of $275,103.19, turned into the United States Treasury. The total net surplus of receipts over expenditures in the Treasury to the credit of the Patent Office on January 1, 1908, was $6,706,181.64, an amount derived entirely from the fees paid since 1837.

UNIVERSITY AND EDUCATIONAL NEWS

The graduate school of the University of Illinois was formally opened on February 4, when President G. Stanley Hall, of Clark University, made the opening address. This was followed by an address by Dean West, of Princeton University. The legislature of Illinois has appropriated the sum of $50,000 a year for the next two years for developing the graduate school. This is said to be the first appropriation specifically for graduate work in a state university.

Harvard University has established twenty-five additional university scholarships of $150 each, to be assigned annually, to seniors of high standing in Harvard and other colleges. These scholarships are to be awarded for study in the Graduate School of Arts and Sciences during the next academic year.

Large public bequests are made by the will of the late Miss Alice Byington, of Stockbridge, Mass., including $50,000 to the Tuskegee Institute and $160,000 to the Hampden Normal and Agricultural School.

A research fellowship in chemistry has been founded by the trustees of Bryn Mawr College and filled for this semester by the appointment of Miss Mary Cloyd Burnley, a former fellow, now of Vassar College.

Manchester University is to receive £12,000 by way of special grant from the treasury for the current year, instead of the reduced sum of £10,000.

The trustees of Columbia University have revised the statutes so that after six years of service a professor or adjunct professor may have leave of absence for one half year with full salary. Hitherto the statutes have permitted a sabbatical year's leave of absence on half salary.

At Syracuse University Dr. John L. Heffron has been appointed dean of the College of Medicine to succeed the late Gaylord P. Clark.

Dr. Benjamin Migne Duggar, formerly of Cornell, since 1902 professor of botany at the University of Missouri, has returned to Ithaca as professor of plant physiology in the State College of Agriculture.

Mr. W. S. Lozier, formerly instructor at the Pennsylvania State College, has been appointed instructor in engineering in the School of Applied Science of New York University.

Mr. W. W. Wallace has been appointed head of the department of applied mechanics in Liverpool University.

Mr. David K. Picken, M.A., chief assistant to the professor of mathematics, Glasgow University, has been appointed professor of mathematics in Victoria College, Wellington, N. Z.

Dr. R. Funter, docent at Marburg, has been appointed professor of mathematics at Basel.

Dr. L. Jost, acting professor in the Agricultural Academy at Poppelsdorf, has been appointed professor of botany at Strasburg.

SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE ANTHROPOLOGY OF CALIFORNIA[1]

FOR many years California was among the regions of North America of which anthropologists knew least. The early traveler touched it, the missionary occasionally left a valuable but fragmentary record, and the resident at times described the native people who were thrown under his observation. But the anthropologist and the trained investigator sought other fields of exploration, and the fact that extensive archeological collections had been formed from one restricted region contributed very little to a knowledge of the general anthropology of the state. Of recent years these conditions have been entirely altered. Several institutions have formed systematic collections or carried on researches, until now the anthropology of the region is nearly as well known as that of most parts of the continent, and certainly presents less obscurities than some. It seems fitting, therefore, to undertake at this time a review of the principal results of study, and of the new problems that these results inevitably open up. It might seem that the student of aboriginal people should be little concerned with the arbitrary limits of a modern political division such as the present state of California. As a fact, however, these limits coincide so nearly with the natural physiographical and ethnographical boundaries, that the artificiality of such a limitation, in an

[1] Address of the retiring vice-president of Section H of the American Association for the Advancement of Science, at the Chicago meeting, 1907–8.

anthropological consideration, is apparent rather than real.

The anthropologist needs no justification for directing his attention first to language. Not only is language recognized as the necessary means to a really exact understanding of the life of any people; it is also the most generally useful instrument of anthropological classification, and one of the aids to historical knowledge which is at times of the most fruitful service when all other methods, even archeology, fail. Particularly in a region like California, where the multiplicity of languages is so marked, and where an absence of other means of segregation and grouping is customary, does an understanding of the linguistic relationships become indispensable.

Thirty years ago the number of distinct linguistic stocks in California was pretty accurately given as about twenty, and Powell's great systematizing work fifteen years later determined the number as only slightly larger. Since then no entirely new languages have been discovered. We may therefore say with certainty that the number of native linguistic families will never be regarded as greater than it is now. On the other hand, recent studies show very little tendency to reduce the total number of stocks. The Shasta and Achomawi have been found related, but this affinity had been at least suggested many years before. That here and there languages, such as Pomo and Chimariko, have certain important words in common with others, such as Shasta, or with one another, is not necessarily an indication of relationship. It seems that almost every stock in California has at least a few words in common with neighboring or more distant languages, but that such words represent a borrowing or diffusion. This is established not only by the small number of such words, but also by the fact that they are frequently common to more than two languages. It would seem as if words of certain significances had been particularly liable in California to spread as loan words to unrelated languages. Even if some further unifications of languages now considered distinct should in future be made by the students of California linguistics, there is no reason to suppose that such a reduction in the number of stocks will be proportionately greater than elsewhere in the North American continent. It is only necessary to recall that a number of conservative scholars believe, or have proclaimed, the relationship of Natchez with Muskogi, of Selish with Kwakiutl, of Sahaptin with one or more of the neighboring languages, of Seri with Yuman, of Shoshonean with Piman and Nahuatl, to become convinced that any analogous conclusions which may be reached in California will not be special, but will form part of a general reduction in the number of distinct linguistic branches, which is almost certain to take place as knowledge gradually increases.

As regards the minor divisions of language, system has pretty well replaced chaos in California. It can not be pretended that all the dialects are even tolerably well known, but at least the number of dialects has been definitely determined in all regions where the practical extinction of the Indians has not made such a determination almost impossible. We know not only the total number of divisions of each linguistic family at the time of first contact with the whites, but also something of the relative degree of divergence of these divisions. The loose statements formerly sometimes made that the number of unrelated dialects of one stock was often very great, and that these dialects showed a gradual continuous change from one end of the territory of a family to the other, have been found to be entirely erroneous. In most cases the divisions of each family are few in number—with two or three exceptions never above six or eight—and they are usually well marked. Over a certain area the speech is identical or practically uniform. In leaving this area for an adjacent one, an abrupt change to another form of speech is encountered, which in turn is uniform over its entire extent. In many cases the changes met in passing from one of two adjoining areas to the other are so great that it would perhaps be more correct to designate their forms of speech as related languages than as dialects. A number of the smaller families are monodialectic. The total number of distinct languages or dialects in the state, excepting those whose divergence is comparatively inconsequential, was not over a hundred, and more probably about seventy-five. The total of distinguishable forms of speech may have numbered twice this.

Structurally the languages of California are usually characterized by a certain simplicity or transparency. As has been pointed out, there are, however, two regions, one in the northwest and one in the southwest, where this morphological quality is lost, and in which certain other qualities seem to be common to the several languages of the area. It has therefore been possible for some years to distinguish a northwestern, a southwestern, and a large central morphological group of languages. The most recent investigations confirm this classification; but it is necessary not to endow the grouping with too much significance. As each language is studied individually, and becomes more thoroughly known, it is obvious that it must prove to possess certain peculiarities that separate it from all others, even of the same morphological type; and from the standpoint of any given language such peculiarities are of course of more importance, and of greater value to the student, than the more vague similarities to the type, which it is plain can be based only on a few characteristics of either an essentially external nature or of the most general kind. The existence of the morphological groups is evident, but it must also be clear that they are only morphological groups of languages that are unrelated, and that therefore the bare circumstance that a certain language forms part of a particular group, furnishes no understanding, of that language, that is more than skin deep.

As to the significance of the morphological groups, it is clear that the lesson to be drawn from their determination is not a belief in the ultimate relationship of the languages constituting a group, but the emphasizing, by fresh examples, of the principle of territorial continuity of characteristics. This is not the occasion to discuss the much debated question of whether vocabulary or structure is the more reliable criterion of linguistic relationship. However this question be answered, the similarities as yet found between the languages of the three California groups are not of such a nature as to be of bearing on the consideration of their genetic unity. The importance of a proper conception of the frequency and influence of territorial continuity of characteristics is still too little recognized, especially among linguists, though instances of its occurrence are numberless. No one impressed with the prevalence of this historic principle would, for instance, dare to affirm, as eminent men have done, the relationship of the languages of southeastern Asia because they are isolating, or of Japanese with Ural-Altaic merely because both use suffixes in abundance.

The probable cause of the multiplicity of linguistic stocks in California may be said to be becoming a little clearer. The division of many of the stocks into sharply distinct dialects or languages indicates how many of them may have originated by a mere process of divergence, continued until practically all traces of original relationship have now become obliterated. While, as has been said, there seems at present no great prospect that we shall ever obtain conclusive evidence as to such original unity of linguistic stocks now apparently unrelated, it is clear that if the processes which have more recently been at work dividing original stocks into distinct languages, have been operative in this region for a considerably longer period, as is only natural, there must have been some such result as the gradual formation of what we now call distinct families. In any case nothing has ever been discovered that supports the so-called fish-trap theory, according to which the multiplicity of languages in California is due to the successive crowding, into this more desirable habitat, of waves or bands of unrelated immigrants from less favorable territories, to which none of them were ever willing to return. While this theory is at once simple and plausible, it has never been anything else than purely hypothetical.

It is still sometimes thought that areas of diverse native languages can be pretty closely correlated in California with areas that are physiographically distinct. Nothing is more erroneous. True, as there are so many forms of speech, the great majority of them can extend only over a small territory, and it is only natural that a small territory should often be confined entirely to a certain physiographical area. But there are numerous instances where not only linguistic families, but even dialects, run counter to all natural boundaries. The Shoshoneans and Washo have both spilled over the high crest of the Sierra Nevada. The Pomo west of the main Coast Range have an offshoot in the Sacramento valley, and the Wintun of this valley occupy territory west of the Coast Range. The Yurok are in part an ocean people, like their neighbors the Wiyot, and in part a river people on the same stream as their neighbors the Karok. Shoshonean people lived in the timbered Sierra, in the Great Basin drainage, the hot deserts of the interior of southern California, the fertile parts of the coast region of southern California, and shared the Santa Barbara islands with the Chumash. The southern Maidu dialect was spoken in the Sacramento valley plains, in the foothills, and in the high Sierra. The northern and central Pomo dialects were each spoken on the immediate coast, in the open Russian river valley, and in the intervening heavily timbered mountainous redwood belt. In certain instances where languages or dialects correspond to physiographic areas, these physiographic areas lack any separating barrier. Thus among the Yokuts and Miwok the dialects of the level plain of the San Joaquin valley are with scarcely an exception quite sharply distinct from the dialects of the adjacent foothill country of the Sierra; and yet the change from plain to hills is so gradual in some parts as to be scarcely visible. It is clear that in such cases the direct cause of the difference of speech is not the environment itself, but a difference in association and mode of life dependent upon physical geography. In fact it is even going too far to name these dialectic divergences as effects and other factors as causes; we are really only justified in saying that the differentiation of speech seems to be causally related with other factors, and that these are immediately cultural and historical, and only indirectly physical and environmental.

Much the same is true of the demonstrable relations of culture and environment. There are instances of the effect of environment on culture in parts of California, which could not well be more vivid; and yet these same instances show also the narrow limits which are imposed upon environmental effect by culture and history. On Tulare lake, in the southern part of the great interior valley of California, live the Tachi and Yokuts tribes. On Clear Lake, in the northern Coast Range, are the eastern and southeastern Pomo. On the Klamath and adjacent lakes, in northeastern California and in Oregon, are the Klamath Lake and Modoc people. All three groups of people have developed certain aspects of their material culture in a very similar direction through the use of a material furnished by their lake environment, the tule or bulrush. Not only houses, mats and boats, but clothing, footwear, cradles, baskets and games are made of this abundant and useful material. A glance at a museum collection from the three regions not only seems to reveal a practical identity of culture, but would make it appear that the eastern Pomo and Tachi Yokuts were culturally more nearly akin to each other than to their respective Pomo and Yokuts neighbors and kinsmen. But the moment the social and religious institutions of these people are considered, the resemblances in industries and arts are counterbalanced and as it were nullified. In ceremonies and habits and customs the eastern Pomo are as distinctively Pomo as any other branch of the family; and so the Tachi are as good Yokuts in religion, in beliefs and in social organization, as they are in language. Even on the material side of life environment is not the only causal factor. The Modoc twines his tule basket, the Tachi coils it, because those are the characteristic textile processes of the culture region in which each lives.

Of course even social life and religion will be colored by environment, and their development can extend only within a certain compass given by environment. But this is self-evident. No one, whether anthropologist or historian, has denied the significance of physical nature as a cultural condition; but the attempt has too often been made, sometimes expressly, more frequently by implication, to derive and explain a culture entirely from geography and climate; and nothing is more unfounded. For the sake of argument it may be granted to those who so wish, that in the ultimate analysis everything historical and everything human is the effect of physical nature. But, on the other hand, too strong a protest can not be made against the assumption which is often unwarrantably and illogically made from this view, that the actual immediate specific causes which have shaped the life of any given people can be sought and found in their particular environment. A body of people, neither at present nor at any time in their history, are ever a clean fresh slate ready to be inscribed by nature. No matter how rude their civilization, it has always a long historical background and is deeply rooted; and it is only upon this complex institutional life that a particular environment can begin to act. In time, no doubt, environment will partially modify all the institutions with which it is brought in contact. But institutions have a life of their own, influence each other, and undergo their own developments and histories. They must be always affected but can never be controlled by nature. Change of environment can destroy an institution by making it unnecessary or impossible, or can be the stimulus which develops a new institution; but in either case something cultural, an existing body of institutions, is present and is acted upon by the stimulus; and this body of culture is in turn dependent upon previous factors that are both cultural and environmental. To look to physical environment for the explanation of cultures is to mistake condition for cause.

The three regions of generally distinct

culture which have been recognized in California seems to be substantiated by further researches. Of course any culture-area or ethnographical province is relative. It rarely has sharply limited boundaries. To hold that what is important about it are not its external limits, but its internal center of dispersion, is good doctrine, but impracticable, in most cases, owing to lack of historical material. Thus, as compared with the rest of America, California seems a well-marked and well-defined province. In a broader view of the peoples of the world, its distinctive characters largely disappear, or are seen to coincide with such as are typical of the whole of America. On the other hand, when California is viewed by itself, the northwestern, the central and the southern areas contrast strongly. But the moment each of these three is considered alone, culturally well-defined groups of tribes are evident within it. This does not weaken the value of the recognition of culture-areas. The genus breaks up when we consider species. Even the species seems no longer a unit when attention is allowed to be given to races. But the differences between genera become insignificant when the family and the order are in view. Neither the order nor the species, the race nor the genus, is, therefore, unimportant or unreliable. A biology recognizing only species is a scientific impossibility; but a biology dealing with nothing lower than genera would be equally impossible. The culture-area, broad or minute, has its value, and in fact is indispensable, as a means to a historical understanding of its components; but it has value only so long as its relativity is recognized.

The northwestern culture-area of California may in some respects be considered the most southerly extension of the distinctive and rather highly organized culture which centers on the Pacific Coast north of Puget Sound. The Yurok and Hupa and Wiyot house is the same in plan as the plank house as far north as Alaska. Immediately to the south, among the Yuki, Wintun, and southern Athabascans, it is replaced by the central Californian brush or bark hut or earth-covered house. The same tribes of northwestern California are the most southerly among whom a well worked-out system of social organization dependent on wealth exists. All through California the rich man was the chief; but only here was every one's standing in the community, and the value of his life and of his children, definitely regulated and expressed in terms of wealth. In this northwestern region, too, is marked the southernmost extension on the Pacific coast of the prevalence of culture-hero and transformer myths. Immediately to the south, creation myths begin. Nevertheless we may well hesitate before counting northwestern California within the North Pacific coast culture. In general scope and tone, life was at least as similar to that of central California as to that on the lower Columbia or in the vicinity of Puget Sound. In addition, there has clearly taken place in this region an independent local development which has more or less influenced the entire culture. The implements, the ceremonies, the beliefs, found only in this region, are exceedingly numerous, and seem to reach the highest development among the Yurok, the Karok, and the Hupa. The remaining Athabascans, the Wiyot, the Shasta, and the Chimariko, who surround these three more highly organized tribes, belong to the same general culture while lacking many of its most individual features.

In southern California, at least three sub-areas of culture, connected largely with environment, are distinguishable. Unfortunately, the people of what was perhaps the most interesting of these, the

Santa Barbara coast and archipelago, were ethnologically extinct long before ethnologists visited their territory. We know of them only from brief notices of travelers and through the less perishable artifacts they have left in their village-sites. As a more or less maritime people, their mode of life must have been quite different from that of the other Indians of southern California, and no doubt their institutions and beliefs also showed much that was peculiar but which we can not even speculate upon.

The people in the fertile and semi-fertile mountain and coast regions of southern California were the most similar, of those in the south, to the central and northern Californians. Their habitat was not essentially different from the greater part of California. Their mode of life is, therefore, naturally also similar to that of central California. In religion, however, especially in the matter of beliefs, there is much that is either distinctive or shows relations with the Pueblo culture. Even the arts are not free from resemblances in this direction.

It is therefore the more surprising that the agricultural Yuman tribes of the Colorado river, to the east of the last group of people, and therefore so much nearer the Pueblo region, evidence no great approximation to Pueblo or southwestern life, even though they are in many respects typically un-Californian. Even such of their cultural features as they appear to have acquired through Pueblo influence, as, for instance, their pottery, have a non-Pueblo character. Their religious life is especially distinct, lacking even certain traits which their Californian neighbors to the west share with the Pueblos and other tribes to the east. In the ceremonies of the Mohave are found no masks, no altars, no painting or carving of ceremonial paraphernalia, the simplest of regalia, no seasonal observances, no societies, and no initiation; and all this in spite of the fact that they maintained some degree of intercourse with the Hopi.

In the great central region of California cultural uniformity is stronger than in the south, not so much through the persistence of certain special positive features, as in a fundamental similarity that is varied only locally. Thus the weaves, the shapes, the patterns and the materials of baskets differ, but basketry is everywhere the most developed and most important art, nowhere replaced by pottery or working in wood. Creation myths and mourning ceremonies vary in form from district to district, but everywhere dominate mythology and public religious expression. Too great a uniformity will not be expected when it is realized how limited the geographical knowledge and intercourse of most of the California Indians were. It is probable that the southern Yokuts did not more than know of the existence of the southern Miwok. These in turn knew no more of the southern Maidu. The southern Maidu may not have been aware that there was such a people as the Shastan Achomawi of Pit River. Again, the Maidu of the higher Sierra did not know more than the easternmost Wintun. These appear to have come in contact only with the easternmost Pomo. The eastern Pomo had but little to do with their western kinsmen on the coast. Whether one traveled from south to north, or from east to west, through the central province of the state, he would, therefore, encounter, in aboriginal times, at least two or three groups of people mutually ignorant of each other's existence; and this condition was probably more marked in north-central than in south-central California. In this respect central California differed as a culture-area from such much more extensive but better interconnected regions as the Plains, or the district of the Great Lakes and

Alleghanies; or probably even the north Pacific coast and the southwest, where at least the majority of tribes had some communication with the majority of others. With the restricted intercourse in central California, common cultural traits should be chiefly general, or of a negative character, and local divergences numerous. The degree of uniformity which exists is, therefore, the more significant.

From the first, archeological investigation in California has concerned itself with questions of time more than with those of culture. It was inevitable that this should be so from the sensational if as yet unsubstantiated discoveries of a generation ago. Of recent years there has been rigorous search for evidences of the geological antiquity of man, and positive results from which would have been the more reliable from the fact that the work has been controlled by geologists. It can not be said, however, that more has yet been shown than that there are good prospects for the ultimate establishment of the existence of man in the state at an early period. But a clue is not a discovery, and probability and opinions represent precisely the status of the question which it is desirable to leave behind. Of recent years no one has ventured to assert positively the human origin of the possible artifacts dating with certainty from Quaternary time, or the geological antiquity of finds of unquestionably human origin. Until such an unequivocal statement of faith is made by those most inclined to a favorable opinion, the skeptically disposed will doubt. The work that has been done is encouraging; but proof of the geological antiquity of man in California remains to be made.

Rather unexpectedly, investigation of shell mounds and deposits on San Francisco Bay has resulted in evidences of antiquity sufficiently great to be geologically observable. In a number of mounds on the immediate shore-line the base has been found to be from three to twelve feet below the present water level. On the other hand, there is at least one case of an extensive shell deposit at a point more than a mile from water and at some elevation above sea level, the presence of which it is difficult to explain except on the assumption that the shore-line has undergone a corresponding elevation. Of course the question at once arises how great a time would be required to effect such changes in a region subject to seismic disturbances.

On its cultural side archeology seems to show above everything else that, broadly speaking, the civilization of California is of some age, and has scarcely changed during the period, perhaps of thousands of years, through which the accumulating finds take us. There is no trace of pottery in former times where it has not been found in the historic period. There are no evidences of agriculture or of architecture in stone. The plummet-shaped charmstones are found chiefly in regions where their use by the Indians has been seen, or explanations as to their employment have been had from the Indians. The straight tubular pipe is as characteristic of the prehistoric as of the present native inhabitant of the state. The peculiar hooked stone adze handle, the large obsidian blade, the perforated stone, the pestle ringed near the bottom, are found buried in village-sites, and in use by the Indians of to-day, in northwestern California. The more specialized of these forms, such as the adze and pestle, are observed by both archeologist and ethnologist only in this region. It would thus appear that even local cultural characteristics are of considerable age. Scarcely any unexplained types of implements, and no forms of art unpractised at the present day, are found by the archeologist. Even where minor changes have taken place, they are superficial. The bowlshaped stone mortar is the commonest archeological find in California. The great majority of the tribes met by the whites did not use such mortars, but a flat slab, or exposed bed-rock, with a mortar or hopper of basketry. Both the prehistoric and the recent people, however, it is clear, lived principally on vegetable food that needed pounding, no doubt acorns above all; and they used the same types of pestles.

Such a close correspondence of the results obtained by the prehistoric archeologist and by the ethnologist investigating present-day conditions, is not a new phenomenon nor confined to California. It recurs in the southwest, on the north Pacific coast, on the plains, to a considerable extent in Mexico, in fact, broadly speaking, over the whole of North America except part of the region between the Mississippi and the Alleghanies. The widespreadness of the correspondence, however, makes it particularly interesting and important, as it seems to show either that all American culture is comparatively recent, or that its principal forms, differentiated a long time ago, have been maintained by a strong conservatism.

The physical anthropology of California is yet in its infancy, but whether it will ever far outgrow this stage seems doubtful. Over great parts of the state prehistoric material for investigation is wanting, owing to the prevalence of the custom of cremation of the dead. In other parts the recent people have become extinct without being measured or photographed. In some regions, such as the Salinas valley, there is neither recent nor ancient material. The map of California will, therefore, presumably always contain large blanks so far as physical anthropology is concerned. At present studies are further restricted through the comparative scarcity of information in most of the surrounding parts. No general correspondences of racial types with cultural or linguistic divisions have been established. In fact, the observed instances more frequently show a lack of correlation. There does not appear to have been any very considerable physical diversification within the limits of the state. Whether a few scattered areas showing aberrant types, such as the long-headed people of the upper waters of Eel River and of the southern Santa Barbara islands, are to be regarded as ethnic islands in which an earlier continuous but now otherwise submerged race has maintained itself to the present in comparative purity; or whether they represent migrations of distinct types from a more remote habitat; or whether they are local developments from a single widely spread and originally uniform type, must yet be considered uncertain.

It may be asked what are the specific problems of the anthropology of California. The most important questions have been outlined in the summary of results that has been given. While something has been done, and some problems have been solved or brought nearer solution, they have only served, as is always the case, to open wider problems. If it has been determined that dialects do not form gradual transitions, but present abrupt changes, a point is gained. But the question at once arises what the conditions are that have brought about and maintained this state. While the structure of some languages is fairly well known, generally through the study of one selected dialect, there are more of which we have only the most superficial conception. If these less-known languages show resemblances among each other, or to the better-known languages, either in content or in form, we need more information than exists in order to follow out the promising comparisons. If half a dozen shell-mounds on San Francisco Bay show varying subsidences below sea level, there are three hundred others, on the shores of the same body of water, whose subsidence should be similarly investigated to make possible a final determination of the age of the culture of this region; and this is only one region of many where similar archeological phenomena can be studied. The cry of the physical anthropologist is for more material—material which is in part no longer obtainable. The ethnologist is beset by the same difficulty. There is not a people in the state whose institutions and religion have been ascertained with such exhaustiveness as is desirable for purposes of comparisons alone. We know that the Maidu and Wintun had certain ceremonies in common. It now appears that other groups, such as the Pomo and Miwok, also practised certain of these ceremonies. We have some idea of the form which these ceremonies took among the Maidu, with whom they do not seem to have been original; but we lack almost all knowledge regarding them among other tribes—and this is knowledge which can still be secured. There is no doubt that something of the history of the aborigines of California, in broad outlines, but in the specific sense of the word history, will be revealed by the continued pursuit of the various phases of anthropology; but what is needed in all domains of the anthropology of the region is more knowledge, more information, and more facts. However gratifying the results of research have so far been, they show only more clearly the greater results that are possible, and emphasize the means by which alone these results can be attained, which is: more work.

A. L. Kroeber

THE AMERICAN CHEMICAL SOCIETY AND SECTION C OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The thirty-seventh general meeting of the American Chemical Society and the meeting of Section C of the American Association for the Advancement of Science was held at Chicago during Tuesday, Wednesday, Thursday and Friday, December 31 to January 3, in the Kent Chemical Laboratories of Chicago University.

Tuesday morning the organization of Section C was effected and this was followed immediately by the opening session of the American Chemical Society and later by the meetings of the sections.

On Tuesday evening a complimentary smoker was extended to the visiting chemists by the Chicago section of the American Chemical Society at the Sherman House. The cordiality and good cheer of the occasion were so much in evidence that this session extended well over into the new year.

Wednesday afternoon personally conducted excursions were made to the Illinois Steel Company, the By-products Coke Corporation, the American Linseed Company and the Chicago Gas light and Coke Company.

In the evening the society was favored by an address on "American Chemical Societies" by Professor M. T. Bogert, president of the society.

Thursday evening the members of the society banqueted at the Auditorium Annex Hotel. This was one of the most enjoyable events of the thirty-seventh general meeting.

On Friday afternoon excursions were conducted through the plants of the Standard Oil Company at Whiting, Indiana, and to the Union Stock Yards and the packing plant of Swift & Company. A complimentary luncheon was served for the visitors by Swift & Company.

At the last general meeting, on Friday, the society extended a vote of thanks to the Chicago section and all others who contributed so much for the success of the meeting in Chicago.

The attendance at this meeting reached 325, almost the largest in the history of the society.

The following papers and addresses were delivered before the general sessions:

The Application of Physical Chemistry to Organic Chemistry: Julius Stieglitz.

The Hydronitrogens and their Derivatives: A. W. Browne.

A Plea for the Broader Education of the Chemical Engineer: Clifford Richardson.

Some Present-day Problems of Biological Chemists: R. H. Chittenden.

The Passage of Substances into the Human System by Osmosis: Louis Kahlenberg.

American Chemical Societies: M. T. Bogert.

The Non-equivalence of the Four Valences of the Carbon Atom: J. U. Neff.

The Chemical Education of the Chemical Engineer: Wm. H. Ellis.

Chemistry in the Government Service: W. D. Bigelow.

The Interrelations of the Elements: Herbert N. McCoy.

The following papers were presented before the different sections:

PHYSICAL CHEMISTRY SECTION

Herbert N. McCoy, Chairman

On the Passage of Substances into the Human System by Osmosis: Louis Kahlenberg.

The experiments began with a study of the treatment of cases of blood-poisoning by means of saturated aqueous solutions of boric acid. In all cases where such solutions are applied to the thoroughly cleansed skin, boric acid is absorbed and makes its appearance in the urine. The percentage found in the urine rarely reaches more than a few hundredths of one per cent.

A large number of pathological samples of urine were examined, their boric acid content being determined colorimetrically by means of a modification of the turmeric paper method. When the feet of a normal individual are immersed in a saturated boric-acid solution up to the ankle, the boric-acid appears in the urine in estimable quantity in ten minutes. The presence of traces may be demonstrated after five minutes. Under like conditions not a trace of lithium passes into the system from lithium chloride solutions. Quite weak solutions and also five and ten per cent. solutions were tried. Chlorides of calcium and rubidium also do not pass into the system. The tests were made by means of the spectroscope. It is a notable fact that through dead animal or vegetable membranes lithium chloride will pass much more rapidly than will boric acid. And when even a small fraction of a grain of lithium chloride is taken into the mouth, the lithium may be demonstrated to be present in the urine in a very short time. When the feet are soaked in a solution of lithium tetraborate, neither lithium nor boric acid is found in the urine. Thus far all attempts to introduce lithium salts into the system by absorption through the skin have been unsuccessful. On the other hand, through the mucous membranes lithium salts readily make their way. Through dead animal and vegetable membranes acids diffuse most rapidly. When the feet are soaked in a tenth normal hydrochloric or sulphuric acid, the urine, which, as is well known, is slightly acid in reaction normally, becomes alkaline in five minutes, also scanty as to amount. In ten minutes the alkalinity is much more pronounced. If now the experiment is stopped, the alkalinity persists for three to five hours longer, gradually disappearing. An attempt to secure the same results with citric acid failed, the urine showing, if anything, a slight increase of acidity. Even a half normal solution of citric acid produced the latter effect. When taken internally, the acids mentioned acidify the urine. Thus it appears that when, for instance, sulphuric acid is taken in through the skin quite a different physiological effect is produced from that found when the acid is taken into the digestive tract.

The work demonstrates clearly that living membranes act differently osmotically from dead ones, and that different living membranes may act very differently indeed toward some substances and yet much the same toward others. Whether a substance will be absorbed or not depends upon its specific nature and that of the membrane. The results of the experiments are a step forward toward a better understanding of the processes of absorption and secretion.

On the Refractive Indices of Absolute and of Aqueous Alcohol: LAUNCELOT ANDREWS.

Absolute alcohol prepared by the use of calcined marble has the same density, the same refractive index and the same critical temperature of solution as that which has been dried by the use of metallic calcium or of magnesium amalgam.

The observations of Caismer to the effect that the critical temperature of solution of absolute alcohol in kerosene is the best criterion of the dryness of alcohol is fully confirmed.

Absolute alcohol was found to have the following constants:

Density	25°/40°	0.78510	0.00002
Zeiss immersion refractometer,	85°.30	0.02 at 25° H	
Index of refraction	1.35941	0.00002	25° H

A table is presented, showing the refractive indices by the Zeiss immersion refractometer readings of aqueous alcohols for each per cent. of water from 0 to 30.

It is shown that aqueous alcohol has a maximum refractive index of 1.363315 0.000010 at 20.7 per cent. of water, corresponding to the formula.

On the Refractive Indices of Ether Alcohol Mixtures: LAUNCELOT ANDREWS.

It is in general possible to determine the concentration of the solution of an organic substance in an organic solvent more rapidly by an observation of the refraction index than by the density. This is eminently so when the observation is made by the Zeiss immersion refractometer, which is frequently possible when the solvent is ether, alcohol or especially methyl alcohol.

Having occasion to determine the ether content of the mixtures named in the title by wholesale, a table was constructed showing the Zeiss constants for mixtures of absolute ether with aqueous (91 per cent.) alcohol, over the range from 100 to 84 per cent. of ether.

This table is given in the paper, together with a description of the experimental work on which it is based.

The Latent Heat of Vaporization of Methyl Silicate: LOUIS KAHLENBERG and ROBERT KOENIG.

Methyl silicate was prepared by treating silicon tetrachloride with absolute methyl alcohol. The pure product was found to possess a latent heat of vaporization of 46.48. Its specific heat between 23° and 115° C. was found to be 0.5011. The liquid boiled at 121° C. under 750 mm. pressure. The latent heat of silicon tetrachloride was redetermined and found to be 36.1. The value determined by Andrews was 37.3. The specific heat of silicon tetrachloride was found to be 0.1904 between 40° and 25° C. This agrees well with the value found by Regnault.

Equilibrium in the System Silver Nitrate and Pyridine: Louis Kahlenberg and Robert K. Brewer.

The entire curve of equilibrium was determined from the freezing point of pyridine −48.5° to 110° C. From −65°, the freezing point of the saturated solution to −24° a solid of the composition $AgNO_3 \cdot 6C_5H_5N$ is in equilibrium with the solution. From −24° to +48.5° the solid in equilibrium with the solution is $AgNO_3 \cdot 3C_5H_5N$. From +48.5° to +79°, $AgNO_3 \cdot 2C_5H_5N$ is in equilibrium with the solution; and above the latter temperature pure $AgNO_3$ is in equilibrium with the solution.

Note on the Solubility Product: Julius Stieglitz.

Arrhenius's work (*Zt. phys. Ch.*, XXXI., 197) on the solubilities of silver salts of the fatty acids in the presence of sodium salts of the same acids destroyed the last vestige of the theoretical foundation of the solubility product constant by showing that the solubility C_{mol} of the non-ionized salts is not a constant, but decreases with the increased concentration of salt solutions. A decreasing molecular solubility C_{mol} and an increasing value for $C' \times C/C_{mol}$ as is found for strong electrolytes is consistent with a constant solubility product $C' \times C$ and the author shows that satisfactory constants are obtained for each of the silver salts by calculation from the data of Arrhenius. Such a constant, even if only an empirical and not a natural constant, is of great practical value in work on solubilities.

Two New Methods of Determining the Secondary Ionization Constants of Dibasic Acid: Herbert N. McCoy.

1. The concentration of the free acid in an aqueous solution of the normal and acid sodium salts of a weak dibasic acid is found by partition with an immiscible solvent. Titration of the aqueous solution gives the remaining data for the calculation of the ionization constant of the second hydrogen ion.

2. This same constant may also be calculated from the values of the equivalent conductances of very dilute solutions of the normal salt and the acid salt. The results of the two methods agree with one another and also with those obtained by other methods as well as could be expected.

The Preparation of Urano-uranic Oxide and a Standard of Radioactivity: Geo. C. Ashman and Herbert N. McCoy.

Pure UO is obtained by igniting pure uranyl oxide in an electric muffle at 650 to 700° C. At much lower temperatures decomposition is incomplete, at higher temperatures oxygen is slowly lost. Standards of radioactivity consist of films of the oxide UO about 40 sq. cm. in area and 0.7 to 0.9 g. in weight, deposited by a special process, on flat, circular plates of copper. Films so made having equal area, have identical activity. The ray activity due to 1 sq. cm. of such a film is taken as the unit of radioactivity.

The Three Component System—CuO, SO_3, H_2O *at 25 Degrees:* J. M. Bell and W. C. Taber.

Purified copper oxide or copper hydroxide was added in excess to a solution of copper sulphate, and the solid and liquid phases analyzed for copper and sulphuric acid after the system had come to equilibrium. In plotting the results on a triangular diagram, by joining the corresponding points of the solid and liquid phases, it was found that the lines did not meet within the triangle, indicating that the solid phases consist of a series of solid solutions, and are not definite chemical compounds of the nature indicated by the formulas, $5CuO \cdot 2SO_3 \cdot 5H_2O$ and $4CuO \cdot SO_3 \cdot 4H_2O$, which have the best status in the literature of the basic sulphates of copper.

When sulphuric acid was added in excess to solutions of copper sulphate, the lines joining the corresponding points representing the solid and liquid phases pass through points representing the penta-, tri- and mono-hydrates of copper sulphate. At still greater concentrations of acid the anhydrous salt is the stable solid phase. The vapor pressure at which any two of these hydrates exist at 25 degrees, as found by Lescoeur and others, agrees well with the calculated vapor pressure of the solution at the corresponding invariant points.

The Action of Nitric and Citric Acid Solutions upon Ferric Hydroxide: F. K. Cameron and W. O. Robinson.

At 25° nitric acid dissolves a little more than its own equivalent of ferric oxide with the formation of a definite solid solution of ferric oxide, nitric acid and water.

From concentrations of nitric acid from 30 to 45 per cent. N_2O_5 the 18-hydrate of the normal salt exists. In a metastable condition it exists to a concentration of 55 per cent. N_2O_5. The stable solid from concentration 45 per cent. to 55 per cent. N_2O_5 is an acid salt of the formula $Fe_2O_3 \cdot 4N_2O_5 \cdot 20H_2O$.

Oxalic acid dissolves more than its own equivalent of iron oxide at 25° with the formation of a solid solution of oxalic acid, ferric oxide and water.

The Rate of Diffusion of Oxygen through Organic Liquids: G. B. Frankfurter and G. W. Walker. Reported by title.

The Casting of Zinc: W. D. Bancroft. Reported by title.

Solution in a Dissolved Solid: Charles L. Parsons. Reported by title.

Reversed Electrolysis: J. W. Turrentine. Reported by title.

Principles Involved in the Construction of College Laboratories: Charles Baskerville. Reported by title.

The Heat of Ionization and the Reversible Potential of Nickel: E. P. Schoch. Reported by title.

Agricultural, Sanitary and Food Chemistry Section

W. D. Bigelow, Chairman

Determination of Sulphites in Food Products: Edward Gudeman.

Paper recommends the use of steam for distillation of sulphurous acid. Acid solutions of food products on concentration or during distillation are liable to be decomposed and sulphur compounds naturally found in the products, distilled over and oxidized and reported as sulphites or sulphurous acid present. Method of using steam prevents such concentration and decomposition. Results reported on fresh meats, gelatine and eggs. Advantages of method that distillate can be directly titrated with iodine solution for sulphurous acid, no danger of bumping or frothing of solutions and no decomposition of products due to concentration of acid solutions. Description of apparatus used for distillation.

Natural and Modified Starches; An Introduction to a Comparative Study of their Physical and Chemical Properties: Chester B. Duryea.

The author outlines an effort to decide whether or not starches are essentially homogeneous chemically. Modified starch is defined. Various methods of preparation are given, and also the more conspicuous phenomena resulting from the "in suspension" and "drying in" processes, which are stated to differ in their effects on the granules because of stratification conditions. Opposing elements in old views involving chemical homogeneity of the granules, and the new hypothesis of the fundamentally different components amylopectin and amyloses are set forth. Objection is made to the indirect methods of previous investigators. The author's scheme of experimentation is explained in detail, and general reference is made to results so far had, which indicate that the new amylo-pectin hypothesis is untenable. The investigation in detail will be published later.

Note on the Dyer Method for the Determining of Plant Food in Soils: FRANK T. SHUTT and A. T. CHARRON.

The authors have submitted the results of an investigation of the influence of time of digestion and the influence of volume as related to the Dyer method for determining plant food in soils. From the results there is every reason for adherence to the time and volume limits as given by Dyer in his original account of the process.

A Recent Analysis of Water from Great Salt Lake: W. C. EBAUGH and KENNETH WILLIAMS.

From analyses made in this laboratory we know that the water of Great Salt Lake has varied widely in composition during the last twenty years, as indicated by the following partial results.

Year	Density at 15° C.	Per cent. by Weight, Total Solids
1885	1.1225	16.716
1903	1.2206[1]	27.721[1]
1907	1.1810	22.920

The solids contain the following constituents:

	Per cent. by Weight of Sample	Grams per Liter
Chlorine	12.67	149.633
Sulphate radical	1.53	18.069
Sodium	7.58	89.520
Potassium	0.72	8.503
Magnesium	0.45	5.314
Calcium	0.04	0.508
Total solids (direct determination)	22.92	270.675

[1] Greatest density ever recorded.

The Precipitation Method for the Estimation of Oils in Flavoring Extracts and Pharmaceutical Preparations: CHARLES D. HOWARD.

The author proposes a modified precipitation method for determining oils in flavoring extracts and this modified form yields very accurate results. No correction for oils retained in solution is necessary, alcoholic solutions are not detrimental except for almond oil. A determination may be made in less than ten minutes.

Effect of Lime and Gypsum on the Solubility of Potassium in Feldspars: F. W. MORSE and B. E. CURRY.

Lime and gypsum in contact with feldspar increases the solubility of potassium. This effect has not been detected when ordinary clay soils are treated in a similar way. This difference is probably due to the absorbing action of the clays which causes the removal of potassium from solutions.

A Study of the Changes Taking Place in the Muscle of Chickens when Preserved at Low Temperatures: M. E. PENNINGTON and E. Q. ST. JOHN, Food Research Laboratory.

The muscular tissue of chickens kept in a solidly frozen condition, at 13° F., shows marked histological changes even after one month in cold storage. These changes are progressive and at the end of six months many muscle fibers are scarcely recognizable.

The observations have been made on chickens of known history and which have been carefully kept, and upon chickens of the ordinary market type. The latter have been examined after storage periods of two and three years, as well as when stored for comparatively short lengths of time.

Methods of Soil Toxicology: OSWALD SCHREINER and EDMUND C. SHOREY.

The presence of small amounts of toxic

organic bodies in soils demands methods for their detection, isolation and study. Their presence and toxic properties are determined by physiological methods in which plants are employed. The isolation and identification must be done by chemical methods, employing the methods of toxicology and of biological and organic chemistry. The authors outlined methods of separating the organic matter from the large mass of inorganic material, and further separation of the pure organic body from the extraneous organic matter by methods of extraction, solution, precipitation, distillation, etc. The specific methods by which several harmful organic compounds have already been isolated from unproductive soils were given to illustrate the general principles involved.

Nitrates as Soil Renovators: Oswald Schreiner and Howard S. Reed.

Attention is called in this paper to an action of nitrates in aiding the destruction of harmful organic bodies which may be present in unproductive soils. After nitrates have acted in such a soil or soil extract, the conditions for plant growth are improved, although the nitrates have been used up by a previous crop. Roots of plants possess a strong oxidizing power and it has been found that this power is greatly augmented by nitrates, so that the oxidizing power under such conditions becomes sufficiently great to destroy harmful organic bodies, resulting in improved conditions for plant growth. When known toxic bodies are used in the experiments, their destruction by the plant and nitrates can be shown by chemical analysis.

The Proteids of Cotton: H. C. White.

This paper presents the results of the first of a proposed series of observations upon the nitrogen feeding of the cotton plant. During the season of 1907 analyses were made of pot-grown and field-grown plants, from sprouting to maturity, to determine the extent and character of the nitrogen compounds. The actual nitrogen content, at comparatively short intervals of growth, is shown and some valuable suggestions gained on which to base future studies of the development of the nitrogen compounds. The investigation will be continued through the coming season.

The Volatilization of Certain Mineral Elements in Ashing Plant Materials: W. W. Skinner, U. S. Department of Agriculture.

The usual method for determining the mineral matter in plants has been to ash the material and submit the ash to a complete mineral analysis; this presupposes that all of the mineral elements in the plant are retained in the ash, an assumption which for a long time has been known to be incorrect.

This work was undertaken to show to what extent sulphur, phosphorus, chlorin and potash are lost by the ordinary method of incinerating in air, and to point out the possibility of faulty conclusions resulting from the attempt to establish the relation of plant growth to the mineral elements in the soil from ash analyses which do not show all of a certain mineral element in the plant, a portion of it being volatilized in the process of ashing.

This paper gives results upon sulphur only, and shows the loss when ashed by the ordinary method as compared with the total sulphur obtained by the peroxide and the combustion in oxygen methods.

Analyses are given of two samples of cotton seed meal, two samples of mustard seed meal, three samples of malt, four samples of barley and three samples of wheat. The loss of sulphur varies from 89 per cent. to 97 per cent.

The Occurrence of Copper in Oysters: J. T. Willard.

Illness having followed eating oysters of a decidedly bluish green color, an analysis disclosed the presence of copper to the extent of 0.212 per cent. of the dry substance in one instance. Other tests of fresh and canned oysters on the Kansas market showed copper to be present in every case. Twenty-six samples from various localities were secured directly from the shells, and copper found in every instance, the average amount in the dry substance being 0.059 per cent. Copper seems, therefore, to be a normal constituent of oysters, and it is probable that some individuals may be affected by it when present in the larger amounts.

Influence of Fertilizers upon the Composition of Wheat: Harry Snyder.

Nitrogen, phosphorus, and potassium containing fertilizers, singly and in combination, were applied to wheat, and complete proximate analyses were made of the crop, and a study was made of the influence of the nitrogenous fertilizers upon the amount and form of the nitrogenous matter in the wheat. Milling and technical tests were also made of the wheat, and bread-making tests of the flour. Over forty samples of wheat were included in the investigation. The results show that an increase in nitrogen content of wheat can be secured by the use of nitrogenous fertilizers, but that the additional nitrogen is not all in the form of gluten proteids, a portion of the nitrogen being in the form of amides, nitrates and allied forms. The influence of the fertilizers upon the commercial and bread-making value of the wheat is also briefly discussed. In general an improvement in the quality of the grain was secured by the use of fertilizers.

The Detection of Formic Acid in Food Products: A. G. Woodman and Albert L. Burwell.

The authors have obtained very satisfactory results in detecting formic acid used as a food preservative by means of a method based on the dry distillation of calcium formate.

The method used may be described briefly as follows: Fifty grams of the sample are mixed with 20 c.c. of 20 per cent. phosphoric acid and distilled by steam.

To the distillate is added 2 c.c. of 30 per cent. acetic acid free from formic acid, and about 20 c.c. of milk of lime (100 grams CaO per liter). The solution is evaporated to small bulk over a free flame and then on the water bath to dryness.

The dry residue is scraped into a test-tube provided with a cork and bent delivery tube and subjected to dry distillation. After the delivery tube has been allowed to drain, 3 c.c. of standard fuchsin aldehyde reagent is added to the distillate, the mixture allowed to stand exactly five minutes and compared with a standard color.

The fuchsin-aldehyde reagent is prepared by dissolving 0.2 gram rosaniline in 10 c.c. of freshly prepared *saturated* sulphurous acid and allowing the solution to stand until the red color has entirely disappeared and only a light straw tint remains. This is diluted with 200 c.c. of distilled water.

An Electrically Heated Polariscopic Tube: B. H. Smith.

The tube consists of a fairly heavy inner tube of brass or other metal of one half inch inside diameter, the ends of which are threaded and capped as in the case of the usual form of polariscopic tube. An aperture, equally distant from either end, is threaded to receive a short wide-mouthed tube at right angles, which admits the thermometer. The latter tube, being removable, as is also the binding screw, allows a metallic jacket to slip over and protect the resistance wire. A short cylindrical sleeve of this jacket fits a groove of the thermometer tube in such a manner as to prevent the possibility of any water getting to the windings. The wire, which is of german silver of 8/1,000 diameter, is put on in layers which are protected from the metallic inner tube and each other by asbestos paper or sheets of mica.

When properly wound, the tube heats up uniformly, the temperature being readily controlled by means of a small rheostat.

The Effect of Temperature on the Respiration of Apples: Fred W. Morse.

The author finds the amount of CO_2 exhaled at 10° and 20° to be respectively about two and four times the amount exhaled at 0°. This follows the laws of reaction velocity in this respect.

Some Notes on Soil Acidity: Fred W. Morse and B. E. Curry.

The authors report the reactions taking place between a number of clays and some common salts. Also some reactions between the organic matter in soils and some common salts.

The Relation between the Effects of Acid in Nutrient Solutions, and of Liming: Burt L. Hartwell and F. R. Pember.

Field experiments have shown that rye and barley, among the common cereals, are very differently affected by applications of alkaline material. Under conditions resulting in no benefit to rye, liming may increase the yield of barley, 100 to 200 per cent. Comparative water cultures[2] were carried on principally with rye and barley seedlings, to see if the addition of acid to the nutrient solution would affect the barley more injuriously than the rye, as might be surmised from the greater susceptibility of the barley to those conditions which are improved by liming. It was shown by repeated experiments that barley was *not* injured more than rye by the addition of acid. Growth in the case of both cereals was scarcely affected by an initial acidity equal to $N/5{,}000$, even though the nutrient solution was changed every few days during the three to four weeks of the experiments. A depression of about 20 per cent. occurred, however, when the acidity equaled $N/2{,}500$. An increase in the acidity to $N/1{,}700$ and $N/1{,}250$, decreased the green weight about 40 and 60 per cent., respectively.

The growth was not materially influenced by any degree of alkalinity which was insufficient to cause precipitation from an ordinary nutrient solution.

The Partial Substitution of Potassium by Sodium as a Plant Food: B. L. Hartwell, H. J. Wheeler and F. R. Pember.

The possibility of an indirect action of sodium in experiments with soil which have been conducted in Rhode Island and elsewhere, precludes an absolute proof of a *direct* beneficial action of sodium upon the growth of plants. This fact led to the growing of wheat seedlings in solution[3] and to the results which are briefly mentioned here. When the seedlings were grown in a nutrient solution containing an optimum amount of potassium there was no increased growth caused by the addition of sodium. When, however, the amount of potassium was reduced so that a depression in growth of about thirty per cent. occurred within a period of about three weeks, the substitution of an amount of sodium equivalent to the potassium which was withheld, caused about a ten per cent. greater growth than when the deficient amount of potassium, but no sodium, was present. An extra amount of calcium did not cause the increase which was produced

[2] Ann. Rpt. Agr. Expt. Sta., **20**, 358–380 (1907).

[3] Ann. Rpt. Agr. Expt. Sta., **20**, 299–357 (1907).

by the sodium: this fact and others indicate that the increase was not due to greater osmotic pressure. An addition of potassium or sodium increased the transpiration less than the green weight. When supplemented by sodium, a larger amount of potassium was left in the solution by the growing seedlings, showing that sodium was a conserver of potassium.

A Study of the Chemistry of the Chinese Edible Bird's Nest "Neossin": E. V. McCollum.

"Neossin" is a glucoproteid. It gives Millon's, Adamkiewicz's, the biuret and xanthoproteic reactions. It contains 2 per cent. of sulphur, 9.69 per cent. of nitrogen and no phosphorus. Hausmann's method showed the nitrogen to be distributed as follows: NH_3, 1.3 per cent.; Humus, 1.27 per cent.; Phosphotungstic acid precipitate, 1.59 per cent.; Amino acids, 5.53 per cent. The substance is remarkable in that about one fourth of its sulphur is liberated as SO_2 when the proteid is hydrolyzed with 3 per cent. HCl. No sulphites are present in the nest. The gas was washed with $CuSO_4$ solution and gave no evidence of hydrogen sulphide. The mercaptan sulphur test is very faint.

When boiled with 3 per cent. HCl, the carbohydrate group is readily split off. The hydrolysis solution was precipitated with phosphotungstic acid and the filtrate used for the estimation of the sugar by Fehling's solution. It showed the presence of 15 per cent. of sugar calculated as glucose in the sample. This solution gave an osazone which melts at 183°–185° C. and has the composition of a hexosazone.

Arginine and histadine were identified in the phosphotungstic precipitate. Lysin appears to be absent.

The Importance of the Publication of a General Bulletin giving the Results of Food and Drug Work in the United States: E. H. S. Bailey and H. L. Jackson.

It would be a great advantage to those who have to do with the enforcement of food and drug laws if the results of analyses and opinions in regard to certain specific articles of food upon the market were published monthly in some general bulletin. It is of course true that articles might be passed in some states and condemned in others.

This difference might be due to the absence of laws in one state that have been enacted in another. Here the tendency would be to induce manufacturers to raise the grade of goods so as to make use of a common label for all states.

There might be a difference on account of the various methods of examination. If attention is called to this fact there would be thus an opportunity to work out better methods and so obtain more uniform results.

There might also be a different judgment regarding what foods are injurious or otherwise in the separate states. Here again a comparison of results would lead to investigations such as are now being carried on by the Department of Agriculture.

It is suggested that in addition to an official list of laboratories where food and drug analyses are made, there might be a list compiled under various headings, such as flavoring extracts, beverages, etc., giving those that are reported by municipal and state laboratories as being illegal, with a simple statement as to the reason why they are so considered. Although it probably does not come within the province of the federal government to issue such a bulletin, if it could be published in some other way, it would be extremely convenient to those who are engaged in food and drug work.

Extracting Sugar from Dried Beet Cossettes: Harry McCormack. Reported by title.

Analyses of Grains and their Comparative Value for Feeding Purposes: Joseph S. Chamberlain. Reported by title.

Changes taking Place in Whisky stored in Wood: C. A. Crampton and L. M. Tolman. Reported by title.

Detection of Thickeners in Ice-cream: G. E. Patrick. Reported by title.

INORGANIC CHEMISTRY SECTION

A. W. Brown, Chairman

Rapid Electroanalysis without Rotating Electrodes: Francis C. Frary.

The apparatus described by the author in the November number of the *Journal of the American Chemical Society* (p. 1592) was shown in operation and its construction explained. The object of the apparatus is to provide efficient stirring of the electrolyte during the progress of an analysis without the use of an electric motor or mechanical stirring device. The stirring effect is produced by the action of a magnetic field upon the solution while the latter is being electrolyzed. Two forms of the apparatus were shown, one for use with a wire gauze cathode and the other for a mercury cathode. Details of the construction of the apparatus may be found in the above-mentioned publication.

A Gas Volumeter with Table of Calculated Values for Carbon Dioxide: S. W. Parr.

An apparatus combining in one piece the advantages of various forms for evolving and measuring various gases from solids or liquids. The chief feature of the paper is intended to point out the errors existing in values now found in all texts of reference for carbon dioxide varying from 0.3 per cent. to 3.5 per cent. in amount. A corrected value with calculated table for various temperatures and pressure is proposed.

Atomic Weight of Chlorine: Wm. A. Noyes and H. C. P. Weber.

A new determination of the ratio between hydrogen and chlorine has been carried out, partly because of the very great importance of the atomic weights of silver and chlorine as a basis for the determination of other atomic weights, and partly because the work could be performed with the use of hydrogen from the same apparatus which was used in the recent determination of the atomic weight of H by one of us. The hydrogen was weighed absorbed in palladium. The chlorine was weighed in the form of potassium chloroplatinate, and the hydrochloric acid was weighed in the first series by absorption in water and in the second series by absorption in water after first condensing it to the solid state by means of liquid air. The ratio found is H:Cl = 1:35.184. This, by combination with the recent value for the atomic weight of hydrogen, determined by one of us, gives the atomic weight of chlorine as 35.461 and the atomic weight of silver as 107.88.

An Yttrium Group Separation Method: Benton Dales and H. D. Young.

The scheme is to dissolve fractionally the rare earth hydroxides in solutions of ammonium salts of organic acids. One series of fractions obtained by the use of cold saturated ammonium acetate solution with material of atomic weight 108 (mostly yttrium, but containing also nearly all the rest of the members of the group) gave five fractions of atomic weights 128, 124, 109, 104, 105. These values are round numbers obtained by the use of a modification of Herrmann's hydrochloric acid titration method. A first fraction contains practically no rare earths, for some reason unknown at present to the authors. The same material as acetates dissolved fractionally in ammonium acetate solution yielded two fractions of atomic weights 125 and 106.

Sodium Peroxide in Certain Quantitative Processes: S. W. Parr.

Fusions by means of sodium peroxide in a closed chamber are shown to have positive advantages in the analysis of substances represented by the following groups. Sulphur and arsenic in pyrites, both iron and copper; sulphur in coal, coke, ashes, etc.; sulphur in rubber, filters and rubber substitutes; halogens, sulphur, arsenic, etc., in organic compounds, especially intended to replace the carius method; silicon and carbon in carborundum.

The Decomposition of Ores and Metallurgical Products by Means of Sodium Peroxide and Certain Metallic Sulphides: J. H. Walton, Jr., and A. Scholz.

By mixing certain ores with sodium peroxide and metallic sulphides such as precipitated zinc sulphide, and igniting the mixture, sufficient heat is liberated to completely decompose the ore. The fusion is carried out in a small nickel crucible. It takes place quietly, the decomposition is rapid and the crucible is attacked to an inappreciable extent only.

The method has been used for the decomposition of galena, chrome iron ore, manganese ores, slags, clays and glazes. The results agree closely with those obtained when the standard methods of decomposition are used.

The Occurrence of Neon in Natural Gas: H. P. Cady and D. F. McFarland.

The rare element neon has been found in natural gas from southeastern Kansas, along with helium. It is separated in pure condition by fractional absorption in bulbs filled with cocoanut charcoal and cooled with liquid air.

The neon is identified by careful measurement of the lines of the spectrum and comparison with best published measurements. All of the stronger lines have been identified. Besides the lines of neon fifteen fairly strong lines are found which can not be identified as belonging to any of the familiar gases.

These same lines have previously been reported by Dewar in the spectrum of the gas from Bath Springs and also in lists of the lines shown by the more volatile gases from the atmosphere. It is possible that these may represent a new elementary gas.

A Discussion of Methods in Use for Separations in the Group and a Description of a New Method of Separating these Earths by Use of their Succinates: V. Lenher.

Dilution of the Strong Acids and of Ammonium Hydroxide: C. W. Foulk and H. E. Surface.

The authors have prepared tables for sulphuric, nitric and hydrochloric acids and for ammonium hydroxide which give in addition to the usual percentage composition and specific gravity the volume of water to be mixed with one liter of the strong reagent to give a mixture of a called-for specific gravity.

The Character of the Compound formed by the Addition of Ammonia to Ethylphosphoplatino Chloride (second contribution): Charles H. Herty and R. O. E. Davis.

Further efforts to prepare the completely ionizable chloride described by Rosenheim have proven fruitless. Slight variations from Rosenheim's directions were likewise failures. In every case only that chloride was obtained containing one ionizable chlorine atom. The constitution of this latter compound is in strict accord with Werner's coordination hypothesis.

The Influence of Temperature on the Electrolytic Precipitation of Copper from Nitric Acid: James R. Withrow.

In determining copper in presence of nitric acid by the older electrolytic methods (without agitating the electrolyte) it was found upon a number of occasions that the nearly complete deposits would disappear from the cathode.

The trouble was traced to accidental fluctuations in the temperature. Copper dissolves in nitric acid more readily at elevated than at ordinary temperature. Therefore, if the current strength is sufficiently low the solvent influence of rising temperature soon exceeds the ability of the current to deposit the metal.

The rate of electrolytic precipitation of copper was, therefore, determined at a number of temperatures, using a current of low intensity, so as to find just what this temperature effect was. Preliminary to this, however, it was necessary to determine the rate of precipitation from varying amounts of nitric acid. The most favorable amount of acid was then used in the elevated temperature experiments.

It was found that nitric acid increasingly retards precipitation even from the smallest amounts upwards. The use of small quantities, however, is advantageous because of the beneficial effect on the character of the deposits.

Using 0.2 per cent. (by volume) of nitric acid, it was found that increasing temperature accelerated the precipitation until 60° C. was reached. Beyond 70° C., however, the influence was a retarding one. This "turning temperature" will of course vary with the current strength.

Action of Certain Oxidizing Agents upon Hydrazine Sulphate: F. F. Sheterly. Reported by title.

The Electrolytic Formation of Selenic Acid from Lead Selenate: F. C. Mathers. Reported by title.

The Reaction Produced by Heat upon a Mixture of Ammonium Chloride and Potassium Bichromate: G. B. Frankforter, E. V. Manuel and V. H. Roehrich. Reported by title.

Action of Water on Galvanized Iron: W. F. Monford. Reported by title.

The Preparation of Silicon Tetrachloride: Charles R. Sanger. Reported by title.

The Preparation and Properties of Pyrosulphol Chloride and Chlorosulphonic Acid: Charles R. Sanger. Reported by title.

Recent Improvements in the Determination of Small Amounts of Arsenic and Antimony: Charles R. Sanger. Reported by title.

The Determination of Small Amounts of Fluorine: Charles R. Sanger.

Sodium Alum: W. R. Smith. Reported by title.

Some New Compounds of Hydrazine: J. W. Turrentine. Reported by title.

Fractionation of the Yttrium Earths: R. D. Hall. Reported by title.

The Rare Earth Bromates—A New Method of Separation of the Yttrium Earths: Charles James. Reported by title.

A Scheme for the Separation of the Rare Earths: Charles James. Reported by title.

A Study of Graphitic Acid: G. B. Frankforter and Lillian Cohen. Reported by title.

B. E. Curry,
Press Secretary

(To be continued)

SCIENTIFIC BOOKS

A History of Chemistry. By ERNST VON MEYER, translated by GEORGE McGOWAN. Third English edition. New York, The Macmillan Co. 1906. Pp. xxvii + 691.

Vortraege über die Entwickelungsgeschichte der Chemie. By A. LADENBURG. Fourth German edition. Braunschweig, Vieweg und Sohn. 1907. Pp. xiv + 418.

A History of Chemistry. By F. P. ARMITAGE. New York, Longmans, Green and Co. 1906. Pp. xx + 266.

A History of Chemical Theories and Laws. By M. M. PATTISON MUIR. New York, John Wiley and Sons. 1907. Pp. xx + 555.

Abhandlungen und Vortraege zur Geschichte der Naturwissenschaften. By EDMUND O. VON LIPPMANN. Leipzig, Veit und Comp. 1906. Pp. xii + 590.

"Man is an animal that looks before and after," but the chemist is, of all men, the one who is most in danger of being so impressed by the activity of to-day as to find little time for looking backward. Yet the greatest chemists, almost without exception, have been students of the history of the science and in many instances their historical reading has influenced strongly the direction and even the quality of their work. It is true that the best source of inspiration is the reading of the original documents, but well-ordered general accounts of the development of the science, or of particular parts of it, are indispensable aids in the larger task, even if they can not replace it entirely. The works before us present the historical side of chemistry in different ways, and, far from being competitors, they supplement one another admirably. Von Meyer's is the most complete, but the mention of many things in very brief. Ladenburg covers much the same period but takes only the salient points. Armitage is briefer still, more highly colored and more lively. Muir follows only certain lines in the development of the science, but in these lines is fuller than von Meyer. Finally, von Lippmann provides us with a series of intensely interesting studies. He deals with single points or with the work of a particular man, and his subjects are as often in physics, or even literature or philology, as in chemistry.

The first and second editions of von Meyer's "History" have already been reviewed in SCIENCE, and its breadth and accuracy of treatment, the fullness of its references to sources of historical information, and the simplicity and directness of its style are well known to every chemist. Since the appearance of the first German (1888) and English (1891) editions the science has been advancing with ever-increasing strides and it has been becoming more and more difficult to disentangle from an overwhelming mass of facts the leading ideas of which these facts are in some sense the fruit. The author has endeavored to recognize these advances by means of special histories of each branch of the science, which follow the main history. In these, after a brief résumé of the main connections with the earlier history, already discussed in detail, he endeavors to trace the growth down to the date of the present edition. In this he is surprisingly successful, when the herculean nature of the task is considered.

The translator has done his work creditably, and the changes he has made, with the sanction of the author, are all useful. It is a pity, however, that these did not include the substitution of a reference to A. S. Couper's paper in the *Philosophical Magazine*, for the two French ones given in the German edition. If so many of our works on chemistry had not been borrowed from Germany, more of us would have escaped errors like that of trying to give a French pronunciation to the name of a Scotsman born in Kirkintulloch!

Ladenburg's "Lectures," which have reached their fourth German edition, are familiar in Dobbin's admirable translation. The period which they cover begins, practically, with Lavoisier, and the seventeenth lecture, prepared for the fourth edition, brings the book up to date. Evidences of the care with which the other sixteen lectures have been revised may be seen in almost every page. The lectures furnish a clear and interesting panorama of the progress of chemistry and hold one's attention, without wearying it, from the first word to the last. While the work is not comparable with von Meyer's in size, yet, to the writer, the choice of material for illustration seems often to be happier. Perhaps no two chemists would make the same distribution of emphasis. But, in view of the theoretical and commercial importance of the work of Roberts Austen, von Jüptner, and Roozeboom on the allotropic forms of iron, for example, few would grudge the page which Ladenburg devotes to the matter, and hardly any chemist would side with von Meyer in ignoring these investigators and the subject entirely.

Armitage's "History" begins at the beginning, or perhaps even earlier. E. von Meyer starts with the Egyptians, but Armitage's opening sentence traces the science back to "the dawn of human intelligence." To make up for this unusual extension in one direction, the book stops rather unexpectedly with what the author might call the morning of the periodic system. Only a few pages, in an earlier chapter on stereo-chemistry, deal with anything later than this epoch. While the book is in some ways immature, it has distinct merits. Its vocabulary of breezy adverbs and adjectives, its rhetorical questions, and its semi-familiar way of interpreting the feelings, as well as the opinions, of the fathers of the science are an effectual antidote to the "dryness" which is apt to settle down on history.

> Berzelius, in reviewing the whole subject [of atomic weights], became oppressed with the unscientific, slapdash manner in which it had been approached by his contemporaries. Was there no general principle . . . which might guide one right in the choice of atomic weights from the many values submitted?

Quotations, brief and to the point, are introduced aptly, and the men are characterized successfully without waste of words. Taking it all in all, the book may be recommended to those who wish a brief and readable account of the men who have made chemistry, of how they made it, and of what they made it. It is too bad, however, that in a book by a Briton, poor Couper should be connected exclusively, and so explicitly, with a French journal, and should be made even more like a Frenchman than usual by an error in his initials—*M.* S. Couper!

Professor Muir's "History of Chemical Theories and Laws" does not profess to be a history of the whole science; to use the author's own words:

> The more I try to understand chemistry, the more I am convinced that the methods, achievements, and aims of the science can be realized only by him who has followed the gradual development of chemical ideas. . . . I have not attempted the uncalled for task of writing a history of chemistry. The object of this book is to set forth what seem to me the main lines along which the science of chemistry has advanced to its present position. . . . As the purpose of this book is to show how the main conceptions of chemistry have arisen, widened, strengthened, gained or lost ground, this purpose will be better served by taking changes in the general ideas of the science as the landmarks, than by arranging the history of the subject in chronological periods. . . . The development of chemical principles is regarded in this book from the position of to-day. The book is not an attempt to move through the past without knowing whereto the course of the science is tending.

It is, in a sense, therefore, a history of chemical philosophy, arranged so that one set of historically related conceptions after another is followed to its latest developments. The author's plan, of choosing certain lines, has the further advantage that his material is selected, and not, as in the general histories, in large measure thrust upon him by the mere fact of its existence. He is thus enabled to enlarge upon the topics and periods which interest him, and therefore to dwell upon them at such length that the interest of the reader has a chance to be thoroughly awakened also.

In the opening chapter, dealing with the ante-oxygen era, and in many places throughout the rest of the book, the author's well-known familiarity with and interest in the ideas of the alchemists and early chemists provide him with a fertile background and, later, aid him in maintaining the perspective as the work develops. The chemical reformation initiated by Lavoisier, with his recognition of the existence of distinct substances and their constitution as either elementary or compound, the work of Dalton, and the differentiation of atom and molecule, with all the history which is implied by these phrases, occupy three long chapters. Three briefer chapters dealing with the extension of Avogadro's hypothesis to dilute solutions, allotropy and the inert elements, together with an appendix on nomenclature, complete the first part of the book. This part (200 pages) deals, therefore, with the evolution of the conception of the substance and of all that is connoted by the terms atom and molecule.

The second and longer part deals with chemical interaction in the broadest sense of the term. The first section of this part treats, in six chapters, of the classification of substances by their chemical properties, molecular structure as an expression of chemical behavior, and the periodic system as the basis of a formulation of both physical and chemical behavior. It includes also a chapter on ionization in solution and electronic ionization, with a full account of J. J. Thomson's corpuscular hypothesis of the constitution and behavior of atoms. The second section of this part deals with the conditions and laws of chemical change. In one chapter chemical affinity from Newton to Van't Hoff is reviewed. In another, chemical equilibrium is brought down to Ostwald's Faraday Lecture. In the last chapter the relation between chemical and optical properties, from Biot to Perkin, and thermochemistry from Lavoisier to Clarke, are treated with considerable fullness.

As the author says, others might have made a different selection of material—one misses, for example, the work of Werner when valence is discussed—but the selection is on the whole excellent. The feeling of growth and organic inter-relation is kept admirably before the reader. The style is attractive and the mode of presentation lucid and interesting. The book is not only suggestive, but highly readable—there is not a dry page in it. It is not mere book-making, either. Every statement is based upon a careful study of the original literature, and the scholarship of the book is worthy of the author and of the university with which he is connected.

Von Lippmann's "Addresses and other Contributions to the History of the Natural Sciences" is undoubtedly, in many ways, the most interesting volume of the set. It is a reprint, with slight alterations, of thirty-two addresses and articles, written during the past fifteen years, by the versatile director of the sugar refinery of Halle. They are not fugitive papers, but profound historical studies, and their permanent value—evident enough to the reader—is shown by the frequency with which they are quoted by other writers, like von Meyer. They are perfect mines of information and entertainment, and the thanks of all interested in science, and of chemists in particular, is due to the author and publisher for issuing the studies thus, in collected form. The longer articles include systematic surveys of the chemical knowledge of Pliny and Dioskorides, a history of gunpowder and firearms, an abstract and critique of Goethe's "Farbenlehre," and an analysis of Leonardo da Vinci's many-sided attainments, as a man of science and mechanics. In another, the author makes a searching inquiry into Francis Bacon's writings and mode of life, with a view to determining the exact measure of the profound knowledge often attributed to him and, incidentally, to settle the question whether, if Shakespeare himself lacked the education and scholarship shown in the plays, Bacon was, as some believe, the one man of that time who obviously had the requisite qualities, and might therefore have been their author. Just as in the earlier essays the author's extensive reading in Latin, Greek and Mediæval literature fills the reader with astonishment, so here his familiarity with English literary, scientific and philosophical writings is amazing. He quotes, in passing, Harvey's remark, that Bacon wrote, not like a scientific man, but like a Lord Chancellor, and cites Carlyle, Whewell, Mill and dozens of others with bewildering appositeness. The author is undoubtedly the Andrew Lang of science. This article leads naturally to another containing a systematic account of the scientific knowledge found in the works of Shakespeare. The volume closes with a biographical and critical estimate of Descartes, and a similar account of Robert Mayer, his life, and the trials which he experienced in the promulgation of his views on energy.

The same wide knowledge of curious matters pertaining to science pervades the briefer articles, even the titles of which can not all be quoted. Saint Augustin on quicklime, the superstitions connected with the mandragora, the mystery of the "coasts of Bohemia" (Winter's tale), which is solved by a remark encountered while reading for his "History of Sugar," are all delightful. A note on Who introduced the experiment of burning of a watch spring in oxygen, shows that it was Jan Ingen-Housz (1730–1799), better known as the discoverer of the fact that plants breathe oxygen and generate carbonic acid, in addition to assimilating the latter as food. Amongst the other papers are interesting biographies of Marggraf and Achard, and a curious report on the profits which Edward Howard (brother of the Duke of Norfolk) derived from the invention of the vacuum evaporating apparatus. Several articles deal with subjects connected with sugar. But the author is more than a sugar-chemist and his book can be recommended most heartily to all who are interested in the history of science.

Alexander Smith
The University of Chicago

Die Zustandsgleichung der Gase und Flüssigkeiten und die Kontinuitätstheorie. Von Professor Dr. J. P. Kuenen in Leiden. Braunschweig, F. Vieweg und Sohn. 1907. Pp. x + 241.

Professor J. P. Kuenen, now at Leyden, and recently at University College, Dundee, is a man whose experience has peculiarly fitted him for the task of writing this book, as might be inferred from an examination of the book itself. The "equation of state" which was devised by J. D. van der Waals, of Amsterdam, in 1873, and which bears his name, is an equation which attempts to give in a compact form, the laws controlling the variations of volume, pressure and temperature of all gases, not only when they are far removed from the critical condition, but even at and near the critical point as well. It is usually written

$$(p + a/v^2)(v - b) = RT$$

where a, b and R are constants for any one gas, and p is the pressure, v the volume of unit mass, or specific volume, and T is the absolute temperature of the gas. This equation is a vast improvement over anything that preceded it, particularly the equation of so-called perfect or ideal gases, representing Boyle's and Charles's laws, and is a landmark in the history of physics, but it nevertheless does not represent the facts with complete success. It seems indeed as if it must always remain impossible to represent by one equation containing only a moderate number of constants, the complexity of real gases, for real gases are simple only when compared with liquids or solids, or when their complexities are overlooked, and we regard merely their most important characteristics. The equation has, however, been of marked service in showing the relation between different gases, and between various phenomena of gases, particularly those connected with their behavior when near the critical point, and when they depart most from the simple laws of ideal gases.

Professor Kuenen's book begins with a general statement of the phenomena attending the condensation of gases into liquids. He shows how the elementary kinetic theory of gases explains their behavior when far above the critical point. He then shows, following van der Waals, how this simple theory may be modified by a consideration of the finite size of the molecules of a gas and the forces of attraction which may exist between them. The equation of state having been obtained, it may be used to throw considerable light on the phenomena of condensation, conditions of unstable equilibrium, etc. Several chapters are devoted to what is perhaps the most important thing to be considered, the agreement between the equation and experimental facts. In these chapters are considered the law of corresponding states, critical constants, behavior at high pressure, saturation pressures, Joule-Kelvin researches, specific heats, etc.

The book also considers the various attempts that have been made to improve the equation of van der Waals, and the equations of state proposed by others. The last chapter gives the mathematical methods by which the equation of van der Waals may be deduced.

The book is a valuable monograph on the subject of which it treats and brings together a large amount of information that otherwise could be found only by a laborious search through journals. At the end of each chapter, and in footnotes, are given full references to the literature of the subject treated of in the chapter. At the end of the book there is an index of names but not of subjects. The need of a subject index is satisfied in part by a full table of contents in the front of the book. A book of this kind, however, has a valuable use as a reference book, and for such a use the lack of a good subject index is a serious shortcoming, which is felt keenly in proportion to the value of what the book contains. It is only a book to which no one wishes to refer that does not need a subject index.

W. S. D.

Plant Anatomy from the Standpoint of the Development and Functions of the Tissues and Handbook of Micro-technic. By W. C. Stevens. 8vo. Pp. xii + 349. With 136 illustrations. Philadelphia, P. Blakiston's Son & Co. 1907.

As is indicated by the title of this book, the standpoint adopted is the physiological one; in fact, the book might have been named Anatomical or Structural Physiology. The titles of many of the chapters indicate this, *e. g.,* Construction of the Plant's Food, Secretion and Excretion, and the general method of discussion is to describe the process, then the structures concerned. No doubt this is a useful standpoint, and the method of treatment is appropiiate, but it seems a pity that the bearing of anatomy on the great problems of morphology should be altogether ignored. Since the book is in no sense a work on comparative anatomy, we find no reference to the structure of fossil plants.

Within the scope of 217 pages the author gives a clear though necessarily brief and elementary account of the main processes and structures of the so-called vegetative parts of a higher plant. The first three chapters describe the development of the tissues from the undifferentiated cell, through the stages of meristem, primary structure and secondary growth. In the main the account is clear and accurate as far as it goes, and is much aided by the carefully executed and elaborate diagrams which illustrate such features as the primary and secondary structure of stems. The diagrams throughout the book are in fact one of its most noteworthy and valuable features. The description of vascular bundles may be adequate from the author's standpoint, but it seems strange to see no reference to protoxylem, nor figures of amphicribral and bicollateral bundles. Several well-chosen "illustrative studies" conclude each chapter.

Protection from Injuries and Loss of Water and The Plant Skeleton are next considered. The treatment here is too brief and incomplete to give the student an intelligent idea of the important ecological adaptations which might be discussed under these heads. Loss of water through stomata is not treated here, as one might expect, but is deferred to a later chapter.

The absorption, circulation and storage of water, gases and foods are the topics discussed in chapters VI. to XI. By means of numerous ingenious diagrams the leading facts are presented in so lucid a way that he who runs may read. A possible exception to this statement may be found in Fig. 94, in which the perspective is faulty. Moreover, it may be questioned whether this diagram as well as some others does not try to show too much. Owing to the standpoint of the book we might expect to find under the heading of circulatory tissues some reference to Strasburger's brilliant discovery of the substitutes for companion cells in the phloem of *Pinus,* but instead of this we find the erroneous statement (p. 162): "In gymnosperms and vascular cryptogams the companion cells do not occur, and their place is taken by vertical rows of parenchyma cells." A series of illustrative studies concludes each chapter of this section.

A chapter on Secretion and Excretion concludes the descriptive part of the book. In this as in other chapters extensive use is made of the classic work of Haberlandt.

The remaining 125 pages are devoted to the subject of technique and the micro-chemistry of plant products, added to which is an introduction to the study of adulterations in foods and drugs. The section on technique contains concise and clear directions for fixing, imbedding and staining, but unfortunately can not be regarded as up to date in all respects. Celloidin is undoubtedly the best imbedding material for the very tissues studied in this book, yet the author says "celloidin is to be looked upon as a last resort in a difficult situation." He says, moreover, "It is difficult to get sections as thin as ten mikrons." These statements can be easily accounted for by the celloidin method which he advocates and which has been greatly improved by Jeffrey. The method of applying the hematoxylin-safranin stain described on page 235 would be made more manageable by using the hematoxylin first, and improved by substituting Ehrlich's for Delafield's hematoxylin.

The chapter on reagents contains some useful recipes, and the directions are concise and to the point. A few inaccuracies occur, *e. g.*, on page 257 "vapor of sulphuric acid" evidently means sulphur dioxide. Further, it is not necessary to ripen aqueous solution of hematoxylin for two months, as stated on page 233.

In a general way the book has much to commend it. The freedom from typographical errors is agreeable ("gram" is printed "grain" on page 227), the typography is excellent, and the large number of new figures is refreshing. In this connection it is unfortunate that Vines's poor figure of a root should have been copied for Fig. 26. Reference has already been made to the diagrams, which are a distinct feature of the book. An index is provided, but the only hint of a bibliography is in the preface. A few terms of doubtful utility have been introduced, *e. g.*, the borrowing of the German word "Borke," and the use of "fixative" for fixing fluid.

To those who consider anatomy as an adjunct of physiology rather than the handmaid of phylogeny the book will form a valuable text for class use, and to all working botanists the book may well find a place on the laboratory shelf.

M. A. Chrysler

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for December contains "Preliminary Notes on Some American Chalicotheres," by O. A. Peterson, based on some fine specimens of *Moropus elatus* in the Carnegie Museum. The author concludes that *Moropus* is essentially a perissodactyl, save in its unguiculate feet, and that the evidence points to an European ancestry. Charles R. Stockhard presents some "Observations on the Natural History of *Polyodon spathula*." The fish has become of considerable importance for food and will probably soon be greatly reduced in numbers. It is fished for with seines running up to one and two miles in length, and on one occasion more than 150 barrels were taken at a single haul. C. H. Eigenmann reviews "Fowler's 'Heterognathous Fishes' with a Note on the Stethaprioninæ," noting that while certain genera and species have been well established new names have been added that in many instances are synonyms. William M. Wheeler discusses "Pink Insect Mutants," considering that they, as well as many brown individuals, are simply sports and belong in the same category as albinos.

Bird Lore for January-February contains articles on the "American Dipper in Colorado," by Junius Henderson; the Canada jay, "The Bird that Nests in the Snow," S. S. Stansell; "Redpoll Linnets," by Lottie A. Lacey; the second paper on "The Migration of Flycatchers," by W. W. Cooke, accompanied by a fine colored plate. There is a list of the members of "Bird Lore's Advisory Council," and "The Eighth Christmas Bird Census," representing the work of a large number of observers from Maine to Oregon, though mainly in the eastern states. In general birds are reported as scarce. The Audubon leaflet is devoted to the snowflake and it is noted that a patrol boat has been placed on Lake Klamath, Oregon.

The American Museum Journal for February records the receipt of two specimens of the rare Haitian *Solenodon*, heretofore known from a single specimen sent to St. Petersburg in 1833. It is stated that only five specimens of the Cuban *Solenodon* have found their way to museums, but are there not more than this? There are notes on "An Archeological Reconnaissance in Wyoming" and on new or rare minerals added to the collection.

The Bulletin of the Charleston Museum for January contains the report of the director for 1907, which states that the main changes in the new museum building are nearly completed. An appeal is made for more funds, which are very much needed, not merely for the extension of work, but for the proper care and exhibition of material already in hand.

The Museum News of the Brooklyn Institute for February has articles on "Insects and Arachnids as Carriers of Disease," "Zuni Weapons and Hunting the Matamata." It notes the acquisition of the collection of shells made by the late Charles A. Dayton, which comprises 3,700 species. This with collections already received gives this museum an unusually fine series of mollusks. It is noted that the library has been moved to larger quarters in the new wing recently opened.

The *Plant World* for February opens with an article by Dr. G. H. Shull on the aims and methods of pedigree-cultures, in which a detailed description is given of the technique of pure-bred and sterilized cultures. The authors of various criticisms upon this method of study of heredity will be surprised to learn that such cultures not only do not isolate the species being tested, but bring numbers of nearly related forms into close proximity under conditions which permit their inter-reactions to be exactly estimated. Dr. D. T. MacDougal discusses the principal features of the problems in genetics and botany which may be attacked with greatest hope of success in the desert and the use of xerophytic forms. The structural and physiological relations of forms known as adaptations are being taken up basally at the Desert Laboratory and its mountain stations.

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 643d meeting of the society was held at Hubbard Memorial Hall on January 18, 1908, President Bauer in the chair. The meeting was devoted exclusively to hearing addresses commemorative of the life and labors of the late Lord Kelvin.

The first paper of the evening was entitled "Lord Kelvin, His Life and Works," delivered by invitation, by Professor Arthur G. Webster, of Worcester, Mass.

Dr. R. S. Woodward spoke of "Lord Kelvin's Contributions to Geophysics."

Professor Simon Newcomb told of "Lord Kelvin's Character and Personality."

By invitation, his excellency the British ambassador, Mr. James Bryce, favored the meeting with an interesting sketch of Lord Kelvin's life, bearing testimony to the simplicity of Lord Kelvin's character and the greatness of his wonderful mind.

The full text of the foregoing addresses are soon to be published as a part of *Bulletin* XV. of the Philosophical Society of Washington.

The 644th meeting was held on February 1, 1908.

Professor C. F. Marvin gave a description of "A Universal Seismograph for Horizontal Motion," recently designed by him at the U. S. Weather Bureau. A full description of this instrument, prepared by Professor Marvin, is soon to appear in the *Monthly Weather Review*.

The second paper of the evening was presented by Professor Frank H. Bigelow upon "Relations of the Temperatures of the United States to Solar Radiation."

The natural synchronism between the variable action of the solar radiation and the terrestrial temperatures may be missed in an investigation in three ways: (1) The use of non-homogeneous data at the sun and at the earth, (2) the application of analytic methods based on perfect periods for the solar variations which are only roughly periodic, (3) the omission to consider the important effects of atmospheric circulation upon the observed temperatures. The temperatures of the United States are very indirect functions of the solar radiation, depending upon transported heat more than upon direct radiation. Many years have been consumed in securing homogeneous data, but we now possess tables covering the interval from 1872 to 1905 for the solar prominence frequencies, the European horizontal magnetic force, the temperatures, vapor pressures and barometric pressures of the United States, comprising more than one hundred stations. The monthly means were in all cases computed from the daily values reduced to homogeneous conditions for the interval. This paper refers only to the variations of the annual means of the several elements, and these are separated into two portions by eliminating the short period ordinates of about three years from the long period ordinates of about eleven years. The result is approximately as follows: Referring to an earlier paper, it was shown there that the temperatures in the tropics vary directly, but in the temperate zones inversely, with the solar prominence frequencies, and that the pressures of the eastern hemisphere vary directly, but of the western hemisphere inversely, as a general rule. In this paper it is shown that these rules hold good in the United States, with certain local modifications due to the general circulation of the atmosphere. In the Pacific states the synchronism of the temperatures is direct, while east of the Rocky Mountains it is inverse. The eleven-year period is well defined in the Pacific States, but is nearly wiped out by the circulation east of the mountains. The three-year period persists in each district, but a partial inversion and a lag of a few months is indicated east of the Rocky Mountains. These and other similar results are the direct products of circulation, since the California district is really a part of the system of the tropics, because the high-pressure belt crosses the United States from Florida to Oregon, and thence passes southwestward. These inversions are naturally connected with the general circulation. An increase in solar radiation, inferred from an increase in the number of the solar prominences and the strength of the magnetic field, causes increase of temperature and circulation in the tropic zone, but a decrease of the temperature in the middle latitudes because the *return* currents from the polar zones bring an excess of cold high areas into the United States. The temperature for a given year in a given locality is due to the transported heat primarily, which rather remotely depends upon the prevailing radiation. Aside from the great difficulty of securing homogeneous tables of the solar radiation by observations with the pyrheliometer, on account of the difficulty of eliminating the local absorptions due to the meteorological conditions of the atmosphere above the station, it is yet more difficult to make allowances for the effect of circulation. The statistical method of recording the facts must be pursued without interruption for many years, and then this historical record will gradually build up laws which will have a practical value in seasonal forecasts. The U. S. Weather Bureau now possesses a set of homogeneous records covering one third of a century, and all its observations are now made so as to continue these synchronous data in a perfectly automatic manner.

R. L. Faris,
Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

At the twenty-fourth annual meeting of the Washington Section of the American Chemical Society, held at the Cosmos Club, Thursday, January 9, the following papers were read: "The Detection of Thickeners in Ice-cream," by Professor G. E. Patrick, and "The Three Component System CuO, SO_3, H_2O," by J. M. Bell and W. C. Tabor.

The following officers were elected:

President—Joseph S. Chamberlain.
First Vice-president—P. H. Walker.
Second Vice-president—G. H. Failyer.
Secretary—J. A. LeClerc.
Treasurer—F. P. Dewey.

The executive committee consists of the officers and the following gentlemen, who were also elected: E. T. Allen, A. Seidell, E. A. Hill and S. S. Voorhees.

W. W. Skinner was appointed chairman of the committee on communications.

J. A. LeClerc,
Secretary

DISCUSSION AND CORRESPONDENCE

IS ALABAMORNIS A BIRD?

A little more than a year ago Dr. Abel published a brief paper, taking the ground that the bones described by me in 1900 as the pelvic girdle of *Zeuglodon* were really the coracoids of a gigantic bird, possibly allied to *Gastornis* and, distantly, to *Anthropornis*. In reviewing this paper I said that it "seemed so clear and convincing that this conclusion was at once accepted, . . . but it became evident that if they (the bones) were the coracoids of a bird, that bird was extraordinary, if not exceptional in many particulars"; it was therefore decided to say nothing more until the bones could be reexamined. It has been impossible for me to do this, but Mr. C. W. Gilmore has kindly examined them for me and corroborated my remembrance of certain details. It is rather difficult to discuss the question without figures, but a description of the bones taken by me for ossa innominata must suffice for the present. One is perfect, save for the loss of a few millimeters on one process; the other has lost the posterior, or proximal, end if it is a coracoid, but the anterior end is perfect, which in this case is an all-important fact. Close by the anterior end is a good-sized cavity, precisely like an acetabulum, and this is *the only articular surface* present; what Dr. Abel considers the glenoid fossa is simply a notch, *not* an articulation. The length of the complete bone is 245 mm., 9⅝ in., and the bones are flattened, but not crushed or distorted.

If we adopt Dr. Abel's view that the bone is a coracoid we are confronted with the following extraordinary conditions: the precoracoid process is longer than the acrocoracoid, Dr. Abel's processus furcularis, and the acrocoracoid aborted, being reduced to a low, rounded mass of bone, without articular faces of any kind. The articulation of the scapula with the coracoid would be by means of a ball-and-socket joint and, were a humerus present, it would rest against the anterior end of the coracoid, with nothing in advance of the shoulder joint. For, it must be repeated, the anterior end of the bone, be it pelvis or coracoid, is absolutely complete, save a chip off the point of the "precoracoid"; it was never any longer. Then, too, the proximal end of the alleged coracoid is thin and narrow, whereas the coracoid in all other birds, and particularly in flightless birds, is expanded where it articulates with the sternum. Finally the texture of the bone is dense and not bird-like.

If the bones are the coracoids of a bird they represent a type of shoulder girdle entirely different from any with which we are at present acquainted, and the bird from which they come not only belongs to a new species and genus, but to a new order or superorder.

There is not the slightest resemblance between the bone named by Dr. Abel *Alabamornis* and the coracoid of *Anthropornis* which is a perfectly normal avian coracoid; nor is there any resemblance between it and the coracoid of *Gastornis,* which is long and slender, the only peculiarity being that it belongs to a degenerate shoulder girdle and its characters are not sharply defined.

Dr. Abel's surmise that *Diatryma* and *Alabamornis* may be one and the same is best answered by noting that not only are the bones separated by many hundred miles of space, but that one comes from the Lower Eocene, Wasatch, the other from the Upper Eocene, Jacksonian. Now, I will not insist that the bones under discussion represent the pelvis of zeuglodon nor deny that they are the coracoids of a bird; I will simply say that it seems to me doubtful that this last ascription is correct and wait for further discoveries to throw more light on the problem. F. A. Lucas

CLADODUS COMPRESSUS, A CORRECTION

In the Thirtieth Annual Report of the Indiana Department of Geology and Natural Resources, page 1378, I named a new species of Cladodontidæ *Cladodus striatus*. As the name *striatus* was preoccupied, having been applied by Agassiz to a species of *Cladodus* from the Devonian, I suggest that the new species be named *Cladodus compressus*. The following is the original description.

Cladodus compressus

Teeth of medium size, base of type specimen 14 mm. wide by about 5 mm. long, tooth broader than high. Outline of base subelliptical, extremities subangular, posterior border with stronger convexity than anterior; under surface smooth, upper surface with a narrow furrow just behind the cones running parallel with the posterior margin of the base, a strong ridge between this furrow and the posterior margin. Middle cone low, broad and thin near base, twice as broad as thick, with sharp cutting edges; outer lateral denticles broad, thin, and very low, one third to one fourth height of median cone; between lateral denticles and median cone a high narrow ridge that bears two minute denticles on one side of the median cone but none on the other side in the type specimen; median cone and lateral denticles all marked with almost vertical, narrow, sharp-crested ridges; spaces between ridges about twice as broad as ridges.

C. compressus differs from *C. euglyphæus*, the nearest allied species, in its much larger size, much greater breadth of median cone, greater breadth and less height of outer lateral denticles, smaller number of lateral denticles, high ridge between outer denticles and main cone, and in the greater approximation of the ridges on the teeth.

Formation and Locality—Salem limestone, Paynter's Hill, Ind.

Type specimen No. 7709—1 American Museum of Natural History.

E. B. Branson

Geological Department,
Oberlin College

THE TERM "THERM"

To the Editor of Science: I have noted in the recent issues of Science discussions in regard to the use of the term "Therm" as a simple way of expressing 1 million gram calories.

While this old term used in a new sense may simplify an expression, it, however, to my mind makes it more complicated as far as its actual meaning is concerned.

The trend to-day in all scientific matters, and primarily it is the object of research, is to bring all phenomena and facts down to a common basis of understanding so that as far as possible one can tell at a glance what the subject is about.

The arbitrary use of a term without the sanction or adoption by the majority of persons or countries engaged in research of the kind to which the term is to be applied, tends more to confuse than to simplify matters.

I am heartily in accord with the suggestion for the term kilo-calorie, mega-calorie, etc., made by A. T. Jones in Science of January 3, 1908.

Lewis W. Fetzer

Maryland Agricultural
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SPECIAL ARTICLES

NOTES ON THE OCCURRENCE OF THE RECENTLY DESCRIBED GEM MINERAL, BENITOITE

During the course of the writer's investigations in the Coalinga oil field, Fresno County, California, the past summer, he was accorded the opportunity of examining the mine from which the new gem mineral, benitoite, is obtained. At the time Dr. Louderback[1] described the mineral, he had examined only a limited amount of material and had had no opportunity of visiting the type locality. The following notes on the field relations of the gem are therefore offered as an addendum to his paper. The writer wishes to extend his thanks to the owners of the mine, Messrs. R. H. Dallas and L. B. Hawkins, the latter one of the discoverers of the mineral, for permission to visit the mine, for the gift of a representative series of specimens, and for other courtesies.

Benitoite, according to Louderback and

[1] "Benitoite, a New California Gem Mineral," by George Davis Louderback, with chemical analyses by Walter C. Blasdale: *Bull. Dept. Geol., Univ. Calif.*, Vol. V., No. 9, pp. 149–153, July, 1907.

Blasdale's determination is a very acid titano-silicate of barium possessing the following properties: It varies in color from dark blue through light blue to colorless, this property having led to the original belief that the gem was sapphire. The pleochroism is very marked, the ordinary ray being colorless, while the extraordinary is blue, with a violet tint when intense. The absorption is $e > 0$. The refractive indices are high, $0 = 1.77$, $e = 1.80$, in sodium light. The double refraction is therefore very strong and the mineral optically positive. Benitoite crystallizes in the hexagonal system, trigonal division, the most common habit being pyramidal. The individual crystals are usually less than a centimeter in maximum diameter, although they occasionally attain a size of 2.5 centimeters (one inch). The hardness is 6¼ to 6½, or below quartz; the density is 3.64 to 3.65. The mineral fuses at about 3, is almost insoluble in hydrochloric acid, quite easily attacked by hydrofluoric acid, and dissolves readily in fused sodium carbonate. Associated with the benitoite is a black or brownish-black prismatic mineral which Dr. Louderback believes to be new, and to which he has given the name carlosite.[2]

Benitoite and carlosite occur as individual crystals associated with veins or geodes of a white zeolite (which Mr. W. T. Schaller has identified as natrolite), in a great schist lens, enclosed by one of the largest areas of serpentine found in the Coast Range of California. This serpentine mass occupies five or six miles of the crest of the ridge north of White Creek in the western part of Fresno County, twenty-five miles northwest of Coalinga, and extends northwestward at least four or five miles into San Benito County. Many irregular lenses and masses of schist and several kinds of more or less basic igneous rocks are associated with the serpentine. The particular schist lens containing the gem mineral cuts through a low hill of serpentine at the bend in one of the headwaters of the San Benito River. The lens is about 150 feet wide at its widest part, at least 1,200 feet long, strikes about N. 70° W. and appears to dip N. 20° E. at angles varying from 70° to 80°. The relations are best studied in the shallow cuts, which comprise the present development works, and which are confined largely to the middle of the southeastern portion of the lens.

The country rock of the gem-bearing natrolite veins is a schist containing glaucophane, and varying in color from dark greenish gray to a rather light blue. Near the lower or southwestern contact with the serpentine (the latter being soft, light-colored and containing numerous thin, flaky asbestos veins) the schist is dark greenish, fine-grained, and breaks with a sharp-edged angular fracture. It contains veins up to three eighths of an inch in thickness, of a light greenish mineral, resembling chlorite, which can be scratched with a knife. The joint faces are coated with thin films having the characteristics of manganese oxide. A peculiar-looking mineral, somewhat resembling iron pyrites in appearance, but quite soft, occurs sparingly in thin veins throughout this part of the lens. Some faint copper stains were also noted at one place. In the immediate vicinity of the gem-bearing veins toward the middle of the schist area the rock is blue, has been considerably altered, probably by the waters carrying the vein and gem-forming materials, and breaks with a fine, granular fracture exposing component crystals discernible with the unaided eye. The schist adjacent to the veins is often largely replaced by natrolite. The planes of schistosity are more plainly visible in the bluer variety, which is apparently the richer in glaucophane. Where extremely weathered and wet the altered schist has the appearance and feel of a tough blue clay. Weathered surfaces of the schist are rough, sometimes being covered by mammilliform nodes. This nodular occurrence is also encountered below the surface in the more weathered and porous portions of the rock. The color of the weathered surfaces is bluish gray to reddish brown, the latter due to iron oxide. The schist usually weathers faster than the natrolite or benitoite and seems to have been protected over those areas which once formed the wall or is at present covered with the remains of a natrolite vein. On one

[2] *Op. cit.*, p. 153.

exposed rock surface about 2½ by 4 feet were over 200 more or less imperfect benitoite crystals, amid thin patches of remaining natrolite, the whole standing out prominently from the surrounding rough and unprotected surface of the schist.

The altered portions of the schist are full of cracks and cavities, varying in size up to two or three inches in width, and having a rough orientation parallel to the planes of schistosity. The cavities are for the most part filled with natrolite, with which benitoite or carlosite or both are often associated. The natrolite is not always accompanied by benitoite and carlosite, but in no instance noted did the benitoite occur without the natrolite and in only a few cases was the carlosite found alone. A soft dark brown mineral substance, resembling cadmium oxide, is also sometimes associated with the natrolite. It is not uncommon to find the cavities only partially filled, in which case the occurrence resembles a geode, the crystals of the natrolite (sometimes associated with benitoite and carlosite) forming the inner surface. The natrolite in such cases is usually coated with a brownish or brownish-yellow stain, or is covered by an intricate mass of microscopic, needle-like crystals of a peculiar greenish-drab color.

As a usual thing the benitoite and carlosite are in contact with the country rock, the carlosite sometimes having one extremity buried in it, while the remainder of the crystal extends into the natrolite. One instance was noted where a long slender carlosite crystal extended across a vein of natrolite with an extremity penetrating the schist on either side. The facts above noted imply the crystallization of the benitoite and carlosite previous to the complete deposition of the natrolite. Isolated crystals of the benitoite and carlosite are not rare in masses of natrolite, however, so that possibly the crystallization of the three minerals was practically contemporaneous, at least in certain instances. In some cases the benitoite appears to be entirely surrounded by the schist, but a close examination usually reveals a thin film of natrolite between the former and the country rock. In the places where the carlosite occurs alone or associated with only minor quantities of natrolite, the carlosite is in the form of thin veins, the crystals being imperfect and forming a series of thin plates or flakes. Close associations of the benitoite and carlosite are not uncommon and indicate contemporaneity of origin for the two minerals. No alteration of the natrolite or benitoite was noticed, but red stains resembling iron oxide were seen emanating from around several of the carlosite crystals. Mr. Schaller has called the writer's attention to the fact that minute fragments of the carlosite also show a brick-red color, so that the coloring around the crystals may be due to fine particles of the unaltered mineral.

Development work has so far been confined to near the middle of the schist lens, and consists of a tunnel and several open cuts following the strike of the schist. The tunnel is 50 feet long and the largest cut 10 feet deep, 4 feet wide and 14 feet long. The gems are secured either by pounding up the richer portions of the matrix and then picking out the few crystals or fragments that have withstood the shock, or else chiseling out the larger individual crystals at the expense of the smaller surrounding ones. Only a small percentage of the gems are saved by either method, as the crystals are very brittle and usually considerably jointed and cracked. The present value of the cut stones is said to be $40 per carat.

Ralph Arnold

Coalinga, California,
September, 1907

NOTES ON ORGANIC CHEMISTRY

KETEN

A number of derivatives of ketene have been known for some time and the announcement has just been made of the preparation of the parent compound.[1] This substance is of great interest because it is the simplest member of the highly important class of ketones and, moreover, it is the simplest anhydride of acetic acid. Its mode of formation and reactions show that its formula is $H_2C:CO$, *i. e.*, it is *methylene ketone;* the

[1] N. G. M. Wilsmore, *Jour. Chem. Soc.* (London), **91**, 1938 (1907).

relationship to acetic acid may be indicated by the expression,

$$H\,CH_2CO\,OH$$

Ketene is prepared by bringing liquid acetone, ethyl acetate, or, preferably, acetic anhydride into contact with a glowing platinum spiral; instead of the spiral an arc burning between carbon or metallic poles may be employed. The gaseous products of the reaction are passed through a condenser and then cooled to — 100° in liquid air. Ketene is a colorless gas at the ordinary temperature, but it may be liquefied and frozen, and it has a peculiar penetrating odor. Its molecular weight agrees with the simple formula given above, but the substance undergoes polymerization rather readily, as would be expected. Ketene does not react with *dry* oxygen, but it quickly combines with water forming acetic acid; with alcohols it gives the corresponding acetates. Moreover, it is an admirable acetylating agent. With aniline, for example, it yields pure acetanilide directly, and similar compounds are obtained with other primary amines. These reactions demonstrate the correctness of the formula for ketene given above. The further investigation of this interesting substance should yield results of decided value.

J. BISHOP TINGLE

MCMASTER UNIVERSITY

THE BALLONS-SONDES AT ST. LOUIS

A FINAL series of ascensions of *ballons-sondes,* or registration balloons, at St. Louis was completed in November, 1907, by Mr. S. P. Fergusson, of the Blue Hill Observatory, under the direction of the writer. These experiments to obtain the meteorological conditions at great heights in America were begun in 1904, with the cooperation of the authorities of the Louisiana Purchase Exposition, as related in SCIENCE, Vol. XXI., pages 76–77, and were continued during subsequent years with the assistance of grants from the Hodgkins Fund of the Smithsonian Institution. Seventy-six balloons have been despatched and all but six have been recovered with the attached instruments, while there is the possibility of the number lost being further reduced by the finding of three of those sent up last autumn. The preliminary results of the earlier ascensions are given by the writer in the *Proceedings of the American Academy of Arts and Sciences,* Vol. XLI., No. 14, and are discussed by Mr. H. H. Clayton in *Beiträge zur Physik der freien Atmosphäre,* Band 2, Heft 2. The object of the recent ascensions, twenty-one in number, was to supply data for the high atmosphere during the autumn, a season when there were few observations, and also to compare with those obtained simultaneously in Europe on the international term-days in October and November. The work at St. Louis at the time of the international balloon race was facilitated by the cooperation of the Aero Club of St. Louis. An examination of the record sheets recently returned indicates generally the presence, at an altitude exceeding eight miles, of the isothermal, or relatively warm stratum, which was found somewhat lower in summer. For example, on October 8 the minimum temperature of — 90° Fahrenheit was found at a height of 47,600 feet, whereas at the extreme altitude reached, namely 54,100 feet, the temperature had risen to — 72°. Similarly, on October 10, the lowest temperature of — 80° occurred at 39,700 feet while — 69° was recorded at 49,200 feet, the limit of this ascension, showing that the temperature-inversion had come down about 8,000 feet in two days. The prevailing drift of the balloons last autumn was from the northwest, whereas in previous years they traveled more from the west.

Professor Moore, chief of the United States Weather Bureau, announces that, in view of the success achieved by the Blue Hill experiments, he will send up *ballons-sondes* simultaneously from various stations.

A. LAWRENCE ROTCH

BLUE HILL METEOROLOGICAL OBSERVATORY,
January 9, 1908

CARL VON VOIT

FROM Munich announcement is made of the death of Carl von Voit in the seventy-seventh year of his age. Voit was born at a time when his native land was poor and when there were no such palaces of learning nor such armies of students as now characterize university life in Germany. His doctor's thesis presented in 1856 was upon the subject "Contributions to the Circulation of Nitrogen in the Animal Organism." In 1860 Voit was made professor extraordinarius in physiology, and in 1863, at the age of thirty-two, was created professor ordinarius and conservator of the physiological institute at Munich, positions which he held until his death.

At the age of twenty-six Voit had demonstrated that the nitrogen in the excreta of an animal could be used as a measure of the animal's proteid metabolism. At the age of thirty-five (1866) his ideas had led to the construction of the Pettenkofer respiration apparatus, and with Pettenkofer he had determined the amount of metabolism in a healthy person on various diets, during fasting and during work, and also the metabolism in patients suffering from diabetes and leukæmia. These experiments established once for all the principles of nutrition upon a scientific basis. Waves of criticism have broken upon them and left them untouched. Then in his afterlife more and more details upon the subject were given to the world. These are to be found throughout the fifty volumes of the *Zeitschrift für Biologie,* of which he was one of the founders. He said last summer: "If I spent my time answering those publications which are only rediscoveries of what I have already shown, I would have nothing else to do."

Voit was always keenly interested in his lectures and his teaching. His joy at a new discovery by any one in his laboratory was inspiring to all who worked there. He was conscientious in every relation in life. An assistant once addressed some flattering remarks to him and received the sharp rejoinder "Es macht nichts *wer* Recht hat, nur dass die Wahrheit herauskommt."

The clinicians Friedrich Müller, F. Moritz, and a son Fritz Voit received their early scientific training in Voit's laboratory, and have carried this knowledge to a wide scope of usefulness in clinical medicine.

Of the physiologists and hygienists who have belonged to the "Munich school" of Voit may be mentioned Rubner, Lindemann, Straub, Ellinger, Otto Frank, Erwin Voit, Prausnitz, Max Gruber, Cremer, Weinland, Heilner, Atwater and Yandell Henderson.

In the midst of conflict among others concerning his views Voit was always calm, and assumed a waiting attitude, trusting to time for his justification. He deprecated hurried publication of results. His last article gave to the world work accomplished seventeen years before.

Voit was honored as among the highest in his own land, but he would have been a great man in any country. He was one of those spirits whose lives are the heritage of mankind. It only requires knowledge of his work to realize that his fame will grow greater as the years pass by.

Graham Lusk

SCIENTIFIC NOTES AND NEWS

The council of the senate of Cambridge University has reported the opinion that the university should hold a Darwin celebration in the course of the year 1909. The senate is reminded that Charles Darwin was born on February 12, 1809; and that "The Origin of Species" was published on November 24, 1859. The one hundredth anniversary of the former event and the fiftieth anniversary of the latter will, therefore, fall in the course of the year 1909. The council does not think it advisable, so long beforehand, to enter into any details; but suggests that representatives of universities and other learned bodies, together with distinguished individuals, should receive invitations to visit the university on the occasion. Should this report be confirmed by the senate, the council will appoint a committee to consider the details of the proposed celebration. The week beginning June 20, 1909, appears to the council to be the most suitable time for the celebration.

Dr. Robert Koch, the eminent German bacteriologist, expects to visit this country during the spring of the present year. He proposes to rest for a year from his scientific work and has refused all invitations to lecture while in the United States.

President Judson closes his last quarterly statement of the condition of the University of Chicago with the following words:

During the current quarter the university has been honored in the person of one of its faculty in recognition of brilliant work of investigation and discovery in the department of physics. Professor A. A. Michelson, head of that department, was awarded the Copley medal by the Royal Society of London. Only one American heretofore, Professor Newcomb, of Washington, has received that medal.

While Professor Michelson was on the ocean on his way to receive this distinguished honor, the official award of the Nobel prizes by the Royal Society of Sweden was announced. Among the awards was one to Professor A. A. Michelson for his discoveries in the measurement and analysis of light. Professor Michelson was obliged to continue his trip from London to Stockholm in order to receive this new and striking evidence of the importance of his tireless and brilliant scientific work. Such recognition of the results of scientific investigation is a renewed incentive to research in all fields of university activity. We, Mr. Michelson's colleagues, unite in felicitations to that modest gentlemen, and, on his return to his home, we hope to extend our greeting and congratulations in a more tangible form.

The sixty-first birthday of Mr. Thomas A. Edison was celebrated by a dinner, given by the heads of the departments of his laboratory, on February 11.

The former students and friends of Dudley Allen Sargent, A.M., Sc.D., M.D., director of the Hemenway Gymnasium, Harvard University, have presented him with a bronze medallion. The medallion, designed by Dr. R. Tait McKenzie, has above the face of Dr. Sargent the words "Dudley Allen Sargent, Pioneer in Physical Education, 1907," while on the reverse is a row of five Harvard seals below the words, "A Recognition by his Friends and Students." Two hundred and thirty persons contributed to the medallion fund. A plaster model of the medallion and a bound volume containing the autographs of the contributors to the fund were presented to Dr. Sargent by Dr. Luther Halsey Gulick at the twenty-fifth commencement of the Sargent Normal School of Physical Training, held in Sanders Theater, June 1, nineteen hundred and seven. The bronze medallion was finished recently and presented to Dr. Sargent. The Sargent Medallion Committee is having struck a limited number of copies of the medal. These are to be presented to President Roosevelt, William Taft, Secretary of War, Major General Bell, Curtis Guild, Governor of Massachusetts, and Booker T. Washington, who were all students under Dr. Sargent.

The occupation of the Smithsonian table in the Naples Zoological Station has been approved for three months from January 9, 1909, on behalf of Dr. Charles A. Kofoid, associate professor of histology and embryology in the University of California.

Dr. E. B. Rosa, physicist, of the Bureau of Standards, has sailed for Europe, where he will spend three or four months in a study of methods for harmonizing standards of light in the gas and electric industries.

W. O. Crosby, emeritus professor of geology of the Massachusetts Institute of Technology, has returned from Alaska, where he has been engaged in private work since August. He returned by way of Panama in order to see the recent progress on the canal. He is now engaged in work for the New York Metropolitan Water Board.

Mr. C. William Beebe, curator of birds in the New York Zoological Park, will sail with Mrs. Beebe on February 20 for Georgetown, British Guiana, for the purpose of spending five weeks in the exploration of some definite section of the Essequibo River. The object will be primarily the study of the rich avifauna of that region under natural conditions, its general aspects and its relations to other classes of the fauna.

Professor George D. Olds, of Amherst College, is to attend the International Congress of Mathematicians to be held in Rome from April 5 to 11.

Dr. Forrest Shreve, associate professor of botany in the Woman's College of Baltimore, has accepted an appointment to the staff of the Desert Botanical Laboratory of the Carnegie Institution at Tucson, Arizona.

Dr. R. B. Sosman, of the Massachusetts Institute of Technology, formerly connected with the research laboratory of physical chemistry, who received the doctor's degree from the institute last June and who has been for the past year in the office of A. D. Little, of Boston, has accepted a position at the Geophysical Laboratory of the Carnegie Institution in Washington.

Mr. C. V. Hartman, curator of the ethnological section at the Carnegie Museum in Pittsburg, has received the call to a similar position at the ethnological department of the Riks-museum in Stockholm.

Chum Zen Chan, a graduate of the College of Agriculture of the University of California with the class of 1907, has been made director of the agricultural experiment station at Mukden, Manchuria.

At the annual general meeting of the British Institution of Mechanical Engineers on February 21 the usual council prizes offered for the best papers read before the Graduates' Association during the preceding session were awarded to Mr. H. H. Broughton for his paper "Notes on the design and equipment of electric traveling cranes," and to Mr. A. B. E. Cheeseman for his paper on "Portland cement and the machinery used in its manufacture."

The second lecture of a series supported by a bequest of James Hamilton to the Smithsonian Institution, known as the Hamilton lectures, will be delivered April 22, at the time of the annual meeting of the National Academy of Sciences in Washington, by Professor George E. Hale, director of the Mount Wilson Solar Observatory, California, on "Some Recent Advances in Our Knowledge of the Sun." The first use of this fund, with accumulated interest, was made in 1905, when Dr. Andrew D. White delivered a lecture on "The Diplomatic Service of the United States with Some Hints toward its Reform."

Dr. E. B. Titchener, Sage professor of psychology at Cornell University and non-resident professor of psychology at Columbia University for the current year, began on February 17, at Columbia University, a course of eight lectures on "The Elementary Psychology of Feeling and Attention."

Dr. L. O. Howard, chief of the Bureau of Entomology, lectured, on February 17, before the New York Academy of Sciences on "Some Recent Discoveries in Insect Parasitism, and the Practical Handling of Parasites." One of the features of the lecture was the description of studies upon, and results as to, exterminating the gypsy moth. The lecture was secured through cooperation with the New York and Brooklyn Entomological Societies.

The seventh lecture in the Harvey Society course will be delivered by Professor Otto Folin, of the Harvard Medical School at the New York Academy of Medicine on Saturday, February 22, at 8:30 p.m., on "Problems of Chemistry in Hospital Practise."

Professor A. Lawrence Rotch, director of the Blue Hill Meteorological Observatory, delivered an illustrated lecture on "Sounding the Ocean of Air," before the Stamford Scientific Society, on February 7.

Dr. Harvey W. Wiley, chief of the Bureau of Chemistry, spoke on February 13 at the Boston City Club on "The ethics of the food and drug trade."

Dr. L. A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution, lectured at Columbia University on February 11, on "The Magnetic Survey of the Pacific Ocean."

Dr. Osler, regius professor of medicine at Oxford, presided on February 4 in the Town Hall, when the Lees and Raper memorial lecture was given by Mr. W. McAdam Eccles, F.R.C.S., whose subject was "The Relation of Alcohol to Physical Deterioration and National Efficiency."

A memorial service for the late Professor O. Lassar was held, January 20, in the amphitheater of his clinic at Berlin under the auspices of the Dermatological Society. Professors Rosenthal and Mayer delivered the main addresses.

We regret to record the death of M. Albert Loewy, professor of mathematics at the School of Physics and Chemistry at Montsouris.

The death is also announced of M. A. Lancaster, director of the meteorological department of the Royal Observatory of Belgium at Uccle.

The Cooper Union recently received a bequest of $100,000 from the estate of Mr. Willis James, and the City of New York has now transferred to the institute the sixty-ninth Regiment Armory.

Mr. L. S. Tiffany has presented to the University of Chicago for the Department of Geology a valuable collection of invertebrate fossils. This collection was made by Mr. Tiffany's father during a period of some twenty-five or thirty years and at a cost of many thousands of dollars.

The president of the United States on February 10, sent to the congress the following message:

To the Senate and House of Representatives:

I transmit herewith a report by the Acting Secretary of State covering a note from the Imperial German Ambassador by which is communicated the acceptance by the International Congress on Hygiene and Demography of the invitation extended to it in pursuance of the joint resolution of Congress approved February 26, 1907, to hold its next session at the city of Washington in 1910.

Theodore Roosevelt

The first regular meeting of the Illinois Academy of Sciences will be held at the James Millikin University, Decatur, Ill., on February 22. In the morning there will be a session for the presentation of papers and in the afternoon a symposium on "The Atmosphere," embracing the following among other aspects: Origin and Maintenance; Chemical Constitution and Activity; Physical Phenomena; Relations to Animal and Vegetable Life; Relations to Human Evolution and to Mental and Physical Efficiency. In the evening Professor A. A. Michelson, of the University of Chicago, will give a lecture complimentary to the citizens of Decatur on "Recent Advances in Spectroscopy."

The mathematical and physical library of the late Professor A. S. Herschel, F.R.S., and also works from the library of the late Mr. F. Moore, author of books on the Lepidoptera of India and Ceylon, are offered for sale by Mr. T. Thorp, Guilford, Surrey, England.

We learn from the *Scottish Geographical Magazine* of the wreck of the *Austral*, the vessel which was taking a party and instruments to set up a meteorological station on Wandel Island. The wreck took place very soon after the vessel left port, and as all the valuable meteorological instruments were lost, the establishment of the new station will be delayed for at least a year. The *Austral* was formerly the *Français*, the vessel of Dr. Charcot's Antarctic expedition.

It is reported that President Roosevelt will appoint a Pure Food Commission of chemists from various universities, to consider cases of dispute against the rulings of the Department of Agriculture.

The council of the National Academy of Sciences has passed resolutions in favor of the setting aside of forest reserves in the Appalachian and White Mountains as follows:

Whereas: Under the present drain upon the forest the timber supply of the entire United States will be exhausted within twenty years while in the eastern states where no adequate means have been employed to protect the forest the end of the supply is even nearer.

Whereas: The headwaters of all important navigable streams to the west of the Mississippi River are now protected by national forests while the Appalachian Mountains, which form the watersheds of many navigable streams of great importance are entirely unprotected and are being damaged to a menacing extent by the wasteful cutting of the forest, unrestricted fires and injudicious clearing;

Resolved, That the council of the National Academy of Sciences heartily favors the extension of the national forest system to the Appalachian Mountains for their protection and permanent utilization;

Resolved, That we urge upon Congress the passage at the present session of a bill to acquire in the Southern Appalachian Mountains and the White Mountains such forest lands as are necessary to protect the navigable streams which have their sources therein, and to make permanent the timber supply of the eastern part of the United States.

A new Psycho-neurological Institute, under the direction of Professor Bechterev, was recently opened at St. Petersburg.

The foundation stone of an Institute for the Study and Prevention of Infant Mortality was laid in Berlin in the presence of the German Empress on December 3.

A Criminological Institute is to be established in connection with the government prison at Buenos Aires. Particular attention will be paid to criminal psychology and forensic psychiatry.

The seventh meeting of the International Congress of Criminal Anthropology will open at Turin on April 28, under the presidency of Professor Lombroso. Communications relating to the congress should be addressed to the Secretariate of the Congress, Instituto di Medicina Legale, Via Michelangelo, 26, Torino, Italy.

The city of Paris has placed a building at the disposal of the International Hygienic Institute which is about to be established.

For the purpose of promoting the forestry industry in south Manchuria, the Chinese officials have engaged a Japanese expert from Tokyo to act as head master for the proposed school of forests at Mukden for a term of four years, with two Chinese gentlemen as his assistants; but, owing to the lack of funds, the school has not yet been opened.

The government of Mysore has, according to foreign journals, made public the new rules for regulating the grant of scholarships for scientific research and technical education from the Damodar Dass charities fund. The scholarships will be open to all Indians who have taken with credit a degree in arts, medicine, or engineering in an Indian or other recognized university. Each candidate selected will be given traveling allowance to England or elsewhere from Bangalore on the completion of his course of study or research. He will be allowed, during his stay in England or elsewhere, outside India, a sum of 200*l.* per annum, this allowance to be inclusive of college fees, cost of books, instruments, and boarding charges.

UNIVERSITY AND EDUCATIONAL NEWS

The contract for the new biological and geological laboratory of Amherst College has been awarded and work will begin when the frost leaves the ground. The building should be completed by January 1, 1909.

Mr. Cullom presented to the senate on February 10 a resolution of the Association of American Universities assembled in convention at the University of Michigan, Ann Arbor, Mich., which was referred to the Committee on Foreign Relations and ordered to be printed in the *Record,* as follows:

Whereas: The executive committee of the Latin-American Scientific Congress had determined to make the next congress "Pan-American" instead of "Latin-American"; and

Whereas: The Chilean government has extended an invitation to the government of the United States to participate in this congress, to assemble at Santiago, Chile, in December, 1908; and

Whereas: This congress will serve to bring the best thought and experience of America to bear on the great problems common to all the republics of this continent and will thus serve to strengthen the ties between the American nations: be it

Resolved by the Association of American Universities assembled in convention at Ann Arbor, Mich., That the Congress of the United States be earnestly requested to make provision for adequate representation at this forthcoming Pan-American Scientific Congress, as recommended in the report of Secretary Root of December 19, 1907, and in the special message of the President of December 21, 1907.

Dr. R. W. Stimson has resigned the presidency of the Connecticut Agricultural College to become president of Smith's Agricultural School, recently established at Northampton, Mass.

C. F. Harding, a graduate of the electrical engineering department of the Worcester Polytechnic Institute in the class of 1902, has been appointed professor of electrical engineering at Purdue University.

Mr. L. Brebant, M.A. Oxon., has been appointed assistant to the professor of moral philosophy in the University of St. Andrews.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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THE AMERICAN CHEMICAL SOCIETY AND SECTION C OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

II

ORGANIC CHEMISTRY SECTION

Julius Stieglitz, Chairman

Stereoisomeric Chlorimido Esters: W. S. Hilpert.

The work is an elaboration and continuation of the work of Stieglitz and Earle, who in 1903 discovered the stereoisomeric chlorimido esters of meta-nitro-benzoic acid.

The new stereoisomers discovered are: methyl chlorimido p-nitrobenzoates, ethyl chlorimido p-nitrobenzoates, methyl chlorimido 4-methyl-3-nitrobenzoates, methyl chlorimido beta-naphtoates, ethyl chlorimido beta-naphtoates.

For each pair of isomers identity of structure was proven by chemical means; the impossibility of polymeric forms being present was substantiated by molecular weight determinations, and physical or crystal isomerism was shown to be absent by the fact that each of every pair of stereoisomers maintained its identity in all changes of physical conditions.

The Applications of Physical Chemistry to Organic Chemistry: Julius Stieglitz.

The author first called attention to the valuable aid given by physico-chemical methods in the study of isomerism, of stereoisomerism of the asymmetric type and of the "cis-trans" type, and of tautomerism, *i. e.,* in the study of organic compounds of the same composition but of different identity. Then it was shown how the mode of action of organic compounds may be analyzed by physico-chemical methods, the active component being found by properly planned determinations of velocities of action or of electromotive forces. Illustrations were drawn from the author's work, theoretical and experimental, on the theory of the catalytic action of acids, which showed that the accelerations produced by the catalyzing acid are simply due to the fact that the reacting component in such actions (esterification, saponification, inversion, amidine formation, etc.) is a positive ion whose *mass* (concentration) *is increased* by the addition of the acid. In the oxidation of aldehydes by silver nitrate in alkaline media (or of glucose by alkaline copper solutions), it was shown that the alkali is used to increase the concentration of the *reducing component of the aldehyde, e. g.,* $(NaO)\overset{+}{\underset{-}{C}}H$, a methylene derivative with a bivalent carbon atom holding a free positive and a free negative charge. The alkali by suppressing the silver ion has a retarding effect on the oxidizing power of the silver nitrate. The demonstration was made with Ostwald's chemometric device.

The Condensation of Nitromalonic Aldehyde with Acetonyl Acetone: W. J. Hall.

From earlier work upon the condensation of nitromalonic aldehyde with acetone and its derivatives it may be inferred that two molecules of the aldehyde would condense with one molecule of acetonyl acetone and give a dinitro-dioxy-diphenyl. This result is accomplished only in the presence of a large amount of the condensing agent, otherwise but one molecule of the aldehyde enters into the condensation and there results a 2-acetonyl-4-nitrophenol. Both of these products, however, form but a small percentage of the total yield in condensation products. The third and largest portion arises from the condensation between one molecule of the aldehyde and one molecule of acetonyl acetone in which the two methylenic groups, between the two carbonyl groups, are found to react with the two aldehydic groups of the single molecule. In this way a fine carbon ring is formed which bears as substituents two acetyl groups and also a nitro group—a 1-nitro-3, 4-diacetylcyclopentadiene. This constitutes therefore a synthesis for derivatives of this class of homocyclic compounds. A number of similar condensations are already under investigation.

The Conversion of Nitromethane into Fulminates: Lauder William Jones.

When a cold solution of mercuric chloride is poured into a cold solution of sodium isonitromethane, a white salt is precipitated, which Nef (*Ann.,* 280, 275) assumed to be mercuric isonitromethane. This salt has been isolated, and has been found to be nearly white and quite explosive. Its reactions show that it is undoubtedly mercuric isonitromethane. If this white salt is heated with water it passes very readily into mercuric fulminate, with the simultaneous formation of the explosive, yellow salt studied by V. Meyer and Rillet (*Ber.,* 5, 1030), Nef, and others.

The formation of formhydroximic acid derivatives by the action of acyl chlorides upon sodium isonitromethane (*Am. Chem. J.,* 20, 25), and the successful transformation of formhydroximic acid derivatives into fulminates by Biddle (*Ann.,* 310, 13), Nef (*Ann.,* 280, 317) and Wieland (*Ber.,* 40, 418) suggest an interpretation of the changes which mercuric isonitromethane undergoes in its conversion into fulminate.

(hg $= \frac{1}{2}$ an atomic weight of bivalent mercury.)

$$\mathrm{hg-O-\underset{\underset{\displaystyle O}{\|}}{N}=C\begin{matrix}\diagup H\\ \diagdown H\end{matrix} \rightleftarrows hg-O-N}$$

$$\mathrm{=C\begin{matrix}\diagup H\\ \diagdown OH\end{matrix} \rightleftarrows hg-O-N=C+\overset{\displaystyle H}{\underset{\displaystyle OH}{|}}}$$

The yellow salt formed at the same time may be a basic mercury salt of formhydroximic acid,

$$\mathrm{hg-O-N=C\begin{matrix}\diagup H\\ \diagdown O-Hg-OH\end{matrix}}.$$

This explanation was offered (*Ann.*, 20, 34) in view of the fact that the yellow salt, upon treatment with dilute hydrochloric acid, yielded some fulminate. Wohler (*Ber.*, 38, 1351) failed to obtain fulminate from this salt. Recently, a repetition of these experiments has yielded fulminate repeatedly.

If the reactions represented by the equations given above are assumed to be slightly reversible, it is possible to account for many of the singular changes of the fulminates. Thus, the change of fulminate into formhydroximic acid would account for the decomposition of fulminates into hydroxylamine and formic acid. By the Beckmann rearrangement, formhydroximic acid might be expected to pass into isocyanic acid, or into ammonia and carbon dioxide.

$$\mathrm{H-O-N=C\begin{matrix}\diagup OH\\ \diagdown H\end{matrix} \rightarrow H-N=C\begin{matrix}\diagup OH\\ \diagdown OH\end{matrix} \rightarrow H-N}$$

$$\mathrm{=C=O+\overset{\displaystyle H}{\underset{\displaystyle OH}{|}} \rightarrow NH_3=CO_2.}$$

This would serve to clear up the behavior of fulminates towards acetyl chloride, ammonia, aniline, thiocyanic acid and certain other reagents.

In 1856 Kekulé represented fulminic acid as nitro acetonitrile, $CH_2(NO_2)(CN)$. The chief experimental evidence for this formula lay in the fact that mercuric fulminate, under the influence of chlorine water, gave trichlornitromethane (chlorpikrine), and a small amount of chlorcyanogen. The formation of trichlornitromethane has never been explained; but its formation becomes self-evident in view of the above hypothesis, since mercuric isonitromethane in the presence of mercuric fulminate would be changed ultimately into trichlornitromethane, free fulminic acid, and mercuric chloride by the continued action of chlorine water. The presence of a small amount of chlor-cyanogen may be accounted for by the presence of prussic acid, a substance very often formed by the breaking down of free fulminic acid.

The Asymmetric Methyl Dialkylisoureas: RALPH H. MCKEE, Lake Forest University.

The isoureas of this series, $Alk_2N-COCH_3=NH$, were prepared by the action of methyl alcohol on the dialkylcyanamide in the presence of sodium methylate. They are strongly basic oils whose water solutions act similarly to ammonia on silver, mercuric and mercurous salts, but are unlike ammonia in that they do not affect copper or cobalt hydroxides. Decomposition of the dry hydrochlorides, or their solutions in water, gives methyl chloride and the urea ($Alk_2N-CO-NH_2$) quantitatively. These isoureas readily condense with phenyl isocyanate, benzoyl chloride, etc., but are not affected by benzaldehyde, ethyl oxalate or ethyl malonate.

Melting Points of Binary Mixtures of Ortho-Meta and Paranitraniline—A New Method for the Determination of these Compounds: J. BISHOP TINGLE and H. F. ROLKER.

Binary mixtures of the three nitranilines have been made in steps of 2 per cent., and the melting points of these mixtures have been plotted against the composition. The curves given by the ortho-meta and meta-para-mixtures are very smooth and of the same type; they rise regularly on each side of the eutectic point to the melting point of the pure isomer. These curves are used for the determination of mixtures of unknown composition in the following manner: The substance under examination is divided into two portions, one of which is termed A; the other portion is mixed with a quantity of one of the pure isomers—say the meta compound, and is termed $A1$. The melting points of A and $A1$ are determined simultaneously. That of A corresponds to a position on each of the two branches of the curve. If the m.p. of $A1$ is *lower* than that of A the composition of the latter corresponds to the temperature marked on the ortho-branch of the curve, otherwise to that on the meta-branch. The curve given by mixtures of ortho- and paranitraniline is highly irregular and an attempt is being made to ascertain the reason for this.

Intramolecular Condensation in the Phthalanilic Acid Series: J. Bishop Tingle and H. F. Rolker.

The work of Bishop Tingle and Cram[4] and Bishop Tingle and Lovelace[5] on this subject is being continued. Acids of the series RNH differ markedly in stability towards increase of temperature, and reactivity with amine as the group R varies. In some cases the action on an amine R, $N.H_2$ causes the formation of an amide; in others R is substituted by R, while with some acids substituted diamides are produced. Phthalanilic acid is stable in boiling aqueous solution, but in presence of a small quantity of aniline it is quickly converted into phthalanil. The action of alcohol on these acids has also been studied and a suggestion is made as to the cause of its "dehydrating" power in this case and in others.

[4] *Amer. Chem. Journal*, **37**, 598 (1907).

[5] *Ibid.*, **38**, 642 (1907).

The Clarsen Reaction: J. Bishop Tingle and Ernest E. Gorsline.

The authors' investigation of the mechanism of the Clarsen reaction and of the part played in it by ether and other catalytic agents such as quinoline and pyridine is being continued and extended so as to determine the influence on the condensation of ketones and esters of varying constitution. The results obtained so far are wholly incompatible with the Clarsen theory regarding the mechanism of the reaction, but are in excellent accord with that of Michael except in so far as it necessarily fails to take account of the influence of the ether, etc. An explanation is offered of the activity of the catalysis mentioned above. Evidence is being accumulated which tends to show that during the course of the Clarsen reaction at least two and possibly more different series of reactions take place side by side leading to quite dissimilar end-products.

Action of Amines on Ethyl Camphoroxalate: J. Bishop Tingle and L. F. Williams.

It has been shown by Bishop Tingle and Alfred Tingle[6] that ethyl camphoroxalate and amines yield compounds of the types

$$C_8H_{14}\left\langle\begin{array}{l}C:CCO_2C_2H_5\\ \quad\;\; |\\ CONHR\end{array}\right. \quad \text{and} \quad C_8H_{14}\left\langle\begin{array}{l}C:CCONHR\\ |\quad\; |\\ CONHR\end{array}\right. .$$

The ability to form one or other of these derivatives depends: (1) on the nature of the amine; (2) on the experimental conditions. A systematic investigation of the influence of these two factors is now in progress.

Studies in Catalysis—The Formation of Guanidines: Julius Stieglitz.

Ammonia acting on urea esters gives only very small yields of guanidines. The author's theory of the catalytic action of

[6] *Amer. Chem. Journal*, **21**, 256 (1899); **23**, 226 (1900).

acids (Congress of Arts and Science, St. Louis, IV., 278 (1904), *Am. Chem. Jour.*, January, 1907, etc.) suggested that probably the real reacting component is the positive urea ester ion and that the addition of an acid to the mixture would, by facilitating the ionization of the urea ester, lead to a perfect method of synthesis. Preparative as well as quantitative experiments carried out with Dr. R. H. Hall completely confirmed this view and brought, therefore, one more experimental confirmation of the theory of catalysis underlying the author's work.

The Oxidation of M-Nitrobenzoylcarbinol: Wm. L. Evans and Benj. T. Brooks.

When benzoylcarbinol is acted upon by oxidizing agents it is found that there is obtained varying amounts of benzoylformaldehyde, mandelic, benzoylformic and benzoic acids, according to the agent used. Preliminary experiments, the results of which are herewith presented, are being conducted to determine the following points:

1. Are the same general reactions followed in the oxidation of these simple substituted sugars, like m-nitrobenzoylcarbinol, as were developed for benzoylcarbinol?

2. And also, what possible effect might introducing substituents into the ring have on the behavior of these substances towards oxidizing agents which were previously used with benzoylcarbinol?

The following results were obtained: (1) m-nitrobenzoylcarbinol gives with freshly precipitated mercuric oxide, freshly precipitated silver oxide and potassium permanganate alone or in the presence of alkalies, benzoic acid and carbonic acid exclusively; (2) m-nitrobenzoylcarbinol gives with cupric hydroxide and caustic alkalies only m-nitromandelic acid; (3) m-nitrobenzoylcarbinol gives with potassium ferri-cyanide and alkalies both m-nitrobenzoic acid and m-nitromandelic acid.

Thus far, these preliminary experiments seem to follow the general interpretation previously given by one of us for the reactions of benzoylcarbinol.

A Chemical Study of a Number of the Wild Fruits from Sylvan Beach, N. Y.: Nicholas Knight.

The territory was formerly the lake bottom, and the soil is of so sandy a nature that it is unfit for purposes of agriculture. The fruit of the *Smilacina racemosa* and *Smilacina fifolia* were first investigated. It was necessary to pick the former while still green and to allow it to ripen slowly on the stems while under cover. Later on opportunity was presented for analyzing the fully ripened fruit that had matured normally. A glucoside in the fruit picked green changed to tannic acid in the ripe berries. In other respects the fruit of the earlier and later picking bore a striking resemblance, as likewise the fruits of the two species. The fruit of *Solanum dulcamara* from the same locality was also reported on.

Brommation of Phenyl and Tolyl Ethers: Alfred N. Cook.

Phenyl ether yields a dibrom and tetrabrom derivative with iodin as a carrier. Ortho-, meta- and para tolyl ethers yield di- and tetrabrom derivative also with iodin as a carrier, as *per se*. The bromine evidently enters the nucleus even when heated to 150° C., and in direct sunlight, as indicated by the fact that the derivatives do not react with caustic potash, sodium carbonate or calcium carbonate and water even when heated under pressure. This is contrary to the well-known law. The halogen usually enters the side chain and not the nucleus in direct sunlight or at elevated temperatures.

Mesoxalic Esters and their Reaction with Hydrazin: Richard S. Curtiss and P. T. Tarnowski.

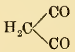
Methylmesoxalate may be obtained by saturating methylmalonate at 0° with N_2O_3. After forty-eight hours it is distilled in vacuo. A yield of 80–85 per cent. of $(HO)_2 > C = (COOCH_3)_2$ can be crystallized from the oily distillate. Hydrazin hydrate and carbonate solutions react with $OC{=}(COOH)$, forming gummy and resinous polymerization products. With carefully chosen conditions both the methyl and ethyl esters give white crystalline bodies.

Owing to the ease of dissociation into hydrazin and mesoxalic esters, the question of an asymmetrical or a symmetrical hydrazin derivative was not settled. PCl_5 proves hydroxyl groups present. Benzaldelyl yields benzalazin and mesoxalic ester. Benzoyl chloride gives symmetrical diberozoyl hydrazin. Acids and alcoli solutions dissociate these derivatives into hydrazin and ester.

Nitrosomalonic Esters: Richard S. Curtiss.

The action of N_2O_3 on malonic esters at low temperatures forms a number of unstable nitrogen derivatives. From the green oils thus obtained with ethyl malonate two potassium salts have been obtained: one (β) canary yellow, the other (α) nearly colorless. The molecular weight and potassium determinations show them to be salts of ethyl nitrosomalonate. The unstable nitroso ester formed by dilute acids on the salt is pale green; stains the cuticle like nitric acid; gives off nitrogen oxides in a desiccator, and is entirely different in its properties from the oxime of mesoxalic ester $HON = C = (Co_2Co_2H_5)_2$. Saponification of the salt with alcoholic potash yields a chrome yellow potassium salt, which when treated with dilute H_2SO_4 and ether gives a yellow oil not at all like the stable crystalline oxime, $HON = C = (CO_2H)_2$. It is in fact extremely unstable. When air is allowed to enter the desiccator, after its ethereal solution has been freed of ethyl in vacuo, it heats up, liberates gases and puffs off white vapor, then flashes into flame, and leaves the desiccator filled with dense clouds of red oxides of nitrogen.

The study of these compounds as well as other nitrose and nitro derivatives of the group



is in progress.

A Peculiar Decomposition of the Esters of Formylchloridoxime: H. C. Biddle.

In the action of caustic potash on methyl formylchloridoxime there are formed methyl cyaniminocarbonic and diiminooxalic esters, nitrogen, and the potassium salts of hydrocyanic, cyanic and oxalic acids.

The methyl fulminate naturally expected is not obtained. If formed at all, the fulminic ester probably condenses to the double molecule, which then dissociates in two directions, in one case giving rise to oxalic acid and methyl alcohol and in the other to cyanogen and alcohol, according to the equation:

$$3(CH_3ONC)_2 + 4H_2O \rightarrow 6CH_3OH + H_2C_2O_4 + N_2 + 2C_2N_2.$$

The occurrence of cyaniminocarbonic and diiminooxalic esters is readily explained by the tendency of cyanogen to absorb alcohol in the presence of an alkali.

The Constitution of Indigos and Related Compounds: M. T. Bogert, K. G. Folk and J. M. Nelson.

Some recent work on indigos (chromophore $CO \cdot \dot{C} : \dot{C} \cdot CO$) is discussed on the hypothesis of the different colors being due to differences in spatial configuration. The possibility of applying a similar explanation to compounds similarly constituted containing the grouping $\cdot CO \cdot C : C$, and also to some dibenzalacetone derivatives $\cdot \dot{C} : \dot{C} \cdot CO \cdot \dot{C} : \dot{C}$, is referred to.

Phenylmalonic Nitrile: JOHN C. HESSLER.

The silver salt of phenylmalonic nitrile is hydrolyzed almost immediately after its preparation, giving dimolecular and trimolecular phenylmalonic nitrile, as well as an oxidation product of unknown molecular weight. Phenylmalonic nitrile and the two polymers give this oxidation product when treated with chromic acid. The sodium salt of phenylmalonic nitrile gives the same substance when treated with bromine.

Dimolecular phenylmalonic nitrile gives a sodium salt and a silver salt. The silver salt reacts with alkyl iodides to give alkyl dimolecular phenylmalonic nitriles.

The Catalysis of Imido Esters by Alkalies: HERMAN I. SCHLESINGER.

The parallel behavior of ordinary acid esters and acid esters when catalyzed by acids, as brought out by Hezty and his collaborators, is found also in their behavior towards alkalies. Imido esters were found to be catalyzed with a velocity proportional to the concentration of the hydroxyl ion.

The Action of Alkalies on the Carbohydrates: J. U. NEFF. Reported by title.

Marrubiin: H. M. GORDIN. Reported by title.

Imido-hydantoine: JAMES B. GARNER. Reported by title.

On the Salts of Tautomeric Compounds: S. F. ACRER, R. F. BRUNEL, J. M. JOHNSON, G. H. SHADINGER and SIDNEY NIRDLINGER. Reported by title.

The Hydrocarbons in the Lignites of the Northwest: G. B. FRANKFORTER. Reported by title.

Some Halides of Pinene: G. B. FRANKFORTER and WALTER BADGER. Reported by title.

INDUSTRIAL CHEMISTRY SECTION

W. H. Ellis, Chairman

The Use of Carbon Tetrachloride as an Extractive in Commercial Analyses of Cotton-seed Meal: CHAS. H. HERTY and F. B. STEM.

Carbon tetrachloride has been found to be an excellent extractive of cotton seed oil from the meal. As a substitute for the Soxhlet apparatus for extraction a simpler method is recommended. The meal is allowed to stand in contact with a definite volume of the extractive in an Erlenmeyer flask. One half of the extractive is then filtered off, the percentage of oil being determined in this filtrate from the weight of the residual oil after evaporation of the extractive. By extracting at 70° C. it is possible to get a complete extraction in $3\frac{3}{4}$ minutes.

The Volatile Oils of Pinus Tæda and of Pinus echinata: CHAS. H. HERTY and W. S. DICKSON.

The volatile oils distilled from specimens of the oleo-resins of *Pinus Tæda* (loblolly pine) and *Pinus echinata* (shortleaf pine) collected near Chapel Hill, N. C., have been studied. The results show these to be practically identical with the volatile oils of the more common long-leaf pine and Cuban pine. The chief constituent of each is pinene.

A New Oxidizing Medium and its Function in the Blood and Muscle Elements:[7] J. E. SIEBEL.

[7] This paper was placed in the industrial section under the title of "A New Oxidizing Agent." The

Experiments are quoted showing that alkaline bicarbonates may exchange carbonic acid for oxygen, which latter is thereby converted into an active modification, thereby enabling such bicarbonate solution to be used for oxidizing purposes, notably also as the negative element in electric batteries constructed by the author in which sugar, oleates, alcohol and other nutrient combustibles are oxidized, yielding a full equivalent of electricity without dissipation of energy. It also appears that alkaline carbonates present in the serous liquids of the human system act as a transmitter of oxygen from the oxyhemoglobin of the red corpuscles to the oxidable matter in the muscle elements, thereby activating or transferring the oxygen into the active modification.

As foreshadowed in a paper on electrodynamics of nutrition read at the former meeting, it is shown that the sarcous elements of the contractile disks of the voluntary muscle fiber represent the electrodes of batteries in which nutrients or their derivates are oxidized by the active oxygen transferred to them by the bicarbonates, thereby causing contraction by the mutual attraction of the parallel electric currents regulated by simple contrivances fully explaining the interior mechanism of the concert action of voluntary muscles, nerves and nerve centers. Calculations are presented showing that currents of very low voltage and amperage suffice for these performances.

It is also found that the order in which, according to Atwater, different substances are preferred and replace each other in nutrition, viz., alcohol, sugar, fat, proteids, is the same as that in which they furnish the greatest amount of electromotive force in batteries constructed by the author in analogy to the supposed muscle batteries.

author subsequently added some biochemical data and presented it before the section.

Wood Turpentines and their Relation to Gum Turpentines: W. C. Geer. Reported by title.

The Deposition of Arsenic upon the Vegetation of Smelter Regions: W. D. Harkins. Reported by title.

Determination of Small Quantities of Monocarbonate in Bicarbonate of Soda: J. D. Pennock and D. A. Morton. Abstract misplaced.

The Criteria of Deterioration in Flesh Foods: W. D. Richardson. Reported by title.

Transparent Soot: a Supercooled Solution: W. D. Richardson. Reported by title.

Examination of Crude Petroleum for Comparative Purposes: David T. Day. Reported by title.

Long-leaf Pine Oil: J. E. Teeple. Reported by title.

Microscopic Detection of Free Magnesia in Portland Cement: Alfred H. White. Reported by title.

Analysis of Turpentine by Fractional Distillation with Steam: W. C. Geer. Reported by title.

BIOLOGICAL CHEMICAL SECTION IN JOINT SESSION WITH AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS

R. H. Chittenden, chairman and president

Organic Soil Constituent: Oswald Schreiner and Edmund C. Shorey.

The authors reported on a crystalline organic compound which had been isolated from several unproductive soils. The compound when tested by physiological methods is harmful to plants and appears to be the cause of the unproductivity in these soils. It can be obtained by extracting the soil with dilute soda solution, acidifying, filtering from the voluminous precipitate of humus bodies produced and shaking the filtrate with ether. The ethereal solution contains the compound, and this is obtained in a crystalline form by evaporating the ether over water. When pure, the compound is white, melts at 98–99° and has the composition and other properties of dioxystearic acid prepared by oxidation of elaidic acid.

Toxic Substances Arising During Plant Metabolism: Oswald Schreiner and M. X. Sullivan.

For the purpose of studying the factors underlying the decrease in yield of plants grown successively on the same soil, wheat and cowpea were grown on different soils until the yield of the plants became poor. Water extracts of these soils proved to be poor media for the respective plants. On shaking the extract with carbon black and filtering, they became far better media for plant growth. It must be concluded then that the soil extracts contained something actually deleterious to the plant since the carbon black made from natural gas acts merely as an absorbing agent.

From wheat-sick soil there was obtained by steam distillation a crystalline body which is toxic to wheat. From cowpea-sick soil in the same manner a crystalline body was obtained which is toxic to cowpea but not to wheat.

The Chemical and the Physiological Properties of a Solution of Hydrochloric Acid and Sodium Chloride: Amos W. Peters.

The influence of neutral salts, *e. g.*, NaCl, extends to both chemical properties of solutions and to correlated physiological functions. The killing concentration of HCl for protozoa is lowered by the addition of a concentration of NaCl which is practically harmless when used alone. This effect can be explained by the increased acidity of the mixed solution, according to Arndt, Euler and others. Colorimetric comparisons with methyl orange, and inversion tests by the polarimetric method, made with the dilute solutions of these experiments, favored this hypothesis, whether the solutions were made with redistilled water or with the original culture liquids. The increased velocity of inversion due to NaCl disappeared when the acid products of the reaction demonstrated by Kullgren increased.

The Endo and Ekto-invertase of the Date: A. E. Vinson.

The invertase of the date remains insoluble in all ordinary solvents throughout its green stages, but becomes readily soluble on ripening. The change in the behavior of the invertase toward solvents coincides very closely in point of time with the passage of the tannin into the insoluble form. Tannin in relatively large amounts does not retard the action of date invertase either in the extract or in the pulp. Soluble tannin, however, hinders the solution of date invertase in water, but the invertase can be extracted by glycerine, provided the glycerine is added at the same time the tannin is added. Green date invertase can not be extracted by crushing and macerating the green fruit with glycerine, therefore the invertase is not rendered insoluble, under the conditions of the experiment, by the escape of soluble tannin on crushing the tannin cells. This conclusion is confirmed by the behavior of the invertase in the tannin-free portion of the date after the tannin-bearing tissues have been completely removed. There is no direct connection between the change in the state of the tannin and that of the invertase.

The inversion of cane sugar by the green date pulp is not accomplished by the living protoplasm liberating a soluble ferment from a preexisting insoluble zymogen or by rendering active a proferment. The rate of inversion by equivalent amounts of green and ripe pulp of the same variety are practically identical. Protoplasmic poisons—picric acid, chromic acid and formalin—retard the action of green and ripe pulp, but to approximately the same degree. If the living protoplasm were in any way connected with the inversion, the retardation would be greatly intensified in the presence of protoplasmic poisons. Green date tissue is not rendered inactive by soaking in ether, chloroform, acetone, etc.

The press juices of the green date contain most of the water in the fruit and large amounts of soluble substances which are usually retained by the healthy and unbroken semipermeable *hautschicht*. These juices and extracts are invariably free from invertase until the fruit ripens, although the press residues are always very active.

Treatment of the tannin-free green date tissue with chloroform, ether, toluol and aceton does not alter the behavior of the invertase towards solvents. Moreover the invertase is not liberated by heat. This treatment should destroy the semipermeable nature of the protoplasmic wall. From these observations the theory of the impermeability of the cell wall for the invertase of green date is untenable.

Enzymic action will take place whenever either enzyme or material to be acted upon is soluble; that is, molecular contact must be established. Tannin removes the invertase of ripe dates from solution, but inversion is not checked unless the precipitate is filtered off. Date extracts precipitated by lead subacetate still invert cane sugar, but on removing the precipitate inversion is stopped. It is thus possible to invert sugar by means of invertase artificially rendered insoluble.

In the place of impermeability of the cell wall to the enzyme, the writer proposes the following theory. It is highly probable that green date invertase and possibly other endoenzymes are held in an insoluble combination by some constituent of the protoplasm. In some cases this combination may be broken down and the enzyme pass into solution while the protoplasm is living, but in others the combination may persist even after the death of the protoplasm. The enzyme may be rendered soluble also by external chemical or physical influence. On maturity of the tissues the enzyme is generally liberated, possibly by autodigestion or other profound change in the protoplasm.

In order to establish the impermeability of the cell wall to the enzyme in any given case it must be shown that the enzyme is in solution in the cell sap and not held in combination by the protoplasm.

On the Occurrence of a Phytin-splitting Enzyme in Animal Tissues: E. V. McCollum and E. B. Hart, Chemical Laboratory of the Wisconsin Experiment Station.

The authors have examined the influence of blood and of water and glycerine extracts of liver, kidney and muscle upon the sodium salt of anhydroxymethylenediphosphoric or phytic acid prepared from wheat bran. The sodium phytate was digested at 40° C. for one or two days with blood and with the tissue extracts, and the phosphoric acid in the mixture estimated by the method of Hart and Andrews[8] for determining inorganic phosphoric acid in the presence of phytin. These values were compared with those obtained with blood and the extracts alone. The results indicate that blood and the liver of calves possess the power of cleaving sodium phytate with the formation of phosphoric acid. Muscle and kidney as well as the enzymes of the digestive tract do not alter phytin.

[8] *Amer. Chem. Journal*, 30, 470 (1903).

Bacterial Growth and Chemical Changes in Milk kept at Low Temperatures: M. E. PENNINGTON, United States Department of Agriculture, Bureau of Chemistry.

Bacteria in milk increased in numbers at a temperature of — 0.55° C. Bacterial growth at the end of a week was pronounced. There was a steady increase in the number of organisms for five or six weeks and at their maximum they numbered hundreds of millions. Occasionally they passed the billion mark per cubic centimeter. This occurred in spite of the fact that, though the milk was never solidly frozen, after ten days to two weeks it was a mass of small ice crystals. Neither odor nor taste indicated the high bacterial content and a curd was not produced even on heating, until the very end of the experiment.

There were present at all times during these experiments acid-forming, liquefying and neutral organisms. Acid formers were in lower and the liquefying organisms in higher proportion than is commonly found. Certain species, such as *B. formosus, B. solitarius* and *B. Ravenel,* were especially resistant to cold and frequently were the predominating species, or almost in pure culture at the end of the experiment.

Storage at this temperature ordinarily cuts down the number of organisms developing at 37° C., the maximum number being found when the plates were kept at 20° or 0° C. The acidity increases to such an extent that sometimes 100 c.c. of N/10 sodium hydrate are required to neutralize 100 c.c. of milk, but this acidity has not caused a curd.

A chemical study of the proteid of milk in cold storage showed that the casein was rapidly digested, until finally more than 30 per cent. of it was changed to soluble compounds. Caseoses, amido acid and, probably, peptones increase, apparently at the expense of the digested casein. The rapidity with which this digestion takes place varies in different samples, but at the expiration of two weeks it is pronounced.

A Demonstration of a Method (with apparatus) of showing the Electric Charge of Colloids: A. B. MACALLUM. Reported by title.

On the Action of Nitric Acid on Nucleic Acids: WALTER JONES. Reported by title.

The Improbability of a Radiotropic Response: C. STUART GAGER. Reported by title.

Glycocoll as a Product of Uricolysis: LYMAN B. STOOKEY. Reported by title.

A Study of the Influence of Potassium Cyanide on the Excretion of Nitrogenous Substances in the Urine of Dogs: WILLIAM H. WALKER. Reported by title.

Transmitted by Charles L. Parsons, secretary of Section C.

B. E. CURRY,
Press Secretary

NEW HAMPSHIRE COLLEGE

THE AMERICAN CHEMICAL SOCIETY CHICAGO MEETING

THE meeting of the American Chemical Society in Chicago was attended by some 350 chemists and was one of the most successful in its history. One hundred and thirty papers were presented at the meeting, including several important addresses of general interest, which required the society to meet in six subsections.

The reelection of Marston T. Bogert as president was announced and of H. P. Talbot, Louis Kahlenberg, A. E. Leach, Wm. D. Richardson and W. Lash Miller as councilors at large.

The meeting was marked by enthusiasm throughout and the announcement that the society had gained several hundred new members this last year and was on a continued upward growth was pleasing to all.

The most important action taken at the meeting was the decision to organize a Division of Industrial Chemists and Chemical Engineers who shall elect their own officers, and to begin the publication of the *Journal of Industrial and Engineering Chemistry* with a board of editors carefully picked as experts in the several lines of chemical industry.

The publication of *Chemical Abstracts*, which is now beginning its second volume, has been a very great benefit to the society and remarks of approval were heard on all sides. It has published this last year 7,975 abstracts, covering 3,047 pages, and abstracting over four hundred journals. Its influence is widely felt in the present prosperity of the society.

It is hoped that by this large union of American chemists the great duplication of effort which has been characteristic of foreign journals will be avoided in America and that the members of the American Chemical Society can be given for a minimum cost literature which will cover almost the entire field of chemistry.

Excursions, banquet, smoker and social functions were largely attended and every member present went home with the determination that he would be at the next meeting.

Charles L. Parsons,
Secretary

THE BOTANICAL SOCIETY OF AMERICA[1]

The second annual meeting of the federated societies (the fourteenth of the Botanical Society of America) was held in Hull Botanical Laboratory, at the University of Chicago, December 31, 1907, to January 3, 1908, under the presidency of Professor G. F. Atkinson. About fifty members were in attendance at the meeting, which was thoroughly interesting throughout. The excellent arrangements made by the members of the local committee and by the staff of the department of botany of the University of Chicago, contributed largely to the success of the meeting.

The officers elected for 1908 were:

President—Professor W. F. Ganong, Smith College.

Vice-president—Dr. C. L. Shear, Bureau of Plant Industry.

Treasurer—Dr. Arthur Hollick, New York Botanical Garden.

Secretary—Professor D. S. Johnson, Johns Hopkins University.

Councilors—Professor W. G. Farlow, Harvard University (one year); Professor J. M. Coulter, University of Chicago (two years), and Professor W. Trelease, Missouri Botanical Garden (three years).

Three associate members were elected to full membership and three botanists were elected to associate membership.

The Committee on the College Entrance Option, Professor W. F. Ganong and F. E. Lloyd, made a report, of which, because of its general interest, an abstract is printed here:

The report outlines the work of the committee from its appointment in December, 1900, to the present. The high school course formulated by the committee, on the basis of the reports of the National Educational Association and after wide consultation with prominent teachers throughout the country, is now used as a basis for its examinations by the College Entrance Examination Board, and is given by a considerable number of preparatory schools. The committee recommended (*a*) that it be enlarged somewhat in numbers and scope, to become a standing committee on education, of three members, having charge of this option and such other educational

[1] A union of the Botanical Society of America, the Society for Plant Morphology and Physiology and the American Mycological Society.

matters as may be referred to it by the society; (*b*) that a fourth edition of its course with appropriate accessory matter be printed at the expense of the society for wide circulation; (*c*) that it be authorized to cooperate with a similar committee of the American Society of Zoologists in formulating a high school course in biology. The committee further recommended (*d*) that all members of the society engaged in college or university work be requested to call the attention of their respective faculties to the fact that college entrance examinations are now being held every June in all the principal centers of the country in a year's thorough course in botany, a course ample to count as one point out of fourteen or fifteen for entrance. It seems desirable for all the interests concerned, the colleges, the schools and the science, that this course should be accepted as an option for entrance by all colleges. The recommendations were all adopted by the society.

The next annual meeting will be held in conjunction with the American Association for the Advancement of Science.

An important feature of the program was the session devoted to a symposium on "Aspects of the Species Question." Six twenty-minute papers were read, by C. E. Bessey, N. L. Britton, J. C. Arthur, D. T. MacDougal, F. E. Clements and H. C. Cowles, and these were followed by an hour's general discussion. These papers will be published soon in Science. The remaining scientific sessions were devoted to the reading of botanical papers, of which abstracts follow:

The Foot in Bryophytes: Professor C. R. Barnes and Dr. W. J. G. Land, University of Chicago.

Cell Lineage in Fern Roots: Professor H. S. Conard, Iowa College, Grinnell, Iowa.

Lateral segments of the initial cell of homosporous leptosporangiates are not divided in the sequence described in German, English and American text-books. On the contrary, the first division is periclinal, and the second and third walls divide the segment into sextants. The fourth wall is periclinal, and lies ultimately between pericycle and endodermis. An attempt was made to determine whether the serial arrangement of rhizogenous cells in cyatheaceous ferns is a trustworthy ordinal character. The series is found to be so much interrupted in *Alsophila australis* as to be of very doubtful taxonomic value.

Report on Dioon and Ceratozamia: Professor C. J. Chamberlain, University of Chicago.

The life history of *Dioon edule* has been studied and a paper dealing with the ovule and female gametophyte has been published. A second paper, which will be published soon, contains a cytological study of the development of the blepharoplast and sperm, an account of fertilization and a study of the embryogeny of *Dioon edule*. The latter is peculiar and may throw some light upon the origin of the free nuclear condition of gymnosperm embryos.

Dioon spinulosum is more primitive than *D. edule* and may show some Bennettitales characters.

A preliminary survey of *Ceratozamia* shows that the blepharoplast is the largest yet discovered, that there are sometimes more than two sperms, and that the embryo develops very slowly, so that it may be little beyond the free nuclear condition when the cone begins to decay. There is only one cotyledon. As in *Dioon,* the seed does not necessarily pass into the resting condition, but growth may be continuous from fertilization up to the leafy plant.

The field study, which is still very incomplete, shows that there are probably only two species of *Dioon,* the confusion having arisen from the fact that the plants present strikingly different characters at different stages in the development of the individual.

A Unicellular Marine Brown Alga: Dr. G. T. Moore, Marine Biological Laboratory. (By title.)

The Cytology of the Male Gametophyte of Polytrichum juniperinum: Professor C. E. Allen, University of Wisconsin.

The chromosome number in somatic and spermatogenous cells is six. In vegetative divisions an aggregation of cytoplasmic materials, but no definite body of kinoplasmic or centrosomal nature, appears in the region of the spindle poles.

In the early spermatogenous divisions, a dark-staining plate appears at each pole; fibers connect the two plates, forming a broad-poled spindle. These plates persist during the division.

In later divisions appears a group of bodies similar to the "chromidial filaments" of animal cells. The group divides into two, which separate from one another and pass to the poles of the future spindle.

In one or more of the latest spermatogenous divisions, probably only in the last, a dark-staining granule, surrounded by astral radiations, appears in the cytoplasm near the nucleus. This divides into two granules, which separate and, each with its aster, pass to opposite sides of the cell. A spindle is formed between the two granules, the nuclear membrane disappears, and nuclear and cell division completed. After the formation of the spindle, the polar radiations disappear; the polar granules become less distinct, but are sometimes seen as late as the telophases. Cell division is in all cases by means of a cell-plate.

After the last division, the cell walls are dissolved and the cells round up. Each now contains, besides the nucleus, a long rod (the blepharoplast) lying just inside the plasma membrane, and a large dark-staining body, which becomes constricted into two (bodies *a* and *b*). The nucleus becomes applied closely to the blepharoplast, pushes out a beak toward one end of the latter (the anterior end), and elongates gradually into a slender spiral of about one and one half turns. After the early stages the blepharoplast can not be distinguished, except that its anterior end seems to extend a short distance beyond the nucleus. The two cilia grow out from this portion of the blepharoplast. Body *a* becomes applied closely to the anterior end of the blepharoplast, persisting to a very late stage. It may give rise to a slight swelling at the anterior end of the mature antherozoid. Body *b* becomes attached to the posterior portion of the nucleus and persists, forming the "vesicle" which is for a time attached to the mature antherozoid.

Apogamy in Nephrodium: Dr. S. Yamanouchi, University of Chicago. (By invitation.)

The nuclear condition in *Nephrodium molle* may be summarized as follows:

1. The nuclei of the prothallia contain 64 or 66 chromosomes, the x number, and the nuclei of the gametes contain the same number. The fusion nucleus in the fertilized egg presents 128 or 132 chromosomes, the $2x$ number, which remains unchanged until it is reduced during sporogenesis. Consequently, in the normal life history of *Nephrodium* the gametophyte generation contains the x number of chromosomes and the sporophyte generation the $2x$ number.

2. The nucleus of a prothallial cell with the x number of chromosomes (64 or 66) sometimes become directly the nucleus of a sporophyte, apogamously produced; so that the x number of chromosomes continues through the whole life history of the apogamous sporophyte. This fact does not seem necessarily to affect the fundamental idea that the alternation of generations is marked by the difference in the number of

chromosomes in the normal life history; it is simply an abnormal case of secondary importance. Still it must be admitted that in the case of apogamy, at least, the number of chromosomes is not the only factor which determines the character of the sporophyte and gametophyte.

Further Studies on the Chromosomes of Œnothera: Dr. R. R. Gates, University of Chicago. (By invitation.)

On account of the well-known variation in chromosome numbers in root-tips, it was important that the chromosomes of *O. gigas* should be counted in the germ cells. The pollen mother cells of *O. gigas* have 28 chromosomes, the reduced number being 14. In rare cases one chromosome passes to the wrong pole of the heterotypic spindle, making the numbers in the daughter nuclei 15 and 13.

This mutant is rare, having appeared only four times in all cultures, only two of these four maturing seeds. It is larger in all its parts than the parent form, and this is found to be due to the larger size of the cells. The leaves, however, are more like *O. lata* than *O. Lamarckiana.* Whether the only primary change, in the production of *O. gigas,* was the doubling of the number of chromosomes, from which resulted the larger cells and hence the larger size of the organs, or whether this is but a part of the original change, can not be determined at the present time.

Evidently all the mutants do not originate in the same way.

O. lata $\times$ *O. gigas* has 21 chromosomes (one plant 20), and in reduction ten are regularly segregated from eleven. Two kinds of germ cells are thus produced. Occasionally one chromosome passes to the wrong pole of the spindle, making the reduced numbers nine and twelve. The same irregularity in the germ cells occurs in all the other hybrids examined, and, more rarely, in several of the pure forms. The deviations of one or two from the normal somatic count, which have been observed in several of the forms, are thus simply and easily explained.

Chromosomes of the Somatic Cells of the Œnotheras: Miss Anne M. Lutz, Station for Experimental Evolution. (By invitation.)

Root tips of pedigreed plants were used exclusively for these studies and a number of forms were reported upon at the Seventh International Zoological Congress (*Amer. Nat.,* October, 1907).

Œnothera lata (self-pollinated), *O. oblonga* and *O. nanella* had been only hastily examined at the time of the first report, but all have since been carefully studied. The evidence for *O. lata* is not conclusive; 15 chromosomes have been counted, 14, and also apparently 16.

Of the three plants of *O. oblonga* which arose from Dr. D. T. MacDougal's self-pollinated *O. lata* (original seed from England), one showed 14 chromosomes and the remaining two 15 each in every root tip studied.

Three plants of *O. nanella* (seed from Holland, pure bred about 15 generations) gave 14 chromosomes each in *A* and *B* and 15 in *C* in every countable figure.

Mr. R. R. Gates has reported the sporophyte number of chromosomes for plants said to be *lamarckiana* arising from a cross between *O. lata* ♀ and *O. lamarckiana* ♂ to be about 20 (Science, February 15, 1907; *Bot. Gaz.,* February and July, 1907). Of the seven offspring of a similar cross which were identified as *O. lamarckiana,* I have found each plant to have 14 chromosomes in the cells of the root tips. Two seedlings of *O. albida* arising from this cross had each 15.

Effects of Exposing Germ Cells to the Rays of Radium: Dr. C. S. Gager, New York Botanical Garden.

At the 1907 meeting of Section G of the American Association for the Advancement of Science I announced that certain results had been obtained by exposing egg and sperm cells of *Onagra biennis* to radium rays, and that these effects were character changes that gave promise, if inherited, of being of specific value. During the past summer these plants matured, and seed has been gathered for the F_2 generation. Results in the F_1 generation were in part as follows:

1. *Functional Asymmetry.*—One side of the plants grew faster and more vigorously than the other, though subjected to perfectly uniform environmental conditions.

2. *Morphological Asymmetry.*—On one side the leaves possess the characteristics, not of the typical *O. biennis,* but of one of its mutants.

3. *A Plant having Two Shoot Systems on One Root.*—One of these systems possessed the characteristics of the typical *biennis,* the other of one of its mutant derivatives. This plant, and the morphologically asymmetrical ones described above, and interpreted as probably sectorial bud-sports, indicate a fundamentally hybrid nature of the plants thus sporting. The characters of the two diverse parents separate out in the bud-sporting, and the parental characters of one of the parents have never found expression in a mature ancestor in the direct line, but have existed only potentially in the parental gamete.

Effects of Radium Rays on Mitoses: Dr. C. S. Gager, New York Botanical Garden.

Root tips of *Allium cepa* were exposed for various lengths of time to rays from radium bromide contained in sealed glass tubes. Exposure was made by placing these tubes close to, but not touching, the roots growing from bulbs in a moist chamber. Thus the α rays were eliminated, only the β and γ rays being able to pass easily through the walls of the glass tube. For purposes of comparison control (unexposed) tips, grown under precisely similar conditions, except for the absence of the rays, were collected at the same time as those exposed.

Examination showed various irregularities in the mitoses in roots exposed to the rays. Exposure to the strongest radium (1,500,000 activity) for a given period completely inhibited nuclear division. With less active preparations and varying lengths of exposure there resulted various disturbances to the chromosomes, some of them lagging behind in the passage from the equator to the poles of the spindle. At times some of the chromosomes appeared to have been accelerated in their passage, even having gone beyond the poles. It was frequently observed that some of the chromosomes failed entirely to pass to the poles, and, consequently, were not included in the formation of the daughter nuclei. This elimination of chromatin from the daughter cells may explain morphological changes in a zygote, following exposure of the fusing gametes to the rays. In one instance the daughter nuclei have apparently separated into two distinct parts, roughly giving the appearance of two nuclei in each daughter cell.

The Relation of Bursa Heegeri to Bursa bursa-pastoris: Dr. G. H. Shull, Station for Experimental Evolution.

Before the beginning of my experiments *Bursa Heegeri* was known with but one type of rosette, apparently agreeing with one of the elementary forms of *Bursa bursa-pastoris* which I had previously shown to possess two dominant Mendelian units in the lobing of its leaves. Upon crossing *B. Heegeri* with that form of *B. bursa-pastoris* which had the corresponding recessive characters, the second generation showed the same four types of rosette, previously secured in a cross between the two corresponding elementary forms of *B. bursa-pastoris,* and appearing just as in that case in the ratio, $9AB:3aB:3Ab:1ab$. This ratio appeared in combination with each type of capsule, so that *B. Heegeri* now exists with four types of rosette.

The form of capsule is a perfectly alternative character, but the F_2 hybrids have the *Heegeri* type of capsule in only one in 18 to 25 individuals.

The fact that *B. Heegeri* has the same Mendelian units in its leaves as are possessed by *B. bursa-pastoris* is held to further confirm its direct derivation from that species.

By hybridization many elementary forms are produced from a small number of initial mutations, and the whole series of such elementary forms occurring in one species may be paralleled in a nearly related species by the same means.

The smallness of the ratio of occurrence of the *Heegeri* type of capsule indicates that that species owes its capacity for self-maintenance in competition with its parent, to the comparative infrequency of cross-fertilization.

The Effect of Heat on the Starch Grain: Professor H. KRAEMER, Philadelphia College of Pharmacy. (By title.)

The Relation of Plant Societies to Evaporation: Professor E. N. TRANSEAU, Eastern Illinois State Normal School.

Methods for the Control and Measurement of Soil Moisture: Dr. BURTON E. LIVINGSTON, Carnegie Institution of Washington.

For controlling soil moisture, a porous cup (of the form used in the evaporation studies described in Publication No. 50 of the Carnegie Institution and in the *Plant World* for December, 1907) is connected by rubber stopper and glass, rubber or lead tubing to a reservoir of water, and the cup is buried in the soil of the pot or other culture container. After equilibrium has been attained, water is taken into the soil only as fast as it is removed. The height of the reservoir, and hence the length of water column to be lifted, determines the amount of moisture which will be maintained in the soil. The reservoir may be of any size, so that the culture may be continued for an indefinite period without attention. The device for measuring soil moisture is essentially the same apparatus as that just described, so arranged that the cup may be filled and emptied at will by means of two tubes which extend above the soil surface. The rate of water flow into the soil, taken for a short period beginning with the filling of the cup, is an index to the attraction of the soil for moisture, and therefore to its moisture condition, the instrument having been previously calibrated for the particular soil question.

Some Unsolved Problems of the Prairies: H. A. GLEASON, University of Illinois.

Rapid settlement has almost completely destroyed the prairies of the eastern arm of the prairie province, leaving a number of important ecological questions unsolved. Among them are: (1) The original causes which led to the occupation of the territory by forest rather than by prairie; (2) the order of invasion of the prairie flora; (3) the manner and rate of invasion of the forests from the southeast; (4) the relation of prairie fires to the forest; (5) the tension lines between the upper austral prairies and the transition forest on the north and the lower austral forest at the south; (6) the structure and composition of the prairie associations. Some of these can never be solved completely, but careful studies on the scattered fragments of prairies still available may even yet do much to give a clearer idea of the ecology of the original prairies.

Type Specimens of American Grasses in European Herbaria: Professor A. S. Hitchcock, Bureau of Plant Industry.

In order to complete a revision of the North American species of *Panicum* it was necessary to consult the types deposited in European herbaria. The following list of collections consulted may be of interest to those who contemplate doing similar work, for the exact location of some of these is not generally known.

Antwerp: Herbarium of Dr. Van Heurck. Collection of Salzmann from Bahia.

Brussels: Jardin Botanique de l'Etat. Collection of Galeotti from Mexico. Some Fournier types.

Paris: Muséum d'Histoire Naturelle. General herbarium: types of Desvaux, Steudel, Fournier, Richard, Kunth (H.B.K.). Segregated: herbaria of Michaux and of Lamarck; herbarium of Cosson with some Poiret types; and of Drake del Castillo with some Michaux types sent by Richard.

Madrid: Jardin Botánico. Types of Lagasca and Cavanilles.

Florence: Orto Botanico. Types of Poiret (cited in Encyc. Suppl. as "herb. Desfont.").

Padua: Orto Botanico. A collection of Bosc from Carolina.

Geneva: Herbarium. Delessert and the private herbaria of de Candolle and of Barbey (Herb. Boissier).

Munich: Botanisches Museum. Collection of Martius from Brazil, with types of Nees and Döll.

Vienna: K. K. Naturhistorisches Hofmuseum.

Graz: Private herbarium of Professor Hackel, now at Attersee.

Prague: Collection of Haenke with Presl's types; part at the Botanical Garden of the German University and part at the Bohemian Natural Museum.

Halle: Botanischer Garten. Professor Mez allowed me to consult the collections of Panicum loaned him by several institutions.

Leipzig: Botanischer Garten. No grass types from America.

Göttingen: Botanischer Garten. Types of Grisebach (Wright's Cuban plants and types from Argentina) and of Meyer (Prim. Fl. Esseq.).

Berlin: Botanischer Garten at Dahlem. Types of Link, Sprengel, Kunth, C. Mueller and Nees (Sellow plants from Brazil). The Willdenow herbarium is segregated.

St. Petersburg: Herbarium Trinius at the Imperial Academy of Sciences and the general collection at the Botanical Garden with Fournier's types based on plants of Karwinsky and F. Mueller.

Stockholm: Natural History Museum. Herbarium of Swartz's West Indian plants and the types of Fries and Lindmann from Argentina.

London: Three large collections. Royal Gardens at Kew, with types of Grisebach (Fl. Br. W. I.), Bentham and Pursh. British Museum (Dept. Botany), the collections of Walter and of Sloane, segregated and those of Raddi, Rudge, Robert Brown, and Gronovius. The Linnean herbarium at the rooms of the Linnean Society.

The Bisexual Inflorescence of Humulus lupulus: Dr. W. W. Stockberger, Bureau of Plant Industry.

Humulus lupulus L. is regarded as a strictly diœcious plant, but at rare intervals cultivated forms of the common hop have been observed bearing on the same flowering branches both staminate and pistillate flowers. By several observers these pistillate flowers are regarded only as aborted forms of the staminate flowers. For several years this phenomenon has been frequently observed by the writer on the Pacific coast. The anthers of the staminate flowers in all the cases examined bore mature pollen grains. The pistillate flowers also were normally constituted. It appears, therefore, that the determinants requisite for the production of gametes of each sex are present in the cells of the plant usually spoken of as female. It is possible that we have here a modification in the habit of the plant produced by the conditions of culture. The inherence of the determinants of each sex in a single plant is further shown in the somewhat rare cases in which a plant reproduces by means of runners. In the wild state and under certain conditions of culture the underground runners of the hop plant occasionally send up shoots which when mature bear flowers of the opposite sex.

The Possible Rôle of Light in Relation to Alpine Plants: Professor C. H. Shaw, Medico-Chirurgical College, Philadelphia.

Readings with the actinometer and black bulb thermometer *in vacuo* in the Selkirks seem to prove that, as is commonly believed, light at high altitudes is considerably more intense than on adjacent lowlands and that the difference is chiefly in the refrangible end of the spectrum.

Cultures of plants were made by the writer and Mr. William Moore under experimental conditions. When *additional* blue-violet light was allowed to fall on plants growing in ordinary daylight, the plants exhibited a distinct structural response. Leaves were more hairy, and internodes shorter than in the control series.

The whole question is therefore open, with the probability that the character of light at high altitudes may have a morphogenic value differing from that at low altitudes.

The Causes of Timber Lines on Mountains; Snow as a Mechanical Agency: Professor C. H. Shaw, Medico-Chirurgical College, Philadelphia.

The phenomena of timber line are not adequately explained by the factors which have been assigned. The timber lines of the White Mountains and Adirondacks can well be referred to the drying action of cold winds, but not so those of the Selkirks. In this case snow, acting as a mechanical agency, plays the chief part. It may do so in two ways:

(*a*) Small trees are directly broken and abraded by weight of snow or by snow creep.

(*b*) Small trees and lower branches which are long held under the late-lying, wet beds of snow, suffer a sort of drowning and become a prey to fungi.

When the struggle of trees for existence is primarily with wind, their height is limited, they grow thickly in level-topped societies, and the upper outposts of the forest are in local depressions or sheltered spots. Wind-cripples have dead or dying tops, often with entire loss of the conical shape; the growth of their branches is limited to a critical line. This leads to a densely branched and often one-sided habit.

On the other hand, when the struggle of trees for existence is primarily with snow, the forest as altitude increases is resolved into groups of trees. These become more separated, and the upper groups of the trees occupy ridges and local elevations. Snow-cripples possess the spire form, with flourishing upper shoots, but the lower branches and foliage are dying or dead, broken by snow and attacked by fungi.

The alpine fields of the Selkirks, which begin at about 6,000 feet, are thus chiefly due to snow. Higher up the characteristic forms of wind-cripples are seen.

It is suggested that the present ideas may be of application to the Alps as well.

Cultures of Uredineæ in 1907: Professor J. C. Arthur, Purdue University.

Eighth annual report on culture work with plant-rusts. Nearly one hundred collections with resting spores and a fifth as many with active spores were employed. The culture of seventeen species was attempted, with only negative results. Thirty species were grown with success, eight of which are now reported for the first time. Of the latter *Puccinia vexans* and *P. Cryptandri* were grown from amphispores, being the first amphisporic cultures ever made. Three sedge rusts were connected with æcial forms, an *Allium* rust carried through its cycle and two species of *Gymnosporangium*, *G. Betheli* and *G. inconspicuum* connected with æcial stages.

Notes on Certain Rusts, with Special Reference to Their Peridermial Stages: Dr. G. P. Clinton, Connecticut Agricultural Experiment Station.

The *Peridermiums* (a form genus which occurs on coniferous hosts) are the æcial stages of heterœcious rusts which belong, in their telial stages, to at least seven different genera as now recognized. So far there have been found in North America forty-nine species belonging to these genera, while only thirty species of the *Peridermiums* are known here. Investigations so far have definitely connected only a few of these species. Shear has shown that *Peridermium cerebrum* belongs to *Cronartium Quercus;* Kellerman, that *Peridermium Rostrupi* belongs to *Coleosporium Campanulæ;* and the writer, that *Peridermium acicolum* belongs to *Coleosporium Solidaginis*. European investigators have solved the relationships of three or four other species whose æcial or other stages have been found here, but these results have not yet been confirmed with American material; and American writers have suggested the possible relationship of a few more species. During the past year the writer made a special study of the various stages of such of these rusts as occur in Connecticut, with the result that through field observations, confirmed by indoor inoculation tests, the relationships of two more species are now known. *Peridermium pyriforme,* which was found on *Pinus sylvestris* and *Pinus rigida,* was found to be the æcial stage of *Cronartium Comptoniæ* on *Comptonia asplenifolia;* and *Peridermium consimile,* on *Picea nigra,* was connected with *Melampsoropsis Cassandræ,* on *Cassandra calyculata.* Some evidence was also obtained that possibly *Peridermium Peckii,* on *Tsuga canadensis,* is the æcial stage of *Chrysomyxa albida,* on *Rubus hispidus;* but further proof is needed before this can be stated positively, since there are certain points in their structure that also make it unlikely that they have any relationship.

Further Studies of the Anthracnoses: Dr. C. L. Shear and Miss Anna K. Wood, Bureau of Plant Industry. (By title.)

Sporangia, Conidia and Zygospores in the Genus Choanephora: Professor A. F. Blakeslee, Connecticut Agricultural College.

Choanephora curcubitarum (B. & Rav.) is one of the mucors found not infrequently infecting withered squash blossoms and causing a soft rot of the fruit. Up to the present time only the *Œdocephalum*-like conidial stage has been found in this country and its connection with the mucors has been somewhat in doubt. By cultivating the fungus at a temperature of about 25° C. under proper conditions of moisture, the writer has obtained the sporangia and the zygospores. The species is heterothallic and its (+) and (—) races have been secured from various localities in this country and in South America.

The Development of the Ascocarp of Melanospora: Professor J. B. OVERTON, University of Wisconsin. (By title.)

Progressive Cleavage in Didymium: Professor R. A. HARPER, University of Wisconsin. (By title.)

On the Development of Immunity for Heart-rot Diseases in Trees: Dr. HERMANN VON SCHRENCK, Missouri Botanical Garden. (By title.)

The Influence of the Swaying of the Wind on the Formation of Mechanical Tissue in Plants: Professor F. C. NEWCOMBE, University of Michigan. (By title.)

A Study of Edaphic Conditions in Peat Bogs near Ann Arbor: Dr. G. P. BURNS, University of Michigan. (By title.)

DUNCAN S. JOHNSON,
Secretary

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SCIENTIFIC BOOKS

Evolution of Mammalian Molar Teeth to and from the Triangular Type. By HENRY FAIRFIELD OSBORN, Sc.D., LL.D., D.Sc. Edited by W. K. GREGORY, M.A. Pp. 250. New York, The Macmillan Company. 1907.

This book, the most valuable contribution to mammalian odontology since that of Sir Richard Owen, consists of a series of collected and revised researches upon trituberculy with new sections on the forms and homologies of the molar teeth in the different orders of mammals. The theory of trituberculy was a conception of the late Professor Cope, but was elaborated by Professor Osborn, who has been by far the greatest exponent of the idea. Four principles have been developed in connection with the general theory: (1) That in the most primitive Tertiary mammalia there are *"three main tubercles on the crowns of both upper and lower molars, disposed in triangles"*; primitive trituberculy. (2) Origin of the tritubercular types from the single reptilian cone. *"The tritubercular type sprang from a single conical type by the addition of lateral denticles."* (3) Cusp addition or differentiation; "a process analogous to budding or outgrowth in other tissues." An opposing theory to this is that of concrescence. (4) Reversed upper and lower triangles. *"In the lower molars the reptilian cone is external and the two denticles internal, while in the upper molars the reverse is the case,* namely, *the reptilian cone is internal and the denticles are external."* It is on this principle that the Osbornian nomenclature, implying a serial homology between the cusps of the upper and lower molars, is based. As applied to the lower molars this principle is generally accepted; but as applied to the upper teeth, it has been most vigorously opposed in the light of three different classes of positive evidence—embryological, anatomical and paleontological. The embryological evidences seem to point to the antero-external cone (Osborn's paracone) as of the greatest antiquity and therefore the reptilian cone. This is also borne out by the analogy of the premolar cusp development (premolar-analogy), and by that of the lower molars. Evidence in favor of Osborn's theory is derived from paleontology, and is also shown by the mechanical development of the cusps, while on the other hand recent interpretation by Gidley of paleontological evidence is in harmony with that of embryology and with the premolar analogy theory.

In the summary of his introduction Professor Osborn says: "That the four great principles of molar evolution *do not stand or fall together."* The first principle, that of primitive trituberculy, is now almost undeniable; the *reptilian cone origin* theory next in order of demonstration and acceptance; the *cusp addition* theory finding at present more advocates than the opposing idea of concrescence. Finally the greatest conflict of evidence occurs with reference to the homologies of the upper and lower cusps. There is no middle ground; either the Cope-Osborn theory is correct and the premolar-analogy plus the embryological theory wrong, or the reverse is true.

Following the introductory section is an admirable classification of the Mammalia and a diagram showing the chronological and stratigraphic succession of the formations in which fossil mammals have been found in the western states.

Chapter I. is a reprinted essay on the teeth of the Mesozoic mammals; Chapter II. sets forth the first outline (1888) of tritubercular evolution in mammals; Chapter III., trituberculy in relation to the human molar teeth and the Primates; Chapter IV., trituberculy in its application to the molar teeth of the ungulates or hoofed mammals and the completion of the nomenclature; Chapter V., the second outline (1897) of tritubercular evolution in Mammalia with discussions of criticisms; Chapter VI. is a brief review of the dental types observed in the successive geological periods; their chronological and geological succession; while Chapter VII. will prove of extreme value to the student of paleontology as it discusses and illustrates all of the ordinal types of molar teeth and often the entire dentition. Bibliographical references are found at the close of each section of this chapter and serve to show how far afield one must go to find the wealth of information which it contains. In the eighth chapter the evolution of the premolar teeth is discussed. Those of primitive mammals; and the adaptation of premolars in which "they either (*a*) enter upon an especial adaptive evolution of their own, as for example in the upper sectorials of the cats (Felidæ), or the elaborate fourth premolars of the Plagiolacidæ, or (*b*) by a serial analogous development they more or less closely mimic the structure and supplement the exact functions and uses of the molar teeth; this mimicry reaches its highest extreme among the Perissodactyl or odd-toed Ungulates, where the premolars gradually *metamorphose into the molar pattern* and even become superior to the molars in size and complication."

Osborn speaks further of this premolar metamorphosis as being "from the biological standpoint most interesting as illustration of convergence, because *form exactly similar to that of the molars* is finally attained from somewhat dissimilar beginnings." This of course depends upon whether one holds to the Cope-Osborn theory or that of premolar analogy. If the latter be true this premolar adaptation is merely a case of parallelism.

Chapter IX. is a very frank review of the objections and difficulties which have arisen with reference to the Cope-Osborn theory and of the rival theories that have been set forth. Professor Osborn finds that two classes of criticism have arisen: (I.) That the tritubercular type is not primitive. (II.) That the Cope-Osborn theory of the origin of the superior molars is incorrect. (I.) The opposing theories to that of trituberculy each presuppose a more complex tooth as the primitive one, arguing that the tritubercular, triconodont and protodont stages are secondary simplifications. The weight of evidence, however, seems to be largely in favor of trituberculy. (II.) The three powerful arguments arrayed against the Cope-Osborn idea of the origin of the upper molars, that of embryogeny, premolar analogy, and finally a different interpretation of the paleontological record, seem difficult to combat. Osborn believes the question to be still *sub judice*, in spite of the fact that he and Gregory have brought forth all of the evidence which ripe learning and exhaustive study have produced.

Writers agree that the Osborn nomenclature should in any case be retained because of its wide use in paleontological literature and its great convenience. One is somewhat dismayed, however, by the fact that the fourth upper premolar and first molar of the horse, for instance, teeth almost indistinguishable in structure, must needs be described by totally different nomenclatures.

The final chapter discusses the idea of rectigradations in the evolution of tooth cusps.

The whole book gives evidence of the most painstaking work, not only on the part of the author but of his able editor as well. Perhaps its most delightful feature is the judicial fairness and frankness with which the whole evidence is reviewed and discussed.

Richard S. Lull

Yale University

Immunochemistry. The Application of the Principles of Physical Chemistry to the Study of the Biological Antibodies. By Svante Arrhenius. New York, The Macmillan Company. Pp. 309. $1.60.

During the last year Arrhenius has published three books which, in the opinion of the reviewer, embody the most advanced results and conceptions of modern science in a classical form. Those who are interested in the methodology of science and the theory of cognition will learn by what methods those scientists, of whom Arrhenius is a representative, are able to build on certainty instead of upon the vague basis of hypothesis; and those who doubt whether or not we have reached any definite conception of the nature of matter will find authoritative information in the books of Arrhenius. These books are: (1) "The Theories of Chemistry," (2) "Das Werden der Welten," (3) "Immunochemistry." The English edition of the latter has just appeared and it is to this that we wish to call special attention.

After Metchnikoff had made the attempt to explain the phenomena of immunity by phagocytosis Ehrlich showed that immunity is due to a chemical reaction between toxin and antitoxin. With the clear foresight which has characterized the scientific career of this brilliant investigator he saw that the ultimate proof for the correctness of the purely chemical conception of the phenomena of immunity could only be furnished by the physical chemist. Through the influence of Madsen, Arrhenius was induced to undertake this task. Partly alone, partly in collaboration with Madsen and his school, he solved the problem in the only way on which it could be solved—namely, by showing that the action of the antitoxin upon the toxin followed the law of Guldberg and Waage. In the execution of this task he adopted the principles of eliminating the unnecessary and disturbing variables and presenting the results as the function of the minimal number of independent variables. The fact that this principle is not sufficiently appreciated by biologists has led here, as in all similar cases, to some opposition. It is, however, obvious that if a variable has been overlooked its effects can easily be added to the results; while without an attempt at the utmost simplification in the beginning no start and no progress would have been possible.

The writer of this review would especially call the attention of the younger biologists to the importance of a study of Arrhenius's books.

Jacques Loeb

The Electrical Conductivity of Aqueous Solutions. A Report presented by Arthur A. Noyes, W. D. Coolidge, A. C. Melcher, H. C. Cooper, Yogoro Kato, R. B. Sosman, G. W. Eastman, C. W. Kanolt and W. Böttger. Contribution from the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology No. 19. Carnegie Institution of Washington, Publication No. 63. Pp. vi + 352.

This volume is a report on a monumental series of investigations which have been in progress in Professor Noyes's laboratory during the past five years upon the electrical conductivity of aqueous solutions of certain salts, acids and bases through a wide range of temperatures extending from 18° to 306°. The work was undertaken with the expectation of studying the properties of aqueous solutions at temperatures up to the critical temperature and beyond, a task burdened with very serious difficulties, as will be realized when one recalls that the critical temperature of water is in the neighborhood of 360°, and that at this temperature the conductivity cell must not only safely withstand a pressure of something like 200 atmospheres without leaking and without contaminating the dilute solutions employed, but must also do this under such conditions as will permit accurate control of the temperature, volume and conductivity of the solutions.

Up to the present time the highest temperature reached is 306°, but to one who studies the ingenious manner in which the experimental difficulties have so far been overcome there can be no doubt that the original plan will be ultimately realized.

Among the important results presented in this volume are data showing the effects of widely varying temperature conditions on the specific volumes of water and water solutions, on the equivalent conductivities of electrolytes, on the specific migration velocities of the ions, on the degree of ionization of various solutes, on the self-ionization of water and on hydrolysis.

The effect of rising temperature is to enormously increase the equivalent conductivity of aqueous solutions and the speed with which the ions travel in such solutions, the speed of the latter continuing to increase even after the equivalent conductance has reached a maximum value, thence to decline with rising temperature. The significant observations have also been made that the specific velocities of all monovalent ions tend toward equality with rising temperature, while divalent ions approach a value double that of monovalent ions. These tendencies, together with the effect of rising temperature on conductance, are illustrated by the behavior of potassium chloride and hydrochloric acid. The equivalent conductances of potassium chloride and hydrochloric acid, extrapolated for zero concentration, which at 18° are respectively 130.1 and 379.0 reciprocal ohms, have been found to be 1,120 and 1,424 respectively at 306°.

Various investigators have called attention to the fact of a connection between the viscosity of the solvent and ionic velocities. It is shown in these investigations that the conductance of salt solutions increases with rising temperature at practically the same rate as the fluidity of the solvent, at any rate up to 156°, which is the limit to which viscosity measurements have been made.

Increase of temperature has been found to be accompanied by a marked diminution of the ionization of the solute and especially at higher temperatures the rate of decrease becomes very great. For example, in a 0.01 normal solution of hydrochloric acid, the percentage ionization at 18° is 97.1, while at 306° it is but 82 per cent. Of an 0.08 normal solution of potassium sulfate, 73 per cent. of the solute is present as ions at 18°, while at 306° only 23 per cent. is present in the ionic condition. The effect of rise of temperature on the dissociation of weak acids and bases is even more marked, as is shown by the change of the affinity constant of acetic acid from 0.0000183 at 18° to 0.000000139 at 306°, and of ammonium hydroxide from 0.0000172 at 18° to 0.000000093 at 306°.

In view of the diverse opinions which have been expressed concerning the connection between the dielectric constant of a solvent and its ionizing power, it is interesting to note that these researches show that the ratio of the concentration of the un-ionized portion of the solute at two different temperatures (at least up to 100°, the limit to which the dielectric constant of water is known) agrees very well with the ratio of the dielectric constants for the same temperature interval.

Since the equivalent conductance of an electrolyte is a function of two variables, specific speed of the ions and the degree of ionization, and since the effect of changing temperature on the ionization is most conspicuous at higher temperatures, it follows that the equivalent conductance must pass through a maximum value thence to diminish continuously towards zero as the temperature passes the critical point. This maximum has been realized in the case of a considerable number of solutes, especially in the more concentrated solutions.

Quite contrary to the influence of rising temperature in diminishing the dissociation of electrolytes in solution is the effect on the ionization of water itself. The ionization constant of water rises with tremendous rapidity up to 100°, thence more slowly, reaching a maximum value over 5,000 times the value at zero, after which it decreases with further rise of temperature. This great increase in the ionization of water with rising temperature, together with its weaker ionizing effect on electrolytes in solution, accounts for the enormously greater tendency of salts to hydrolyze at higher temperatures.

As at ordinary temperatures, so also at higher, the mass law does not apply to solutions of salts, strong acids and bases. On the other hand, the applicability of the law to weak acids and bases has been shown to be independent of the temperature. In this connection it is important to note that in the summary to this series of papers Dr. Noyes expresses his conviction that "the ionization of salts, strong acids and strong bases is a phenomenon primarily determined not by specific chemical affinities, but by electrical forces arising from the charges on the ions, that it is not affected, excepting in a secondary degree by chemical mass action, but is regulated by certain general, comparatively simple laws, fairly well established empirically, but of unknown theoretical significance, and that, therefore, it is a phenomenon quite distinct in almost all aspects from the phenomenon of dissociation ordinarily exhibited by chemical substances, including that of the ionization of weak acids and bases."

It is scarcely necessary to emphasize the importance of such a study of aqueous solutions as Professor Noyes has inaugurated, for, in addition to the direct physical and chemical significance of the knowledge thus to be gained, every one will recognize the importance of such investigations in their bearing on certain phases of chemical technology and chemical geology.

E. C. Franklin

Stanford University

SCIENTIFIC JOURNALS AND ARTICLES

The opening (January) number of volume 9 of the *Transactions of the American Mathematical Society* contains the following papers:

F. L. Griffin: "Certain periodic orbits of k finite bodies revolving about a relatively large central mass."

G. H. Darwin: "Further note on Maclaurin's spheroid."

O. D. Kellogg: "Potential functions on the boundary of their regions of definition."

O. D. Kellogg: "Double distributions and the Dirichlet problem."

G. A. Miller: "Groups defined by the orders of two generators and the order of their commutator."

E. J. Wilczynski: "Projective differential geometry of curved surfaces. (Second memoir.)"

The February number (volume 14, number 5) of the *Bulletin of the American Mathematical Society* contains: Report of the First Regular Meeting of the Southwestern Section, by O. D. Kellogg; "Note on the Composition of Finite Rotations about Parallel Axes," by Alexander Ziwet; "On an Integral appearing in Photometry," by A. S. Chessin; "Hermitian Forms with Zero Determinant," by J. I. Hutchinson; "Two Tetraedron Theorems," by H. S. White; "Singular Points of a Simple Kind of Differential Equation of the Second Order," by C. A. Noble; "The Theory of Electricity" (review of Abraham's Theorie der Elektrizität, volume 2), by E. B. Wilson; "Notes;" "New Publications."

The March number of the *Bulletin* contains: Report of the Fourteenth Annual Meeting of the Society, by F. N. Cole; Reports of the December Meeting of the Chicago Section and of the Joint Meetings at Chicago of Mathematicians and Engineers, by H. E. Slaught; Report of the Fifty-eighth Meeting of the American Association for the Advancement of Science, by G. A. Miller; "Shorter Notices" (Larmor's Memoir of G. H. Darwin, by E. W. Brown; Lambert's Computation and Mensuration, by E. W. Ponzer; Schütte's Darstellende Geometrie für Gymnasien, by Virgil Snyder; Thompson's Petrus Peregrinus, by F. Cajori; Broggi's Traité des Assurances de la Vie, by G. H. Ling); "Notes;" "New Publications."

SOCIETIES AND ACADEMIES

THE SOCIETY OF CHEMICAL INDUSTRY

In place of the regular meeting of the Society of Chemical Industry on January 24, a joint meeting of the Society of Chemical Industry, the American Chemical Society, the American Electro-Chemical Society, the Chemists' Club of New York City and the Verein Deutscher Chemiker was held for the presentation of the Perkin Medal to Mr. J. B. F. Herreshoff. Mr. George C. Stone was in the chair.

After a few introductory remarks by the chairman, in which he emphasized the importance of stimulating chemical research by proper recognition, and bringing to the attention of the audience the life-work of Sir Perkin, who not only discovered a new product, but worked out its manufacture, developed the method of using the same and sold it, he requested the secretary to read the report of the Perkin Medal Committee, and to speak about the meaning and importance of the Perkin Medal.

The secretary then delivered his address, "History of the Perkin Medal and Report of the Committee for its Presentation."

The chairman then called upon Professor M. T. Bogert to speak on the subject allotted to him, "Stimulus given Chemical Research and Invention by Suitable Recognition."

Then Mr. H. A. Metz followed with his address on "Services rendered by the Chemist in the Development of the Coal Tar Industry," and then Professor S. A. Tucker spoke on "Electricity as applied to Industrial Chemistry."

Professor Charles F. Chandler then presented the Perkin Medal to Mr. J. B. F. Herreshoff, with an appropriate and extremely interesting address.

Mr. Herreshoff in a well-chosen speech acknowledged the honor conferred upon him.

The ceremonies were concluded by an address by Dr. William H. Nichols, in which he described the intimate association between the recipient of the Perkin Medal and himself for the last thirty years. He also read a cable which he had just received from England, in which Lady Perkin and her daughters congratulate Mr. Herreshoff on receiving the medal.

Mr. J. B. F. Herreshoff was born in Bristol, R. I., and is a brother of the well-known yacht designer and builder; received his college education at Brown University and in 1870 was assistant instructor in chemistry for two years. After that he was chemist with Professor Charles A. Seely in New York and after that chemist for the Silver Spring Dyeing Establishment and chemist with William Habershaw at New York. In 1875 he was made Superintendent of the Laurel Hill Chemical Works of W. H. Nichols & Co. In 1890 he was made vice-president of the corporation of the Nichols Chemical Co. In 1900 he became the vice-president of the Nichols Copper Co. and consulting engineer of the General Chemical Co., and is still occupying these positions.

H. Schweitzer,
Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

The 180th regular meeting of the Washington Section of the American Chemical Society was held at the Cosmos Club on Friday, February 13, 1908, at 8 P.M. The attendance was 44. The following papers were presented:

E. T. Allen: "The Rôle of Water in Tremolite and certain other Minerals."

H. C. McNeil: "Some Metallic Salts of Guaiacol."

F. W. Smither: "A Sample of Ferro-phosphorus."

J. A. LeClerc,
Secretary

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

The fifth regular meeting of the session of 1907–8 was held at the Chemists' Club, 108 West 55th Street, on February 7.

Professor Chas. Baskerville read the first of a series of three papers relating to the chemical department of the College of the City of New York, his title for the evening being "Laboratory Organization."

Dr. A. S. Cushman, of the Office of Public Roads, read a paper on "The Extraction of Potash from Feldspathic Rocks."

The electrolytic method described was of scientific value only, but Dr. Cushman hoped it might lead to some commercially possible process. He described a practical method of rendering the rock itself available for fertilizing purposes and finally called attention to the great advantage this country would derive from having a cheap domestic source of potash.

C. M. Joyce,
Secretary

THIRTEENTH ANNUAL WINTER MEETING OF THE VERMONT BOTANICAL CLUB

This meeting was held January 17, 18, 1908, at the University of Vermont, Burlington. The following papers were read:

"Progress in the Forestry Movement," by Dr. L. R. Jones, University of Vermont.

"Notes on Moss," by Miss Towle, Edmunds High School.

"Seven Giant Puffballs," by Mrs. Lord, Burlington.

"Questions concerning Weed Distribution," by L. C. Cook, University of Vermont.

"The Fruits of some Shrubs and Trees of Vermont," by F. V. Rand, University of Vermont.

"Local Observations on Effect of Altitude on Vegetation," by Joseph A. Chapin, Middlesex.

"The Botrychiums of Dorset," by Allan Bourn, Yonkers, N. Y.

"*Oxalis Brittonæ* at Pownal," by Dr. Tracy Hazen, New York.

"Discovery of the Water Chickweed in Vermont," by Richard W. Woodward, Yantic, Conn.

"The Late Alphonso Wood," by Miss Alice E. Bacon, Bradford.

"The Fernery," by Miss Elizabeth Billings, Woodstock.

"Reproduction in Bread Mold," by L. R. Whitcomb, Edmunds High School.

"A New Station for the Green Dragon," by Geo. L. Kirk, Rutland.

"Soil Acidity in Relation to Flora," by H. A. Edson, University of Vermont.

"Some Rare Plants on Mount Horrid," by D. L. Dutton, Brandon.

"A Bacterial Rot of the Muskmelon," by N. J. Giddings, University of Vermont.

"A Trip to Mount Mitchell," by W. W. Eggleston, Rutland.

"Mount Washington" (illustrated with lantern), by John W. Ritchie, Jr., Boston.

Professor M. L. Fernald, Gray Herbarium, Harvard University, was the guest of the club and delivered a public lecture on "The Flora of the Shickshock Mountains and the Gaspe Coast" (illustrated with lantern).

The following were elected officers for the ensuing year:

President—Ezra Brainerd, Middlebury College.

Vice-president—Cyrus G. Pringle, University of Vermont.

Secretary—L. R. Jones, University of Vermont.

Treasurer—Mrs. N. F. Flynn, Burlington.

The next meeting will be in conjunction with the Federation of New England Natural History Societies at Mt. Washington about July first.

The club has an active membership of nearly 200 and publishes an annual bulletin, of which the third number will appear in April.

L. R. Jones,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 196th meeting of the Society, held at the Cosmos Club, on Wednesday evening, November 27, 1907, under informal communications, Mr. Willis T. Lee announced the discovery of fossils in the red beds of the foothills region of New Mexico. Collections were made near Rowe, a station of the Atchison, Topeka and Santa Fe Railway in the Pecos Valley and also at a point about five miles northwest of Las Vegas, near the base of the red sediments which are here 5,000 feet or more in thickness. The fossils have been identified by G. H. Girty, of the United States Geological Survey, and found to belong to the fauna characteristic of the lower group of the Pennsylvanian (Carboniferous) series of central New Mexico, now known as the Magdalena group. These collections indicate that a part, at least, of the so-called "Permo-Triassic Red Beds" of the eastern Rocky Mountains are of Pennsylvanian age.

Professor G. D. Harris, of Cornell University, presented informally a summary of the results of his investigations of the salt domes of Louisiana and Texas. The Mississippi embayment is a huge *"pitching trough,"* pitching southward, and in the course of its development, differential uplift or settling of one of the planes has given rise to lines of weakness in two directions, northeast-southwest and northwest-southeast. The points of intersection of such lines generally occur at sharp anticlines and there saturated salt solutions could easily escape upwards into the overlying later formations. But salt waters, if saturated at high temperatures, precipitate, on cooling, a portion of their dissolved salt, and the force which can be exerted by crystallizing salt is of about the same order of magnitude as its ultimate strength. On testing it was found that a 4-inch cube of salt withstands a pressure of 50,000 pounds without even cracking, and the inference is therefore warranted that the crystallizing salt can lift at least 3,000 feet of Tertiary and Quaternary sands and clays. Clays and sands, however, have a density of about 2.5, while that of salt is 2.16, and the expansive force of the salt from the crystallizing source will be very circumscribed and the salt domes local in character. The domes in both Texas and Alabama are of similar origin, though some may consist in large part of gypsum, limestone or sulphur as well as of salt. Some of these cores of salts have been pushed up through Cretaceous strata, others through Eocene and many into the Quaternary; they are distinctly exogenous in character and may be termed foreign intrusions. Similar occurrences of salt domes have been noted at Ischel in Algeria and seemingly in the Salt Range of India. The material for these salt domes is considered to have been taken up by the circulating solutions from the late Paleozoic or Mesozoic salt and gypsum layers which constitute the floor of the pitching trough of the Mississippi embayment. The arching or doming up of pervious and impervious strata by the crystallizing salt domes facilitates the segregation of the oil and gas which are also found in this region.

Regular Program

The Occurrence of the Silurian in Western America: Mr. E. M. Kindle.

Mr. Kindle reviewed briefly the evidence on which many geologists have questioned the reported occurrences of Silurian strata in the western states. Three localities which had come under the speaker's observation were cited from which distinctly characteristic Silurian faunas had been obtained. These localities are in the Wasatch Mountains of Utah, in southeastern Alaska and in northeastern Alaska. The bearing of these observations on one of the problems of Silurian paleogeography was pointed out.

The Origin of Limestone Breccias: Mr. Marius R. Campbell.

There is such a common tendency to ascribe all brecciation of rocks to movement, that the writer takes this opportunity to describe the formation of a solution breccia which, fortunately, he was able to observe in various stages of its development near Fort Stanton, New Mexico. The exposure is in a narrow box canyon cut in horizontally bedded carboniferous limestone.

The initial stage of the process consisted of a solution channel formed by a stream of running water. From this channel the limestone has been dissolved along the bedding planes for varying distances, amounting, in some cases, to as much as fifty feet. As the limestone is variable in composition, the cavities are irregular, extending in many places vertically through the beds, probably along incipient joint cracks. In some places this action had gone on until the more siliceous portions of the rock remained as a mere honeycomb, filling a cavity possibly 100 feet long and 8 or 10 feet high. Subsequently the rock had been eaten through and droppings had filled the cavern with an irregular mass of subangular fragments. The final stage showed this mass recemented by the calcareous waters into a solid breccia completely filling the cavern in which it was formed.

Several examples were seen where this process had gone on to its culmination, and in such cases one could follow the bedding of the limestone above and below and on both sides of the original cavern, but within all trace of bedding had been obliterated. If this process were repeated many, many times, it is conceivable that it might result in the complete brecciation of certain beds which were more soluble than the rocks above and below and thus give rise to such a formation as the "sheet ground" of the Joplin zinc and lead district.

A Recent Vein at Ojo Caliente, New Mexico: W. Lindgren.

Ojo Caliente is a small village situated in northern New Mexico, about fifteen miles west of Barranca station on the Denver and Rio Grande road. Strong mineral springs of great local reputation issue here from the bottom lands of a small tributary to the Chama River. The water has been analyzed by Dr. Hillebrand. It is of a strongly alkaline character and contains much sodium carbonate. Other interesting constituents are boron, fluorine and barium. Fluorine is present in considerable amount. Near these springs the foot-hills of pre-Cambrian gneiss contain veinlets of colorless fluorite, which doubtless was deposited by these hot waters when they issued at a somewhat higher elevation. Still higher up on the western slope is found a narrow vein, which contains small amounts of gold and silver in a gangue of colorless fluorite with a little barite, and this vein appears to be capped by a deposit of tuffaceous character, which principally consists of carbonate of lime, but also contains a notable amount of fluorine and traces of gold and silver. It is believed that this vein and the deposit were formed at about the same time, the deposition of the lime carbonate taking place at the surface while fluorite was the principal deposit in the vein a short distance below the surface. All this indicates that these springs have been active during a long time, and it is probable that the hot waters issued at gradually lessened elevations as the erosion deepened the valley.

AT the 197th meeting of the society, held on December 19, 1907, Mr. Waldemar Lindgren, the retiring president, presented an address, entitled "Present Tendencies in the Study of Ore Deposits."

Mr. Lindgren stated that he wished to place before the society in the briefest way the tendencies of the study of ore deposits as shown during the first seven years of the twentieth century. In a way the year 1900 might be considered as marking a mile-stone in the progress, for during that year the prevailing theories found specially clear exposition at the hands of many observers. The activity of the various nations in this study was mentioned, and it was shown that the United States, Germany and Scandinavia were most prominent in this respect. The different modes of publication, monographic descriptions *versus* geographic treatment were emphasized. Next, the progress in the technical methods was noted and special reference made to the metallographic methods to the study of opaque minerals. The relation of chemistry to the science of ore deposits occupied attention and it was shown that in spite of some recent activity much remained to be done in this direction, not only with reference to investigation of methods of mineral formation, but also, for instance, in regard to the examination of the hot springs and their deposits, especially in the western states. The relative merits of the monographic and the geographic treatment of ore deposits was discussed. It was stated that excellent results had been obtained by Professor DeLaunay in Paris by applying this method to the ore deposits of Africa and Italy; it was also shown that much remained to be done in this direction in the United States.

In regard to classification it was shown that no consistent genetic system had as yet been successfully applied. The usefulness of the terms "syngenetic" and "epigenetic" was insisted upon and mention was made of the present tendencies in transferring a large number of deposits to the epigenetic class. This was exemplified by reference to iron ores of Sweden and pyritic deposits in various countries. In the latter class a syngenetic origin was maintained by a few observers, but the general trend of opinion was away from the view of chemical precipitation in lakes or seas and in favor of the subsequent introduction of the metals by hot solutions.

Historic geology has its counterpart in our branch of the science, and it was pointed out that during the last years, both abroad and in the United States, attempts have been made to distinguish the various periods of mineralizing activity.

The latter part of the address was devoted to the question of the origin and genesis of ore deposits, always a most difficult and unsatisfactory problem since its solution must always be based on hypothesis and suppositions. The general prevalence in the end of the last century of the theory of ore deposition by circulating surface waters was noted, and it was shown that the theory of ore deposition from magmatic waters began to find general acceptance in the first years of this century. It is impossible to peruse the literature of any country of the last few years without noticing the remarkable spread of this idea. It seems to pervade the whole atmosphere of research and find expression among the workers from all countries. The views of contemporary workers on this subject were explained and it was stated that while the adherents of the theory of magmatic emanations may go too far in some directions, this theory has come to stay, and that it and no other satisfactorily explains a great number of ore deposits.

The prevailing theoretical tendencies of the present might be summed up as follows: We unanimously agree in seeking the ultimate source of the metals in the igneous rocks. We say that the rarer metals in concentrated forms, dissolved in water, emanate from the magmas during and after their eruption into higher levels of the lithosphere, and that minerals containing these metals are deposited along the pathways of the waters. We assert that atmospheric waters may search the congealed rocks, abstract from them a part of the small residues of the valuable metals, and deposit them along the channels. We say further that metamorphism, when acting upon these igneous rocks, is a potent factor in favor of further concentration, aided by the moisture contained in the rocks.

We say finally that as erosion degrades the volcanic mountains and their ore deposits, and the fragments are carried down to form sedimentary beds, the heavy native metals, such as gold and platinum, are concentrated into placers, and the baser metals are distributed as salts of various kinds throughout the beds. Atmospheric waters take up these particles into solution, and, aided by the influence of reducing substances as organic matter, concentrate them as deposits in congenial places.

At the close of Mr. Lindgren's address the fifteenth annual meeting of the society was held for the purpose of electing officers, and the following officers were elected for the ensuing year.

President—Mr. Waldemar Lindgren.

Vice-presidents—Mr. M. R. Campbell and Mr. A. H. Brooks.

Secretaries—Messrs. Ralph Arnold and Philip S. Smith.

Treasurer—Mr. Joseph A. Taff.

Members at Large of the Council—C. A. Fisher, F. L. Hess, C. E. Siebenthal, G. B. Richardson, George H. Ashley.

Fred E. Wright,
Secretary

DISCUSSION AND CORRESPONDENCE

THE TEACHING OF MECHANICS

To the Editor of Science: It seems to me high time for something to be done for the teaching of the first principles and definitions of mechanics in our schools. In the "Report of the Committee of the Central Association on Algebra in the Secondary Schools" which has just reached me. I find the following:

6. Momentum $=$ velocity $\times$ weight. It is a measure of the force with which one body strikes another.

The "clear and concise statements" of physical laws which the committee recommends should have the additional merit of a reasonable degree of accuracy.

Ernest W. Brown

New Haven, Conn.

ADJUSTABLE BURDEN BASKETS

To the Editor of Science: Dr. William L. Abbott has sent to the U. S. National Museum five Dyak burden baskets of an entirely new type. They might be called "adjustable burden baskets," since by means of lacings their holding capacity may be expanded or contracted, like a shoe front.

Three of the specimens have each a framework of two U-shaped bows crossing on the bottom; the others have each a four-sided footing, incurved on the sides and pinched in at the corners to fit the lower ends of the four uprights that strengthen the body. All of the specimens are left open, the wrapping on the upper margin being continued down the front opening and united at the "up-set," or place where the bottom turns into the body. Hence the two margins are joined together in the examples with U-shaped bows even to the center of the bottom. The border consists of a small rattan stem, whose close neat wrapping with a thin split of the same material is, at intervals of an inch or two, united with the warps on the sides and to the twined weaving of the upper margins, by mousings.

There are other features of the specimens that will be described and illustrated in a larger paper on Malaysian basket work in preparation. I wish now to call attention to a new variety of textile and to inquire concerning the existence of other examples.

O. T. MASON

U. S. NATIONAL MUSEUM,
January 30, 1908

NOTE ON THE "LAFAYETTE BEDS" OF LOUISIANA

SOME very interesting facts are being brought to light in southern Louisiana by the large number of oil-wells put down since the date of the famous Lucas gusher in 1901.

In undisturbed beds near the coast we find the Quaternary molluscan fauna extending down to about 2,000 feet. The drill samples show sands, clays and gravels, the latter of typical Lafayette type to at least 1,500 feet. Oyster reefs are encountered more or less frequently, showing a sinking of several hundred feet in comparatively late times. In the Texas Galveston well, and in the regions where underlying beds have been brought up near the surface, as in the Jennings oil field, the first pre-Quaternary fauna is *Miocene* in appearance, not Pliocene. It has been customary to regard the Lafayette as approximately Pliocene. But our well records seem to indicate that the seaward continuation of the gravels in the central portion of Louisiana as well as in those states to the east and west are rather Quaternary than Pliocene, and that the whole embayment region, perhaps, was above sea-level in Pliocene times and was being eroded instead of being below sea level and receiving hundreds of feet of coarse littoral sediment. It would seem then, that Hilgard's views as to the contemporaneousness and interrelationship of the coarse "Orange sands" in the south and the ice sheets in the north may prove correct in spite of the fact that certain "Lafayette" gravels are said to lie beneath glacial till farther north.

G. D. HARRIS

SPECIAL ARTICLES

THE PENETRATING RADIATION

IN the present article three distinct methods will be given to show that the penetrating radiation which produces part of the ionization in closed vessels is not due to γ rays from radium in the ground itself. It seems quite probable that the penetrating radiation must be due to radioactive products in the air and it is quite probable that the origin of these products is in the ground as Elster and Geitel's theory indicates.

The first method is based upon the radium content of the various rocks as analyzed by Strutt and Eve. The highest value for the radium content of sedimentary rocks was found to be $2.92(10)^{-12}$ grams of radium per gram of rock. The mean value found by Strutt for sedimentary rocks was $1.1(10)^{-12}$ grams and by Eve $.8(10)^{-12}$ grams. The value of the radium content varies greatly with the locality, but for surface soils which are subjected to all the various kinds of weather changes the radium content is probably smaller than that found above. For instance, Strutt found a radium content for chalk at the bottom of a cliff to be $.39(10)^{-12}$ grams and at the top of the same cliff $.12(10)^{-12}$ grams.

$.9(10)^{-12}$ grams per gram of rock will probably be in general a maximum value for surface rocks. This quantity will be called Q.

Eve (*Phil. Mag.*, Sept., 1906) has determined K, the number of ions produced per c.c. by the γ rays in air from one gram of radium bromide supposed concentrated at a point and at a distance of 1 cm. The number of ions produced per c.c. at a point near the surface by a semi-spherical shell of ground of radius r and thickness dr is

$$\frac{2\pi r dr \delta K Q}{r \times .6} \varepsilon^{-\lambda r},$$

where δ is the density (about 2.7) and λ is the coefficient of absorption for the ground (say .09). The factor .6 comes in since K is given for radium bromide and Q for pure radium; K is $3.1(10)^9$. The total number of ions produced per c.c. per second by the ground would be

$$\int_0^\infty \frac{2\pi r \delta K Q dr}{.6 r} \varepsilon^{-\lambda r}.$$

This value comes out about .8 ion per c.c. per second as a probable maximum amount.

Cooke found that the penetrating radiation produced about 4.5 ions per c.c. per second and McClennan has recently found 9. We thus see that the radium content of the ground is too small to account for all of the ionization produced by the external penetrating radiation. Eve (*Phil. Mag.*, August, 1907) reaches a similar conclusion.

Taking λ for air to be .00004 and assuming Cooke's value for the ionization produced by the penetrating radiation, one can calculate the radium content of the air necessary to furnish a sufficient amount of γ radiation. Supposing these radioactive products to be contained by the lower strata of air—say for a height of 300 m.—one finds that this is equivalent to the radium content of some 60 centimeters depth of ground, taking Q equal to $.9(10)^{-12}$. This depth is rather large, but is not entirely impossible. The diurnal temperature wave penetrates to a depth of about one meter and barometric waves probably penetrate much deeper.

It has been found by Campbell, Wood, the writer and McKeon that the value of the external penetrating radiation which produces part of the ionization in closed vessels varies very considerably in amount, these variations often amounting to more than one or two hundred per cent. in the course of two or three days. If this penetrating radiation is due to the γ rays from the ground it should be practically constant. Moreover, Dike has found that the active deposit in the air also varies very greatly in amount. The writer has found in several instances that the penetrating radiation falls almost to zero value during a heavy rain or snow (SCIENCE, July 12, 1907). Now Wilson, Rutherford and Allen have shown that rain and snow carry down radioactive products. If this is true, then, according to our theory, the penetrating radiation would be considerably decreased. During a very heavy rain the decrease should be very noticeable, and might reach a very low value. If the external penetrating radiation is due to radium products in the air, then after a heavy rain the penetrating radiation should increase rapidly for one or two hours after the stopping of the rain, since the products radium *A*, *B* and *C* will reach equilibrium values in that length of time, and the γ rays come from radium *C* only. Results indicating a recovery of the penetrating radiation similar to this have been noted in one instance.

The writer has tried glass electroscopes with practically all metal parts covered with sulphur. Since glass and sulphur give off very little intrinsic radiation, the ionization should be produced chiefly by the external penetrating radiation. The results found so far are so irregular that they are as yet hard to interpret.

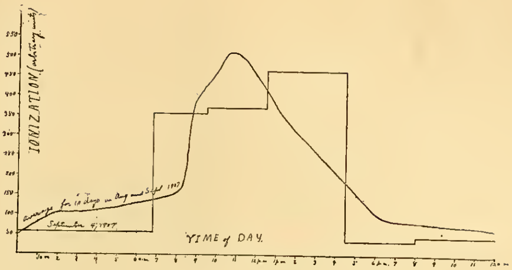
During the summer of 1907 some observations were made in the Cumberland valley (Trenton limestone similar to that analyzed by Eve) seven miles from Harrisburg, and one mile from any town. The electroscopes were lined on the inside with aluminium. Readings during the day were made every few hours. During the night, as the leak was very slow, few readings were made, so that readings were not frequent enough to show the double daily period. The curves do show the enormous increase of the ionization during the early hours of the day. During the night the ionization was very small. The electroscope was placed in a cistern in the ground and was thus surrounded on all sides by at least four feet of water. In this case the penetrating radiation was entirely cut off and it was found that there was no difference in the ionization found during the various parts of the day. Moreover, the amount was roughly the same as that observed during the night on the surface of the ground.

The conclusion is that during the early hours of the day the penetrating radiation was quite large, the walls of the electroscope being thick enough to absorb any β-like rays.

Curve 1 represents the values found September 4, 1907.

Curve 2 represents averages found for several days during August and September, 1907.

During the early hours of the day, according to Elster and Geitel's theory, the ground would become warmer and its emanating power would be greatly increased. Radioactive products would thus accumulate in the lower strata of the air, and as the coefficient



of absorption for air is very small, the penetrating radiation would be very considerably increased. The amount of ionization in the open air is in agreement with this view.

Curve 2 is very similar to the curves representing the hourly rate of change of temperature during the day.

The third method is the determination of the rate of leak below the ground. If the penetrating radiation is due to the γ radiation from radium in the ground, the ionization caused by it should be twice as much in a well or cave in the ground. During the summer the writer tested this by placing the electroscope in a cave. The rate of leak was found to be somewhat less than that occurring during the night on the surface, and was found to be about the same as the leak when the electroscope was surrounded with four feet of water in a cistern. Moreover, the rate of leak was the same during the day as during the night. Similar results have been found by Elster and Geitel.

The conclusion is that a large part of the ionization in closed vessels due to the external penetrating rediation is subject to large variations, and probably consists of γ rays from radioactive products in the air rather than in the ground. These products vary very much in quantity according to atmospheric conditions. A very convenient method of measuring these products is by measuring the amount of the ionization due to the penetrating radiation.

The writer wishes to express his sincere appreciation of the constant spirit of interest shown by Professor Ames.

W. W. Strong

Johns Hopkins University

MELTING-POINT CURVES OF BINARY MIXTURES OF THE THREE NITRANILINES

Some interesting results have developed in the course of an investigation of the subject mentioned above. We prepared a series of mixtures of ortho- and metanitraniline, the difference in composition between each consecutive member being 2 per cent., and plotted the melting points of these mixtures against their composition. The curve produced was regular, it fell from 71°, the m. p. of the pure ortho compound, to 54°, the eutectic point, then rose steadily to 114°, the m. p. of pure metanitraniline. It is possible, therefore, to employ the curves to determine the composition of mixtures of the two isomers. For this purpose the melting point of the substance under examination is determined; this gives, in general, a temperature corresponding to a position on each limb of the curve and therefore to two possible mixtures. Another portion of the substance is now ground up with an approximately equal weight of either of the pure isomers—say the meta- and the m. p. of this mixture is determined. If it is *lower* than that of the first one the composition of the original material is represented by the point on the *ortho-* limb of the curve, whereas, if the second m. p. is higher than that of the first, the composition is read off from the *meta-* side of the curve. In practise the two melting points are determined simultaneously, on the same thermometer. The method is extremely simple and requires a minimum of time and material, the results, so far as we have been able to test them, appear to be accurate to within 2 per cent. The ordinary method for the separation of these substances consists in laborious, repeated fractional crystallization.

We believe that this application of melting points is new.

A curve of a similar nature is given by mixtures of meta- and paranitraniline; it also can be used in the manner described above for quantitative analytical purposes. On the other hand, the melting points of mixtures of ortho- and paranitraniline vary in a remarkable manner, rising and falling through many degrees for relatively small differences in composition. The reason for this behavior is at present under investigation; it is possible that it may be connected causally with the constant, simultaneous production of ortho- and para-disubstituted benzene derivatives.

We expect to publish the full details of the work outlined in this note in an early number of the *Journal of the American Chemical Society.*

J. Bishop Tingle,
H. F. Rolker
McMaster University
Toronto, Canada,
December 21, 1907

NOTES ON ENTOMOLOGY

Dr. Hans Roeschke's revision of *Cychrus*[1] is a work of much interest to American coleopterists since about half of the forms occur in the United States. The material at his command was quite extensive for the western species, but with the eastern species he has a rather slight acquaintance. Dr. Van Dyke has examined for him the types of Leconte and Horn, and from the St. Petersburg Museum he has had types of Eschscholtz, Mannerheim and Ménétries, and much valuable material from the Oberthür collection. He recognizes three genera; *Scaphinotus,* with seven subgenera, among them *Nomaretus* and *Brennus; Cychrus,* with two subgenera; and *Sphæroderus.* Dr. Roeschke is a "lumper," and reduces the host of nominal species to 62; most of them with one or more subspecies, varieties or aberrations under them. There are three new species of *Scaphinotus,* all from Arizona, and one new subspecies of *S. elevatus. Nomaretus* is restricted to *N. cavicollis, bilobus* and *fissicollis,* the others forming a new subgenus, *Pseudonomaretus.* A new subgenus, *Neocychrus,* is erected for *C. angulatus,* and a new form, *N. behrensi,* from California. There are several new subspecies in *Brennus.* The plate illustrates the structural characters of the genera.

Major T. L. Casey, who apparently loves to study difficult groups of beetles, has published a large work on one of the little-known subfamilies of darkling beetles.[2] He divides the subfamily into 25 tribes, nine of which have no representatives in our fauna. There are 350 species, arranged in about 50 genera and several subgenera. Nearly all of the species are described as new, and most of them come from Arizona and California, others from Texas and Utah. Extremely few of the species are as yet known from more than one locality. About 25 of the species are from Mexico or Central America.

Mr. W. L. Distant has issued another part of his large work on Transvaal insects.[3] This part deals with the Fulgoridæ, and contains descriptions of many handsome species. But the most notable thing about the work is the placing of the portraits of Francis Walker and Carl Stål side by side.

[1] "Monographie der Carabiden-tribus Cychrini, mit Bemerkungen über Typen und Lokalrassen der amerikanischen Arten von Dr. Edwin C. Van Dyke," *Ann. Mus. Nat. Hung.*, V., pp. 99–277, 1 plate, 1907.

[2] "A revision of the American components of the Tenebrionid Subfamily Tentyriinæ," *Proc. Wash. Acad. Sci.*, IX., 275–522, 1907.

[3] "Insecta Transvaaliensia," Part VIII., pp. 181–204, 1907; 2 colored plates and several text-figures.

A remarkable new scale-insect is described[4] by Mr. Hugh Scott, from a desert plant found in Algeria. The scale is covered by a thick mass of white threads. It belongs to the Dactylopiinæ and is near the genus *Asterolecanium,* but the mass of white threads hides the true nature of the insect.

Dr. R. Sternfeld has written an account of the mouth parts and the use of the stomach in Ephemeridæ or may-flies.[5] The mouth parts of the adult may-fly are useless, and rudimentary. He finds that this degeneration began in the nymphal stage. As the adult insect takes no food, another than the natural use has been found for the stomach. It can be inflated with air, and serves to lift the insect during flight or in aerial dancing. The author has made use of American may-flies in much of the work.

Mr. E. D. Ball has published a revision of the leaf-hoppers of the genus *Eutettix.*[6] He divides the genus into three subgenera. He gives tables to the 33 species, one of which has a number of varieties, formerly considered species. There are chapters on the phylogeny of the genus and subgenera, geographical distribution and adaptation, and life histories, and economic relations of the genus. Four excellent plates illustrate the article.

In the *Proceedings of the Entom. Society of London,* 1907, pp. xliii–xlvii, Mr. E. E. Austen treats of a parasitic African fly whose larva sometimes is a subcutaneous parasite on man. It is known to the natives as the "Tumba" fly. This fly, which belongs to the subfamily Calliphorinæ, was formerly supposed to be the *Bengalia depressa,* but Mr. Austen shows that, though very similar, it is quite distinct, and should be known as *Cordylobia anthropophaga* Grünberg.

[4] "On *Cerococcus eremobius,* gen. et sp. n.; an aberrant form of Coccidæ," *Trans. Linn. Soc. London Zool.* (2), IX., pp. 455–464, 1 plate, 1907.

[5] "Die Verkümmerung der Mundteile und der Funktionswechsel des Darms bei den Ephemeriden," *Zool. Jahrb. Abt. Anat.,* XXIV., pp. 415–430, 1 plate.

[6] "The Genus *Eutettix,*" *Proc. Davenport Acad. Sci.,* XII., pp. 27–94, 1907; also as Contrib. Dept. Zool. Entom. Ohio State Univ., No. 27.

The increased interest taken in the blood-sucking flies of the family Stomoxyidæ has induced Dr. M. Bezzi to give a synopsis and catalogue of the species.[7] A synoptic table is given to the genera, and to most of the species. Three new species are described, two from Africa, one from China. There is a list of species wrongly referred to *Stomoxys.* The author adopts the generic name *Siphona* in place of *Hæmatobia;* our species of the latter genus, however, belong in *Lyperosia.*

The problems furnished by the life of cave insects holds always a peculiar attraction for entomologists. Mr. A. M. Banta has followed this lure and investigated the fauna (largely insect) of Mayfield's cave in Indiana. The results now issued[8] make a most interesting addition to cave literature. He records the capture of 63 species of insects and 21 species of Arachnida, and to many of them he has furnished notes on habits or development. More than one half of the insects (33 species) are flies, two of which are described (by Adams) as new species. There are chapters on the origin of cave life, food of cave animals, light, temperature, moisture, etc. A long bibliography completes the paper.

Mr. C. G. Hewitt has begun the publication of a considerable work on a long-neglected insect, the common house-fly.[9] Part 1, which is now issued, deals with the anatomy, both external and internal, of the fly. Especial attention is paid to the internal structure of the head, and the tracheal system is described in detail. The muscular and nervous system is similar to that of *Volucella* and *Calliphora,* while the alimentary canal is much like that of the blood-sucking flies, *Stomoxys* and *Glossina.* Plate 1 gives colored figures of the house-fly, the root-maggot fly, the small house-

[7] "Mosche ematofaghe," *Rendic. R. Inst. Lombardi Sci. Lett.* (3), XL., 1907, 30 pp.

[8] "The Fauna of Mayfield's Cave," Publication No. 67, Carnegie Institution of Washington, 114 pages, 13 figures, 1907.

[9] "The Structure, Development and Bionomics of the House-fly, *Musca domestica* Linn.," *Quart. Journ. Micr. Sci.,* Vol. 51, pp. 395–448, 1907, 5 plates.

fly, and the stable fly. There is a long bibliography.

NATHAN BANKS

SCIENCE IN NEW ZEALAND

THE Canterbury Philosophical Institute, New Zealand, has made arrangements for conducting an important expedition to some of the islands in the Southern Ocean. About twenty New Zealand scientists will be taken to the Auckland Islands and the Campbell Islands in one of the government's steamers, and they will remain on the islands for about a week, inquiring into many branches of scientific work. The primary object of the expedition is to enable observations to be made by Dr. C. Coleridge Farr and other investigators in regard to terrestrial magnetism. The time is very opportune for this, because active work in the same field is being undertaken in other parts of the Pacific Ocean. The council of the Canterbury Institute, however, suggested that the sphere of operations should be largely extended. The government of the dominion has fallen in with the suggestion, and a fairly large party will be taken to the islands.

The Auckland Islands lie about 200 miles south of New Zealand, and the Campbell Islands about 300 miles southwest of the dominion. They are visited periodically by the government's steamers, which have provisions on them for shipwrecked mariners. The Campbell Islands are used as a sheep run, but the Auckland Islands are quite uninhabited. Scientists have reported upon both groups on previous occasions, but the coming expedition will make very comprehensive investigations. The principal interest of the expedition centers in the fact that there will be concerted action to obtain further evidence in regard to the old antarctic continent, which, it is supposed, joined New Zealand to South America on the one hand and to Australia, Kerguelen Land, Mauritius, Madagascar, Africa, and the island of Tristan D'Acunha on the other hand. If this ancient continent had an existence, the Auckland and Campbell Islands are probably waifs and strays that it has left behind. This theory has found general acceptance in New Zealand. A mass of evidence has been collected by zoologists and botanists, and it seems to leave little doubt that the antarctic continent once enjoyed a mild climate, that it carried large and extensive forests and other vegetation of a rich, luxuriant, and almost tropical character, and that it was inhabited by a large population of animals, some of which are still represented in New Zealand, Australia and South America. The latest evidence in this direction is the discovery of fossil leaves by a member of the "Discovery" Antarctic Expedition in South Victoria Land. These fossil leaves corroborate evidence that was obtained previously. It is hoped that more evidence will be added by the New Zealand scientists. They expect to leave in the middle of November of this year, and to return in the following month. They will be divided into two parties, one party going to each group. The Hon. R. McNab, minister for lands, has been asked to take the lead, but if Parliament is in session he will not be able to take part in the expedition. The following scientists will join the party:

Auckland Islands: Magnetic observers, Dr. C. Coleridge Farr and Mr. H. D. Cook (Christchurch); zoologists, Dr. C. Chilton (Christchurch) and Dr. W. B. Benham (Dunedin), general zoology; Mr. G. V. Hudson (Wellington), insects; Mr. J. Drummond (Christchurch), ornithology; Mr. G. R. Marriner (Christchurch), general zoology. Botanists, Dr. L. Cockayne (Christchurch), ecological botany; Mr. A. H. Cockayne (Wellington), plant pathology, and Mr. B. C. Aston (Wellington). Geologists, Messrs. R. Speight (Christchurch) and Clark (Auckland). Photographer, Mr. S. Page (Christchurch).

Campbell Islands: Magnetic observers, Mr. H. P. Skey and Mr. E. Kidson (Christchurch). Zoologists, Professor Kirk (Wellington) and Mr. J. B. Mayne (Christchurch), Dr. Hilgendorf (Christchurch), general zoology, and Mr. E. B. Waite (Christchurch), ichthyology. Botanists, Mr. M. M. Lairy (Christchurch) and Mr. D. Petrie (Auckland). Geologists, Dr. Marshall (Dunedin), Professor Jarman

(Auckland), mineralogist, and Mr. A. Hamilton (Wellington).

James Drummond

SCIENTIFIC NOTES AND NEWS

The Silliman lectures at Yale University will next year be given by Dr. Albrecht Penck, professor of geography at the University of Berlin.

The following have been elected by the council of the British Association to be presidents of sections at the meeting of the Association to be held in Dublin in September next under the general presidency of Mr. Francis Darwin, F.R.S.: Section A (Mathematical and Physical Science), Dr. W. N. Shaw, F.R.S., director of the Meteorological Office; Section B (Chemistry), Professor F. S. Kipping, F.R.S., professor of chemistry in University College, Nottingham; Section C (Geology), Professor J. Joly, F.R.S., Professor of geology and mineralogy in the University of Dublin; Section D (Zoology), Dr. S. F. Harmer, superintendent of the University Museum of Zoology, Cambridge; Section E (Geography), Major E. H. Hills, C.M.G.; Section F (Economic Science and Statistics), Lord Brassey; Section G (Engineering), Mr. Dugald Clerk, M.Inst.C.E.; Section H (Anthropology), Professor W. Ridgeway, professor of archeology in Cambridge University; Section I (Physiology), Dr. John Scott Haldane, F.R.S., university reader in physiology at Oxford; Section K (Botany), Dr. F. F. Blackman, F.R.S., professor of botany in the University of Leeds; Section L (Educational Science), Professor L. C. Miall, formerly professor of biology in the University of Leeds. Invitations to deliver evening discourses during the meeting of the association at Dublin have been accepted by Professor H. H. Turner, F.R.S., Savilian professor of astronomy at Oxford, who will take as his subject "Halley's Comet"; and Professor W. M. Davis, of Harvard University, whose lecture will be entitled "The Lessons of the Colorado Cañon."

The following Americans expect to attend the Fourth International Congress of Mathematicians, to be held in Rome, April 6–11: Professor E. H. Moore, University of Chicago; Professor T. S. Fiske and D. E. Smith, Columbia University; Professor G. D. Olds, Amherst College; Professor Virgil Snyder, Cornell University; Professor C. A. Noble, University of California; Professor J. G. Hardy, Williams College; Dr. W. D. A. Westfall, University of Missouri; Dr. C. L. E. Moore, Massachusetts Institute of Technology.

Professor Theodore W. Richards, of Harvard University, has been elected an honorary and foreign member of the Chemical Society of London.

The gold medal of the Royal Astronomical Society was awarded to Sir David Gill by the Royal Astronomical Society at its annual meeting on February 14, in recognition of his contributions to the astronomy of the southern hemisphere.

Professor George H. Darwin and Mme. S. Curie have been elected corresponding members of the St. Petersburg Academy of Sciences.

Mr. C. M. Conner, agronomist at the North Carolina College and Station, has been appointed assistant commissioner of agriculture for the Philippine Islands.

Dr. August Martin, professor of gynecology at the University of Greifswald, will visit this country next summer to attend the annual session of the American Medical Association.

Professor C. W. Hall, head of the geology department of the University of Minnesota, has been chosen to represent the university at the Pan-American Scientific congress to be held at Santiago, Chili, next December.

Dr. W. N. Shaw, Emmanuel College, Cambridge University, has been appointed to represent the university at the meeting of Imperial and Colonial meteorologists, convened by the Royal Society of Canada, to be held at Ottawa in May, 1908.

Dr. J. P. Rowe, professor of geology in the University of Montana, has been elected president of the Montana State Teachers Association.

The Montana Academy of Science, Arts and Letters held its annual meeting at Missoula, during the month of December. Dr. H. H. Swain, president of the State Normal School at Dillon, was elected president, and Dr. W. D. Harkins, professor of chemistry at the University of Montana, secretary and treasurer.

Mr. J. C. Pearson, magnetic observer of the Carnegie Institution of Washington, formerly on the magnetic survey yacht *Galilee,* has gone abroad to make magnetic observations in the regions of Asiatic Turkey and of Persia, where but few data have hitherto been obtained.

The Belgian government proposes to send a meteorological expedition to the Arctic next summer. The expedition will be under the command of M. Georges Lecointe, director of the Royal Observatory at Uccle.

Dr. George H. Shull, of the Station for Experimental Evolution, Cold Spring Harbor, addressed the Scientific Association of Johns Hopkins University, at the meeting of February 17, on "Recent Aspects of Mendelism."

The board of managers of the Franklin Institute gave a reception on the evening of February 14, when there was an exhibition of historical models and new inventions and a lecture by Dr. Persifor Frazer on "The Franklin Institute, its Services and Deserts."

The Association of Technical Institutions of Great Britain was entertained at luncheon by the Drapers' Company, on February 21. The annual meeting followed, when Sir Norman Lockyer delivered his presidential address.

A resolution was passed at a committee meeting of the London section of the Society of Chemical Industry, held on February 7, recording the great loss the society has suffered through the premature death of its chairman, Mr. Richard John Friswell.

Dr. Rudolf Burckhardt, director of the Zoological Station, Rovigno, has died at the age of forty-two years.

Dr. Maximillian Meissner, curator in the Berlin Zoological Museum, died on January 27, at the age of forty-seven years.

Dr. Albert Thierfelder, professor of pathological anatomy at Rostock, has died at the age of sixty-five years.

The U. S. Civil Service Commission announces an examination on March 25, 1908, to fill the position of soil chemist, in the Bureau of Soils, Department of Agriculture, at a salary of from $2,000 to $2,500 per annum. Applicants will not be assembled for any of the tests.

The British Treasury has agreed to give an annual grant of £200 to the Royal Scottish Geographical Society in Edinburgh in lieu of rent of premises. The society has had to vacate the rooms in the National Portrait Gallery, which it had leased from the government at a low rent for a considerable number of years, in favor of the recently created board of trustees of the national galleries of Scotland.

The following recommendations were adopted at the general meeting of the Geological Society of America, held December 31, 1907, at Albuquerque, New Mexico. The action of the society was taken as a result of an overture made to it by the Association of State Geologists of the Mississippi Valley.

The Geological Society of America recommends to the various organizations concerned:

1. That a general committee on geological nomenclature be formed; one fifth of its members to be from the United States Geological Survey, one fifth from the state geological survey organizations, one fifth from the Canadian Geological Survey organizations, one fifth from Mexico and one fifth from geologists at large as selected by the Geological Society of America.

2. That this general committee have authority to appoint special committees on nomenclature from within or without its own membership for the investigation of the particular questions referred to them, the special committees to report back their conclusions to the general committee with full reasons therefor; the different sections to report in turn to their own organizations.

3. That the fact that any subject is under discussion by this general committee be made known to the scientific public at large.

The purpose of the recommendations is to provide a source from which any geologist may on application obtain advice regarding nomenclature.

The society, by vote at the same meeting, adopted the following preamble and resolution, and instructed the secretary to send copies thereof to the executive authorities of the United States, Canada, Mexico, Newfoundland and the West Indies; to the governors of Alaska, the Philippines, the Hawaiian Islands, Porto Rico and the Canal Zone; to the directors of the several weather bureaus and geological surveys; to the secretaries of the Smithsonian and Carnegie Institutions, the Seismological Society of America and the Committee on Seismology of the American Association for the Advancement of Science. The preamble and resolution, which were drawn up and signed by a committee consisting of Professor T. A. Jaggar, Jr., Massachusetts Institute of Technology; Professor James F. Kemp, Columbia University, and Dr. Edmund Otis Hovey, American Museum of Natural History, are as follows:

Whereas: The United States, Canada and Mexico possess in the Cordilleran Belt, Alaska, the Philippines, the Hawaiian Islands, Porto Rico and the Canal Zone a wide field for investigation of active volcanoes and earth movements; and

Whereas: Geological science needs permanent records, made in the field, of physical phenomena accompanying earthquakes and eruptions both before and after the event; and

Whereas: Such record has direct bearing on prediction, and on protection of life and property, therefore be it

Resolved, That the Geological Society of America strongly recommends to the several North American governments and to private enterprise the establishment of volcano and earthquake observatories.

Taking into consideration the serious damage caused by fire at previous exhibitions, the executive committee of the Turin International Exhibition of 1911 has decided to open an international competition for preparations best adapted to render incombustible the wood and cloth structure of the exhibition, and will award a prize of lire 4,000 and two gold medals and two silver medals in this connection. The preparations must be such that they can be applied without visible alteration of the color and resistance of the materials.

The President has signed a proclamation creating the Jewel Cave National Monument within the Black Hills National Forest, South Dakota. This remarkable cave, which is located thirteen miles west and south of Custer, the county-seat of Custer County, in a limestone formation, is believed by geologists to be an extinct geyser channel. The National Monument will embrace an area of 1,280 acres. This cave, which was explored as late as 1900, has been found to consist of a series of chambers connected by narrow passages with numerous galleries, the walls of which are encrusted with a magnificent layer of calcite crystal. The opening of the cave is situated in Hell Canyon, the walls of which are high and precipitous. The surface of the country in which the cave is located consists of a high rolling limestone plateau about 6,000 feet above sea level. The area is almost entirely covered by a forest of bull pine, a considerable portion of which is merchantable, while the remainder consists of a vigorous young growth. The Jewel Cave National Monument will now be given permanent protection by virtue of the Act of June 8, 1906, which provides that objects of scientific interest may be declared National Monuments if such action is deemed necessary for their preservation and protection.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Mrs. Amy Sheldon, of Newport, a bequest of $300,000 to Harvard University is made in the codicil. It is requested that the money be used for the rebuilding or enlargement of the university library building known as Gore Hall, but if the corporation does not desire to use the money in this way it may do otherwise. In addition to this bequest the university is to receive a portion of the residuary estate, to be known as the Frederick Sheldon fund, the income to be used for the promotion of traveling by students after graduation.

By the will of Royal L. Smith, of Plattsburg, N. Y., various public bequests are made and the residue of his estate is to form a trust fund to educate the boys of Clinton

County by furnishing them funds to pay their expenses at preparatory schools and colleges. The daily papers state that this fund will amount to at least $2,000,000 and probably to $3,000,000.

By the will of the late Mary E. Ives, Yale University receives $10,000 for the Art School, and $10,000 for a fellowship in philosophy for women.

By the will of Edward Hall Cole, of Brooklyn, $9,000 is given to St. Lawrence University, at Canton, N. Y.

Mr. William S. Mather has given $5,000 to Trinity College to be added to the fund for the payment of salaries.

The contract for the erection of the new building for the College of Physicians, of Philadelphia, was awarded January 28. The building will cost $300,000, and is to be erected at Twenty-second and Ludlow Streets. It will be a two-story fireproof brick and stone structure, 110 by 150 feet, containing a museum, lecture hall, library, laboratory and portrait gallery. It is said that the work of erection will be started at once.

At the January meeting of the regents of the University of Michigan, architects were authorized to draw up detailed plans and specifications for a new chemistry building. The structure, which will be three stories and a basement in height, is to be 270 feet long and 150 feet wide, with the 150 foot front located on North University about 75 feet west of the gymnasium—where the dental building is now situated. It will be of brick with stone trimmings and with interior of reinforced construction throughout. There are to be two interior courts separated by a crossbar connecting opposite sides of the building. The cost complete will probably be $275,000.

Nature, quoting from the *Pioneer Mail* states that the Maharaja of Darbhanga, has made a gift of nearly £17,000 to the Lieutenant Governor for the purpose of constructing a library building in connection with the Calcutta University.

At the midwinter commencement of the University of Nebraska, on February 14, there were graduated 16 bachelors of arts, 10 bachelors of science, 3 bachelors of laws, 3 masters of arts and 1 doctor of philosophy. Those receiving advanced degrees are as follows: Doctor of philosophy: Brayton Howard Ransom in zoology; thesis—"Some Cestodes from North American Birds." Masters of arts: Venus Worrell Pool in botany; thesis—"Some Tomato Fruit Rots." Leva Belle Walker in botany; thesis—"A New Form of *Sphæropsis* on Apple" and "Zonation in Artificial Cultures of Fungi." John Bennett Whelan in chemistry; thesis—"Studies in the Reductions of Aldehydes and Ketones."

The new medical laboratories building in connection with Queen's University, Kingston, Ont., was opened formally on January 14. Biology, histology, pathology, physiology and bacteriology will occupy this building. The Ontario government contributed $50,000 toward this new building.

Dr. Henry T. Bovey, dean of the faculty of applied science at McGill University, has resigned to accept the principalship of the Imperial College of Science and Technology, London.

The Rev. C. L. White has resigned the presidency of Colby College to engage in work for the Baptist Home Mission Society.

Professor E. Hershey Sneath, who resigned his chair at Yale University two years ago owing to ill health, has accepted an appointment as lecturer on philosophy in the graduate school. Dr. Roswell P. Angier has been promoted to an assistant professorship of psychology.

Howard E. Simpson, instructor in geology at Colby College, Waterville, Maine, has been appointed associate professor.

Mr. G. G. Chisholm has been appointed lecturer on geography at Edinburgh University.

The council of the University of Sheffield has appointed Mr. John L. Annan, M.B., Ch.B. (Edin.), to the post of demonstrator in anatomy. Mr. Annan is at present at the University of Edinburgh.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MARCH 6, 1908

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THE AMERICAN SOCIETY OF NATURALISTS PRESIDENTIAL ADDRESS[1]

ON several occasions during the last few years, indeed, ever since my election to the honorable position which I occupy to-night, I have been asked "What is the use of continuing the existence of the Society of Naturalists?" When one is in the full enjoyment of an honor so greatly appreciated as that which I now enjoy it is a veritable cold douche for some well-meaning but not altogether tactful friend to suggest that the honor may after all be an empty one and that the presidential chair I occupy is that of a society so moribund that it would be a kindness to let it turn its face to the wall and enter into its eternal rest. But a cold douche may have a highly salutary effect both in tempering a too great elation and in bringing one into the proper frame of mind for considering whether, after all, there may not be force in the suggestion. Gentlemen, I have passed through these experiences, I have considered calmly and, so far as possible, impartially the condition of the society and its relations to other organizations, and a reaction has set in. My appreciation of my position is reestablished and I am now more convinced than ever before that the Society of Naturalists has still an important part to play in the advancement of scientific achievement on this continent.

The society makes for the solidarity of those sciences which, in older days, were included in the term natural history. It was originated for the purpose of pro-

[1] Delivered on December 31, 1907.

moting that solidarity and its existence has been a struggle to maintain it against an increasing tendency toward segregation. Twenty years ago it was an organization of great vitality, including in its membership practically all the leading exponents of natural history in the eastern states, and its meetings were a stimulus and an inspiration to all who were privileged to attend them. But the very cause which called it into existence was destined in the course of a few years to sap its foundations. It was the outcome of the remarkable growth of interest in scientific education in this country which occurred in the eighties of last century and was associated with the establishment of two important departures in collegiate and university instruction.

One of these departures was the introduction into our college curricula of the course in general biology, inaugurated in England with so great success by Professor Huxley and fostered in this country by Huxley's one-time assistant and coadjutor, Professor Newell Martin, whose interest in the success of this society was both active and lasting. The establishment of this course of study, so philosophical in its conception, had the effect of disintegrating the older discipline of natural history, with certain results by no means in harmony with the ideals which the course was intended to realize. For its establishment led, in the first place, to a severance of geology from biology, a result not in itself to be deplored from the standpoint of efficient instruction, but, unfortunately, geology, as then understood, included both the dynamic and historical aspects of the subject and hence its separation from biology led also to the separation of paleontology. For the geologist paleontology is a means to an end but it is an essential constituent of biology. Further, the establishment of the course in general biology brought about an increased interest in zoology somewhat at the expense of botany, since the great majority of those in charge of the teaching of general biology were trained in zoological methods. This state of affairs undoubtedly acted detrimentally to the progress of botany, but we all rejoice to see that science so ably rising superior to her disadvantages and now coming again into her own.

Practically concurrent with the recognition of general biology as an undergraduate study was the development of graduate instruction as a proper and important part of the work of our larger universities, and as a result it became possible to supply the demand for teachers of this or that science with men thoroughly trained in modern methods and conversant with the literature of their specialty. For naturally graduate instruction tended toward specialization.

And this was the tendency that "like a worm i' the bud" fed on the "damask cheek" of the young society. The same interest in scientific education which led to the establishment of the society led also to increasing specialization, and solidarity gave place to segregation. The physiologists, as their numbers and influence increased, established a temple of their own where they might worship exclusively the goddess Function; the geologists, too, deserted the common shrine and fled to the mountains and valleys to erect in the groves altars to Pluto and Neptune; and the anatomists, ignoring the fact that their special cult was but a side issue of the broader worship of animal morphology, forsook the company of their fellows and wandered off to secluded spots where they might, without offence and free from disturbing suggestions from their coworkers, set up as an idol—a cadaver.

And so of the original membership there were left true to the parent society only the zoologists and the botanists, the latter at that time few in number, and the question had to be faced whether the Society of Naturalists should become a strictly zoological assembly, should be allowed to lapse, or should continue to exist as a possible bond of union between the specialist societies. The *tertium quid* seemed the most satisfactory solution of the difficulty and the secession of the zoologists as the American Morphological Society gave opportunity for the reorganization of the Naturalists as a parent society beneath whose wing the several offspring might assemble yearly for mutual encouragement and fellowship. This new relation of the society of necessity curtailed its activities by reducing the time available for its sessions, but it still remained faithful to its original purpose, as it does to-day.

But additional factors came into the question. The rapid growth of the scientific spirit in the middle west which began in the later eighties and the nineties, one of the most striking features, it may be remarked in passing, in our educational history, called to that section of the country many enthusiastic naturalists who felt the need of maintaining just those wider interests which the society endeavored to promote. The society then had to determine whether it would extend its influence to this new territory and hold occasional meetings outside the pale of the northeastern states, but at the time it seemed that the limitations of the sessions to localities readily accessible to the majority of the members would better tend to conserve the energies of the society. It was recommended, however, that the naturalists of the central states should form a branch organization, which would do for that section of the country what the parent society did for the eastern territory, and this was done. But the growth of the scientific spirit in the more western section was not yet completed, nor is it even now. And with the increasing growth there arose a greater community of interests and more perfect intercourse between the two sections, leading eventually to the realization that occasional meetings of the one organization in the territory of the other, far from having a weakening influence, would further the objects for which both were striving. Hence the present arrangement, which, however, still requires modification in one respect, namely, in that of placing the Central Branch in the position to which its importance and influence entitle it—an equality with the parent organization.

A second factor of more recent development has been the irruption of the American Association for the Advancement of Science into the quiet and sociable serenity of convocation week, and the consequent desire on the part of some that the association should assume responsibility for all the fostering which the different scientific societies may require. Personally, I am not at all sure that the association as a mother by adoption can satisfactorily perform the functions of the real parent. In a family, real and adopted, so large and with such diverse interests, it seems almost certain that one or more unfortunate individuals may find themselves unable to secure the necessary shelter beneath the maternal wings and be forced to perch disconsolate upon the edge of the nest, "remote, unfriended, melancholy." A gradation of individualities is the rule in nature, and in our social combinations. Between the organ and the person there is an intervening individuality and it is that individuality which is lacking in the organization of the association, but which is represented by this society. The solidarity, which is the *fons et origo* of the Naturalists is, I am well aware, the aim also of those who desire absorption into the association, but under the present organization of that body the solidarity of the biological sciences would, by the absorption, be lost, and they would become, if I may be permitted to misquote a celebrated definition, members of an indefinite, incoherent heterogeneity, instead of, as now, parts of a definite, coherent homogeneity.

I have thus briefly sketched the history of the Society of Naturalists with the object of showing those among us who may not be familiar with its past, how steadfastly it has clung to its original purpose through all the crises which have threatened its existence. Is not the idea for which the society stands worthy of such consistency? And are there not questions pressing in upon us to-day which stand in need of consideration by the united strength of the society?

These interrogations have been answered in part by the discussion of this afternoon. The undertakings of biologists are becoming broader year by year and are more and more demanding cooperation for their successful completion. The time-honored discipline of natural history has been divided into numerous specialties, each of which is as wide as the whole field of natural history as our fathers and grandfathers knew it. Encyclopedists were possible in their days, although even then it required an exceptional ability to be a master of the entire field. But encyclopedism died in this country with such men as Louis Agassiz, Leidy and Cope, and we of to-day find our capabilities fully tested in mastering one small division of the older discipline. We may comfort ourselves somewhat with the thought that the limitations of to-day are not due so much to differences in the men as to differences in the scope of the subjects. The lakes of our predecessors have broadened to seas and the seas to oceans whose farther shores are far beyond the limits of any one man's horizon, and hence specialization has become a necessity, and where but a few years ago we had zoologists, we now have systematists, anatomists, embryologists, cytologists, experimentalists, statisticians and ecologists. But let me quote the words of one of our distinguished members: "*Union* is just as essential a part of the law of progress as division. If specialization is a necessity, so is organization. But there is this difference between the tendencies—that the one precedes the other and comes into recognition first. Specialization has already forced its way to the front, and is nearly everywhere recognized as a necessity; organization follows, but lags lamentably behind the needs of the times." Throughout the organic world we see continually contrasting forces combining to produce progress. We have variation and heredity, division of labor and organization. Specialization is with us, and the Society of Naturalists is but striving to add the other factor which makes for progress —cooperation.

The necessity for cooperation in scientific research is no new need evoked by the increasing specialization of the times. Even in the days of Lord Bacon it was presented as a desirable ideal, and nowhere can we find a more definite advocacy of its employment in the investigation and application of scientific problems than in the plan set forth in the *New Atlantis* of the duties of the fellows of Solomon's house. Such a complete plan is, however, impracticable so long as human nature remains as it is. We would all be "interpreters of nature" or at least "lamps." But to function thus we must needs cooperate with our fellows, we must meet together to tell of our investigations, to learn of those of others and to take counsel with our coworkers as to the further elaboration of our results. And it is this form of cooperation that the Society of Naturalists promotes. If the society did nothing further than to bring us all together on occasions such as the present its existence would be fully justified.

But can not its influence be enlarged? Are there not problems bearing upon the advance of the biological sciences which require the cooperative action of just such a body as this for their solution? We have listened to-day to suggestions concerning cooperation in problems of investigation and of these I need not speak further. But there is another field in which, I believe, the society, by its influence, can accomplish much that will, both directly and indirectly, aid in the advancement of the biological sciences. In the early days of its existence this society took great interest in the question of scientific instruction in our schools and colleges, and I recall especially two reports submitted to the society on this question, one by Professor William North Rice and the other by Professor S. F. Clarke, which contained much that was of value and undoubtedly of influence in shaping the scientific course in many of our schools and colleges. This was many years ago, and now, with the increased interest which obtains in scientific instruction and after the numerous discussions and reports on the place of scientific studies in our secondary schools, it would seem that the time is again propitious for a pronouncement upon the subject from such an organization as this.

Partly from lack of time, but more especially from lack of the necessary information, I can not venture to discuss all the phases of this question. But do we as a body of working biologists properly understand the conditions of science-teaching in the schools, and have we shown sufficient interest in bringing it to that state of efficiency which its importance demands? In later years a wave of nature study has passed over our primary schools, driven by Froebelian breezes. But, unfortunately, in many schools it seems that the Froebelianism which should blow as a gentle zephyr has been permitted to increase to a hurricane and the wave of science study, instead of being an educational blessing, has carried devastation on its crest. Two of our members, Professors Hodge and Bigelow, have accomplished much by their endeavors to establish nature study upon a proper basis and their work deserves a greater meed of credit than it has hitherto received. But even yet, so far as my observation and information extend, the teaching of nature study is in many schools in the hands of inefficient instructors, untrained in the methods and purposes of such instruction, and the result is a minute crumb of solid food overlaid by a heavy coating of mawkish sentimentality. The principal aim of nature study should be to train the child to the observation of natural objects and phenomena and to awaken in his mind a healthy curiosity as to their meaning and significance. In other words, its purpose should be to develop in the child the scientific spirit, which is not inborn but requires development. Its primary object should not be a directly utilitarian one and it should certainly not be used as a means of evoking an unhealthy and unnatural sentimentalism when no sentimentalism should exist. Surely in a search for the sentimental nature is the last place to which we should turn. Perhaps the causes of the mistakes in nature study are largely due to conditions which are beyond our control, but have we done our duty in upholding the hands of our fellows who are striving for efficient instruction, in calling the attention of those in authority to errors in method, and in endeavoring to set science teaching in the primary schools upon a proper basis?

We are accustomed to regard the German system of scientific instruction as very efficient and yet it is noteworthy that a joint committee for the German Zoological Society and the Gesellschaft für Naturforschenden Freunde und Aertzte is now at work upon the question as to how science teaching in the schools may be brought to a proper degree of efficiency. If a need for improvement is felt in Germany, is it not likely that it is present also with us? How often have we heard a colleague in one or another of the scientific departments state that he would sooner receive into his classes students entirely unfamiliar with his subject, than those who had received some training in it in the high school? An occasional statement of this sort might be attributed to that indiosyncrasy which is popularly regarded as a characteristic of a university professor. But it is made too frequently to be altogether due to that cause, and allowing for a certain amount of rhetorical exaggeration, the statement is an indication that a need for improvement in science teaching in our high schools certainly exists. From what body could the initiation of a movement for the improvement of instruction in the biological sciences more appropriately come than from this society? In passing, let me recall that at our last meeting in this city we had the pleasure and profit of listening to an eloquent and serious arraignment by our then president, Professor Sedgwick, of the prostitution of scientific teaching to the intemperate propagandism of a powerful organization. Have we as a body or individually followed up that deserved indictment as we should? The recent publication in SCIENCE of a letter from the organization in question shows that the snake is not even scotched and that with cool effrontery the organization proposes to continue its dictation of what text-books of physiology shall be used in our public schools.

And even in connection with our college courses, in which the majority of us are more directly interested, there is opportunity for this society to exert a healthful influence. Our college education is at present in a stage of transition, and it is difficult at the moment to determine what will be the final outcome. But in one direction at least there seems to be a definite tendency and that is toward a more distinct cleavage between undergraduate and post-graduate work. It is showing itself in our professional schools, which are more and more approaching the ideal condition in which they will represent post-graduate courses, students being allowed to enter upon the special work of the schools only after they have laid a broad foundation for their professional studies by completing a collegiate course. In other words, the professional schools are beginning to recognize the value of a broad training as a preparation for successful specialization. This movement should receive a hearty support from this society, for it is at one with its aims and it is a movement for whose further expansion there is still ample space. Up to a few years before the organization of this society the completion of the literary curriculum meant the completion of one's education; the man who was entitled to write A.B. or some such letters after his name was the final product of our educational system. True, there were higher degrees, A.M. and what not, but the training for these was more or less perfunctory and unorganized, and there were also occasional students who had the opportunity to carry on their studies beyond the ordinary four years of the university curriculum. The majority of these, however, found it to their advantage to pursue their later studies in the old world universities, and especially in Germany, which first had recognized the advantage of making the university something more than the mere dispenser of knowledge already acquired. In 1876 the cleavage between undergraduate and post-graduate studies—similar to that between the German university and gymnasium—became established in this country, and now there are few of our large universities which do not recognize it in giving prominence to university work in what are called graduate schools.

But in one respect the conditions in our graduate schools are very different from those obtaining in the German universities, for the instructors in our graduate schools are also, almost without exception, teachers in the undergradute or collegiate department and are comparable, as some one has pointed out, to a Gymnasiallehrer who also lectures in the university. And in this lies a serious defect, for it has led to the encroachment upon the collegiate course of studies which properly belong to the university or graduate course. The enthusiastic teacher who is also an investigator finds his greatest pleasure in leading his students on toward investigation and he is too often inclined to carry them with him into that kind of work before they have received a foundation of sufficient breadth and solidity to make such a course advisable. And the adoption of an extensive system of electives in the collegiate course has favored the development in this way of precocious investigators who so frequently are like the seeds which fell in places where they had not much earth and forthwith sprang up, "and when the sun was up they were scorched; and because they had no root they withered away."

I have recently been looking over a number of college calendars with a view to ascertaining the extent to which specialization might be carried by undergraduates. And let me say in passing that as a result of the examination of the calendars my opinion as to the intellectual capabilities of the American undergraduate has been greatly increased. The young man who can successfully thread his way among the multitudinous courses with their limitations and continuations as stated in the larger calendars, and from these select as consistent and suitable a course as the majority do, manifests a degree of intelligence and perspicacity which augurs well for the race.

It would be both unprofitable and tedious to give you the complete results of my studies in this direction, but I may briefly indicate what I found to be the case in regard to specialization in one subject, namely zoology, in three or four of our leading colleges. The different standards employed in estimating the credit value of a course renders an exact comparison of several colleges somewhat difficult, but so far as I can understand the schedules presented the results are as follows: In four of our most influential universities I find that a student out of the total number of scheduled hours may elect in zoology in A, 33 per cent.; in B, 41 per cent.; in C, 45.5 per cent., and in D, 68.3 per cent. This represents undergraduate work only and the enormous inequality of the courses in the different institutions is most striking, D university, for example, allowing over twice as much specialization in zoology as A. This difference is necessarily associated with great differences in the amount of time devoted to the humanities or non-scientific studies, and these also stand in relation to the amount of specialization in scientific studies as a whole, which the various curricula permit. Thus in A a student in zoology may take an additional 30 per cent. of his studies in other sciences, making a total of 63 per cent. of scientific studies; in B he may take 44.3 per cent. additional in science, or a total of 86 per cent.; in C an additional 44 per cent., or a total of 89.5 per cent.; and in D 26.7 per cent., or a total of 95 per cent. Or, to state the reverse of the story, a student in A may secure his A.B. degree only after taking 37 per cent. of his work in non-scientific studies; a student in B may graduate with 14 per cent. of his studies in non-scientific subjects; a student in C with 10.5 per cent. of non-scientific subjects; and a student in D with only 5 per cent. It seems certain that one or other of the extremes must be utterly bad in principle. The one represents a broad collegiate training upon which the student may build a specialized university course, the other is extreme specialization by which the student is carried into the graduate type of work before he has acquired a well-rounded collegiate training. Indeed, it may be pointed out that in the extremely specialized course the student is allowed to devote ten hours a week throughout his final year to research in zoology.

I do not wish it to be understood that such narrow courses as have been mentioned above are frequently taken. Indeed, I believe that the great majority of students of their own accord choose rather a broader course, and, furthermore, in some institutions elections must be approved by a member of the faculty or by a committee, a system conducing to some extent to the prevention of extreme specialization. But such courses as I have indicated are possible; indeed, in the institution D a student who expects to teach zoology is openly advised to elect as many as possible of the courses offered in that subject, that is to say, to elect the extremely specialized course mentioned above. Surely such advice betrays a sad misunderstanding of the proper functions of the college and university and must tend in the long run to prejudice rather than to advance the claims of zoology to a place among the so-called culture studies.

Nor do I wish to imply that zoology is the only grievous offender in this respect. Results similar to those already given may be obtained from the study of possible elections in other courses, both scientific and non-scientific. A student may graduate from college without ever having seen the inside of a laboratory or listened to a single course of lectures on a scientific subject during his four years of attendance. And to give such a student an imprimatur which should imply that he has received a broad collegiate foundation is a crime against good scholarship.

But this is not the occasion for a general discussion of this question; we are concerned with it especially as it relates to biology. I may say, I believe, without an imputation of Chauvinism, that biological investigation on this continent stands second in quality to none, and it should be our endeavor to see that quality is not sacrificed to quantity. A multitude of effusions characterized by narrow specialism will advance the position of biological research far less effectually than a more moderate product in which thoroughness is combined with a scholarly appreciation of the scope of the problems in hand. This latter desirable conjunction will not be secured by devoting a considerable part of a student's collegiate course to university studies. An instructor in collegiate courses may and should, by both precept and example, set forth the methods of the investigator and endeavor to awaken in his students the spirit of the investigator. But let him see that a vaulting ambition is not allowed to o'erleap itself, and secure for his students that broad outlook which alone can produce the scholarly investigator. That extreme specialization should be even possible in an undergraduate course is a serious mistake. It narrows the field of vision and is a serious obstacle to the carrying out of the cooperation so much needed in biology. And cooperation implies solidarity, the main plank of the platform upon which the Society of Naturalists stands. Surely there is still work for the society both in advocating a system of training in our schools and colleges which will make cooperation in investigation possible, and in promoting the solidarity among biologists which will make cooperation feasible.

J. PLAYFAIR MCMURRICH

COOPERATION IN BIOLOGICAL RESEARCH [1]

THE idea of cooperation in science is not new; our universities, learned societies and publications represent or involve forms of cooperation that are well established and have demonstrated their usefulness in the progress of science. Without them, progress would be painfully slow. They are, in fact, the very framework and supporting skeleton of science, without which there might be life indeed, but at most aimless amœboid movement, no dignified or effective progress.

I suppose it was not intended that the present discussion should concern itself with such old established organizations, but rather that it should deal with needs that have arisen as a result of recent growth of science and its increasing specialization, and which are not adequately met. Organization must keep pace with specialization, if the true objects of specializing are to be attained.

The last decade has witnessed the origin or farther development of institutions planned to meet the specific needs of the present, and organized to anticipate the growing demands of the future. I name various departments of the national government, the Carnegie Institution of Washington, the Wistar Institute of Anatomy and Biology, the Rockefeller Institute for Medical Research and the McCormick Institute for the Study of Infectious Diseases. These institutions recognize the fundamental importance of research for the well-being, nay, for the very life, of the commonwealth, and they also recognize cooperation as the vital principle in the conduct of research. The institution that inbreeds, that does not seek for the original and productive investigator, and that does not lend its own cooperation and secure his is on the high road to ineffectiveness.

I believe, however, that the full conception of cooperation in scientific research is not usually grasped and that the logical outcome of the principle is, therefore, not really understood: An organization may be formed that proposes to make cooperation with scientific men and institutions its main business; it may propose to seek out the original investigator wherever he may be found and to support his work in every possible way; it may welcome every new branch of scientific investigation and propose to favor it according to its importance and its needs; and yet such an institution may not be fully cooperative. It may be privately controlled; if so, its impulses are primarily benevolent and not free, guided by tradition and charter and not by the native interests of the governing body, and for these reasons apt to fail to profit to the fullest extent by the fertilizing influences of new conceptions.

The fundamental idea of cooperative organization is a free association of individuals that proposes definite ends and effects an organization to attain them. The members of the organization are at the same time the court of last resort; they may elect representatives as a board of management, or as officers of the organization; but the representatives are responsible to the organization for the conduct of affairs. The functions of such an organization are not benevolent, but free, for the members are vitally interested in the conduct of its affairs and they are themselves the governing body. The organization is plastic, responding to new ideas, so long as membership in it is determined by broad prin-

[1] Discussion before the American Society of Naturalists, December 31, 1907.

ciples and not merely by personal considerations.

Our scientific societies are the type of such organizations in science. The members make their own laws, elect new members, appoint officers in rotation from the membership, read their own papers and pay their own expenses. In turn, groups of members take on the duties of hosts to the others, and it is a genuine and deep pleasure, for are they not returning the numerous hospitalities that they have received? Such meetings are among the best events of the year in science, the most stimulating, the most fraternal; and the impetus to the progress of science is incalculable.

The Marine Biological Laboratory is another example of a free cooperative organization in biology. I believe I need not apologize for using this organization to illustrate my remaining remarks, because it belongs to the Naturalists of America and it illustrates better than any other institution with which I am thoroughly familiar certain working principles of cooperation in biology.

The government of the laboratory is vested in a corporation consisting of 64 life members and about 125 annual members, and a board of trustees of 31 members (at present, full number 35), of whom three are *ex officio*. The corporation meets annually to elect a clerk, treasurer and eight trustees to serve four years. Membership in the corporation is by election by the board of trustees. To the latter body is delegated the administration of laboratory affairs, and they appoint all officers and agents. Of the 189 members of the corporation, 129 are professional biologists; of the 31 members of the board of trustees, 25 are of the same class. The corporation has the power to modify the policy of the laboratory in any respect by virtue of its control of the membership of the board of trustees.

The government and ownership of the laboratory thus rest absolutely in the hands of American biologists, and this is the first and fundamental cooperative feature of the organization, viz., cooperation of those interested in affecting an organization for research. I believe that much of the usefulness and effectiveness of the institution rests on this basis. It establishes a thorough democracy of sentiment, which is more nearly like the sentiment of our scientific societies than that of any other institution that I know. Out of this grows a feeling of loyalty that is shared in greater or less degree by nearly all who have worked at the institution. These now represent practically every university and college of the country, most of which are represented either in the board of trustees or in the corporation.

This fundamental cooperative principle was established at the foundation of the laboratory, though the proportion of professional biologists in the membership, both of the corporation and of the board of trustees, was less then than now.

A second important form of cooperation exists between the laboratory and other institutions. Many of our institutions require the facilities of a marine station for the research work of their biological departments. Some have sought to supply these facilities independently, but I believe I am correct in saying that this method has not usually proved permanently successful, partly because of the expense of the undertaking, and partly because such an individual undertaking lacks the inspiration that comes from the presence of representatives of other institutions, who bring in new ideas and establish a congenial community.

In the year 1891, after four years of experience in conducting the affairs of the laboratory, a committee of the board of trustees prepared and sent out a circular letter requesting the cooperation of the biological departments of our colleges and universities in the maintenance of the Marine Biological Laboratory. The form of cooperation suggested was that of subscription for students' tables or research rooms, the former at $50 each and the latter at $100 each for the season. In this way the laboratory anticipated the need of biological departments for marine facilities both in instruction and in research.

The response was unexpectedly general and prompt; the following institutions subscribed at once: Columbia, Brown, The Missouri Botanical Garden, Williams, Chicago, Massachusetts Institute of Technology, Rochester, Bryn Mawr, Mount Holyoke, Vassar, Wellesley, Cincinnati, Miami and Northwestern. The majority of these institutions have continued their subscriptions up to the present time. Others have since come in, some sporadically, others continuously. Last year the number of subscribing institutions was 17. There has not, however, been considerable growth in this respect; and this is perhaps partly due to the fact that the laboratory has rarely refused a free working place to competent applicants, unless space was lacking.

It is clear that an institution may secure for its investigators by this form of cooperation the best of facilities for marine work at a cost many times less than would be required on an independent basis, with the added advantage of association with representative investigators from other laboratories. At the same time such an institution is aiding to support an organization that supplies one of the most general needs of American biology.

Special forms of cooperation with institutions are entered into from time to time. Relations with the Woods Holl Station of the U. S. Bureau of Fisheries have always been mutually helpful. The laboratory also exchanges investigators' tables with the biological stations of Canada and desires to enter into similar relations with other marine laboratories. For three years the laboratory furnished working places for twenty appointees of the Carnegie Institution and this relation was a great aid to the Marine Biological Laboratory at a critical juncture of affairs, and furnished a permanent stimulus and incentive to the prosecution of its work.

It is very desirable that such cooperative relations with other institutions should be extended and strengthened; and it is probable that this will take place in the near future. The maintenance of such relations implies that they shall be mutually advantageous. I believe that this has been demonstrated, and that, in proportion as this is realized and the spirit of research increases in our institutions, such cooperative relations are bound to grow. The principle of cooperation does not mean that all shall do the same amount, but that all shall enter into it in the same spirit and do according to their means and opportunities.

A third fundamental form of cooperation is that of and with the various subdivisions of biological inquiry. Four departments are formally organized in the Marine Biological Laboratory; in the order of their establishment they are: zoology, botany, embryology and physiology. These are, of course, broad divisions and their organization as departments does not mean that other subjects are excluded; indeed, the laboratory welcomes any biologist with a problem in the solution of which the facilities or fellowship of the organization may aid. There has been a good deal of research done both in pathology and in psychology at the laboratory, and it is hoped that it will grow; the laboratory is ready when the time is ripe to organize departments in these subjects.

The problems in the various departments of biological research are so intricately interrelated that each department is sure to be of aid to others in many ways often curious and unexpected. This is not a matter for surprise. It only emphasizes the necessity of the broadest organization of our work if any subject is to march forward with the least degree of impediment.

Indeed, I question very much if the work can logically be confined to the subject-matter of biology. Our physiological chemists are already urging a chemical laboratory. This seems necessary for the physiologist who has chemical problems, and it may prove attractive to the chemist who has biological problems. A department of chemistry in connection with the Marine Biological Laboratory would be of distinct advantage to every other department; even the morphologist has his chemical problems, particularly in connection with the complex matter of stains.

An institution organized in the manner outlined is in a position to develop in harmony with its environment, and should be in little danger of outliving its usefulness, because it is national, representative and plastic. It should thus represent at any time the best traditions and methods of research so long as it maintains the fundamental forms of cooperation: its free organization, its free cooperation with scientific societies and men, and the free cooperation of the biological sciences within the common organization. If these are maintained, it must inevitably keep pace with the increasing subdivision of biological specialties and be guided by the community of ideas and problems in different fields.

An important result of the cooperation of biologists in the maintenance of the Marine Biological Laboratory is the direction given to research. It is true, of course, that every productive investigator aids in giving direction to research; he has students and he has imitators. Where a number of such investigators come together for considerable periods of time and problems are discussed, there tend to be a clearing of ideas and sharper definition of problems. This effects a larger circle, and the influence spreads. The best results of this sort can be attained only if people discuss their work freely, and do not keep it locked up until after publication. I believe that a considerable effect has been thus produced in direction of research, particularly in cytology, experimental embryology and physiology at the Marine Biological Laboratory. Organized efforts to direct the research of others, excepting one's own students, are apt to be futile, especially on a large scale, and in a large subject such as biology, where fundamental problems are dimly perceived or perhaps yet unsuspected. For this reason and others even more important, the institution has never prescribed or limited subjects of research.

I have spoken thus for the most part about the work of the Marine Biological Laboratory, because it illustrates in a practical working model various possible forms of cooperation; and because such a demonstration is worth much more than a merely academic exposition of the nature and advantages of cooperation.

Frank R. Lillie

Especially when only a few minutes can be devoted to a very large subject, definition of terms is of much importance.

Cooperation in education or research may be compared with efforts as dissimilar as those of an army, a swarm of bees, an ant-hill after enumerating all of its denizens, or the cells or cell-complexes of that unit that we biologists know as an individual animal or plant.

Every professor having to do with graduate instruction exemplifies a simple type of cooperative alliance in his relations with students: sometimes stating a problem, encouraging them with a nod of appreciation, or setting them to thinking by a suggestive question in the Sprechstunde to which association with them is limited, while they are left to fight out their own salvation at other times; sometimes being brain and ganglion to their muscle, and himself doing all but the mechanical parts of their thesis majors; occasionally, perhaps, drawing equally facts, inspiration and reputation from their surpassing initiative, energy and success—and then possibly being even more than an incubus.

There may be good administrative reasons why a research department should not show seeming narrowness of vision and purpose; but there is a great chance, in a department blessed with armies of capable graduates, to distribute between them the details of a broad study, the blocking out and accomplishment of which marks its architect as a master in the truest sense.

May I suggest that cooperation—the mention of which instinctively sets us to thinking of enlisting for our own purposes the effort of remote workers—may sometimes at least, like charity, begin at home; and that many of the good theses which now appear to the average critic as dissociated from one another, and without obvious environmental relation, can be given thus an excellent ecological meaning?

People with a capacity for business organization see that this simple type of cooperation might reach much farther if the various graduate schools of biology were further to differentiate and coordinate their respective effort. It is safe to say that the students of a given department, in which they stay for only a few years, can effect such a coordinated and cooperative attack on the several parts of a large and divisible problem only by chance or a miracle; but the result is quite within the power of the permanent heads of departments, if they are willing to take it up and desire to do so.

Popular interest in biology to-day centers about the plant or animal as a mechanism, the plant or animal in action, rather than as illustrating that abstract concept called, sometimes sarcastically and usually vaguely, a species. Illustrations of intra-departmental cooperation are afforded by a few of the great morphological and physiological laboratories, and in the studies which Bateson is having made in genetics and Pearson in biometrics. Who can doubt that we who admire the great men who edit *Pringsheim's Jahrbücher* are really able to characterize its editors, Strasburger and Pfeffer, as leaders in their profession almost as much because of the correlated contributory studies of their pupils as from their own great investigations?

For interdepartmental cooperation, which I understand is admirably exemplified in current astronomical work, illustrations in our own field may be taken from the now unpopular—but fundamentally indispensable—systematic branch of botany. The master mind in this field to-day, Engler, is exemplifying in a large way, by the publication of "Das Pflanzenreich," what united effort may accomplish; and our own incipient "North American Flora," under Britton's editorship, has been launched on the same lines—which have long been successfully followed in the much simpler preparation of encyclopedic matter.

There appeared at one time a possibility that Mr. Carnegie's great research foundation might knit together and unite the workers of our country into a net by which the depths of science should be dragged, but there is a bottom to every purse, and, large as its resources are, the Carnegie Institution has found the requirements of investigators to be still larger, and its policy seems to be crystallizing wisely into ample support of relatively few definitely controlled studies rather than a broadcast dissipation of its resources without such control. There is perhaps nowhere a better illustration of efficient, self-centered organization on a large working basis, but our national Geological Survey offers an equally good illustration of this type.

When the agricultural experiment stations were established, with national support and under the supervision of a national bureau, some persons thought that cooperation between the stations might be secured through the latter. Whatever the purpose of the law may have been, as conceived, its provisions, as embodied in legislation, have given to the central office little authority beyond financial supervision. Perhaps it is best that this should be so—every question is many-sided: but it is generally conceded theoretically that larger strides might have been made in agricultural science by greater concentration and correlation of the effort of the stations. The newer addition made to their equipment for investigation by the Adams act more clearly provides for this, and promises adequate results; but it is already bringing prominently to the front other cooperative needs, the most important of these referring to the channels of scientific publication.

As a matter of fact, the Carnegie Institution and United States Geological Survey do not illustrate cooperation in the sense in which I understand the word to be used this afternoon. Each is really an aggregation of workers whose tenure of office as well as their scientific activities are more or less definitely under the control of a recognized chief. Their effort, because of this control, is as certain to be productive of desired results, under good leadership, as is that in a well-managed factory—subject always to the greater difficulty of directing the activity of educated men with wishes of their own as to the application of their talent. The—not always popular and variously successful—efforts of such an organization to enlist extraneous volunteer cooperation are beset by peculiar difficulties that are not to be disposed of in a word; one of the greatest of these perhaps lying in unexpressed and unaccepted but no less real punitive power at the central desk. The ultimate coordination of experiment station activities, if effected, can only add another illustration of good administration of a self-contained organization which pays its constituents for the effort that it therefore controls.

Real cooperation, though it will always have to direct its aims with reference to those of such powerful endowed aggregates as may exist, can hardly be looked for through the latter. Its units must be the scattered men of science who constitute the university and museum forces of the country—one or a few in a place. The difficulties of effecting and maintaining such cooperation are identical in part with those underlying good government, and can be met, apparently, only in the way in which municipal problems are met successfully.

Is such cooperation desired? The native Mexican never hails the coming of the civilizer after he has once understood him and his ways; more work and greater competition are what he sees as his own portion. His question, Is greater progress worth its cost? is worthy of consideration. If it be granted that it is, it is hardly necessary to await the coming of a leader in order to effect organization through which it may be reached. The cry for a king is answered, in the proverb of our profession, by misfortune. Our tastes and institutions are democratic. Our greatest achievement of cooperative scientific organization promises to come through the methods that we know and like. Initiative lies at the door of a few universities whose graduate departments are the home of the larger part of the biological research of the day. We really can not be so poor in men as not to be able to find an executive of ability and tact, if we desire him and search for him. Not impossibly, when found, he may prove to be so conscientious in "pottering" over his new task that his own hand will lose its cunning in technique, and opportunity for mental concentration in his own chosen field may be sacrificed to the new duty. If so, and the duty be performed, need we begrudge him the recognition that, if successful, he must win as the coordinator of our research?

The decision to form an effective research organization must be made by us if it is to be made; action on such a decision is equally ours; responsibility for cooperative success must depend in equal measure on investigators and executive. There is no strong reason to doubt that such success is attainable; but the purest spirit of democratic government, dominated by that love of advanced scholarship which makes and marks the investigator, seems essential for its permanence.

WILLIAM TRELEASE

FROM the history of biology, it would be easy to show that the idea of cooperation had not been always with us. Indeed, so late as the founding of the Naples Station, when Dohrn sought the approval and support of the venerable Eulenberg, that worthy refused to aid him, on the ground that Dohrn's plan would exhaust all zoological problems within twenty years.

Eulenberg's fears have proved unwarranted, and we no longer regard the supply of problems as dangerously limited; in fact, it is the very opposite condition that is most in evidence. The attempt has been made to meet this superabundance of opportunities by an increasing division of labor, and it is pleasant to note that the workings of specialization in the field of biology, impress us with the fact that specialization and cooperation are but two aspects of the same process.

This idea is so familiar, however, that I do not need to expand it, yet despite the general acceptance of the broad fact, the intimate nature of the relation between cooperation and specialization is often rather vaguely felt, and the present discussion should assist us to intensify our consciousness of this intimacy, and so make clearer how we may, and ought to act.

In its immediate and simple form, cooperation hardly requires to be discussed. We are familiar with such examples of cooperative work as Keibel's "Normentafeln," or the biological investigations undertaken in behalf of the alcohol commission. Matters like these arrange themselves. On the other hand, even without previous agreement, we get similar and in some ways better results, when a number of investigators independently direct their attention to the same problem, as has occurred in the study of Mendelian inheritance, or of the auto-regeneration of nerve fibers.

In attempting combinations for the solution of large problems it must be kept in mind that any arrangement which suppresses or eliminates the pleasures and excitements of the hunt for truth, or which cramps the cooperator, is in so far faulty. Against this we must be always on guard, for it is agreed, I believe, that the solution of problems and the answering of questions is of most worth as a means for developing the workers themselves, and good plans for cooperation must be in harmony with this idea.

Recognizing these limitations, by which cooperative endeavors are necessarily restricted, and at the same time recognizing the existence of relations which might be improved by a more vivid appreciation of the cooperative spirit which underlies biological activity, my colleague, Dr. Greenman, with the assistance of his advisers, has undertaken to utilize the Wistar Institute for the purpose of such improvement.

Permit me to mention two things which have been done, and which are distinctly promising. They constitute my special contribution at this time.

On looking over the field a year ago, it appeared that American biologists lacked suitable facilities for the publication of papers which were extensive and required ample illustrations. Most journals did not feel justified in devoting to such long single communications the space and money which are demanded for them. Nevertheless, papers of this character mark a step in advance, for they result from the effort to be more critical and thorough, and plainly they deserve encouragement. It appeared, therefore, that we could advantageously cooperate with investigators in this country, by arranging for the publication of such researches, and through the appreciative generosity of a colleague it has been possible to do this by reviving the *Journal of Morphology* under most favorable conditions.

In your presence it is hardly necessary to enlarge on the significance of this step, but I have ventured to call attention to it, as one example of cooperative activity.

My second example is from quite a different field and relates to the collection and preservation of material, in order to make it accessible to investigators at large. The endeavor to do this has grown out of a movement started and fostered by His. Some years ago His persuaded the Associated Academies to appoint commissions for embryology and for brain study, in order to develop cooperative work in both these fields. His knew from personal experience that studies in these departments had reached such a stage of elaboration, and were so largely comparative, that the labor of preparing the material for a given research often overtaxed the powers of even the most industrious, and the hour had come to assist investigators by gathering and storing at central stations series of sections and related material, which should be available for all.

This idea naturally appealed to us, and we are now endeavoring to develop it, laying emphasis at present on the material which illustrates the structure of the nervous system. The plan gives to the museum of the institute something of the functions of a library, with this difference, that it handles specimens instead of books.

Such specimens are derived from two sources: from the laboratories of the institute itself, and from elsewhere. In connection with the latter source, permit a passing comment.

We all have occasion to lament the fact that many of our promising scientific youths, after an encouraging start, turn aside from pure science to follow the primrose path of some more remunerative calling. For their loss and ours, we must always grieve, but there is comfort in the thought that in a measure it may be possible to save the pieces. The youth is gone, his special skill diverted, but his preparations may still be rescued for the benefit of others.

Too often these preparations find their last resting place in some forgotten trunk or lofty laboratory shelf, from which they are never recovered. Such loss should be prevented, and at this point the museum comes forward and offers to care properly for these materials.

To do this effectively, however, there must be genuine cooperation on the part of the investigators. Such material is not worth storage or arrangement unless accompanied by descriptive notes, notes so complete that by the aid of them the material may become really useful to a second person. The museum can offer the opportunity, but the acceptance of this by the investigator implies also the obligation we have named, and it will be of interest for us, in the course of years, to observe how far the obligation will be met. Such is my second example, and it completes the instances which I desired to present.

Before closing, however, allow me to reenforce the general statement that aside from the obvious occasions for simple cooperation, which in a measure take care of themselves, there also exist between investigators more complex relations which offer special opportunities for cooperative treatment. The examples given have been selected as illustrations of such opportunities, and indicate how some of these may be utilized not only for the general advancement of biological research, but also for the stimulation and assistance of the individual biologist.

Henry H. Donaldson

Agitation in favor of cooperation and coordination in scientific research has been noticeable in recent years in many departments of science. It seems quite possible that the importance of cooperation and combination of effort has been borne in upon us by recent demonstrations of the effectiveness of such movements in industrial enterprises. However this may be, it is safe to assert that the general idea has come to the front repeatedly of late years, and it is probable that as an outcome of the discussions aroused some definite attempts will be made to utilize this principle more fully than has been done heretofore in the advancement of science. Indications of such an effort may be seen in astronomy in the organization effected for the preparation of an astrographic chart, and in the successful establishment of the International Union for Cooperation in Solar Research. As a matter of history, we are all aware that the idea is not a new one in science. This fact has been especially emphasized by Merz in his valuable book upon "The History of European Thought in the Nineteenth Century." He states that cooperation formed the underlying principle upon which the great academies and scientific societies of Europe were based. In the organization of the Académie des Sciences, particularly, the idea was kept clearly in mind, and, indeed, was most successfully applied in various important pieces of work, such as the measurement of arcs of the meridian and the determination of the variations of gravity in different latitudes. We may believe, in fact, that the recognition of the value to be derived from combined effort on the part of those interested in a common pursuit explains the existence of such societies as this which we are attending to-day. No one probably is disposed to doubt the importance of cooperation when the term is interpreted in a broad way, but if we give it a narrower connotation in the sense of an intensive combination of the scattered energies of many workers there is, perhaps, room for differences of opinion in regard to its value. The point for discussion, as it presents itself to my mind, is whether or not it is desirable and feasible in the actual work of investigation to seek for an intelligent coordination of the activities of numerous individuals, and to attempt to focus this combined effort upon specific problems. Speaking in general terms, it is evident that the bulk of the investigation going on at present is not being conducted on this principle. The productive investigators in the various laboratories of the world are working independently. The problems that engage their attention are determined by personal interests or accidents of equipment or opportunity, and their researches are not correlated except in so far as certain problems come to the front from time to time, and by the general interest which they excite attract for a period numerous workers to a common line of study. The fortunate investigator who unearths a new idea, or devises a new method of importance, is sure to have many followers, and there results for a while a certain kind of cooperation, which is lacking, however, in the element of intelligent coordination; so that oftentimes there is an apparent waste of energy and material, due to the fact that the individual investigator is unable or unwilling to make full use of the results obtained by his coworkers. The method of independent investigations needs no apology or defense, and we should be careful not to minimize its importance. The competition that it implies encourages originality and carries with it all the benefits that accrue from differences in point of view. It is to this kind of investigation that we must look for our epoch-making discoveries, so at least we may infer from the past history of science. No one surely has any wish other than to see this kind of research grow in volume and importance in this country. Nevertheless we may ask whether it is not possible that in some ways better and quicker results would be obtained by directed cooperation. In the accumulation of reliable data, for example, by the concentrated application of approved methods of work. It needs no argument, I am sure, to convince any experienced worker in science that eventually such accumulated knowledge will cause of itself the destruction of false theories and the development of newer and truer points of view. In my own subject, at least, it is undoubtedly a fact that brilliant discoveries have come, as a rule, not as a bolt from the blue, but from a slow accumulation of diverse facts and theories which, eventually, in the mind of some one gifted worker, when the time was ripe, have burst forth as a new conception. Our individual workers of genius must be supplied with raw material in the way of facts and theories in order that their talent may be productive of real good, and it is in the accumulation of this raw material that most of us make our contributions to the advancement of science. It is in this direction also, as well as in the utilitarian application of scientific knowledge, that cooperative work, as defined above, might be depended upon to greatly accelerate the rate of progress. From the point of view here adopted the success of cooperation in scientific investigation must depend chiefly upon the possibility of devising an efficient organization for carrying it on, and obviously two essential requirements of such an organization are, first, that it shall possess sufficient dignity and authority to make its direction respected, and second, that it shall have at its disposal sufficient funds to pay for the expenses of the work. Several possible ways may be suggested for developing such a mechanism for cooperative research. In the first place it is quite possible that any body of scientific men may cooperate by a series of conferences and some sort of a voluntary compact. A notable example of an important effort of this kind is found in the International Union for Cooperation in Solar Research, already referred to. Quite recently also the National Academy of Sciences, through a special committee, has taken steps to organize a definite plan for cooperative research upon the equilibrium conditions of chemical reactions. A similar plan might be followed with advantage by any or all of our special societies. Speaking for my own subject, there is no reason why the American Physiological Society should not, through its council or by means of special committees, plan out work of a general character and enlist the cooperation of selected investigators. There are a number of questions in physiology which bear upon public health or social conditions which might be studied systematically in this way. There is an important field also in the determination of physiological constants and the standardization of methods and apparatus which might be worked better by this method than by the accidental cooperation of individual investigators. There can be no doubt that such an effort would be well worth making even if it fell short of the full measure of success hoped for. Some data of fundamental importance would be obtained with a degree of completeness and certainty which could hardly be reached by any other method. There is another consideration of subsidiary importance which is worthy of passing notice in this connection. It is, I believe, a matter of common knowledge that in every department of science there are many able workers who remain unproductive because of a certain lack of initiative, or because they waste their time and opportunities in ill-directed efforts. Quite often these workers are the very ones who have had the most careful training in technique and are the best qualified to accomplish difficult research work. If under the influence of some central organizing force they could be enlisted in a systematic campaign of work, their training would be utilized for the benefit of science and to their own best interests. There is another class of workers, to be sure, who are so constructed temperamentally that they never accomplish their best work except as free lances—for them cooperation would be irksome and deadening. In any such plan of work as that contemplated some discretion in the selection of workers would have to be exercised by those charged with the general direction. I am convinced, however, that an earnest persistent effort to organize cooperative work is well worth making on the part of all of our scientific societies. It goes without saying that a voluntary cooperation of this character would meet with many partial failures; much that was initiated might fail to run a completed course, owing mainly to the lack of a compelling sense of obligation on the part of those entrusted with the details of the work, but on the principle that half a loaf is better than none I believe that we should all do well to follow the example set us by the astronomers. Another source to which we might look for aid in developing and testing the cooperative method is found in those large scientific bodies which have a certain amount of money at their disposal for the encouragement of research. In some cases the money controlled by these societies has been given for specific purposes and would, therefore, be difficult to administer in the way here suggested. More frequently, however, the funds are available for the promotion of scientific knowledge in general by means of investigations. As a rule such funds are disbursed on the principle of competition rather than of cooperation. They are used to subsidize individual researches, and the work accomplished, however good it may be in the single piece, is scattered over a wide field and lacks the effectiveness which might be obtained by intelligent supervision. The method of subsidizing is a method fitted to encourage or perhaps to discover the individual worker of talent, rather than to promote an increase in knowledge. While it has much more to commend it than the wasteful and almost useless system of granting prizes, we must admit that in its actual working it is haphazard; a blind sowing of seed, the harvest from which depends largely upon chance and circumstances. One may be allowed to question, therefore, whether it might not be more productive of good, if societies with funds entrusted to their keeping, such as the National Academy of Sciences, would make an effort to dispose of their funds in the systematic investigation of fundamental problems. The society mentioned has at hand, in its own membership, men who are abundantly qualified to select the right problems and to direct and coordinate the work of those entrusted with the several investigations. Whether such a use of its funds is permissible I can not say, but if such is the case one can scarcely doubt that by organizing systematic research of a cooperative character the National Academy could make itself a living and stimulating force in the scientific activity of this country. But among the agencies to which we may look for help in the matter of cooperative work, the two which seem best adapted for this variety of research are the laboratories supported by the government and the specially endowed institutions of the type of the Carnegie, Rockefeller, Wistar, etc. In regard to the governmental laboratories it is natural to suppose that the problems to which their resources might be applied most appropriately are those possessing an immediate economic importance. Individual scientists in the service of the government have without doubt contributed many investigations of the first importance, as they would have done under any circumstances which offered them equal facilities for work. But the specific function to which these departments are best adapted would seem to be the prosecution of investigations bearing more or less directly upon the health and wealth of the citizens of the country. I do not mean to say that it is inappropriate for the government to give its support to investigations of the more fundamental and theoretical problems of science, but at present, at least, funds from this source can probably be obtained with least opposition when the work undertaken gives promise of a more or less immediate application to the needs of life. In following out such investigations the laboratories of the government are peculiarly fitted by their organization to effect a coordination of the labors of their individual workers. On the contrary, the specially endowed institutions have a freer hand in the disposition of their resources and are less hampered by the necessity of adopting a utilitarian policy. With large means at their command and with a centralized authority, fitted to direct and control the investigations made by their scientific staffs, these institutions constitute ideal mechanisms for testing the effectiveness of cooperative research—it would seem, indeed, that in this field there lies for them an especial opportunity. The laboratories of our universities form training schools wherein young men and women must be taught to use the appliances of research, and it is almost a necessity of the case that the work shall be large and varied. The whole range of a given science should be presented and exemplified as far as possible. In these laboratories also the opportunities for individual research should be made as wide as possible—therein lies their special mission, and as a matter of fact this condition prevails at present, and has prevailed from the beginning of scientific laboratories connected with academic institutions. If our specially endowed institutions simply follow the same general plan they will add nothing distinctive to the character of the scientific activity of the country. It will be as though one or more new universities had been organized, and the present opportunities and methods had been somewhat extended—a chance for a few more investigators to try their powers under conditions not materially different from those already existing in many laboratories. If, on the contrary, the energies and appliances of these institutions were directed toward a cooperative concentration of effort, then indeed, they would fill a need not now efficiently met by any of our existing scientific foundations. There seems to be no reason why the directors in such institutions should not exercise the power of planning a campaign of work in which all the talent and training of the workers under their control should be brought to bear upon a systematic continuous investigation from several sides of problems of importance. The policy that seems to have been adopted by the Carnegie Institution, of applying its funds to the creation and maintenance of special laboratories, such as the laboratory of nutrition and the Desert Botanical Laboratory is a welcome step in this direction. Well equipped and well directed, they will accumulate data of the greatest importance and will fulfill a function which our teaching laboratories, by their organization, are unfitted to exercise. Laboratories of this character so organized that their forces can be coordinated now upon one problem and again upon another constitute a kind of machinery which is at present lacking in our scientific workshop and from which results of the greatest value may reasonably be expected. William H. Howell

The Johns Hopkins University

The topic before us for discussion permits of a great variety of interpretation. It would be feasible and interesting to discuss the possibilities of cooperative endeavor on the part of university departments of psychology on the one hand, and the medical departments of mental and nervous pathology on the other. Such cooperative enterprises have already been given a trial in one form or another both in this country and abroad, and so far as I am aware, with general satisfaction to all concerned. A much further development, however, is practicable, and one of the first steps in this direction, already taken by the more progressive medical schools, consists in the requirement that medical students should familiarize themselves with the rudiments at least of modern psychology. In my judgment this movement is but an expression of the most obvious common sense and I welcome it as such; but I am sure that much remains for the psychologist to do even on this level of cooperation in supplying the medical student with a selected material peculiarly appropriate to his needs.

We might also discuss the possibilities of cooperation between the departments of neurology and psychology. This is a hobby which I am glad to ride at any time. Again we might with advantage consider the possibilities of cooperative division of the field of study dealing with animal behavior as between the zoologists and the animal psychologists. But it is clear that within the limits of time at my disposal any such discussions would monopolize my part of this program and at the end find us with only one of many equally important groups of relations examined. I have therefore chosen to devote myself to a consideration of the special demands which psychology has to make upon several of the biological sciences and to a brief statement of some of the contributions which it is in position to offer in return for favors received. I choose this course in the hope of furthering among the distinguished naturalists here present a fuller understanding and appreciation of the ideals, aims, and necessities of modern psychology.

In emphasizing the *demands* psychology makes I am by no means oblivious to the inestimable services already rendered her by the natural sciences, but I may safely assume that the more important of these services are familiar to you and I prefer to attempt to make vivid the future favors for which we look.

It should be remembered at the outset that historically psychology arose out of philosophy, and it still retains a large measure of intimate filial relations with its first parent. In recent years, however, it has been increasingly adopting the manners and point of view of its brothers and sisters, the natural sciences. This has been particularly true since the introduction into psychology of experimental methods. Although there are not at present any sharp lines of division between what may be called philosophical psychology and psychology as a natural science, the distinction in emphasis is none the less real. I shall, for the present purpose, disregard the more philosophical branches of psychology and confine myself to those of a more scientific character whose relations to the biological sciences are necessarily most intimate.

It should perhaps be added that the psychology of this stripe conceives its business as the study of the organization and operations of mind; broadly and metaphorically, this field may be called the anatomy and physiology of mind. Moreover, it regards the mind not as a remote, abstract metaphysical entity, but as a concrete vital function bound up in the most intimate connection with physiological processes which must be taken into account before it can be properly and fully understood.

Perhaps the most persistent and important levies which psychology undertakes to make are at the expense of neurology, using this term to designate the scientific study of both the anatomy and physiology of the nerves, it being understood that this includes certain phases of physiological physics and chemistry. The situation here is so obvious and so familiar as to require little elaboration. For modern psychology, the hypothesis that the mind is functionally dependent upon the nervous system has become substantially a postulate. Whatever we can learn, therefore, about the nervous system, is clear gain to us in our efforts to disentangle the complexity of mental life and to apprehend its principles of organization. We wish to know everything which the neurologists can tell us regarding the ways in which nervous currents act, how they reinforce one another, how they are inhibited, and what are the conditions of their original arousal. We wish to know also, more completely than we now do, what the great typical pathways are through the nervous system and what junction arrangements these pathways have with one another. These facts we wish for the light which they may throw upon certain recognized peculiarities of mental process. What explanation, for example, can the neurologist offer us for such peculiar facts as are disclosed by the synæsthesias, in which the stimulation of one sense organ like the ear is immediately followed by sensations not only of sound but of color or taste? What explanation can he offer for the fact that the color threshold is lowered by the simultaneous stimulation of the ear?

We should like to know what occurs as

regards neurone transmission when an act previously carried on with painstaking, conscious effort, becomes so habitual and automatic that conscious control can be, and often is practically, done away with. Does this involve the use of pathways below the level of the cerebral cortex, or does it simply mean decreased resistance in cortical neurone systems, consciousness being the expression of such resistance? Our basal conception of the relation of consciousness to the nervous system will be determined in no small measure by a conclusive answer to this question. Despite much dogmatic assertion and certain very interesting recent experimental investigations, the problem is still unsolved.

We wish also and particularly to know what portions of the nervous system, or what modes of nervous action are primarily responsible for the great subdivisions of our mental life. In a rough way we have already learned something in reply to such questions regarding the portions of our brain responsible for certain of our sensations and movements and even for certain of our ideational activities. But the details are still very hazy. We should be glad for a more definite knowledge of the differences in cortical action which distinguish sensations and perceptions from ideas and images. Here again dogmatism runs far in advance of well-organized and demonstrable fact. We should also welcome most enthusiastically any fundamental illumination as to the physiological basis of memory.

We want to know much more than the specialist can now tell us about the structure and function of sense organs. Behavior is simply a generic term for muscular movements made originally in response to sensory stimulations of one kind or another. It is obvious that we must know the characteristics of these sensory excitations before we can adequately understand the reactions which are made to them. This is peculiarly true of comparative psychology, with its interest in the mental processes of animals, but it is equally true at bottom in the case of human psychology. We want, for example, to know the structure of the retina in the lower animals and especially those whose vision is not binocularly unitary, and we also want to know the facts about the visual conduction pathways in the central nervous system in the case of such animals. This knowledge we desire, not only to enable us more exactly to interpret the behavior of such animals but also, and particularly, for the light which it may throw upon human visual processes. That animals have eyes might seem to imply that they see colors and yet, as is well known to you, evidence is rapidly accumulating to render it fairly certain that many animals supposedly possessed of color vision, in reality are sensitive only to differences in brightness or luminosity. A careful examination of the retinæ of such animals may well give us our long needed clue wherewith to untangle the puzzles of the human color sense. In the case of man it seems not unlikely that a completely adequate color theory must await researches in physiological chemistry as yet unmade. Nevertheless, we may get our start from such investigations as these just suggested upon the animal retina.

I need hardly add that a correct interpretation of animal behavior depends upon the solution of problems such as these: for example, much evidence is now at hand indicating that animals may possess developed sense organs of which they make little or no actual use under normal conditions. It is wholly problematic whether certain birds make any actual use of smell as a sense process, and yet the evidence suggests that anatomically they are equipped to respond to odors. Similarly, certain varieties of rats make under many conditions little or no use of their eyes. For such animals these senses are almost as much of a luxury as the vermiform appendix is for man. The naïve observer of these animals, unfamiliar with these peculiar facts about the non-use of these sense-organs, must inevitably go astray in interpreting their reactions.

We can not hope for a thoroughly satisfactory theory of auditory consciousness until we learn more adequately the anatomical and physiological facts about the cochlea. Of late the widely accepted Helmholtzian theory of sympathetic resonance by the basilar membrane fibers, has received some almost fatal wounds and none of the substitutes as yet proposed is wholly convincing. I might unfold a similar tale of defective present-day knowledge in the case of each of the senses, and the psychologist stands ready and eager to appropriate with gratitude whatever can be given him here. Are there without doubt special end-organs for the temperature sensations, and for the several forms of contact? What is the implication as to our bodily sensations of Head's recent experiments on sensory nerve regeneration and the return of sensitivity after nerve section? Are there specialized end-organs for the four elementary tastes whose psychological and physiological distinctness seem so certain? Is there no differentiation in the olfactory end-organ comparable with the bewildering profusion of olfactory sense qualities? The answer to these and to dozens of other similar questions must be obtained before psychology can be satisfied with the finality of its analyses and explanations of sensory consciousness.

From comparative anatomy and physiology, as well as from embryology, we look for much helpful light on the circumstances surrounding the appearance and growth of intelligence. Time fails me, however, to attempt to specify details.

Modern psychology gladly acknowledges a great debt of gratitude to the alienist and the pathologist. The study of insanity and nervous diseases, chaotic as are the present conditions in those branches of medicine, has been of indisputable moment to psychologists. Moreover, we recognize that the studies of the neurologists and the pathologists are mutually indispensable to one another and that answers to many of our questions already formulated must come from both these scientists in order to be complete. The study of alternating personalities, of hypnotic phenomena, of somnambulism, and the positive insanities, to mention only these, has let in a flood of light upon the complexities of organization in the mental machinery which could not otherwise have been attained. The questions which the psychologist still has to put to these colleagues of his are so numerous as wholly to baffle summary. They can only be illustrated.

Is the disintegration of the self found in the so-called alternating personalities simply an exaggeration of normal conditions, or is it wholly pathological in the sense in which scarlet fever is? Already intimations of the final answer to this question are looming large. What is the origin and inner character of the so-called "phobias," so characteristic of our day? This man is a neurotic hypochondriac; that man a neurotic recluse. Have these diseases their foundation in specific lesions of one or another kind; are they expressions of hypertrophy of normal physiological functions, or are they purely psychic? What is the physiological basis of suggestion often employed in treating such conditions? Perhaps, if a satisfactory reply could be obtained to this last question, our medical friends would be less generally willing to hand over to Christian

Science and Faith Cure healers the undeniable therapeutic values of this process. Medicine, as well as psychology, could therefore profit by the answer. What is the physiological foundation of hypnosis? Answers to questions such as these would set us far on our way to a better understanding of the mind and its connection with the body. With due modesty I may as a psychologist say that the issues raised here concern matters about which our present knowledge is almost exclusively psychological.

I trust that in this brief sketch I have made it clear that psychologists are watching with utmost eagerness a wide range of neighboring scientific territory from which they will purloin anything of value to them if not prevented, and I hope I have also shown that their needs are many and genuine and definite. But what has the psychologist to offer in return for the blessings of natural science past and future?

I shall make my reply very brief and confine it to a few words dealing first with the general advantages which psychology offers and second, to the specification of a few more concrete details of service.

One very obvious and simple service which the psychologist would be glad to render his scientific colleagues is the tender of a knowledge of a few simple psychological distinctions and a reasonably satisfactory terminology in which to clothe them. It is depressing to the psychologist to find his brethren still using ideas and terms which were becoming obsolete in psychology at the beginning of the nineteenth century. It may readily be granted that the terminology created for strictly psychological purposes may be found unsatisfactory in some particulars when employed in psychiatry or neurology. But the correct alternative to choose in the face of this difficulty would not seem to be the naïve creation of a new terminology, nor the utilizing of one already outworn, but rather the modification of the best one in vogue. I would not seem to imply that psychological terminology is a finished and satisfactory product. Quite the reverse is true, but it has some relatively stable features to offer and some good reasons for offering them. Moreover, there are certain elementary psychological ideas and principles which are quite firmly established, and should be familiar to every scientist whose work requires him now and again to indulge in psychological statements. Such terms as sensation, perception, imagination, memory, attention, association, conception, reasoning, emotion, and volition have sufficiently fixed and definite meanings attached to them to render their use perfectly practicable. Without such knowledge it is hardly possible to make any extended statement about mental facts without becoming involved in needless terminological difficulties.

I trust my attitude will not be misunderstood. I speak in sadness, not in irritation; in sorrow, not in anger. Open the standard anatomies of the nervous system and you will not infrequently find diagrams of the cerebral cortex with one set of areas marked "sensory" and another set marked "psychic," as though sensations were not psychic and as though psychic meant anything in particular anyhow. What kind of psychic? Emotional psychic; ideational psychic; volitional psychic? To classify the functions of a region as psychic is much like classifying the people of the United States as human. It may be true but it is not illuminating; and if the term psychic is employed as significant simply of something not immediately sensory in character it is an unpardonably vague term for which good substitutes are easily available in psychology. If it is used as a cloak for ignorance, then the term "*unknown*" should be substituted for it in the regions concerned.

There are many general advantages of a similar character to be gained by the scientist from a slight acquaintance with psychology, and not the least of these is perhaps the more vivid appreciation on his part of the elaborate technique which modern psychology has worked out to meet her needs and the substantial foundation which now underlies modern psychological doctrines. In so enlightened a body of scientists as this which I now have the honor to address, there is undoubtedly no such shallow misconception of the attainments of modern psychology, but there are many who still dwell in the darkness of intellectual night so far as concerns this matter.

I shall select simply a point or two to illustrate the more specific and particular ways in which psychology may contribute to the natural sciences. The contemporary naturalist often has occasion to make use of the psychological principle of association and I would urge on his thoughtful consideration the psychological analyses of this feature of mental life. The bland naiveté with which he often uses this principle makes one gasp who has ever faced its multitudinous complexities. It is a safe surmise that Aristotle had forgotten more about the principle of association than certain modern naturalists have ever known. It is respectfully submitted that it is not good common sense in the use of a principle like this wholly to disregard the elaborate analyses of generations of previous workers. Again, it is out of the question for the neurologist, for instance, studying the function of the auditory end-organ apparatus to go far or safely without a knowledge of such generally unfamiliar phenomena as those of combination tones with their many varieties. Similarly the physiology of the visual processes must remain lamentably incomplete in the hands of an investigator unfamiliar with the important facts of color vision: for example, the peculiarities of such vision under dark and light adaptations respectively, the phenomena of contrast, peripheral retinal color deficiency, the peculiarities of peripheral and foveal space impressions, and so on. In other words, psychology is in a position to furnish a systematized statement of vast ranges of mental phenomena which not only *may* be taken into account by the neurologist, but which *must* be taken into account before his science can approach completion, because these phenomena constitute many of the concrete facts which it is his business to explain. In other words, psychology—or some other science doing her work—sets many of the most important problems for the other biological sciences. Facts which she finds, they must take account of and, if possible, explain.

James Rowland Angell
University of Chicago

SCIENTIFIC BOOKS

The Value of Science. By H. Poincaré, Member of the Institute of France. Authorized Translation with an Introduction, by George Bruce Halsted, Ph.D., F.R.A.S. With a Special Prefatory Essay. Pp. iv + 147. New York, The Science Press. 1907.

In calling attention to M. Poincaré's masterly little book, I propose—these columns being what they are—to consider rather its general significance than to traverse the technical problems of logic and epistemology which it raises. For scientific workers at large, the *tendency* of the monograph happens to be the most important thing about it. It adds another to the numerous contemporary evidences that scientific investigation, when subjected to reflection, and viewed with regard to its methodology and intellectual presuppositions, leads unavoidably to difficulties that belong in the field of philosophy. No doubt, I may incline to exaggerate this view, but, as

I have preached it for years, when another tide was running, I am accumulating no fresh sins on my head, now hoary with them!

Since the days when Lavoisier dethroned phlogiston, Black founded his kitchen-laboratory, Schleiden and Schwann enunciated the cell-theory, Helmholtz published his epoch-making paper on energy, and Pasteur discovered chiralitry, we have been so occupied in the detail of scientific acquisition that little time and, perhaps, less appetite remained for inquiry concerning the fundamental principles in human consciousness whereon all discovery is based ultimately. Doubtless some did philosophize, like Lotze and Mill, and even E. du Bois-Reymond; but in the rush of new and ever new knowledge, they fell upon neglect, or their speculations consorted, in most minds, with other curious diversions. So, fate working with irony as always, many were content to wallow mid most serbonian bogs, hidden away in the recesses of mental construction and, in the eyes of the too few elect, contrived to cut sad antics. The fine futilities of agnosticism, the unashamed, because unconscious, contradictions of materialism, and the mystic improprieties of hylozoism thus came to do duty as presentable accounts of first principles. Anything "went." Every student of the history of culture knows perfectly well that this sort of thing can not go on indefinitely. A day of reckoning has arrived invariably, later if not sooner; and there is no reason to surmise that our own case will furnish any exception to a constant rule. If we would tarry only long enough to ask, for example, the simple question, To what does hypothesis amount? we would, beyond peradventure, rub our eyes when confronted with the unexpected result. It is well, therefore, that a past master in one realm of science should have taken heart of grace to call a halt for the purpose of reviewing some of the fundamental presuppositions incident to all phenomenal research. M. Poincaré's troubles may, indeed, seem far removed from the daily storm and stress of our laboratories. Nevertheless, they can not be dodged if one would know what reliance can be placed upon that elusive thing we label confidently "scientific certainty."

Now, obviously, when normative, and therefore very general, problems come in question, the thinkers who attack them will be influenced, severally, by previous interest, familiarities, and consequent constructive intention. They are helpless to rid themselves of distinctive standpoint. Here, if anywhere, we perceive that the "human" is himself the most important piece of apparatus in the laboratory. We must not expect Poincaré and Ostwald, for instance, to stress identical differences, or even to approach the same issues with similar intent. Nay, even naturalists, like Brooks and Arthur Thomson, diverge widely both in method and outlook, when they record their conclusions on first principles. Naturally, then, M. Poincaré proves this rule—he is always the mathematician, and the mathematician of most "modern port." For this very reason his work proves enthralling, even if some young lions of philosophy could pierce his speculative guard here and there.

Nor is this all. The mathematical spirit comes permeated by gallic genius. Where we, and our kith in the British isles, achieve results by vast compilation of examples, where we are valiantly empirical, the French proceed by way of abstraction and quick appeal to rational principles. Knowledge must fetch and carry for us; for them she is a mistress to be worshipped with a kind of holy joy. Ideas render us restive or impatient, the French would die for a "cause." Hence, as Glazebrook records, in his monograph on Maxwell (pp. 216 f.), Poincaré experiences "a feeling of uneasiness, often even of distrust," in approaching Maxwell's investigations, because "Maxwell does not give a mechanical explanation of electricity and magnetism, he is only concerned to show that such an explanation is possible." The canny Scot was not there to buy out the entire store; he would go in and ask change for sixpence! And he would get it, moreover. But, what is the basis for his procedure? Ignorant of this, his action can not be grasped. The philosophical instinct, with its ineradicable suspicion so intolerable to the eager researcher, speaks here, and the vital question of legitimacy of method looms up.

M. Poincaré's tendencies in this connection are familiar already to readers of, say, his "Electricité et Optique," or "La Théorie de Lorenz et le Principe de Réaction" (*Arch. néerland.*, ser. 2, v. 5), where his criticism of mechanical constructs ends in the affirmation that, not these, but *unity*, do men really seek. In a word, the empirical references of mechanics must be expressed in mental terms if we would estimate their value for a human experient. The way in which men regard things, the way of thought, calls for consideration just as close as the grasp they may have obtained upon particular objects. In fact, thus the value of alleged grasp must needs be estimated. In a more concrete sense than Grassmann's, and with no necessary reference to prudence, "a doctrine of Forms should precede a doctrine of Magnitude," as H. Hankel pointed out forty years ago. In short, two questions, long subordinated, thanks to preoccupation in special discovery, thrust themselves forward. What basis does scientific thought possess in the sphere of logical reasoning? What value can be assigned to scientific thought in the complexus of human experience? That is to say, M. Poincaré confronts the Sphinx, who asks, What validity, if any, does the scientific view of the universe hold in its own right. And, naturally, his interest being what it is, his achievements being what they are, he presupposes the work of such earlier masters as Riemann and Weierstrass, of such recent scholars as Kronecker, Paul du Bois-Reymond and F. Klein, to say nothing of the remarkable group of his own fellow countrymen. I mean his approach is from this side, not from that of the philosopher *pur sang*. But this matters little, for he has been gifted with a double portion of that Gallic wit which, in our time, stands for Attic salt—the wit to refine ideas of all dross, and to present them crisp from the crucible of thought.

The contrasted, yet complementary, nature of the labors of Riemann and Weierstrass, as noted by M. Poincaré himself (*Acta Math.*, xxii.), serves to hint the general scope of the problem with which he wrestles in this book. "By the instrument of Riemann we see at a glance the general aspect of things—like a traveler who is examining from the peak of a mountain the topography of the plain which he is going to visit, and is finding his bearings. By the instruments of Weierstrass analysis will, in due course, throw light into every corner, and make absolute clearness shine forth." What is this but the age-old puzzle of the universal and the particular? What kind of author have we but one who, being a marvelous analyst, is also an ornament of the school of synthetic mathematics? And we must be prepared to learn, accordingly, that rule of thumb may turn out no rule. A theory may never render a more valuable service to science than when it breaks down, as M. Poincaré has himself said ("La Science et l'Hypothèse," p. 170).

M. Poincaré's conclusions are dominated by considerations like the following: "A reality completely independent of the mind which conceives it, sees or feels it, is an impossibility" (p. 14). "We have not a direct intuition of simultaneity, nor of the equality of two durations. If we think we have this intuition, this is an illusion. We replace it by the aid of certain rules which we apply almost always without taking count of them" (pp. 35–6).

"Space is a mathematical continuum, it is infinite, and we can represent it to ourselves only by physical continua and finite objects. . . . Absolute space is nonsense" (p. 56). "Experience does not prove to us that space has three dimensions; it only proves to us that it is convenient to attribute three to it, because thus the number of fillips is reduced to a minimum" (p. 69). "I believe, therefore, that if by space is understood a mathematical continuum of three dimensions, were it otherwise amorphous, it is the mind which constructs it, but does not construct it out of nothing; it needs materials and models" (p. 72). "The invariant laws are the relations between the crude facts, while the relations between the 'scientific facts' remain always dependent on certain conventions" (p. 128).

"A philosopher really anti-intellectualistic is impossible" (p. 114). *"All the scientist creates in a fact is the language in which he enunciates it"* (p. 121). "Since the enunciation of our laws may vary with the conventions we adopt, since these conventions may modify even the natural relations of these laws, is there in the manifold of these laws something independent of these conventions and which may, so to speak, play the rôle of the *universal invariant?* . . . In any case a minimum of humanity is necessary" (pp. 127–8). "All classification supposes the active intervention of the classifier" (p. 135). "Sensations are therefore intransmissible, or rather all that is pure quality in them is intransmissible and forever impenetrable. But it is not the same with relations between these sensations" (p. 136). "Nothing is objective except what is identical for all; now we can only speak of such an identity if comparison is possible, and can be translated into a 'money of exchange' capable of transmission from one mind to another. Nothing, therefore, will have objective value except what is transmissible by 'discourse,' that is, intelligible" (p. 137). "All that is not thought is pure nothingness; since we can think only thought and all the words we use to speak of things can express only thoughts, to say there is something other than thought is, therefore, an affirmation which can have no meaning" (p. 142).

It is plain enough, from these representative and characteristic selections, that M. Poincaré has not acquired familiarity with psychological investigation; that, as yet, he has not compelled himself to think through to a definite, coordinated, basis in epistemology; that his logical methods tend to gloss the secondary character of symbolism; and, above all, that he has not clarified the ultimate metaphysical problem immanent in his acute dialectics. But of these limitations, as the professional philosopher will at once see them, I incline to make light. For it is an immense gain that M. Poincaré should have insisted, not merely upon the existence of such riddles, but upon their fundamental import for an evaluation of scientific modes of presentation.

The book ought to be in the hands of all who desire to "mix their colors with brains."

R. M. Wenley
University of Michigan

Atlas of Absorption Spectra. By H. S. Uhler and R. W. Wood. Carnegie Institution of Washington, Washington, D. C., 1907.

"To furnish graphical representations, on a normal scale of wave-lengths, of the absorption spectra, both in the visible and ultraviolet regions, of a reasonably large number of compounds," is stated by the authors as their chief object in producing this book, and with the exception of the fact that their spectrograms do not extend into the red, their object has been very well attained.

The book opens with a two-page introduction by Professor Wood, which is followed by eighteen pages including descriptions of the apparatus used, spectrograph, sources of light, photographic materials, explanation of the tables, etc. The tables occupy about forty pages, and give, in systematic form, the results obtained for 147 aniline dyes and some of their related organic compounds, and 36 miscellaneous absorbing media, chiefly inorganic salts. Twenty-six plates, 102 figures, positives of the spectra observed, complete the book.

The dispersing apparatus used was a concave grating of 98.3 cm. radius, the ruled surface of which was 1.96 cm. by 5.36 cm. Most of the photographs were taken on celluloid films, sensitized with Seed's "L-ortho" emulsion. A few photographs were taken on Cramer's Trichromatic plates, for the orange and red regions up to about .63 μ. Most of the plates extend from about .20 μ or .22 μ to about .59 μ or .60 μ, where the Seed plates cease to be sensitive for normal exposures.

A Nernst glower carrying .8 ampere on a 104 volt 133 cycle circuit, furnished a continuous spectrum down to about .32 μ or .34 μ. A spark between electrodes, one of sheet brass and the other of equal parts of zinc and cadmium, furnished a bright line spectrum from about .2 μ up. The spark spectrum was cut off from the plate by a movable screen for all wave-lengths greater than .4 μ so that the second order ultra-violet might not overlap the continuous spectrum. The spectrum of the Nernst glower was too weak to affect the plates at .325 μ in the first order, and could not therefore have produced any effect below .650 μ by the overlapping of the second order. A 75-second exposure was usually given to the spark, then the screen was removed and a one-minute exposure given to the spectrum of the Nernst glower. The spark terminals were made very broad and chisel-shaped and their edges were placed parallel to the slit, a considerable length (about a centimeter), of which was thus illuminated. A large Leyden jar was connected across the spark gap.

An ingenious form of cell for holding the absorbing liquids is described in full. By means of it a wedge-shaped film of liquid was confined between quartz plates which could be set at any desired angle to each other and at any distance apart up to 6 mm. When properly placed before the slit the light coming to each successive point of the slit came through successively increasing thicknesses of the dye. Three exposures were usually made on each plate, their edges nearly in contact and the angle of the wedge and its position at each exposure was such that the three photographic strips showed, from the top of the first to the bottom of the last, the effect of a continuously increasing thickness of the absorbing film. The thickness at one edge was zero and at the other usually about .25 mm., although the thickness at the thicker edge varied over a considerable range.

The authors have anticipated the chief criticisms which might have been advanced against the book. In stating their "chief object" they disclaim any intention to attempt quantitative measurements or to make an exhaustive study of all known dyes. They have certainly investigated "a reasonably large number of compounds." Their statement that "only aqueous solutions of the aniline dyes have been investigated up to the present time" leads us to hope that the investigation will be continued both for other solvents and for other dyes, including some of the very important new photographic dyes which are not in their present list.

No attempt has been made to give to a high degree of exactness the positions of the absorption bands, and it is doubtful if either this or the relative strengths of the absorption bands could have been found satisfactorily with the commercial plates used. And it is perhaps because no attempt in this direction was intended that no data are given as to time of development, temperature of developing bath, etc.—nor are we told whether or not any attempt was made to secure uniformity in these respects.

The authors give ample warning that the photographic minimum in the Seed plates used may produce apparent absorption in the green. Without doubt there is much of interest in the red of many of these dyes, and it is to be regretted that the authors did not make use of some of the modern methods of plate bathing, or even of some of the later plates now obtainable commercially, both to secure a more uniform photographic sensitiveness throughout the spectrum, and to extend the observations into the red. As they point out, however, the slope of the limiting line at the red end of their plates indicates whether or not an absorption band is present in that region.

The book is very well printed and the plates seem to be excellent, although they do not seem to show all that may be seen on the original negatives, as is evidenced by a comparison of the tabulated data of some of the figures with the figures themselves, *e. g.*, in the case of potassium permanganate, Fig. 75, we are told that the negative shows seven absorption bands in and near the green. Only five of the seven can be detected in Fig. 74. The absence of typographical errors is noticeable. Under Fig. 99, however, we are referred to page 169, instead of, evidently, page 59.

Henry G. Gale
Ryerson Physical Laboratory

SOCIETIES AND ACADEMIES

THE OREGON STATE ACADEMY OF SCIENCES

The third annual meeting of the Oregon State Academy of Sciences was held at the

Oregon Agricultural College on January 17 and 18. Four sessions were occupied in the presentations of papers.

A reception was given to the academy members by the faculty of the Oregon Agricultural College on the evening of the seventeenth.

Papers were presented as follows:

"South African Flora," by Mary F. Farnham.

"Oysters in Oregon," by A. R. Sweetser.

"Future of Mining," by A. C. Terrill.

"Space and Number Systems," by H. B. Leonard.

"Theory of Electrons," by L. A. Robinson.

"Surface Tension applied to Ore Dressing," by H. M. Parks.

"The Birds of the Three Arch Rock Regions," by Wm. L. Finley.

"Apple Tree Anthracnose," by C. C. Cate.

"Notes on Trichoptera," by Annie Laura Hill.

"The Tides," by J. D. Lee.

Officers for the ensuing year were elected as follows:

President—A. R. Sweetser.

First Vice-president—A. T. Bohman.

Second Vice-president—A. B. Cordley.

Recording Secretary—C. E. Bradley.

Treasurer—C. O. Chambers.

Trustees—Dr. J. Withycombe, T. C. Bridwell and P. L. Campbell.

Librarian—A. W. Miller.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The paper of the 412th meeting was by Dr. George Byron Gordon, Free Museum of Science and Art, Philadelphia, on "An Ethnological Survey of the Kuskokwim River, Alaska." Dr. Gordon said that in continuation of his Alaskan explorations begun in 1905 he visited during the summer of 1907 the region of the upper Kuskokwim River, and embarking on that stream, descended its whole length to the mouth in Bering Sea. The upper river for 200 miles he found to be untenanted by man, and it appears that there is a corresponding scarcity of animal life. The first habitations reached were abandoned, and in one house five dead bodies were lying as though overtaken with a sudden pestilence, and later it was ascertained that virulent pneumonia had swept the valley, almost exterminating the natives. Lower down the river an uninhabited village was reached, and Dr. Gordon observed that the people were of Eskimo type, but spoke a Tinne Indian dialect. Their houses are of logs, stood up in arch-shape and covered with earth. Assembly or club-houses of large size exist here, and there are numerous caches, graves and salmon-drying racks. The caribou, on which the natives depended, have left their former range and do not now visit the Kuskokwim. Dr. Gordon visited the Eskimo village at the mouth of the river and secured photographs, measurements and other data concerning the people. The inroads of disease among the natives, says Dr. Gordon, are frightful, and in a few years it is possible that the inhabitants of this region will be exterminated by maladies introduced by whites. Dr. Gordon said, in answer to a question by Mr. Robinson, that the timbers of the old houses on the upper Kuskokwim had been cut with ivory and stone tools. The discussion of Dr. Gordon's highly interesting paper was participated in by Messrs. Heye, Robinson, Hrdlicka and others.

Walter Hough,
General Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 642d meeting of the society was held on January 4, 1908, President Bauer in the chair.

By invitation, Mr. Percival Lowell read a very interesting paper on the subject of "The Recent Discoveries at Flagstaff in Saturn's Rings." In June, 1907, a new phenomenon was observed in Saturn's rings, at Flagstaff. At this time the plane of the planet's rings was directed towards the earth and the interesting thing was the band. The dark chord or core seen in the band at this time was the phenomenon that had not been previously known or observed. The same phenomenon was again seen in October last by all of the observers at Flagstaff, and careful measurements were made of the band, the dark medial chord and of the positions (in terms of the planet's radius) of the several luminous appendages.

It was shown by the speaker that the observed width of the band was too great to be explained by the rings' shadow or by their penumbra and it was stated that its width could be accounted for by supposing the existence of matter outside of the plane of the rings, or in effect by tores or thickenings of the rings; the dark medial core of the band being the projection of the ring proper. It was explained in what way the tores could have been produced and in what part of the rings they should occur. In this connection it was shown how the separations of the rings were produced by the planet's satellites; and it was stated that one should expect that the tores should occur just inside of the paths of the satellites. By observation the tores were found to be just where celestial mechanics would put them under the disturbing influence of the satellites.

In reviewing the conclusions as to the constitution of the rings, and the disintegration that must be taking place as evidenced by the positions of the tores, the ultimate disappearance of the rings was predicted.

R. L. Faris,
Secretary

DISCUSSION AND CORRESPONDENCE

AGE OF A COOLING GLOBE

To the Editor of Science: In my paper on a cooling globe in Science for February 7, pages 231 and 232, the depth of the level of isostatic compensation is stated as 71 miles or 140 kilometers. This last should be 114 kilometers. The blunder arose in copying, and the correct value was used in the computations.

George F. Becker

THE EARTH AS A HEAT-RADIATING PLANET

To the Editor of Science: Of the many far-reaching consequences resulting from the discovery announced in Science for November 22 and December 20, 1907, perhaps no one fact stands out more clearly and strongly than this—*The inherent heat of the earth still plays an important if not controlling part in all terrestrial phenomena* (as, for instance, in the formation of ocean and atmospheric currents, in cloud formation, and the increase in temperature with increase of cloudiness, etc.), *for it now seems certain that without this inherent heat radiation the terrestrial atmosphere could not exist.*

With a surface which, even at its lowest known temperature, is still more than 200° C. above the temperature of surrounding space (ocean temperatures at great depths being about 270° above) and with the temperature increasing with the depth below the surface, there can no longer be much reasonable doubt as to the facts concerning the past or future history of the earth, so far as effects due to temperature changes are concerned.

The earth is now, and has been for ages, radiating heat into space, shrinking in size, and, with a constantly decreasing surface temperature, growing colder.

The mean absolute surface temperature of the earth is, let us say, 300° C. If we regard this as made up of an inherent surface-temperature of 200° C. and a stored or trapped heat equivalent to a temperature of 100° C., the radiation into space is such that the moon, for example, receives about one twenty-seventh as much heat from the earth as it does from the sun.

The sun's influence is rendered overpoweringly conspicuous because this influence is zonal and varyingly differential, thereby obscuring to a great degree the nearly constant but large effect of inherent earth-radiation.

The earth's desert areas are increasing and the glaciers are retreating not because the sun's influence has seemingly become predominant, but because the earth has, even during known historical time, grown sensibly colder.

At any given time in the history of the earth, an ice age was inaugurated at a given place whenever the snow-fall during the colder months of the year was so great that the snow could not all be melted during the warmer months of the year. But since the earth is continually growing colder the supply of moisture, through evaporation from the water surface of the earth, is continually growing less, so that *finally even the land areas in the polar regions will be completely bare,* and the upper limit of the atmosphere will then practically coincide with the surface of a solidly frozen ocean.

With the modifications, resulting from the fact that inherent earth-heat has always been and will continue to be a controlling factor in terrestrial phenomena, Manson's hypothesis as to the cause of the ice age may now, perhaps, be said to be demonstrated as a true theory.

Astronomical observations, for absolute parallax of the fixed stars, when made from the surface of a heat-radiating body revolving about another *central* heat-radiating body, are so influenced as to cause the stars to appear to be more distant than they really are. The effect is similar to the case which I have already treated in No. 3935 of the *Astronomische Nachrichten,* issued March 19, 1904.

As will be demonstrated later on, the evidence seems to be almost conclusive that our now reduced sun is the parent body of both the sidereal and the solar systems; the former created by one process simultaneously going on with the creation of the latter by a largely different action of the same forces of nature.

J. M. Schaeberle

Ann Arbor,
December 25, 1907

PROGRESSUS REI BOTANICÆ

It may not be amiss to call the attention of botanical workers to the very excellent summary of the present status of paleobotany from the pens of Professors Scott, Zeiller and Laurent which is contained in the first two volumes of the "Progressus Rei Botanicæ" published by the International Association of Botanists under the supervision of Dr. J. P. Lotsy, of Leiden.

There will no longer be any excuse for the lamentable ignorance, too often displayed by botanists, of the striking contributions of paleobotany to the progress of botany.

Professor Scott's article, the first to appear and the most extensive, is entitled "The Present Position of Palæozoic Botany,"[1] and briefly discusses the great plant groups of the Paleozoic, chiefly from the viewpoint of morphology and phylogeny. The quickened interest caused by the recent discoveries of seed-bearing among the fern-like plants and the actual proof of the fern ancestry of at least the cycads among the gymnosperms will serve, no doubt, to save this paper from neglect.

The second article, by Professor Laurent, of Marseilles, is entitled "Les Progrès de la Paléobotanique Angiospermique dans le dernièr décade,"[2] and may be said to treat of the botany of the Cenozoic age, since the floral Cenozoic commences with the dominance of angiosperms in the Mid-Cretaceous. This paper, while it leaves much to be desired, is a thoroughly good, if somewhat philosophical, discussion of angiospermous fossils. It does not go into details as much as would have been desirahle and treats of principles rather than the available facts.

The third article, which has just appeared, is entitled "Les Progrès de la Paléobotanique de l'ère des Gymnospermes,"[3] thus roughly corresponding to the Mesozoic age and filling the gap between the contributions of Professors Scott and Laurent. This is a most excellent summary of the recent progress in the realm of Mesozoic botany and no discovery however small seems to have escaped Professor Zeiller's watchful interest. As this treats of the age when cycads and ginkgoes were dominant groups with a world-wide range and when the ancestors of our modern conifers and ferns make their appearance, it is one of very vital interest. Naturally the recent work of Wieland on the Bennettitaceæ receives considerable attention.

A regrettable feature, seemingly part of the plan of the editors, is the absence of citations, except as to authors' names, and the lack of any sort of bibliographies. While this is rendered unnecessary in the first instance by the Paleozoic bibliography compiled by Professor Arber and printed immediately following Professor Scott's paper, it is greatly missed in the other two papers. Paleobotanical workers may be expected to be familiar with the literature, but this is hardly the case with the rank and file of botanical workers to whom these articles are primarily addressed.

It is certainly a cause for congratulation and a distinct sign of progress that the International Association of Botanists recognizes

[1] Erster Band, erstes heft.

[2] Erster Band, zweites heft.

[3] Zweiter Band, erstes heft.

the importance of fossil plants by giving them so prominent a place in the early numbers of their publication.

Edward W. Berry

Johns Hopkins University

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

The Rockefeller Institute for Medical Research purposes to award for the year 1908–1909 a limited number of scholarships and fellowships for work to be carried on in the laboratories of the institute in New York City, under the following conditions:

The scholarships and fellowships will be granted to assist investigations in experimental pathology, bacteriology, medical zoology, physiology and pharmacology, physiological and pathological chemistry and experimental surgery.

They are open to men and women who are properly qualified to undertake research work in any of the above mentioned subjects and are granted for one year.

The value of these scholarships and fellowships ranges from eight hundred to twelve hundred dollars each.

It is expected that holders of the scholarships and fellowships will devote their entire time to research.

Applications accompanied by proper credentials should be in the hands of the secretary of the Rockefeller Institute not later than April 1, 1908. The announcement of the appointments is made about May 15. The term of service begins preferably on October 1, but, by special arrangement, may be begun at another time.

L. Emmett Holt, M.D.,
Secretary

44 West 55th Street,
New York City

THE UNIVERSITY OF ILLINOIS

OPENING OF THE GRADUATE SCHOOL

The formal opening of the Graduate School of the University of Illinois, which was held on February 4 and 5, marked a significant step in advance, not only for that institution, but also for all the great universities of the middle west that owe their existence to the support of the state. Illinois has maintained a graduate school for some years, but last June the legislature of the state appropriated $50,000 annually for the next two years for the development of the school. This is the first time in the history of American education that the people in their corporate capacity have put themselves on record as definitely in favor of that kind of work the graduate school is doing. This action means much in the development of higher scholarship and research in all those institutions that depend on public money for their income.

The opening address was made by Dr. G. Stanley Hall, president of Clark University, his subject being "The Educational Value and the Danger of University Research." Dr. Hall called attention to the immense sums that the national government has spent for investigations and to the results of greatest practical importance that have come from these investigations. Thus, he said, it is seen that original research pays and that the assertion that state universities should not and can not undertake graduate work is untenable.

The exercises were brought to a conclusion by Professor David Kinley, dean of the Graduate School, who spoke on the subject, "Democracy in Education." In his address Dean Kinley maintained that scholarship of the highest type was not only compatible with the best interests of a democracy, but necessary for its continued existence and advance.

Other speakers were Dean Andrew F. West, of Princeton University, whose subject was "The Personal Qualities of the Graduate Student and their Effect upon his Graduate Studies"; President Rammelkamp, of Illinois College; President McClelland, of Knox College; Robert W. Hunt, consulting engineer, of Chicago, and the Hon. William A. Smith, of the *Engineering Review*. Addresses were also made by Professors Noyes and Greenough, of the university faculty.

In connection with the exercises Dr. W. F. M. Goss was installed as dean of the College of Engineering. Professor Clifford Moore, of Harvard University, also delivered a series of lectures on "The Last Five Centuries of Western Paganism."

INSTALLATION OF DR. W. F. M. GOSS AS DEAN OF THE COLLEGE OF ENGINEERING

The formal exercises incident to the installation of Dr. W. F. M. Goss as dean of the College of Engineering of the University of Illinois occurred February 5, in connection with the formal opening of the graduate school of the university. The exercises of installation included two sessions and a tour of inspection through the laboratories of the College of Engineering.

The program for the morning session began with a brief address by the president of the university, Dr. Edmund J. James, introducing the chairman of the session, Professor James M. White. Professor Ira O. Baker, who for more than thirty years has been identified with the College of Engineering, described some significant events in the development of the college, giving special emphasis to the work of Stillman W. Robinson, the first professor in the College of Engineering of the University of Illinois, who continued in its service for a period of seven years. Mr. William L. Abbott, president of the board of trustees and a graduate of the College of Engineering, discussed briefly the standing of the technical graduate in the engineering profession. Following this, a formal installation address entitled "The State College of Engineering", was delivered by Dean W. F. M. Goss. This session was made memorable by the presentation of a token of their esteem by his associates in the College of Engineering to Dr. N. Clifford Ricker, a member of the class of 1872, the first professor of architecture, for thirty-five years a member of the instructional staff of the University of Illinois, and for the most of this period dean of the College of Engineering. Letters were read expressing interest in the occasion from Dr. Andrew S. Draper, president of the University of Illinois from 1894 to 1904; from Professor Stillman W. Robinson, the first professor of mechanical engineering, now a resident of Columbus, Ohio, and from Professor J. Burkitt Webb, the first professor of civil engineering, later of Stevens Institute of Technology.

The afternoon session included an address by Mr. Robert W. Hunt, of Chicago, on "The Value of Engineering Research," and an address by Mr. Willard A. Smith, of Chicago, on "The Need of Graduate Courses in Engineering."

During the trip of inspection, which occurred between sessions, the visitors were conducted through the several laboratories. Especial interest was shown in the electric test-car which is a normal interurban car equipped with apparatus for observing and for recording the characteristics of the current absorbed in its operation. This car is operated by the university upon the tracks of the Illinois Traction System. Interest was also shown in the dynamometer car which is the joint property of the Illinois Central Railroad and the university, and which has recently been newly equipped with apparatus for more accurately determining the pull exerted by locomotives and the resistance of trains. The steam engineering laboratory, containing the experimental boiler used by Professor Breckenridge in his elaborate experiments involving the combustion of Illinois fuel, was visited and served as a center of interest for many of the out-of-town guests. The materials testing laboratory, under the direction of Professor Talbot, proved to be of especial interest. The 600,000-pound testing machine, which is installed there, and the work in reinforced concrete, which was seen in progress, proved convincing evidence of the activity of the laboratory in this important field of research.

SCIENTIFIC NOTES AND NEWS

At a recent meeting of the general council of Glasgow University it was resolved to ask Lord Lister to allow his name to be proposed for the chancellorship, vacant through the death of Lord Kelvin. Lord Lister has replied as follows: "I can not imagine any honor that would have gratified me more had my health permitted to accept it, but I am so enfeebled by illness that there is no prospect of my ever being able to visit Glasgow, and in my hands the high office of chancellor would be an absolute sinecure."

S. H. Gage, professor of histology and embryology at Cornell University, will retire at the close of the present academic year from teaching to devote himself to research, under the provision of the Carnegie Foundation for the Advancement of Teaching, which provides for an allowance after twenty-five years of service. Dr. James Law, director of the New York Veterinary College, having reached the age of seventy years, will retire with an allowance from the foundation. He will be succeeded by Dr. V. A. Moore, professor of comparative pathology. Professor Gage will be succeeded by Dr. B. F. Kingsbury, now assistant professor of physiology.

Mr. Charles F. Choate, Jr., a Massachusetts lawyer, who graduated from Harvard College in 1888, has been made a regent of the Smithsonian Institution to succeed the Hon. Richard Olney.

Dr. Philip Lenard, professor of physics at Heidelberg, has been elected an honorary member of the Royal Institution of Great Britain.

The following have been elected honorary and foreign members of the Chemical Society: A. E. J. Gautier, Paris; A. Haller, Paris; J. W. Hittorf, Münster; J. A. Le Bel, Paris; H. L. Le Chatelier, Paris; T. W. Richards, Harvard University; and O. Wallach, Göttingen.

The Hon. James Bryce, British Ambassador at Washington, has accepted the appointment to be the next Dodge lecturer on the "Responsibilities of Citizenship," at Yale University. The lectures will be delivered next fall.

Dr. C. B. Robinson, for the past sixteen months assistant curator in the New York Botanical Garden, has sailed for the Philippine Islands, where he has been appointed economic botanist in the Bureau of Science.

Mr. Robert Ridgway has recently left Washington for a six months' ornithological expedition to Costa Rica, in the interests of the U. S. National Museum.

Mr. J. C. Simpson, advanced student, of Emmanuel College, Cambridge, has been appointed to occupy the university table at the laboratory of the Marine Biological Association at Plymouth.

Mr. W. W. Eggleston has been assigned a research scholarship for two months in the New York Botanical Garden to aid him in continuing his work upon North American Thorns.

Dr. Hall-Edwards, of Birmingham, has had his left hand amputated, owing to his having contracted the disease known as "X-ray dermatitis." Dr. Hall-Edwards was the pioneer operator with the Röntgen rays in Great Britain. He was senior radiographer with the Imperial Yeomanry in the South African war, and he is surgeon radiographer to the General Hospital. His right hand is affected, but it is hoped that this will be saved. In spite of his great suffering and the heavy sacrifice, Dr. Hall-Edwards declares his intention of resuming his special work as soon as he is able to do so.

The Special Board for Biology and Geology at Cambridge University reports that the Gordon Wigan income for biology and geology has been applied during 1907 as follows: (*a*) a grant of £50 a year to Dr. D. Sharp for a period of three years, or such part of it during which he holds the curatorship in zoology; (*b*) a grant of £50 for one year to Professor Seward to enable the Botanic Gardens Syndicate to offer greater facilities for plant-breeding experiments; (*c*) a grant of £50 to Professor Hughes to enable Mr. E. A. N. Arber, of Trinity College, to continue his researches into the stratigraphical and geographical distribution of fossil plants.

The Smith's prizes at Cambridge University have been adjudged as follows: W. J. Harrison, B.A., Clare College, for his essay, "Problems in the Wave-motion of Viscous Liquids"; J. E. Littlewood, B.A., Trinity College, for his essay, "On the Asymptotic Behavior of Integral Functions of Zero Order, and Allied Problems"; J. Mercer, B.A., Trinity College, for his essay, "On the Solution of Ordinary Linear Differential Equations having Doubly Periodic Coefficients." The above names are arranged in alphabetical order. The adjudicators are of opinion that the following essays are deserving of honorable mention, namely, "On Energy Accelerations and Partition of Energy," by C. W. Follett, B.A., Trinity Hall; "On Some Problems in the Theory of Metallic Reflection," by H. R. Hassé, B.A., St. John's College; "The Geometry of Apolar Triads," by W. P. Milne, B.A., Clare College; "Perpetuant Syzygies of the *n*th Kind," by H. T. H. Piaggio, B.A., St. John's College; "The Reflection of Plane Waves of Light at the Surface of a Medium of Special Periodic Character," by C. J. T. Sewell, B.A., Trinity College.

The eighth lecture in the Harvey Society course will be delivered by Professor Ross G. Harrison, of Yale University, at the New York Academy of Medicine building, on Saturday evening, March 7, at 8:30 P.M. Subject: "Embryonic Transplantation and the Development of the Nervous System."

At the February meeting of the Philadelphia Section of the American Chemical Society, Professor Leonard P. Kinnicutt, of the Worcester Polytechnic Institute, gave a résumé of the work of the past ten years in sewage treatment, illustrated by slides. He has been asked to give a similar lecture before the Syracuse section of the society at their March meeting.

On January 30 Professor Koch delivered a lecture, illustrated with lantern slides, on sleeping sickness and the means of combating the disease, in the presence of the German Emperor and Empress.

Sir Dyce Duckworth, lecturer at St. Bartholomew's Hospital and president of the British Section of the Medical Entente, delivered a lecture on February 18 in French at the Faculty of Medicine in Paris, under the presidency of the dean, M. Landouzy, on diathesis—that is to say, the natural predisposition to certain maladies. It is intended that this lecture shall be followed by others, both in London and Paris.

Mr. A. Watt, meteorological secretary of the Scottish Meteorological Society, delivered a lecture on the climate of the British Isles to the Royal Scottish Geographical Society, in Edinburgh, on February 19.

Professor G. Hellmann, director of the Royal Prussian Meteorological Institute, will deliver a lecture on "The Dawn of Meteorology," at the meeting of the Royal Meteorological Society, on March 11, in the rooms of the Institution of Civil Engineers, London.

A committee has been appointed from the senior class of Harvard University to procure a portrait of the late Professor N. S. Shaler to be hung in the living room of the Union.

The sum of £1,000 has been collected among the patients and friends of the late Dr. W. S. Playfair, and is to be presented to King's College Hospital with a view to erecting a memorial to him at the institution with which he was associated for thirty-five years.

Donations of £1,000 each, in memory of the late Mr. Walter K. Foster, have been promised towards the building fund of the new museum of archeology and of ethnology at Cambridge University by Mrs. Walter K. Foster, Mr. E. Bird Foster, Mr. C. F. Foster and Mrs. E. Rawlings. Mr. Foster, in whose memory this gift has been made, bequeathed to the university in 1891 a valuable collection of prehistoric and Anglo-Saxon antiquities.

Othniel Foster Nichols, a prominent civil engineer, known for his work on foundations, bridges, tunnels and steel construction, died on February 3, aged sixty-three years, at his home in Brooklyn.

The death is announced of Mr. George E. Davenport, of Medford, Massachusetts, a student of North American ferns, at the age of seventy-four years.

Lieutenant-general Sir Richard Strachey, F.R.S., died on February 12, at ninety-one years of age.

The death is announced of Dr. Johannes Friedrich August von Esmarch, professor of surgery at the University of Kiel and surgeon-general during the Franco-German war, in his eighty-sixth year.

The deaths are announced of Dr. A. Rümpler, professor of agricultural chemistry in Breslau, and Dr. Rinaldo Ferrini, professor of technological physics at Milan.

Mr. William Kent, of Chicago, Ill., and Kentfield, Cal., has presented a tract of 295 acres of magnificent sequoias in Redwood Canyon, near San Francisco, to the government.

Mrs. Bell Pettigrew, the widow of the late professor of medicine and anatomy at St. Andrews, has given £6,000 for the new museum of natural history of the university.

The large and specially organized herbarium of the Field Museum of Natural History, Chicago, has received through the University of Chicago the complete herbarium of that institution; a herbarium inaugurated and augmented by Professor J. M. Coulter during the past twenty-five or more years of his active botanical researches. With the placing of this herbarium in intimate association with the museum herbarium the university transfers its taxonomic researches to the laboratories of the more fully equipped institution, where the students may receive the associate benefit of conducting their investigations under the supervision of the botanical staff of the museum and of the university. The herbarium thus transferred contains about 50,000 sheets, among which are a large number of types, cotypes and specially studied species.

At a meeting of scientific men held in the Transvaal Museum, Pretoria, on January 13, it was resolved to form an association to be called "The Transvaal Biological Society" with the object of promoting the discussion of scientific problems by biological investigation, to arrange for regular meetings for this purpose, and to publish the proceedings of the meetings. To this society all persons are eligible for membership who are actually engaged in biological investigations, and have published at least one scientific paper, or are working on such. At least six meetings are to be held each year, special meetings to be called by the committee if necessary. Every member is expected to furnish at least one paper each year. The committee for the current year consists of Dr. Theiler, C.M.G., president; Mr. Burtt-Davy, vice-president, and Dr. L. H. Gough, secretary and treasurer.

The German Surgical Society will hold its thirty-seventh annual congress at Berlin from April 21 to 24, under the presidency of Professor Freiherr von Eiselsberg, of Vienna. An exhibition of instruments and apparatus will be held in connection with the congress.

It is announced that an International Positivist Congress will be held at Naples on April 27. The program will consist of two parts, one devoted to the elucidation of positivist principles, the other to their applications to the problems of psychology, ethics, pedagogy, comparative theology, etc. Among those who have promised to read papers are Professor Haeckel, Professor Lombroso, M. Yves Guyot, Professor Villari and Lord Avebury.

A dinner of the Physical Society was held, on February 1, at the Hotel Cecil, London. The chair was taken by the president, Professor J. Perry, F.R.S., and a number of guests and fellows of the society were present, including Sir David Gill, Sir William Ramsay, Sir William White, Sir J. Denison-Pender, Rear Admiral Sir H. B. Jackson, Sir Arthur W. Rücker, Sir Joseph Swan, Colonel R. E. Crompton, C.B., Professor W. G. Adams, F.R.S., Mr. Shelford Bidwell, F.R.S., Dr. C. Chree, F.R.S., Mr. W. Duddell, F.R.S., Professor Carey Foster, F.R.S., Dr. R. T. Glazebrook, F.R.S., Professor Reinold, F.R.S., Mr. J. Swinburne, F.R.S., Professor S. P. Thompson, F.R.S., and Dr. W. Watson, F.R.S.

A new medical society has been formed under the title of Société de Pathologie Exotique, its object being the study of tropical diseases in man and animals, colonial hygiene, naval hygiene, and sanitary measures destined to prevent the extension of epidemics and diseases of animals of exotic origin. The society will meet at the Pasteur Institute. The following officers have been elected: *President,* M. Laveran; *vice-presidents,* MM. Chantemesse and Kermorgant; *General Secretaries,* MM. Marchoux and Mesnil.

At the sitting of the Paris Academy of Sciences on February 17 particulars were given, according to the correspondent of the London *Times,* of investigations by M. Roubaud into the conditions of reproduction of the Tsetse fly, which is the most active instrument in the spread of the sleeping sickness. According to M. Roubaud, this insect seeks the vicinity of water courses and the shelter of moist plants, and its larvæ perish rapidly if exposed for a few hours to the rays of a tropical sun, even when covered by a thin layer of dry earth. This shows that the Tsetse may be destroyed by cutting down the coverts in which it lays its eggs.

ACCORDING to a law passed by the Danish Rigsdag, the use of the metric system is made compulsory for all government purposes not later than May 4, 1910, the date of adoption prior to the limiting date to be fixed by the king; and two years after this adoption the system is made compulsory throughout the kingdom.

IT is reported that three heavier than air-flying machines, capable of carrying two persons, remaining an hour in the air and traveling at least thirty-six miles an hour, have been contracted for by the United States government. They are to be built by Mr. A. M. Herring, of New York; the Wright Brothers, of Dayton, O., and J. F. Scott, of Chicago.

PROFESSOR A. W. GRABAU, chairman, and Dr. Charles P. Berkey, secretary of the Section of Geology and Geography of the New York Academy of Sciences, have sent out the following notice: "Almost every one appreciates the advantages of general meetings for those interested in similar lines of work or investigation. For geology and mineralogy, the Geological Society of America and Section E of the American Association for the Advancement of Science are accomplishing much in this direction. For various reasons, however, it frequently happens that large sections of the country are poorly represented at the yearly meetings, and the men of those sections are deprived of such advantages for a considerable time. It is also true that, in the larger meetings, the programs are crowded, and therefore opportunities for extended discussions are wanting, and the consideration of local or sectional matters are overshadowed or even forced out entirely by matters of general interest. It would seem that somewhat informal district or sectional meetings might be inaugurated that would meet these conditions. Field trips, such as are arranged occasionally by the geologists of New England, are a partial equivalent, but there is still too little attempted. It is the belief of the members of the Section of Geology and Mineralogy of the New York Academy of Sciences that it would be advisable each year to hold at least two meetings of the geologists and mineralogists of the northeastern section of the United States for the presentation of papers and the cultivation of a closer personal acquaintance. It is not proposed to encourage the formation of any new organization. It seems preferable to enlist the cooperation of the geological departments of colleges and sections of geology and mineralogy in academies of science, surveys and museums, and to depend upon such local units for chief support and guidance. Furthermore, it seems particularly desirable that meetings should be held successively at the different centers of greater activity, so far as they may be also points of easy access; such, for example, as New York, Boston, New Haven, Philadelphia. In accord with these suggestions, believing that they will meet with general approval, the Section of Geology and Mineralogy of the New York Academy of Sciences will arrange for such joint meeting to occupy one or more days early in April. We cordially invite you to attend, and we urge you to forward to the secretary of our section the titles of papers that you wish to present. A program will be printed as soon as these titles can be secured, and this, together with other items of information, will be mailed in advance of the meeting. The date will be the sixth of April."

AN engineer has been despatched to Africa to arrange for the construction of a large dam in the southern part of the German protected territory in Southwest Africa. By this means a reservoir would be created capable of holding about 44,000 million gallons of water. This supply, located about twenty-five miles from Keetmanshoop, would be utilized for the irrigation of the fertile plains below, which are at present incapable of cultivation owing to want of water. Mr. Schmick, the engineer selected for this purpose by Mr. Secretary Dernburg, will likewise visit East Africa, and will survey the courses of several of the rivers in order to ascertain whether they are capable of being employed in a similar way for irrigation purposes.

UNIVERSITY AND EDUCATIONAL NEWS

We noted last week that by the will of the late Mrs. Frederick Sheldon, Harvard University received $300,000 for the enlargement of the library building or such other purpose as may be preferred, and the residue of the estate for establishing traveling scholarships. The Harvard *Bulletin* states that the residue of the estate will probably exceed half a million dollars, and the total bequest will thus probably amount to more than $800,000. Mrs. Sheldon was the widow of the late Edward Sheldon, of the class of '42.

By the will of the late Mrs. Rylands, the Victoria University, Manchester, will receive the sum of £50,000; Owens College, Manchester, £25,000, and Mansfield College, Oxford, £10,000.

Professor Wilhelm Erb has given the University of Heidelberg a donation of $20,000, one half to be applied for the benefit of students and assistants and their maintenance in hospital when required, the other towards the promotion of scientific research by students.

The council of the senate of Cambridge University have had under their consideration, as we learn from the London *Times,* the desirability of giving the university the power of conferring upon professors who resign their office after having done good service to the university some honor which shall be a public recognition of that service. The title of professor emeritus has been employed for this purpose in various universities; but the existing statutes of this university contain no express provision giving power to confer it. The council think that it would be desirable to obtain that power, to be exercised in cases in which the university may desire to confer the honor. They accordingly recommend that the necessary steps be taken for altering the statutes by the insertion of a paragraph giving the university power, upon the retirement of a professor, either at the date of his retirement or subsequently, to appoint him, on the recommendation of the council of the senate, with the approval of the general board of studies, as a professor emeritus in the subject of the professorship previously held by him. A professor emeritus shall not as such receive any stipend. He shall be subject to no conditions as to duties or residence.

The inauguration of Dr. Edward Dwight Eaton as president of Beloit College took place March 4.

Professor Thos. H. Montgomery, Jr., of the University of Texas, has been appointed professor of zoology at the University of Pennsylvania to fill the vacancy caused by the removal of Professor Edwin G. Conklin to Princeton University. Professor Montgomery was assistant professor at Pennsylvania from 1898 to 1903.

In the faculty of the college of medicine of the University of Wisconsin Dr. Arthur S. Loevenhart, of Johns Hopkins University, has been appointed to the chair of pharmacology and toxicology, and Dr. Charles H. Bunting, of the University of Virginia, to the chair of pathology. Dr. Bunting was graduated from Wisconsin in 1896, and received his medical training at Johns Hopkins. He was subsequently on the faculty of the University of Pennsylvania and on the faculty of the Johns Hopkins University. For the past two years he has been at the University of Virginia. Dr. Loevenhart is also a graduate of the Johns Hopkins Medical School, where, since 1904, he has been associate in physiological chemistry and pharmacology.

Professor F. D. Heald, of the University of Nebraska and botanist of the Nebraska Experiment Station, has been offered the professorship of botany in the University of Texas, at a considerably increased salary. It is not yet known whether or not he will accept the offer.

Dr. Wm. A. Hammond, assistant professor in Cornell University and special lecturer in philosophy at the University of Pennsylvania for the year 1907–8, has been appointed Sage professor of ancient philosophy at Cornell.

Dr. E. A. Darling, has been appointed assistant professor of hygiene at Harvard University.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MARCH 13, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
ANTHROPOLOGY AT THE CHICAGO MEETING

THE joint meeting of Section H of the American Association for the Advancement of Science, the American Anthropological Association and the American Folk-Lore Society was held at the University of Chicago, Chicago, December 30, 1907, to January 2, 1908.

MEETING OF THE SECTIONAL COMMITTEE

Professor Boas, vice-president of Section H, presided over the sectional committee meeting, other members present being Miss Alice C. Fletcher and Dr. George Grant MacCurdy, acting secretary. Officers for the Chicago meeting were nominated as follows:

Member of the General Committee—Professor Frederick Starr.

Member of the Council—Miss Fletcher.

Sectional offices were filled by the nomination of Professor R. S. Woodworth, Columbia University, New York, as vice-president for the ensuing year and of Professor Roland B. Dixon as member of the sectional committee to serve five years. These nominations were later approved by the association in general committee.

COUNCIL MEETINGS OF THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

Professor Boas as president of the association likewise presided over the deliberations of the council. Members of the council present in addition to the president were: Miss Fletcher, Charles Peabody, G. A. Dorsey, E. L. Hewett, R. B. Dixon, B. T. B. Hyde and G. G. MacCurdy.

The secretary, Dr. George Grant MacCurdy, reported that there had been no special meeting of the association since the beginning of the year; but a meeting of the council was held at Yale University Museum, October 11, in the interest of the program for the Chicago meeting. Those present were, Professor Boas, chairman, Professor Saville, Dr. Peabody and Dr. MacCurdy, secretary. There was also a meeting of the committee on program in New York on November 18.

The responsibility for the Chicago joint meeting having been left in Dr. MacCurdy's hands by the secretaries of Section H and of the American Folk-Lore Society, a call for the meeting was mailed in October to the more than 700 members of the three societies.

In response to this call thirty-nine titles were received. A preliminary program was prepared and mailed to members December 14. In addition all abstracts that reached the secretary in time to be submitted for approval were printed (fifteen in number) and were distributed on the opening day of the meeting.

Among the social functions arranged for the benefit of the anthropologists was a reception on the evening of January 1 by Dr. and Mrs. Geo. A. Dorsey at their home, 5609 Monroe Avenue.

ADDRESSES AND PAPERS

Professor Boas's address as president of the American Anthropological Association was on "Anthropology as a Subject of University and College Instruction." It will not be published at present.

The address of the retiring vice-president, Dr. A. L. Kroeber, which was read by title in the absence of the author, was printed in SCIENCE of February 21.

The president of the American Folk-Lore Society, Professor Roland B. Dixon, chose for his subject "Some Aspects of the American Shaman." The Shaman was considered in the making, in regard to functions and activities as healer, sorcerer, seer, priest and educator, in relation to the degree of organization, and as regards his position in and influence on the community. The geographical distribution of several features connected with the Shaman was briefly considered, and some of the characteristics of American shamans, as opposed to those of other regions, were pointed out.

Brief abstracts of the papers read are given in so far as material at the disposal of the secretary will permit.

Professor Roland B. Dixon read a paper on "The Chimariko Language." A few of the more characteristic features of the language were considered and compared with the types found in neighboring languages. The question of loan words from surrounding stocks is briefly discussed, as were also one or two phonetic traits.

Dr. Alfred M. Tozzer presented two papers. The first of these was "On the Teaching of Anthropology to Large Classes." He discussed the character of a general course in anthropology, taking "Anthropology 1" at Harvard as an example. Requirements for entrance; composition of the class; difficulties peculiar to a large class, and how these difficulties are met; aids in conducting the course, and results were all touched upon. In "A Note upon Star-Lore among the Navajos," Dr. Tozzer emphasized the keen powers of observation of the Navajos as seen in the case of a gourd rattle which is used in connection with the "night chant" ceremony. Holes made in the rattle have been identified as representing stars which are seen in the month of the year in which the ceremony takes place and in the particular part of the sky towards which the special rites of the day are directed. The stars thus seen are supposed to represent certain gods of the tribe.

In "A Number-Form from Folk-Medicine," Professor Charles Bundy Wilson presented a peculiar combination of numbers occurring in a remedy for rheumatism, which was discovered by the writer when gathering material for a paper on folk-medicine. The application of the remedy calls for three series of doses of three doses each. When the numbers of units in these doses are arranged in regular form, the sums of the vertical, horizontal and diagonal columns present interesting results, particularly with reference to 13 and 3.

Professor Francis W. Kelsey's paper on "Some Archeological Forgeries from Michigan" was accompanied by photographs and specimens illustrating the forgeries of 1891–92, 1898 and 1907, respectively. The three series include objects of clay, copper and slate, decorated for the most with bogus hieroglyphics. The jumble of ancient Oriental writing was explained as due to the composite character of a colony, Egyptians and Phœnicians as well as Assyrians, which in a remote period found its way from the drainage area of the Euphrates and Tigris across seas, up the St. Lawrence and the Lakes to Michigan. The distributing center of these forgeries[1] during the past year has been Detroit.

The success that has attended these efforts at imposition—so far as they have been successful—is, Professor Kelsey thinks, almost wholly due to the religious element in several of the designs. These are at the same time self-interpreting and mystifying; and their presence has seemed to turn the attention of many away from consideration of the material and of the crass incongruities in design and technique.

[1] It seems a pity that there is at present no legal means of punishing the forgers.

There is no danger that by frauds such as these purchasers for museums will be imposed upon; but it is the duty of the expert to protect so far as possible the amateur collector, not only for his own sake but because he creates the market for archeological remains which without such a stimulus would be neglected or destroyed as of no value and so lost to science.

In "The Prehistoric Habitations of the Sioux" Professor N. H. Winchell called attention to the evidence which indicates that in prehistoric times the well-known form of earthen house of the Mandans was common in Minnesota. This evidence consists of traditions amongst the Ojibwa, the existence of many flat-topped, or concave-topped, low mounds, the persistence of such terms as "Ground House River," coming through the Ojibwa, who expelled the Sioux, found in Kanabec County, the stock alliance of the Sioux with the Mandans and the Hidatsa, as well as with the Omaha, all of whom are known, even in historic time, to have occupied such habitations, and finally some slight historic allusions to houses of this kind.

"Recent Aspects of the Eolithic Discussion" were reviewed by Dr. Charles Peabody, who called attention to Rutot's Tertiary eoliths and to his eolithic series persisting through all ages to and including recent Tasmanian cultures; also to a proposed change in the connotation of "eolithic," "paleolithic," etc. It is proposed to determine whether an eolithic industry may not exist in America.

Dr. Peabody also presented a "Report for the Committee on American Archeological Nomenclature" of which he is chairman. This report has been published and is already in the hands of members of the American Anthropological Association.

It covers only certain divisions of objects in clay and objects in stone, and is accompanied by sixty-six illustrations. The classifications offered and the definitions proposed are based so far as possible on form alone, due weight being given to systems of classification already made standard by writers of distinction. In all cases measurements are considered as referring to an upward direction.

The variations in the body, rim, neck, foot and handle of a clay vessel are noted. Articles in stone are classified as *chipped* and *ground;* and these two groups are subdivided, with an enumeration of all the types in each subdivision.

The "Report for the Committee on the Preservation of American Antiquities" was prepared and read by Mr. E. L. Hewett, secretary of the committee. Attention was called to the national monuments that have been created during the past year, including Chaco Canyon, Montezuma Castle and others.

Owing to the unsatisfactory nature of the rules and regulations prescribed by the secretaries of the interior, agriculture and war to carry out the provisions of the act for the preservation of American antiquities not much has been done in the way of field work. The Joint Committee on the Preservation of American Antiquities prepared a revision of these rules which was approved by the secretaries of war and of the interior, but the approval of the secretary of agriculture has not yet been secured. This failure to agree on a revision has resulted in the abrogation of the rules, an order from the war department by direction of the president taking their place.

Professor Franz Boas, chairman, reported for the Committee on the Concordance of American Mythology. "Advance Report on the Nomenclature of Indian Linguistic Families" by Mr. F. W. Hodge, chairman of the committee, was printed for distribution and in the absence of the author was read by title.

The paper by Professor W. H. H. Rivers, of Cambridge, England, on "The Genealogical Method in Anthropology" was illustrated by lantern slides. Dr. George A. Dorsey's paper on "Field Work of the Department of Anthropology, Field Museum of Natural History," was supplemented by inspection of the museum collections under the guidance of Drs. Dorsey, Lewis and others. Professor Albert Ernest Jenks presented "Race Statistics of the University of Minnesota" and the Rev. Stephen D. Peet discussed "Migrations as shown by Archeology."

Papers were read by title as follows:

Dr. Walter Hough: "Blow Guns of the Abbott Malaysian Collection in the U. S. National Museum."

Mr. R. Lowrie: "Catchwords for Mythological Motives."

Professor M. H. Saville: (*a*) "The Archeology of Esmeraldas"; (*b*) "Further Investigation of the Archeology of Manabi."

Professor Henry Montgomery: "Recent Archeological Explorations in Western Canada."

Miss Adela Breton: "The Ancient Mexican Sites near Juchipila, Teuchitlan, Zapotlan, Perote and Yoalliche."

Mr. Frederick Monsen: "A Description of Certain Ruins in an Unnamed Canyon in Southeastern Utah."

Dr. Berthold Laufer: (*a*) "The Ancient Culture Types of Asia"; (*b*) "The Cocoanut Palm as a Historical Problem."

Mr. William C. Mills: (*a*) "Explorations of the Seip Mound"; (*b*) "Explorations of Jackson County Rock-shelters."

Mrs. M. Burton Williamson: "The Haliotis, or Abalone Industry of the California Coast: Preservative Laws."

Mr. H. J. Spinden: "The Mythology of the Nez Percé Indians."

Dr. Geo. B. Gordon: (*a*) "Ethnology of the Koskokwin Valley"; (*b*) "Linguistic Variation among the Alaskan Eskimo."

Dr. A. H. Thompson: "Anthropology Past and Present."

Mr. V. Stefansson: (*a*) "Physical Characters of the Eskimos of the Coast West of Cape Bathurst"; (b) "Social Organization and Daily Life of the Mackenzie River Eskimos"; (c) "The Treatment of Disease among Mackenzie River Eskimos."

DR. MAXIMILIAN HERZOG: "The Brain Weight of the Filippino."

PROFESSOR OTIS T. MASON: "Mind and Matter in Culture."

DR. SARAH NEWCOMB MERRICK: "A Unique Method for Preserving the Inscriptions in Our Historic Burial Grounds"; (b) "Present-day Beliefs in some Medical Superstitions."

GEORGE GRANT MACCURDY
YALE UNIVERSITY,
NEW HAVEN, CONN.

THE GEOLOGICAL SOCIETY OF AMERICA

THE Geological Society of America held its twentieth annual meeting, December 30 and 31, 1907, at the University of New Mexico, Albuquerque, N. M. The attendance was small, of course, as compared with that at the New York meeting, but it was satisfactory and there was time for considerable discussion. About thirty fellows of the society were present, besides other geologists, students and visitors to the number of nearly as many more. Seven members came from the Cordilleran Section, which extends from the Rocky Mountain region to the Pacific coast; five members and three visitors came from eastern Canada, and the remainder were from the eastern half of the United States, five of them being from the Atlantic coast. The local arrangements for the meeting, which were made by President W. G. Tight, of the university, were admirable, and the welcome extended by President Tight and his associates and the citizens of Albuquerque was most cordial and substantial. Furthermore, the Atchison, Topeka and Santa Fé Railway Company made considerable reductions in the rates for tickets, which were appreciated. The meeting was held under the following officers:

President—President C. R. Van Hise, Madison, Wis.

First Vice-president—Mr. J. S. Diller, Washington, D. C.

Second Vice-president—Professor A. P. Coleman, Toronto, Canada.

SESSION OF MONDAY, DECEMBER 30, 1907

President Van Hise presided, calling the meeting to order at 9:15 A.M. The secretary, Dr. E. O. Hovey, of the American Museum of Natural History, reported that the printed list of fellows contained 294 names. During the year the fourteen new fellows elected at the New York meeting qualified; two fellows, Professors Safford and Heilprin, were lost by death, and one was lost by resignation. After the reading of the memorials of the deceased fellows the regular program of papers was taken up as follows:

The Occurrence of Proustite and Argentite at the California Mine near Montezuma, Colo.: FRANK R. VAN HORN, Cleveland, Ohio.

Massive proustite and argentite occur with argentiferous galena and sphalerite in a gangue of siderite and quartz in a fissure vein in gneissoid rocks at the California Mine on Glacier Mountain, about three miles from Montezuma, Summit County, Colorado. The vein generally shows a banded structure, but in places, is more or less brecciated on account of faulting of the region. The chief ore is argentiferous galena, with considerable sphalerite irregularly mixed with it. In some parts of the vein proustite and argentite occur at the center in seams which sometimes have a thickness of two inches. In places the argentite has been reduced to silver.

The paper was discussed by C. R. Van Hise, George D. Louderback and H. E. Gregory.

Field Assay of Mine Waters: Alfred C. Lane, Lansing, Mich.

The theory of ore deposition and circulation by underground waters much needs to be supplemented by tests and analysis of mine waters. Some of the "field assay" methods are applicable, but the presence of calcium chloride makes the sodium acid sulphate test for carbonates inapplicable. It is well to make a preliminary test of the concentration of the water by a hydrometer or by a specially devised total reflectometer. In the stronger mine waters it is often best to add the water to a solution of the reagent.

The following papers were read by title:

The Phosphate Deposits of Florida with Relation to the Underground Water Level: E. H. Sellards, Tallahassee, Fla.

Asbestos Deposits of the Grand Canyon, Arizona: Joseph Hyde Pratt, Chapel Hill, N. C.

Ancient Tectonics of the Basin Ranges: Charles R. Keyes, Des Moines, Ia.

Rock-flora of Intermont Plains of Arid Regions: Charles R. Keyes, Des Moines, Ia.

The next paper read was

Glacial Periods and their Bearing on Geological Theories: A. P. Coleman, Toronto, Can.

Four well-defined glacial periods are known in geological history, occurring in the Pleistocene, the Permo-Carboniferous, the lower Cambrian and the lower Huronian, final proofs of the last-named glacial period having been obtained only recently. The wide distribution of glacial deposits in at least three of these periods proves that refrigeration was general and included both hemispheres. There is evidence of important interglacial periods in three of the ice ages. The importance of these facts as bearing on the origin and early history of the earth and on the factors which cause variations of climate was pointed out.

An active discussion was participated in by W. G. Tight, A. C. Lawson, I. C. White, H. M. Ami, G. K. Gilbert, H. E. Gregory and C. R. Van Hise.

The Chief Features of the Stratigraphy and Structure of Mount Diablo, California: George D. Louderback, Berkeley, Cal.

Mount Diablo is a distinctive feature of the central coast ranges because it rises from low valleys on practically all sides and is not merely a more prominent peak of a continuous range. It shows a remarkably complete stratigraphic series of the characteristic Coast Range formations. Structurally it is an overturned and overthrust anticline of very late origin. There is also evidence of an earlier structural form. The geology of Mount Diablo may be taken as showing a stratigraphic succession and an orogenic history characteristic of the coast ranges from the Klamath Mountains to the Tehachapi.

The paper was discussed by A. C. Lane, A. C. Lawson and H. P. Cushing.

The following papers were then read by title:

The Earthquake in Owens Valley, California, in 1872: William Herbert Hobbs, Ann Arbor, Mich.

Beginning and Recession of Saint Anthony Falls: Frederick W. Sardeson, Minneapolis, Minn.

The "Nebraska Loess Man": B. Shimek, Iowa City, Iowa.

The Distribution of Drumlins and its Bearing on their Origin: Frank. B. Taylor, Fort Wayne, Ind.

The Cirques and Rock-cut Terraces of Mt. Tobey, Mass.: B. K. EMERSON, Amherst, Mass.

The next paper was

The Lower Portion of the Paleozoic Section in Northwestern New York: H. P. CUSHING, Cleveland, Ohio.

In Jefferson County, N. Y., in the district between Watertown and Alexandria Bay, the Potsdam sandstone and the Lowville, Black River and Trenton limestones are present in quite normal expression. Between the Potsdam and the Lowville are two additional formations. The lower of these passes into the Potsdam by gradation and is lithologically like similar "passage beds" elsewhere in northern New York. It consists of alternating sands and sandy dolomites, varies in thickness from 15 to 75 feet, and has an erosion unconformity at its summit. It is overlain by an impure limestone formation which overlaps on the district from west to east, reaches a thickness of 125 feet, and holds a fauna not hitherto noted in New York, which is tentatively correlated by Dr. E. O. Ulrich with that of the upper Stones River formation of southern Pennsylvania. It has close relationship to the Lowville formation above. The Chazy formation is absent, as is also the entire Beekmantown. The physical break between the two formations is the most prominent one as yet noted in the New York Lower Silurian. The section was compared with those east and south of the Adirondacks, and the additional light which it throws on the physical oscillations of the region was considered. Discussed by H. M. Ami.

At 12:15 o'clock the society adjourned for luncheon in the dining room of the university, after which President Tight led the way to the flat roof of one of the pueblo-style dormitories, from which he pointed out the geological features of the surrounding country.

At 2 o'clock the afternoon session began with the reading of the annual address by the retiring president, President Charles R. Van Hise, of the University of Wisconsin, who chose as his subject "The Problem of the Pre-Cambrian." By request of the president, his address was thrown open to discussion, and remarks were made by A. C. Lane, A. C. Lawson, A. P. Coleman, H. M. Ami and C. R. Van Hise.

The following papers were then read by title:

The Red Sandstone Formation of Southeastern Minnesota: C. W. HALL, Minneapolis, Minn.

The Geological History of the Redstone Quartzite: FREDERICK W. SARDESON, Minneapolis, Minn.

Geology of a Portion of Central Wyoming: N. H. DARTON, Washington, D. C.

Some Features of the Geology of Arizona and Western New Mexico along the Santa Fé Railroad: N. H. DARTON, Washington, D. C.

After this the society listened to the reading of a paper on

Grenville-Hastings Unconformity: WILLET G. MILLER and CYRIL W. KNIGHT, Toronto, Canada.

The crystalline limestone and associated pre-Cambrian sedimentary rocks of southeastern Ontario and the adjacent parts of the province of Quebec, to which Logan and his colleagues long ago gave the names of Grenville and Hastings series, have never been satisfactorily classified as regards their age. Recent work by the present writers has shown that much at least of what has been called the Hastings series, consisting of limestones, conglomerates and other fragmental rocks, is much younger than, and forms a well-defined unconformable series with, the typical crystalline limestones and associated fragmental rocks of what has been called the Grenville series proper. The view that the Grenville and Hastings constitute one series, the former being a more highly altered phase of the latter, is no longer tenable.

The writers find the Keewatin series of the Lake Superior region represented in southeastern Ontario by ancient rocks of like character. The Grenville limestones have been deposited on the surface of the Keewatin. The writers class the Grenville limestone as regards age with the Keewatin iron formation of Lake Superior, which it has not been found possible in that region to separate from the greenstones. The pre-Cambrian conglomerate and associated sedimentary rocks overlying, unconformably, the Grenville limestone, are classed as Huronian. The conglomerate contains not only ordinary fragments of the Grenville limestone, but "eozoon"-like boulders as well, thus showing that the limestone is much older than the conglomerate. Moreover, the "pebbles of cherty and ferruginous rocks resembling those found in the iron ranges of Lake Superior" in the conglomerate of eastern Ontario are found by the writers to have been derived from layers or bands of this material in the Grenville limestone.

The paper was read by Mr. Miller and the discussion was participated in by A. P. Coleman, H. P. Cushing, C. R. Van Hise, A. C. Lane and W. G. Miller.

The next paper was

Relation of the Equus Beds of Kansas to Reversed Mississippi Drainage: W. G. Tight, Albuquerque, N. M.

Discussed by A. P. Coleman, H. E. Gregory, A. C. Lane and F. W. Cragin.

The following two papers were read without intermission by Dr. A. C. Lane:

A New Siluric Fauna from Michigan: W. H. Sherzer, Ypsilanti, Mich., and A. W. Grabau, New York City. (By permission of the state geologist of Michigan.)

In the vicinity of Detroit some 275 feet of dolomites and limestones overlie the Sylvania sandstone, and constitute the Upper Monroe. This series has been traced through parts of Wayne and Monroe counties and into the adjoining regions of Ohio and Canada. A threefold division is possible in the Detroit region, but in most of the other localities one or more of the members disappear by overlap on the Sylvania as a basal bed or by pre-Onondaga erosion. A pronounced hiatus exists between these Upper Siluric beds and the Mid-Devonic Dundee limestone, which rests disconformably on various members of the Upper Monroe, or even on the Sylvania. Two distinct faunæ are recognizable in the Upper Monroe. In the lower two members the fauna is coralline, the middle member (Anderdon limestone) being in most localities a more or less continuous coral and stromatopora reef. A considerable number of species has been obtained from this limestone. The corals are nearly all closely allied to Mid-Devonic types. The stromatoporoids are chiefly Siluric, though two Devonic genera with one species each occur. The brachiopods are Siluric, but the pelecypods are of Devonic genera and species not heretofore known from the Siluric of America. The gastropods and cephalopods, on the other hand, are all of Siluric types. This remarkable fauna of the Anderdon bed is soon displaced in the overlying dolomites by a more strictly Siluric fauna, though even here species of Devonic affinities are not unknown. The fauna of Gothland is similar in many respects to the highest Siluric fauna, the species, while not identical, being closely representative. The bearings of these facts on the paleographic conditions of North America in late Siluric time will be discussed.

The Nomenclature and Subdivisions of the Upper Siluric Strata of Michigan, Ohio and Western New York: A. C. Lane, Charles S. Prosser, W. H. Sherzer and A. W. Grabau.

The Monroe formation of Michigan and Ohio comprises a number of paleontologic zones, each ranging through from fifty to two hundred feet of strata. The species of each zone are restricted to it, and the zones are recognizable at widely distant localities. The lowest of these extends into western New York, having been named by Grabau, in 1898, the "Greenfield formation," and being represented in eastern New York by the Cobleskill Limestone. The characteristics of the several divisions were discussed, and the conclusions reached by the four authors given. Names for the divisions were proposed and their distribution given.

The papers were discussed by A. C. Lawson, A. P. Coleman, A. M. Miller, H. M. Ami, I. C. White and A. C. Lane.

The concluding paper of the afternoon was

Structure and Stratigraphy of the Ouachita Ordovician Area, Arkansas: A. H. Purdue, Fayetteville, Ark.

Discussed by A. C. Lane and G. K. Gilbert.

Soon after 5 o'clock the society adjourned and at 7:30 met again in the dining room of the Hotel Alvarado for its annual dinner, which was enjoyed by thirty-seven persons, including a few of the prominent educators of the territory.

SESSION OF TUESDAY, DECEMBER 31, 1907

The society convened at 9:10 A.M., with President Van Hise in the chair. The report of a committee favoring the establishment of a series of stations for the study of volcanic and seismic phenomena was adopted. The consideration of an overture on the formation of a Committee on Geological Nomenclature was deferred to the end of the session. The report of the council was accepted and ordered printed in the *Proceedings,* and the auditing committee was continued and given leave to report to council. The society then proceeded with the reading of papers, the first two being presented together by Professor J. E. Wolff. They were

Notes on the Crazy Mountains, Montana: John E. Wolff, Cambridge, Mass.

The Crazy Mountains were visited by the author in 1883 and 1889, and a paper on their geology was published in the *Proceedings* in 1892. Last summer, with Dr. G. R. Mansfield and Mr. H. E. Merwin, a review was made of their physiographic and geologic features, and some three hundred photographs were obtained, dealing with points of especial interest. One small glacier was discovered and visited, and another, not so readily accessible, was noted; the relative age of the granite-diorite stocks and of alkali-syenite was found and minor points determined. After a review of the geology of the mountains and of their special features, the results of last summer's work were described and the whole illustrated by a small selection of lantern slides. The accompanying paper, by Dr. Mansfield, was included in Professor Wolff's presentation.

Glaciation in the Crazy Mountains of Montana: George Rogers Mansfield, Cambridge, Mass. (Introduced by J. E. Wolff.)

During the Glacial Period the Crazy Mountains were the seat of local glaciation. All the higher valleys contained small glaciers, as indicated by the numerous cirques. Some of the glaciers on the south and east slopes attained considerable size, notably those of Big Timber and Sweetgrass-American Fork canyons, which must have had lengths of approximately 15 to 18 miles, as shown by the extent of morainic deposits. Glaciation is not yet extinct. A tiny glacier was seen at the head of Big Timber and another in Sweetgrass Canyon, and a third is reported by Assistant Forester Wilson at the head of Rock Creek. Glacial topography predominates throughout the southern section of the mountains and occurs locally in the southern section. Striæ and truncated valley spurs along the sides of the canyons show that the ice must have been 500 to 800 feet thick. The glaciation succeeded a long erosion period in which the region had reached an early stage of peneplanation. It continued long enough to form broad, deep troughs in the weaker rocks and to produce much of the sharp arête topography so characteristic of the southern section of the mountains. Later stream erosion has incised the glacial deposits and in some cases the old troughs.

The papers were discussed by A. C. Lawson.

The following papers were read by title:

The Shaler Mountains, Unalaska, a Granite Core to the Aleutian Islands: T. A. Jaggar, Jr., Boston, Mass.

The Growth and Destruction of Metcalf Cone, Bogosloff Island, 1906–7: T. A. Jaggar, Jr., Boston, Mass.

Then was read

The Sandia Mountains: W. G. Tight, Albuquerque, N. M.

The following papers were then read by title:

The Geology of the Alaska Range: A. H. Brooks, Washington, D. C.

The Paleozoic and Associated Rocks of the Upper Yukon Basin: A. H. Brooks and E. M. Kindle.

Discovery of Fish Remains in the Ordovician of the Black Hills: N. H. Darton, Washington, D. C.

The next paper read was

The Topaz-bearing Rhyolite of the Thomas Mountains, Utah: Horace B. Patton, Golden, Colo.

Extensive rhyolite flows occur in the Thomas Mountains of Juab County, Utah, associated with somewhat more basic eruptives. The rhyolite has been profoundly affected by mineralizing vapors that have removed all trace of dark-colored constituents and have caused the development of a surprising number of topaz crystals, with occasional garnet and specular hematite. The topaz crystals occur, first, in lithophysal cavities associated with quartz, and are then mostly clear crystals having a handsome brownish-yellow wine-color that quickly disappears on exposure to direct sunlight; second, imbedded in the solid rhyolite and having frayed out ends but fairly well developed prismatic faces. These are brownish in color before exposure to light, but are rendered opaque by numerous enclosures of quartz crystals. Similar crystals, but perfectly developed and with double terminations, were found imbedded in fragments of a very fine grained rhyolite tuff, the fragments being themselves inclosed in rhyolite. Discussed by G. K. Gilbert.

The next two papers were read without break.

Strata containing the Jurassic Flora of Oregon: J. S. Diller, Washington, D. C.

The Jurassic flora of Oregon has been described and designated by Professors Lester F. Ward and William M. Fontaine in the U. S. Geological Survey Twentieth Annual Report, pt. 2, p. 217 and Monograph 48. The localities of its occurrence have been greatly extended among the Klamath mountains of California, and several distinct faunas have been found at different places in the same strata. On the one hand it is clearly associated with a characteristic Knoxville fauna, and on the other with a fauna that may be older than the Mariposa.

Local Silicification of the Knoxville: J. S. Diller, Washington, D. C.

There are certain localities in the Riddles Quadrangle and the adjacent region of Oregon in which portions of the Knoxville strata are silicified and contain numerous small quartz veins. In these quartz-veined rocks *Ancella pioclii* and *Ancella crassicollis* are widely but sparsely distributed. When these fossils are abundant the cement is calcareous and the rocks are less firmly lithified. Discussed by A. C. Lawson.

On account of the special interest due to the excursion after the meeting to the Grand Canyon of the Colorado, the following paper was, in the absence of its author, read by Dr. C. W. Hayes:

Wind Erosion in the Plateau Country: Whitman Cross, Washington, D. C.

The next paper was read by title:

The Association of Pegmatite with Hornblendic Border Beds of Granite and the Appearance of Large Isolated Masses of the Two together Deep in the Ground: B. K. Emerson, Amherst, Mass.

The next paper was read by Mr. Louderback. It was

Benitoite, its Mineralogy, Paragenesis and Geological Occurrence: George D. Louderback and W. C. Blasdale, Berkeley, Cal.

Benitoite and the associated minerals were briefly described and chemical analyses presented. The paragenesis and geological mode of occurrence were discussed and compared with geologically related but mineralogically different deposits in the same geologic province. Discussed by W. G. Tight.

The next papers were read by title, as follows:

The Igneous Rocks of the Ortez Mountains: Ida H. Ogilvie, New York, N. Y.

The Preglacial Drainage in Central Western New York: Amadeus W. Grabau, New York, N. Y.

Geographic Cycle in an Arid Climate: Charles R. Keyes, Des Moines, Ia.

The next paper read was

Shoreline Studies on Lake Ontario and Erie: Alfred W. G. Wilson, Montreal, Canada.

The initial shore lines of these lakes were very complex because of the complex character of the basins in which they lie. The process by which the shore lines have been brought to their present stage of development is almost wholly due to the action of waves and the currents generated by them. Tides and other currents strong enough to be effective agents in transportation do not exist in the Great Lakes. The materials found on the shores are almost wholly of glacial origin. They are being distributed along the shores by the shore processes, and there is evidence of the existence of two nodal points on each lake, one on the north shore, and one on the south. East of these points the resultant general movement of shore débris is east, west of these points it is west. Locally there may be at any specified time movements in either direction, according to the direction of wind and wave at that time.

Some special features of the shore lines were described in detail—such as Toronto Island on Lake Ontario, Long Point, Rondeau Point, Point Pelee and Erie Point, on Lake Erie.

The place of the shore lines in the cycle of shore development was considered and they were classed as adolescent.

The following papers were then read by title:

Faults and Folds of the Grand Canyon District: Douglas Wilson Johnson, Cambridge, Mass.

Coon Butte, Arizona: John B. Hastings, Denver, Colo.

The Occurrence of Petroleum in the Coast Counties of California: Ralph Arnold, Washington, D. C.

Stream Conglomerate in the Mt. Diablo Range, Calif.: R. Arnold and R. Anderson.

Distribution of Gold in the Saddle and Leg Region of the Meguma Series of Nova Scotia: J. Edmund Woodman, Halifax, N. S.

Probable Age of Meguma Series, Nova Scotia: J. Edmund Woodman, Halifax, N. S.

The Giant Springs at Great Falls, Montana: C. A. Fisher. (Introduced by C. W. Hayes.)

After the end of the reading of formal papers, Dr. C. W. Hayes informally exhibited a set of photographs of the fossil woods of Arizona together with notes on them by Dr. David White, paleobotanist to the United States Geological Survey. Then President W. G. Tight exhibited and described a series of stereopticon slides illustrating glacial and other phenomena among the high Andes of Bolivia and the scientific program was declared finished.

The question of endeavoring to form a General Committee on Geological Nomenclature was thoroughly discussed by C. R. Van Hise, A. C. Lane, A. C. Lawson, A. P. Coleman, G. K. Gilbert, H. E. Gregory, R. D. George, C. W. Hayes and W. G. Tight, and the following action was taken unanimously:

The Geological Society of America recommends to the various organizations concerned:

1. That a general Committee on Geological Nomenclature be formed; one fifth of its members to be from the United States Geological Survey, one fifth from the Canadian Geological Survey organizations, one fifth from Mexico and one fifth from geologists at large selected by the Geological Society of America.

2. That this general committee have authority to appoint special committees on nomenclature from within or without its own membership for the investigation of the particular questions referred to them, the special committees to report back their conclusions to the general committee with full reasons therefor; the different sections to report in turn to their own organizations.

3. That the fact that any subject is under discussion by this general committee be made known to the scientific public at large.

The purpose of the recommendations is to provide a source from which any geologist may on application obtain advice regarding nomenclature.

The following resolutions of thanks were presented by Mr. G. K. Gilbert, seconded by President Van Hise and heartily adopted.

The Geological Society of America acknowledges with gratitude the many and substantial courtesies extended to it by the citizens and the Commercial Club of the City of Albuquerque.

The society also tenders its sincere and emphatic thanks to the University of New Mexico and particularly to President W. G. Tight for the hospitality it has enjoyed, a hospitality which included arrangements of exceptional completeness and attentions most assiduous.

The following fellows of the society registered as being in attendance at the meeting: Charles R. Van Hise, H. B. Patton, George E. Collie, G. K. Gilbert, George

D. Louderback, Herbert E. Gregory, W. G. Miller, T. L. Walker, Andrew C. Lawson, C. W. Hayes, G. D. Harris, Alfred W. G. Wilson, R. W. Brock, A. H. Purdue, I. C. White, Frank R. Van Horn, Alfred C. Lane, H. M. Ami, J. S. Diller, H. P. Cushing, A. P. Coleman, R. D. George, Samuel Calvin, W. G. Tight, John E. Wolff, Arthur M. Miller, F. W. Cragin and E. O. Hovey. There were in addition at least five visiting geologists, not members of the society, and many students and casual visitors.

The Cordilleran Section met with the general society. On Tuesday, December 31, the section held a business session at which Andrew C. Lawson and George D. Louderback were reelected chairman and secretary respectively.

The following officers were elected by the general society for the year 1908:

President—Samuel Calvin, Iowa City, Iowa.

First Vice-president—George F. Becker, Washington, D. C.

Second Vice-president—A. C. Lawson, Berkeley, California.

Secretary—Edmund Otis Hovey, New York City.

Treasurer—William Bullock Clark, Baltimore, Md.

Editor—Joseph Stanley-Brown, Cold Spring Harbor, N. Y.

Librarian—H. P. Cushing, Cleveland, Ohio.

Councilors—H. P. Cushing, Cleveland, Ohio, and H. B. Patton, Golden, Colorado.

The council voted to accept the invitation which had been received from the authorities of Yale University to meet in New Haven, Conn., next winter. It was decided to hold the meeting during the week of December 29, 1908.

Edmund Otis Hovey,
Secretary

THE AMERICAN BREEDERS' ASSOCIATION

The fourth annual meeting of the American Breeders' Association was held at Washington, January 28–30, 1908. This association now comprises about 1,100 members and includes the more active breeders of the country, both those engaged in plant breeding and those who are breeding animals. It has attempted to bring together those who are doing breeding work with scientific aims and those whose aims are primarily commercial or "fancy." This attempt has been successful to a marked degree; not only in the meetings of the association, which have been well attended by all classes of breeders, but also in the three year-books which have appeared and which undoubtedly have skimmed the cream of the stupendous yield of results of the breeding industry during the past few years. Take, for example, the last year-book. It contains papers on breeding horses by Professor C. W. Gay, of the Ohio State University; cattelo by C. J. Jones ("Buffalo" Jones), of Nevada; dairy cattle by M. A. Scoville, Director of the Kentucky Agricultural Experiment Station; swine by Professor D. A. Gaumnitz of the Minnesota Station, and Geo. M. Rommel, of the U. S. Department of Agriculture; poultry by Professor J. E. Rice, of Cornell University; sugar beets by J. E. W. Tracy, of the U. S. Department of Agriculture; corn by Eugene and J. D. Funk, of Funk Brothers, Illinois, leading commercial breeders; carnations by J. B. Norton; nut and forest trees by Messrs. Sudworth and A. D. Hopkins, of Washington. There are theoretical papers by Castle, Shull, Q. I. Simpson, C. W. Ward, Spillman and others, the commercial men uniting with the theoretical men in these papers also.

The Washington meeting was not behind its predecessors in interest. Reports of committees occupied, perhaps, a larger part of the program than hitherto. Among these reports may be mentioned that of Mr. David G. Fairchild on the "Introduction of Animals and Plants." He called attention to the danger of introducing noxious plants and animals with the useful and urged that investigations should be made as to the best method of shipping plants and animals so as to prevent introducing diseases or injurious insects. Methods of quarantine should be made the object of a rigorous scientific inquiry. The discussion brought out the present danger from the importation to this country of a *Peronospora* disease of corn that has recently appeared in Java; and a new disease that appeared among cattle in India two years ago and has cost much to eradicate.

A report on "Animal Hybridizing" was read by Professor W. J. Spillman. The greater part of the report was based on the work of Mr. M. M. Boyd, of Bobcaygeon, Ontario, who is crossing bison and cattle. The hybrids are large; the hump of the bison is dominant (though incompletely so) and, in consequence, the cuts of this part of the vertebral column contain, in the hybrid, double the quantity of lean meat that is yielded by cattle. The lean hind quarters of the bison are recessive, consequently the hybrid offers large cuts of meat in this valuable portion also. Certain difficulties occur in hybridizing. The bison is usually taken as bull, but the abnormal amount of amniotic fluid produced frequently kills the cow, so the cow must be as large as possible. More male hybrids die early than females and they are often sterile, but several good breeders were obtained that were fertile with either parent species. Mr. Spillman referred also to the practical application among breeders of the knowledge that the polled condition is a mendelian dominant. An investigation is being made by the committee on the relative vigor of hybrid hogs over pure bred. A case was cited of the recent discovery by a Michigan wool buyer of two samples in his stock that were worth 90 cents per pound as compared with 25 cents for other wool. An attempt will be made to find the origin of this peculiarly valuable wool.

Mr. C. M. Winslow, of the Ayrshire Breeders' Association, spoke of methods used by the association for perfecting the breed. He traced the history of the breed from the native wild cattle of Ayr in Scotland through the first stages of their improvement in 1700 until they were first imported to America in 1837. He stated that the ideal is the creation of a dairy producer rather than a show ring cow and that tests of the milk production of a cow for advanced registry extend over a full year.

A paper by Mr. J. J. Hemingway, of the American Jersey Cattle Club, was read by Dr. W. H. Dexter, of Washington. The history of Jersey cattle in America was traced from their introduction into the United States in 1850. He stated that the ideals of the club were beauty of form inside the type and much milk rich in butterfat; and cited many cases of extremely high performances of individual cows.

Professor Andrew Boss, of the Minnesota Agricultural College, reported on "Breeding for Meat Production." Improvement is brought about by considering performance first and ancestry second. Progress is hampered by the necessity of judging "on the block"—the prize winning individual can not be a breeder. Improvement is made by breeding from individuals that gain weight economically, that are prolific breeders, and that belong to strains or families that show well when cup up for market. Feeding records, breeding records and block records are the basis of improvement. It is also desirable to attempt by breeding to gain disease-resistant strains. In the discussion Mr. Spillman spoke of the high percentage of tuberculosis of calves fed on skim milk or following cows.

If placed early on grass or fed grain they were relatively clear of disease.

Mr. W. M. Hays, assistant secretary of agriculture, reported on cooperative work in animal breeding. He divided the subject into the three classes of creative breeding on the production of new races; pure bred breeding, or the improvement of established races; and herd or grade breeding, or the improvement of ordinary farm stock. He spoke of the work of the committee in the collecting of data concerning individual performance and breeding power and proposed the establishment of circuit breeding as a means of finding individuals with which to establish new and valuable strains.

Professor H. J. Webber reported for the Committee on Theoretical Research in Heredity. He referred to certain deviations from mendelism in apparently mendelian phenomena. Thus in cotton the upland race has smooth black seeds and this smoothness is recessive to the fuzzy type. But the F_1 generation shows all gradations of fuzziness, and it is hard to fix any one of these types. Thus if one selects to breed for the second generation seeds of the black smooth type fuzziness appears in that generation. Dr. Webber also referred to the practise of corn breeders in preventing self-fertilization as based on insufficient evidence; and suggested that we need additional evidence that close inbreeding of corn results in loss of vigor.

Professor Spillman read a paper entitled "Mendelian Phenomena and Discontinuous Variation Color Factors in the Mammalia." He referred to the mendelian nature of poll in cattle. He argued that the fact of the absence of an intermediate type to-day is no proof of the absence of an intermediate form in the ancestry of the existing races. Discontinuity of variation is due to the complexity of the characters of a race. Variations that appear to be discontinuous are due to new combinations of characters. He spoke of belting and other sorts of color inheritance in swine and other mammals.

C. B. Davenport in continuation of the report on heredity gave evidence from poultry breeding that between discontinuous and continuous variation there are all degrees; and that mendelian inheritance differs not in kind but only in degree from the blending inheritance of biometricians.

Mr. C. W. Ward spoke of heredity in carnations. He finds that the amount of any character in the offspring depends upon the proportion of ancestor in which that character occurs. Thus two white flowers may throw all white, but if there has been much pink in the ancestry they may throw some pink in the flowers. Again, the offspring of the same parents will differ with the environmental conditions of the season.

Mr. E. M. East, of New Haven, spoke of "Correlated Variations," from the standpoint of plants. Professor W. E. Castle gave an address on "Color Variations of Domesticated Animals." He stated that the colors found are selfs (either black, red, white or gray) or spotted. These various color varieties are known to us best under domestication but they occur also in nature not less than under domestication only in nature they are eliminated; the gray being the usual wild color because less conspicuous. This gray is a complex of three factors: black + yellow + a pigment pattern (banding). Where the pattern factor is absent yellow is dominated and the coat is black. The spotted condition is a mosaic that has arisen secondarily and become fixed in the germ cells.

Mr. A. F. Woods, of the U. S. Department of Agriculture, reported on "Cooperative work in Plant Breeding." First, the committee cooperates with individual farmers by distributing certain seeds.

Some seeds distributed have already developed new varieties as good as, or better than, the strains from which they came. Second, the committee cooperates in synthetic breeding—where a certain foreign variety or species is needed to secure a certain desired combination a man will be sent abroad to get the required species.

Mr. Jouett Shouse, of Lexington, Ky., read a paper on "Improvement of the American Thoroughbred Horse." He traced the history of the thoroughbred in America from "Bull Rock" imported to Virginia from England in 1730. The development of the thoroughbred was bound up with that of racing which was extensively practised from the revolution until the civil war; racing stimulated the breeding of race horses. Since the war racing in the South has languished except at the larger cities, but in the North it has developed, and to-day the thoroughbred is the best it has ever been. Breeding thoroughbreds is an industry worth many millions of dollars and supporting many thousands of people; the industry is centered in Kentucky owing to its favorable climate and soil. The thoroughbred is the foundation of the saddle horse and the standard bred, but the former has more of the thoroughbred than the latter. The great value of the thoroughbred is for crossing with farm mares; the product is the best kind of generally useful horse. The speaker opposed anything which would interfere with horse-racing as bound to discourage breeding the thoroughbred and was led to the conclusion that the elimination of gambling from racing would, by diminishing the interest in racing, have this effect.

Mr. Robert N. Sewall, of Oyster Bay, N. Y., gave an illustrated address on the "Origin of the Modern Horse and his Relationship to the Arabian." He spoke of the dual origin of the horse from the cold-blooded northern horse (Przewalski's horse) and the hot-blooded Lybian horse from which the Arabian has been immediately derived. He showed how the northern horse had been improved by crossing with the Arabian to get our best races and entered a plea for the further development of the Arabian in order further to improve our thoroughbred and standard-bred types.

Mr. C. J. Jones spoke about his work of breeding and hybridizing the American bison, and the successful attempt to make a hardier hybrid. He referred to the necessity of using large cows as mothers on account of the great amount of amniotic fluid surrounding the embryo. He also spoke of his hybrids with Persian sheep which attain a weight of nearly 300 pounds and whose mutton is of superior quality.

Dr. Alexander Graham Bell spoke for the Committee of Eugenics. His paper has been published in *The National Geographic Magazine.*

Many other papers, mostly based on the breeding of plants, were presented on Wednesday and Thursday, including reports of the committees on breeding forest and nut trees by Dr. Pinchot; tobacco, by A. D. Shamel; bush and small fruit, by Professor Hansen; corn, by Mr. J. D. Funk and Dr. Shull. On Thursday afternoon the association was received by President Roosevelt.

The following officers were elected for the year:

President—Hon. James Wilson, Washington, D. C.

Vice-president—C. W. Ward, Queens, N. Y.

Secretary—W. M. Hays, Washington, D. C.

Treasurer—N. H. Gentry, Sedalia, Mo.

Chairman Animal Section—A. P. Grout, Winchester, Ill.

Secretary Animal Section—C. B. Davenport, Cold Spring Harbor, N. Y.

Chairman Plant Section—H. J. Webber, Ithaca, N. Y.

Secretary Plant Section—N. E. Hansen, Brookings, S. Dak.

All persons interested in the science or art of breeding are invited to join the Association and to send their names to the secretary. The membership fee of two dollars includes the year-book of proceedings which can be obtained only by members.

Chas. B. Davenport

INLAND WATERWAYS[1]

To the Senate and House of Representatives:

I transmit herewith a preliminary report from the Inland Waterways Commission, which was appointed by me last March in response to a wide-spread interest and demand from the people. The basis of this demand lay in the general and admitted inability of the railroads to handle promptly the traffic of the country, and especially the crops of the previous fall.

This report is well worth your attention. It is thorough, conservative, sane and just. It represents the mature judgment of a body of men exceptionally qualified, by personal experience and knowledge of conditions throughout the United States, to understand and discuss the great problem of how best to use our waterways in the interest of all the people. Unusual care has been taken to secure accuracy and balance of statement. If the report errs at all it is by over-conservatism. It contains findings or statements of fact, a number of specific recommendations and an account of inquiries still in progress, and it is based in part on statistics and other information contained in a voluminous appendix. The subject with which it deals is of critical importance both to the present and to the future of our country.

[1] Message from the President, delivered to the Senate and House of Representatives on February 26, 1908.

Our river systems are better adapted to the needs of the people than those of any other country. In extent, distribution, navigability and ease of use, they stand first. Yet the rivers of no other civilized country are so poorly developed, so little used, or play so small a part in the industrial life of the nation as those of the United States. In view of the use made of rivers elsewhere, the failure to use our own is astonishing, and no thoughtful man can believe that it will last. The accompanying report indicates clearly the reasons for it and the way to end it.

The commission finds that it was unregulated railroad competition which prevented or destroyed the development of commerce on our inland waterways. The Mississippi, our greatest natural highway, is a case in point. At one time the traffic upon it was without a rival in any country. The report shows that commerce was driven from the Mississippi by the railroads. While production was limited, the railways, with their convenient terminals, gave quicker and more satisfactory service than the waterways. Later they prevented the restoration of river traffic by keeping down their rates along the rivers, recouping themselves by higher charges elsewhere. They also acquired water fronts and terminals to an extent which made water competition impossible. Throughout the country the railways have secured such control of canals and steamboat lines that to-day inland waterway transportation is largely in their hands. This was natural and doubtless inevitable under the circumstances, but it should not be allowed to continue unless under careful government regulation.

Comparatively little inland freight is carried by boat which is not carried a part of its journey by rail also. As the report shows, the successful development and use of our interstate waterways will require intelligent regulation of the relations between rail and water traffic. When this is done the railways and waterways will assist instead of injuring each other. Both will benefit, but the chief benefit will accrue to the people in general through quicker and cheaper transportation.

The report rests throughout on the fundamental conception that every waterway should be made to serve the people as largely and in as many different ways as possible. It is poor business to develop a river for navigation in such a way as to prevent its use for power, when by a little foresight it could be made to serve both purposes. We can not afford needlessly to sacrifice power to irrigation, or irrigation to domestic water-supply, when by taking thought we may have all three. Every stream should be used to the utmost. No stream can be so used unless such use is planned for in advance. When such plans are made we shall find that, instead of interfering, one use can often be made to assist another. Each river system, from its headwaters in the forest to its mouth on the coast, is a single unit and should be treated as such. Navigation of the lower reaches of a stream can not be fully developed without the control of floods and low waters by storage and drainage. Navigable channels are directly concerned with the protection of source waters, and with soil erosion which takes the materials for bars and shoals from the richest portions of our farms. The uses of a stream for domestic and municipal water-supply, for power and in many cases for irrigation, must also be taken into full account.

The development of our inland waterways will have results far beyond the immediate gain to commerce. Deep channels along the Atlantic and Gulf coasts and from the Gulf to the Great Lakes will have high value for the national defense. The use of water power will measurably relieve the drain upon our diminishing supplies of coal, and transportation by water instead of rail only will tend to conserve our iron. Forest protection, without which river improvement can not be permanent, will at the same time help to postpone the threatened timber famine, and will secure us against a total dearth of timber by providing for the perpetuation of the remaining woodlands. Irrigation will create the means of livelihood for millions of people, and supplies of pure water will powerfully promote the public health. If the policy of waterway improvement here recommended is carried out, it will affect for good every citizen of the republic. The national government must play the leading part in securing the largest possible use of our waterways; other agencies can assist, and should assist, but the work is essentially national in its scope.

The various uses of waterways are now dealt with by Bureaus scattered through four federal departments. At present, therefore, it is not possible to deal with a river system as a single problem. But the commission here recommends a policy under which all the commercial and industrial uses of the waterways may be developed at the same time. To that end, congress should provide some administrative machinery for coordinating the work of the various departments so far as it relates to waterways. Otherwise there will not only be delay, but the people as a whole will fail to get from our streams the benefits to which they are justly entitled.

The commission recognizes that the cost of improving our inland waterways will be large, but far less than would be required to relieve the congestion of traffic by railway extension. The benefits of such improvement will be large also, and they will touch the daily life of our people at every point, uniting the interests of all the states and sections of our country. The cost and the benefits should be equitably distributed, by cooperation with the states and the communities, corporations, and individuals beneficially affected. I heartily concur in the commission's recommendation to this end. Such cooperation should result in united effort in carrying out the great duty of improving our inland waterways. While we delay, our rivers remain unused, our traffic is periodically congested and the material wealth and natural resources of the country related to waterways are being steadily absorbed by great monopolies.

Among these monopolies, as the report of the commission points out, there is no other which threatens, or has ever threatened, such intolerable interference with the daily life of the people as the consolidation of companies controlling water power. I call your special attention to the attempt of the power corporations, through bills introduced at the present session, to escape from the possibility of government regulation in the interest of the people. These bills are intended to enable the corporations to take possession in perpetuity of national forest lands for the purposes of their business, where and as they please, wholly without compensation to the public. Yet the effect of granting such privileges, taken together with rights already acquired under state laws, would be to give away properties of enormous value. Through lack of foresight we have formed the habit of granting without compensation extremely valuable rights amounting to monopolies on navigable streams and on the public domain. The repurchase at great expense of water rights thus carelessly given away without return has already begun in the east, and before long will be necessary in the west also. No rights involving water power should be granted to any corporations in perpetuity, but only for a length of time sufficient to allow them to conduct their business profitably. A reasonable charge should of course be made for valuable rights and privileges which they obtain from the national government. The values for which this charge is made will ultimately, through the natural growth and orderly development of our population and industries, reach enormous amounts. A fair share of the increase should be safeguarded for the benefit of the people, from whose labor it springs. The proceeds thus secured, after the cost of administration and improvement has been met, should naturally be devoted to the development of our inland waterways.

The report justly calls attention to the fact that hitherto our national policy has been one of almost unrestricted disposition and waste of natural resources, and emphasizes the fundamental necessity for conserving these resources upon which our present and future success as a nation primarily rests. Running water is a most valuable natural asset of the people, and there is urgent need for conserving it for navigation, for power, for irrigation and for domestic and municipal supply.

The commission was appointed to obtain information concerning our waterways as related to the general welfare. Much work was done, but more remains to be done before a plan for their development can be prepared in detail. We need additional information on the flow of our streams, the condition of channels, the amount and cost of water traffic, the requirements for terminals, the area in each watershed which should be kept under forest, and the means of preventing soil-waste and the consequent damage to our rivers. But it is neither necessary nor desirable to postpone the beginning of the work until all the facts are obtained. We have suffered heavily in the past from the lack of adequate transportation facilities, and unless a beginning is made promptly we shall suffer still more heavily in the future.

Being without funds or an expert staff, the commission has confined itself to principles affecting the whole problem and the entire country. Its report is a plea, in the light of actual facts, for simplicity and directness in dealing with the great problem of our inland waterways in the interest of the people. It submits no specific plans or recommendations concerning even the most important projects. The first of these, of course, concerns the Mississippi and its tributaries, whose commercial development will directly affect half our people. The Mississippi should be made a loop of the sea and work upon it should be begun at the earliest possible moment. Only less important is the Atlantic inner passages, parts of which are already under way. The inner passages along the Gulf coast should be extended and connected with the Atlantic waters. The need for the developing of the Pacific coast rivers is not less pressing. Our people are united in support of the immediate adoption of a progressive policy of inland waterway development.

Hitherto our national policy of inland waterway development has been largely negative. No single agency has been responsible under the congress for making the best use of our rivers, or for exercising foresight in their development. In the absence of a comprehensive plan, the only safe policy was one of repression and procrastination. Frequent changes of plan and piecemeal execution of projects have still further hampered improvement. A channel is no deeper than its shallowest reach, and to improve a river short of the point of effective navigability is a sheer waste of all it costs. In spite of large appropriations for their improvement, our rivers are less serviceable for interstate commerce to-day than they were half a century ago, and in spite of the vast increase in our population and commerce they are on the whole less used.

The first condition of successful development of our waterways is a definite and progressive policy. The second is a concrete general plan, prepared by the best experts available, covering every use to which our streams can be put. We shall not succeed until the responsibility for administering the policy and executing and extending the plan is definitely laid on one man or group of men who can be held accountable. Every portion of the general plan should consider and so far as practicable secure to the people the use of water for power, irrigation and domestic supply as well as for navigation. No project should be begun until the funds necessary to complete it promptly are provided, and no plan once under way should be changed except for grave reasons. Work once begun should be prosecuted steadily and vigorously to completion. We must make sure that projects are not undertaken except for sound business reasons, and that the best modern business methods are applied in executing them. The decision to undertake any project should rest on actual need ascertained by investigation and judgment of experts and on its relation to great river systems or to the general plan, and never on mere clamor.

The improvement of our inland waterways can and should be made to pay for itself so far as practicable from the incidental proceeds from water power and other uses. Navigation should, of course, be free. But the greatest return will come from the increased commerce, growth and prosperity of our people. For this we have already waited too long. Adequate funds should be provided, by bond issue if necessary, and the work should be delayed no longer. The development of our waterways and the conservation of our forests are the two most pressing physical needs of the country. They are interdependent, and they should be met vigorously, together and at once. The questions of organization, powers and appropriations are now before the congress. There is urgent need for prompt and decisive action.

Theodore Roosevelt

SCIENTIFIC BOOKS

Darwinism To-day. A discussion of present-day scientific criticism of the Darwinian selection theories, together with a brief account of the principal other proposed auxiliary and alternative theories of Species-Forming. By Vernon L. Kellogg. New York, Henry Holt and Co. 1907. Pp. 403.

Undoubtedly the best book of its kind, and cordially to be recommended to the student or layman who struggles with the fluctuations of evolutional belief. This commendation, however, will not seem extreme when it is pointed out that this is practically the only book of its class! For few indeed are the authors who have attempted the herculean task of sifting out the vast literature which has accumulated around the problems of evolution during the past two decades. The present book then is one which fills a decided need. It is brief, clear and contains summaries of general and technical interest which are elsewhere not to be obtained in the English language. Indeed nowhere else will one find attractive digests even of the classical work of Roux, Naegeli and Weismann. The nearest approach to it is Plate's "Über die Bedeutung des Darwin'schen Selectionsprincips," of which a translation has never been published. And to this work Professor Kellogg acknowledges frankly his great indebtedness.

Particularly to be commended in the present book is its style. It breathes of the open air, and leads one, oftener than usual in these days, away from the click of the microtome. The main text of the book is interesting, its illustrations—there are no pictures, by the way—are chosen discreetly, and technical summaries and discussions are usually tucked away in the form of appendices.

The author has brought together the objections to old-fashioned natural selection (which have become a lengthy part of post-Darwinian writings) with a fair degree of completeness. Such objections, off-hand, are these: that natural selection makes for constancy not variability; that it produces changes quantitative not qualitative; that it can operate only on great averages, not on individuals; that it does not account for continued degeneration; that small variations give no "handle" for selection; that sexual selection is impotent; that it explains the survival not the arrival of new variations; that the struggle for survival of one set of characters leaves the others to fall effetely to panmixia; that great variations are apt to be eliminated by panmixia; that plural variations are necessary to insure the origin of species; that correlated variations are excessively difficult to explain; that there is weakness in the evidence as to the elimination of the unfit. And these objections are threshed out in adequate detail.

On the other hand, the author considers, but rather incompletely, the replies of the neo-Darwinians to their critics. He examines, for example, the question of the rise of qualitative differences by correlation; the importance of the principle of change of function, and the demonstrable value of small fluctuating variations in certain cases.

In a book of this kind the critical reader is always interested in determining the point of view of the author himself, and in this regard Professor Kellogg is entitled to hold views by virtue of his own valuable studies on matters evolutional. Professor Kellogg, it appears, feels keenly the criticism directed against the Darwinian factor and pronounces early in his work that "each naturalist for himself must decide how vigorous is selection." Withal, however, he realizes the particular lack of and weakness in substitutional explanations. His own view of the origin of species is, we gather, a peculiarly composite one; in many regards it resembles Plate's, and is a compound of Darwinism, orthogenesis, mutation (mildly emphasized), Lamarckian use-inheritance, and the "unknown factors." It is clear that he attaches less importance than Plate to the Darwinian factor. Thus he believes that Plate's "passive adaptations" may be explained by other means than by natural selection, and in this regard he derives help from the views of Roux to explain mechanically the initiation of delicate inner adaptations. So, also, it appears, he looks upon organic selection as not strictly neo-Darwinian, for, he argues, if ontogeny can constantly bring into the organism a beneficial structure (as in orthogenesis), what need is there for the selection of minute beneficial variations? On the other hand, he does not sympathize in any sense of the word with teleologicians: and in this regard he stands sharply cut off from several recent writers, for we can not deny that these reactionaries are gathering strength. In explaining "purposive" adaptations he sides rather with Plate, but attributes little value to amphimixis, and he has little leaning to germinal selection. To the various micromeric theories, as well, his attitude is nonsympathetic. To the influence of isolation he gives considerable space and takes a middle ground in estimating its importance. With many critics of selection he agrees that too much prominence in the problem of the origin of species has been given to artificial selection. At the same time he is a convert to the causo-mechanical conception of orthogenesis, which he calls "one of the most important matters connected with the whole great problem of descent," one which deals with the "basic problem," for it touches "the problem of beginnings." He does not indicate, however, to what degree this form of evolution can be regulated, and in this regard is unlike Weismann, who seeks to construct a mechanism, which corrects automatically too extreme a type of orthogenesis.

Kellogg's own conception of evolutionary processes, then, is extremely complicated: and we have not yet included in it the "unknown factors." This article in his faith he declares more emphatically, I think, as he progresses in the book. But it is clear that he does not consider these unknown factors as in any sense vitalistic: he thinks unnecessary a "mysterious tendency of the germ plasm to vary," and, nearing an ultimate problem, suggests that the "inevitable non-identity of vital process and environmental conditions may alone be enough to supply the automatic modifying principle, antedating and preceding selection, which must affect change determinate, though not purposeful. Naegeli's automatic perfecting principle is an impossibility to the thorough-going evolutionist seeking for a causo-mechanical explanation of change, but an automatic modifying principle which results in determinative or purposive change . . . is not that the very thing provided by the simple physical or mechanical impossibility of perfect identity between process and environment in the case of one individual and process in environment in the case of any other?" But this conception of Kellogg is, so far as we can see, little more than the restatement of the idea of environment and variability which has been woven into the warp of discussion ever since evolution has been seriously considered.

In a work of this kind, one should be grateful for its utility and its general accuracy, and not go far out of the way to dig into its structural details. Without wishing to be unduly critical, one might nevertheless point out that in this *Darwinism to-day* there is no reference to many and notable discussions of the last half dozen years, some of which, by the way, were published in the pages of this journal. Nor is the neo-vitalistic side of evolutional philosophy given due consideration—not, be it understood, that the reviewer is in keen sympathy with this point of view. Nor is the more wholesome neo-Lamarckian philosophy expounded adequately. In such a work, there should have been some reference to Pauly's "Darwinismus and Lamarckismus" (1905), and some citation to the Lamarckian utterances of so distinguished a biologist as Professor Boveri (in his address (1906) as

Rector of the University of Würzburg). One does not leave out of sight in commenting on these omissions the fact that the present book aims to be popular, not encyclopedic. Furthermore: There is scanty reference to recent Mendelian work. And there is altogether too brief notice of the evolutional work of paleontologists: the extraordinary studies of Hyatt are inadequately referred to and there is no mention at all of his pupils, Jackson and Grabau. And while Jaekel's epistasis is summarized, there is no reference to the kindred and earlier neotænia of Boas. In the treatment of the environmental factor there is similar unevenness: for while there is given an excellent and detailed account of Wagner's speculations, there is scanty mention of the distinguished services of Professor J. A. Allen, and his name, by the way, does not occur in the index—but this proves nothing, for the index is sadly defective. In general, however, from the point of view of book-making, one does not find serious defects. Printers' slips are not numerous, but one can find them, if he looks hostilely, as he can in any other book. Thus Perameles—even in these days when ill-spelling commends itself to taxonomists—would hardly recognize itself as Permales on page 280. And here and there careless or inaccurate expressions have not been eliminated in the proof. Thus, it is stated that the lung sacs of birds penetrate "through hair fine holes into all the bones," and that in "many fishes the female may never even see the male at spawning time."

BASHFORD DEAN

An Introduction to Vegetable Physiology. By J. REYNOLDS GREEN. Second edition. Pp. xx + 459, 182 figs. in text. Philadelphia, P. Blakiston's Son & Co. $3.00.

The first edition has been favorably known for a number of years and the publication of a second edition aroused the expectations that it might be further improved and brought up to date. However, in the volume before us we find little change from the original imprint. It is indeed to be regarded more as an American reprint than as a second edition in the proper sense of the word. It is noticeable that there is no new preface and that the one printed is word for word the same as the first edition with the exception that the date has been omitted. In fact, throughout the book the plates are almost identical, if not wholly so. The one important difference is that Chapter VIII. of the first edition, entitled "Respiration," has been shifted and amalgamated with Chapter XIX. which deals with the release of energy, the two together constituting Chapter XVIII. of the new edition under the title "Energy of the Plant." This is undoubtedly an improvement and renders the presentation of the nutrition phenomena, already well treated, much more logical and comprehensible. Some smaller changes are to be noted in the alteration of introductory paragraphs to certain chapters and the substitution of the more modern word protein for the older term proteid.

Despite the fact that so little new material has been added, it remains one of the best shorter reading books in physiology that we have in English, particularly in the matter of nutrition physiology, which is treated very much more fully than the growth phenomena. It is perhaps to be regretted that more was not done to amplify the second edition, but if its publication in this country will serve to bring it more to the attention of students here, it will serve a useful purpose.

HERBERT M. RICHARDS

SOCIETIES AND ACADEMIES

THE CHICAGO ACADEMY OF SCIENCES

THE Chicago Academy of Sciences held its annual meeting on Tuesday evening, January 14, 1908, at the academy's building in Lincoln Park. The report of the secretary showed that the work of the academy had been pushed steadily forward during the year and that much had been accomplished in promoting educational matters of a scientific nature among the schools and citizens of Chicago.

Monthly meetings and Friday evening popular lectures have been maintained by the academy, in addition to a number of lectures by other societies, under the auspices of the academy. The most notable of these lectures by affiliated societies have been twelve lectures given by the Chicago Medical Society and the Society of Social Hygiene on preventive medicine. The Illinois Audubon Society also held its annual meeting in the spring. The total number of lectures and meetings has been thirty-four, at which the combined attendance was 4,008. The smallest number present was fifty and the largest three hundred, the seating capacity of the lecture hall being two hundred.

The academy has been officially represented at several notable gatherings of scientific men, including the Illinois State Academy of Sciences, the Seventh Zoological Congress, the American Association for the Advancement of Science and the American Association of Museums.

The Entomological Section has held eleven meetings, at which papers of interest have been read and discussed.

The Natural History Survey has published two reports on the fauna of the Chicago Area, Bulletin IV., part II., on the "Trilobita of the Niagaran Limestone," by Dr. Stuart Weller, and Bulletin VI., on the "Birds of Chicago," by Mr. F. M. Woodruff. A special illustrated edition of the bird bulletin was prepared for free distribution among the schools and teachers of Chicago and the opportunity was taken advantage of by a large number of both schools and teachers. The academy has been the recipient of many favorable comments for thus aiding in the study of the local bird fauna.

The curator's report showed that interest in the museum by visitors, schools and students was increasing. The schools have made use of the collections to an unprecedented degree and the exhibit collections have been largely used for the acquisition of general information. Laboratory and study facilities have been provided for those who desired to work at the academy building.

During the year the building has been redecorated throughout, the light oak cases on the main floor have been refinished in weathered oak and the interiors of the cases have been painted a blue-gray color. All museum cases have been installed with glass shelves with inconspicuous supports.

The notable additions to the exhibits have been a collection of economic minerals with distribution maps; a collection of Philippine Land Mollusks from the Quadras collection; a large expansion of the exhibit illustrating the pearl button industry; the expansion of the collection of native birds with their nests and eggs or young and with habitat maps, and an ecological collection of invertebrates, arranged in groups.

The label department showed a total of 8,088 labels produced.

A feature of the academy's work has been the identification of material for institutions and individuals, which amounted to 2,625 specimens, submitted by twelve individuals and institutions.

The accessions for the year aggregated 30,111 specimens, of which 28,547 were in the department of Mollusca.

The annual election of officers for the year 1908 resulted as follows:

President—T. C. Chamberlin.

Vice-presidents—Charles S. Raddin and Albert L. Stevenson.

Acting Secretary—Frank C. Baker.

Trustees (five years)—Charles S. Raddin and Charles H. Blatchford.

Executive Board (three years)—Stuart Weller and Lester Curtis.

FRANK C. BAKER,
Acting Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 438th meeting was held January 25, 1908, President Stejneger in the chair.

The first communication consisted of an "Exhibition of Colored Lantern Slides by the Autochrome Plates," by Professor W. P. Hay. He discussed the process of direct color photography recently perfected by the Lumières, of Lyons, France, in its relation to scientific work and exhibited a number of lantern slides made on the new "Autochrom" plates.

These plates bear a panchromatic film of great delicacy and sensitiveness underlaid by a stratum of starch grains colored orange-red, purplish blue, and green. The granules average about 1/2,500 of an inch in diameter, are spread out in a single layer in almost perfect contact with each other and are mixed so intimately and in such proportions that light passing through an unobscured plate appears white, or, more strictly speaking, a neutral gray.

For taking a photograph any ordinary camera may be used but a light orange color screen specially adapted to these plates must be fitted to the lens. The plates must be placed in their holders glass side toward the lens, instead of the reverse as in ordinary plates, so that during the exposure any light which reaches the sensitive film must first encounter the layer of starch grains, each grain of which will allow the passage of light of its own color and prevent the passage of light of any other color. Owing to the color screen and the still more retarding effect of the starch grains the plates are exceedingly slow and the exposures are from 75 to 100 times or more as long as would be required by the most rapid plates under the same conditions of light. After exposure the plate is developed in total darkness in a pyrogallic acid developer for about two and a half minutes, rinsed in water, and at once placed in a bath of permanganate of potash and sulphuric acid and carried from the darkroom into full daylight. The permanganate of potash and sulphuric acid mixture rapidly dissolves away the reduced silver in this negative but does not effect the unreduced portion. A second development in daylight, in paramidophenol, or a similar developer working without alkali, results in the reduction of the hitherto unchanged silver salt of the film and produces a positive in which the form and color of the object photographed are accurately reproduced. The colors, however, are generally weak and the plate must be intensified in order to bring them out in full brilliancy. The operations of clearing, fixing, drying and varnishing follow in rapid succession and the transparency is completed. As yet no method of making a colored print on paper has been perfected, but duplicate transparencies may be made by the ordinary methods.

As a means of easily and quickly producing colored photographs of many kinds of natural history objects this new process presents many advantages and in spite of the cost and shortcomings of the plates will doubtless come extensively into use. The exposure required, even under the most favorable conditions and with the most rapid lens, is so long that photographs of moving objects are out of the question. The plates are much less transparent than ordinary plates and when used as lantern slides require a stereopticon equipped with a powerful light and placed comparatively close to the screen. Added to these disadvantages is the much more serious one, that the colors of the starch granules, on which the color of the image depends, are not stable and gradually disappear if long subjected to the intense concentrated light of the oxyhydrogen or electric lantern.

The lantern slides exhibited covered a wide range of subjects, such as microphotographs of rock sections, various mineral and organic crystals with polarized light, direct photographs of the solar spectrum, copies of paintings, views of beetles, butterflies, shells, flowers, etc., and landscapes, demonstrating conclusively that it is now possible to photograph the color as well as the form of any object and fix them for future reference on a plate which, except under the most trying conditions of light, should last indefinitely.

The next communication, from Dr. F. V. Coville, was on "The Probable Assimilation of Free Nitrogen by the Swamp Blueberry (*Vaccinium corymbosum*)." An abstract on this subject will appear later.

The last communication, entitled "Some Problems and Possibilities in Hop Culture" was presented by Dr. W. W. Stockberger in the form of a lecture illustrated by lantern slides showing methods of cultivation, harvesting and curing the crop, and the comparative growth of local and European varieties on American soils.

Attention was directed to the desirability of selecting varieties adapted to the various conditions of soil and climate, to the influence of seasonal distribution of rainfall on growth and quality and to the necessity of a much broader knowledge of the physiological activities involved in the process of curing. A machine which promises soon to be available for picking the crop was mentioned as a possible solution of the labor question involved in harvesting.

The opportunity for the improvement of quality through selection and breeding was pointed out, the immediate problem therein being the discrimination of varieties which are now almost hopelessly confused. The work of breeding is further hampered by the fact that while more than a hundred varieties of the female form of the hop have been named only *one* variety of male plants is recognized.

M. C. Marsh,
Recording Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 198th meeting of the society, held at the Cosmos Club, on Wednesday evening, January 8, 1908, under informal communications, Mr. E. S. Bastin described a pyrrhotitic peridotite from East Union, Maine. This dike rock is unusual because of the presence in it of nearly 30 per cent. of pyrrhotite so related to fresh olivine and plagioclase grains that it is proved to be an original constituent. The analysis shows the rock to belong to subclass 2 of Class V. It is the first described representative of this subclass and has been named Lermondose. The total percentage of nickel, cobalt, and copper sulphides is about 2 per cent. It furnishes, therefore, an example of an ore of purely igneous origin.

Mr. R. H. Chapman exhibited photographs illustrating an ancient method of ore crushing near Gadug, about 300 miles southeast of Bombay, India. The bedrock with a gradual slope toward a stream has a shallow trench along the higher portion, from which water was fed over the surface, in which more than a hundred saucer-like depressions are located. These holes were used as mortars in which the ore was crushed by stone pestles in the hands of native laborers. Similar forms are known in which the mortars were larger and the crushers were boulders, of one half to one ton weight, which were handled with a framework. It is estimated that this quartz mill was in use about 2,000 years ago.

Regular Program

Centenary of the Geological Society of London: Mr. Whitman Cross.

Some Volcanoes of the Western Mediterranean: Henry S. Washington.

In the summer and fall of 1905 the speaker undertook the investigation of some of the less well-known volcanoes of the western basin of the Mediterranean for the Carnegie Institution of Washington. The volcanoes of Catalonia occupy the site of a Pliocene gulf, and are post-Quaternary. The earlier eruptions formed extensive and often deep lava flows, which partially filled the preexistent and still persistent drainage, and these were followed by the formation of numerous, small, cinder cones. The lavas are feldspar-basalts, nephelite-basalts, and limburgites, of quite uniform chemical characters.

The volcanic rocks of Sardinia are referred to three periods: a series of sheets of basalts and rhyolites, of Tertiary age, which cover extensive areas in western Sardinia; the subsequent large volcanoes of Monte Ferru and Monte Arci, near the west coast; and the numerous, small, recent, cinder cones which extend from near Bonorva to near Sassari. The lavas of Monte Ferru are trachytes and phonolites, which form the core of the deeply dissected volcano, and rather monotonous basalts, which cover the other lavas and extend far over the surrounding country. Similarly, the core of Monte Arci is composed of chemically uniform, though texturally diverse, rhyolites, covered by a mantle of later basalts. The recent cinder cones are wholly basaltic. Their eruption antedated the construction of the prehistoric nuraghi, for which Sardinia is famous.

The island of Pantelleria is wholly volcanic, the earliest eruptions being the trachytes of the dominating, but badly worn, Montagna Grande, with flows of other trachytic rocks. These were followed by flank eruptions of pantellerites, very high in silica and low in alumina, and distinctly sodic. The latest eruptions are basaltic and formed small cinder cones, like those of Catalonia and Sardinia, while submarine eruptions took place in the neighborhood of Pantelleria in 1831 and 1891. The small and hitherto undescribed island of Linosa, about one square mile in area, contains nine volcanic cones. These are referred to two periods; an earlier one of cones of greenish and yellow tuffs, containing blocks of basalt, and a later one of cinder cones, with lava flows of feldspar-basalt and nephelite-basalt. The Linosa lavas are very uniform in chemical characters.

Many analyses of the rocks have been made, and they are shown to be closely alike in their chemical features, one of the most notable of these being the uniformly high percentage of titanium. All the volcanoes mentioned are considered, therefore, to be genetically related and to belong to the same co-magmatic region or petrographic province, which possibly extends into Africa, as far as the Great Rift Valley. This petrographic province is very different in its characters from those of the Italian peninsula and also from that embracing the volcanoes of the Grecian Archipelago and Asia Minor, which have also been studied by the speaker. The reputed volcano of Boukournine, near Tunis, was visited and was found to be composed entirely of limestone. A brief account was given of the occurrence of orbicular diorite at Santa Lucia di Tallano in Corsica. The paper was illustrated by lantern-slides.

Ralph Arnold,
Secretary

DISCUSSION AND CORRESPONDENCE

THE DISTRIBUTION OF CLOSELY ALLIED SPECIES

The idea that closely related species do not possess identical geographical distributions is a theoretical deduction which should be rigorously tested by the examination of actual cases. Recently, R. G. Leavitt has done this with reference to plants (chiefly orchids),[1] and arrives at the conclusion that this principle, as expressed by D. S. Jordan,[2] is not well supported.

Nevertheless, I think that Jordan's sentence is fundamentally correct, provided it is changed so as to refer not only to purely geographical, but also to ecological conditions.

I have expressed this idea in two sentences:[3] (1) "Closely allied species occupy neighboring areas"; (2) "More or less closely allied species occupying the same or nearly the same territory, generally possess different habits." Further, I have treated of this subject more especially in a recent publication,[4] classifying the forms of segregation of closely allied species, geographically as well as ecologically.

It will be remarked that, wherever I have talked about this subject, I always have used the word *species*.[5] Leavitt, in the paper referred to (p. 230), deliberately changes the word *species* in Jordan's sentence into *kind*, and investigates the distribution of "pairs of kinds" of plants. This substitution, *kind* or *form* in place of *species*, is also advocated by J. A. Allen.[6]

This change, however, is entirely inadmissible. I used the above phrases in connection with the bearing of isolation or segregation upon the formation of species (speciation), and wanted to bring out the idea that geographical or ecological segregation is a criterion by which *species* may be recognized. I intended the word "species" in the strict taxonomic sense, that is to say, for "forms" which are morphologically separated from the allied forms. My object was to express the opinion that the morphological segregation of true species is connected with and due to some kind of segregation in the physical conditions under which the "species" live, and I pointed out that this might be either purely geographical or ecological. *Ecological or geographical segregation is the factor which results in speciation,* that is to say, the factor which

[1] "The Geographical Distribution of Nearly Related Species," *American Naturalist*, 41, 1907, pp. 207–240.

[2] "Given any species in any region, the nearest related species is not likely to be found in the same region" (Science, 22, 1905, p. 547).

[3] *Proceedings American Philosophical Society*, 44, 1905, pp. 127, 128.

[6] *American Naturalist*, 41, 1907, p. 654.

[4] "The Crawfishes of the State of Pennsylvania," *Memoirs Carnegie Museum*, 2, 1906, p. 512.

[5] See also Science, 23, 1906, p. 949.

makes species out of variations or varieties ("forms" or "kinds").

Consequently, when Leavitt demonstrates that there are many "pairs of kinds" of plants, which possess the same range, he does not prove that the sentence referred to is incorrect, but he may have shown only that the "kinds" he discusses *are not species*.

This is clearly seen in the instance of *Cypripedium pubescens* and *parviflorum* (p. 235). Even granted that the ranges of these two forms practically coincide (p. 236), we may conclude as well that they are not species. This indeed is supported by other observations. O. W. Knight has shown[7] that these two "forms" are merely variations, which may be observed successively in one and the same plant, according to the character of the environment: *C. parviflorum* has been transformed into *C. pubescens* by the change of the environment, and *vice versa*.

In other cases, quoted by Leavitt, we may have to deal with species: but the facts given are too scanty to form an opinion. I have repeatedly emphasized that only an exact and *complete* knowledge of the distribution is apt to give us the means of judging as to segregation and speciation of the forms in question. Leavitt's instances are very defective in this point, and I shall take up one of them, in order to make clear what I mean.

The range of *Spiranthes cernua* (= *Ibidium cernuum*) is given (p. 234 f.) as: Massachusetts, Ontario, Iowa, Georgia;[8] and that of *Spiranthes odorata* as: Georgia, Florida, Alabama, Louisiana, Texas.[8] Thus, as Leavitt says, the range of the latter "coincides widely with that of *S. cernua*." However, we do not know whether the two "forms" are ever found associated, *i. e.*, under the same environment, in those parts of their range which overlap in the southern states. Besides, it is evident that the one is more northern, the other more southern in its distribution, and possibly their centers of origin and radiation were segregated accordingly. And finally, the morphological facts are different from what they appear in Leavitt's statement.

According to this (and to the quotations from Britton and Brown), we should expect *Ibidium cernuum* in western Pennsylvania. But this species seems to be absent here, and it is represented by another one, described recently by O. E. Jennings:[10] *Ibidium incurvum*. This was first discovered in Erie County, Pa. But additional localities in Beaver, Allegheny, Westmoreland and Armstrong Counties, Pa., are represented in the herbarium of the Carnegie Museum (the specimens were partly labeled *cernuum*, partly *odoratum*), and the new species has been found in large numbers very recently (September and October, 1907) in Allegheny county by Jennings, and in Beaver county by the present writer. *Ibidium cernuum* is absent in this part of Pennsylvania: at any rate, all plants called by this name seem to be *incurvum*. Thus, with reference to *Ibidium cernuum* and *incurvum*, the rule holds good, that two closely allied species are not found associated under the same conditions, and this rule also fits beautifully the case of *Ibidium incurvum* and *odoratum*, which are even more closely allied. It remains to be seen what the distribution of *I. incurvum* will turn out to be outside of western Pennsylvania. Possibly, many plants called *cernuum* or *odoratum* may be the new species.

Of course, the question is not yet settled. I only took up this instance in order to show how incomplete our knowledge is. Large tracts of the country are poorly or not at all known, and in addition, the knowledge of the morphological details is often defective. It would not be astonishing, if finally it should be found that *Ibidium odoratum* runs through *I. incurvum* into *I. cernuum*, but for the present all these forms are morphologically well separated, a separation which corresponds, at

[7] "Some Notes on our Yellow Cypripediums," *Rhodora*, 8, 1906, pp. 93, 94.

[8] According to Britton and Brown, "Illustrated Flora of the United States," 1, 1896, p. 471: Nova Scotia to Ontario and Minnesota, south to Florida and Louisiana.

[9] *Ibid.*: North Carolina to Kentucky, Florida and Louisiana.

[10] *Annals Carnegie Museum*, 3, 1906, p. 483.

least in part, to geographical segregation. If further studies should show that there is segregation, geographical or ecological, between these forms, then they are *species;* if not, they are *varieties,* which fact then also will be expressed in their morphological condition, one form running into the other at least in certain parts of their ranges.

A. E. Ortmann

Carnegie Museum,
Pittsburg, Pa.,
November 23, 1907

SPECIAL ARTICLES

CARBOHYDRATE METABOLISM

When we consider the fact that the products of the oxidation of sugars *in vitro* are not well known, the uncertainty that prevails regarding the mechanism of utilization of the common sugars in the body can be understood. Not only are the products of their metabolism unknown, but the form in which the carbohydrate must reach the cell to be available as a food is also not beyond dispute. It is ordinarily held that the cell can utilize sugar as such. On the other hand, some hold that the sugar must reach the cell in a colloid form or combination to act as a food. Again, it is claimed that dextrose is the form in which sugar is utilized by the tissues, and that the other sugars, as levulose or galactose, are transformed into dextrose before they are oxidized. The present preliminary report aims to give the results of some work on this problem.

The method adopted consists essentially of perfusing an organ with blood containing a known quantity of the sugar under investigation, and determining the loss after perfusion. The weight of the organs before and after perfusion is taken into account; the loss in volume of the perfused liquid; the gain in weight of the organ and the total carbohydrate before and after perfusion. In this way the quantity utilized by the organ may be determined. Perfusion was also done in dead organs to see that the mechanical construction had nothing to do with the loss of sugar. Also samples of the liquid were kept at the temperature of the perfused blood (37–40° C.) during the time of perfusion to ascertain the extent of glycolysis occurring without perfusion.

A very brief summary of results will be given:

Experiment I.—Perfusion of the hind legs of a dog with dextrose-blood solution. The legs were stimulated at 30 times per minute and the perfusion was made at the rate of about 125 c.c. in ten minutes.

	Dextrose per mille.
Blood before perfusion	3.1916
Blood after 20 minutes	2.9659
Blood after 30 minutes	2.7750
Blood after 45 minutes	2.4736
Blood after 65 minutes	1.9473
Blood after 71 minutes	1.5384

It is readily seen that a loss of sugar has taken place. This loss could occur in one of several ways: (1) by actual oxidation; (2) by accumulation in the surrounding tissues; (3) by storage in the tissues as glycogen, etc.; or (4) by absorption by the tissues. As a result of a number of experiments it has been found that both oxidation and accumulation take place. In every instance there was a distinct loss of dextrose when perfused through the living tissue. The accumulation by edema and other means increased as the tissues died, and in the dead organs an accumulation took place without any oxidation.

When the liver was perfused, there was likewise a loss of sugar. No glycogen storage occurred unless the perfusion was commenced very rapidly after the interruption of the circulation. In other words, the glycogen-storing function of the liver was lost much more quickly than the glycolytic function. No definite conclusions could be drawn as to the influence of the hepatic circulation when perfusion was made through the hepatic artery, simultaneously with the perfusion through the portal, the ordinary method used.

The utilization of levulose: What has been said of dextrose will hold good for levulose. A brief summary of results with this sugar will illustrate.

Weight of perfused leg	1,000	gms.
Weight of muscles of same	610	"
Weight of opposite leg	1,020	"

Total carbohydrate in leg before perfusion (glycogen and sugar) (.12 per cent.)	1.260 gms.
Total carbohydrate in leg after perfusion (.1645 per cent.)	1.645 "
Gain	.3850 "
Total volume blood used in perfusion	500 c.c.
Content of sugar at beginning (.5472 per cent.)	2.7160 "
After four perfusions (2 hrs., 30 mins.) blood remained after samples were taken for analysis	310 c.c.
Amount of sugar this contained (.4348 per cent.)	1.3478 "
Total loss of sugar in blood	1.3682 "
Sugar recovered from samples	.3508 "
Recovered by difference in muscles at end	.3850 "
Sugar loss by oxidation	.6324 "

If the amount of dextrose in the original blood be calculated at one part per thousand there would be at least .3204 gm. of levulose used by the muscles, granting that the dextrose be utilized before the levulose, an assumption which has no facts to support it.

A second experiment carried out in the same way where the sugar at the beginning was .8620 per cent. at the end of the perfusion of over four hours' duration contained .3360 per cent. The total loss of sugar was 1.0997 gm. Dextrose content at beginning was .0801 per cent. Loss of levulose at least .7693 gm. The results show that levulose as dextrose is attacked directly by the living tissues. If there be a conversion of either into glycogen it takes place in the muscle as it is oxidized, which is highly improbable.

Maltose is not used directly by the muscle. There is some loss of sugar, but if we assume that the dextrose in the blood is utilized in preference to maltose, no reduction of the quantity of maltose takes place. If we grant that both are used equally there could be at most only a slight reduction of the maltose. Some interesting features in connection with the vitality of the muscles are brought out in maltose perfusions, *e. g.*,

	Per Cent.
The blood after addition of maltose	.6325
The blood after 30 minutes (first perfusion)	.5720
The blood after 68 minutes (fifth perfusion)	.5720
The blood after 4 hrs., 16 mins. (fourteenth perfusion)	.4720
Sugar in non-perfused leg	.0500
Sugar in perfused leg at end of experiment	.2250

The total sugar recovered is almost equal to that at the beginning. Between the fifth perfusion and the fourteenth the reaction to stimulation decreased markedly, and the transudation of the sugar into the muscles appeared to occur *pari passu* with the loss of the vitality of the muscle. The loss of sugar in the first thirty minutes was less than the dextrose content of the blood at the beginning. The loss thereafter was very slight.

Investigation of the other sugars has not been concluded.

Hugh McGuigan
Washington University
Medical School

QUOTATIONS

THE COMMITTEE OF ONE HUNDRED

One of the largest and most enthusiastic of the sectional meetings of the American Association for the Advancement of Science, recently held in Chicago, was the Symposium on Federal Regulation of Public Health, held by the Economic Section in conjunction with the Committee of One Hundred on National Health, and representatives from other great organizations. The opening address was by Professor William H. Welch, the retiring president of the American Association for the Advancement of Science, and in it he emphasized the importance of the movement conducted by the Committee of One Hundred. He described the existing neglect of health as shameful, and pointed out that, if existing hygienic knowledge were fully applied, the death-rate might be cut in two. As examples of what a Federal Health Bureau might do he cited the work of Pasteur and Koch, whose best work was done for the national governments of France and Germany, though the benefits have been shared by all nations. In America we lack even the statistics of disease except in a limited area. Professor F. F. Wesbrook, the dean of the Medical School of the University of Minnesota, showed the need of federal jurisdiction over railways and waterways, which carry diseases from one state to another, and showed that such jurisdiction would have prevented the Chicago-St. Louis controversy over the drainage canal. Mr. Edward T. Devine made a stirring speech, bringing home to the audience what a reduction in the death-rate means in the concrete experience of the individual. The elimination of deaths from tuberculosis, even if the same number of deaths were added to the mortality from other diseases coming later in life, would lengthen the average life by twelve years. In the summer of 1906 Professor J. P. Norton, of Yale, read a paper before the Economic Section of the American Association for the Advancement of Science, on the "Economic Advisability of a National Organization of Health," which excited much interest and resulted in the formation of the Committee of One Hundred. This committee was first formally organized on April 18, 1907. Its officers at present are: President, Irving Fisher; secretary, Edward T. Devine; treasurer, Title Guarantee and Trust Company; vice-presidents, the Rev. Lyman Abbott, Miss Jane Addams, Dr. Felix Adler, President James B. Angell, the Hon. Joseph H. Choate, President Charles W. Eliot, Archbishop Ireland, the Hon. Ben B. Lindsey, Mr. John Mitchell, Dr. William H. Welch. In the following month (May, 1907) President Roosevelt sent the committee a letter of indorsement in which he said:

> Our national health is physically our greatest national asset. To prevent any possible deterioration of the American stock should be a national ambition. We can not too strongly insist on the necessity of proper ideals for the family, for simple living, and for those habits and tastes which produce vigor and make men capable of strenuous service for their country. The preservation of national vigor should be a matter of patriotism. I can most cordially commend the endeavors of your committee to bring these matters prominently before the public.

There are now about six thousand five hundred persons on the various mailing lists of the Committee of One Hundred. The American Health League, the national society affiliated with the Committee of One Hundred, is growing with amazing rapidity—a fact significant of the popular interest in the movement. Every member of congress has been written to, and a large number have expressed their willingness to advocate health measures. The first legislative measure will be one to authorize the President to redistribute the existing scientific and health bureaus of the government. The recent unfortunate experience with the present arrangement of bureaus in the navy is only one of many instances of lack of cooperation and coordination. It is not anticipated that these existing bureaus will oppose a rearrangement. On the contrary, it is known that most of them favor it, especially as, after the redistribution, their powers and appropriations, as well as their efficiency, will be increased. The committee has received the indorsement of the American Medical Association and of a number of other organizations engaged in the work of human betterment, including the American Association for the Advancement of Science itself, which at its recent meeting voted that hereafter the committee should represent not only the Economic Section in which it originated, but the entire association.—*The Outlook.*

BOTANICAL NOTES

A STUDY OF PHILIPPINE WOODS

In the *Philippine Journal of Science* for October, 1907, Mr. F. W. Foxworthy publishes an interesting and very valuable paper on the structure, physical and chemical properties, uses, durability and botanical classification of the commercial woods of the Philippine Islands. The paper opens with a general and technical discussion of the gross morphology, the minute anatomy, color, odor, weight, seasoning, durability and uses, and this is followed by a key to the commercial woods, based upon structural characters of the woods themselves, and supplemented by photographic plates of fifty-five kinds. The names given are those which are used on the islands, and the kinds are arranged in the alphabetical order of the most widely used of these names. Thus the native name is given first, then are given in succession, the scientific name (with occasional synonyms), the natural family, the several vernacular names, the distribution, properties of the wood, uses and structure. Sixty-eight kinds are described in this way, and these represent somewhat more than eighty species. For the most part these belong to families and genera but little known to the botanists of temperate climates, as *Pithecolobium, Parkia, Intsia, Pterocarpus, Sindora* and *Pahudia* of the *Leguminosae; Euphoria* and *Pometia* of *Sapindaceae; Koordersiodendron* and *Buchanania* of *Anacardiaceae; Sarcocephalus* and *Nauclea* of *Rubiaceae;* and such unfamiliar families as *Dipterocarpaceae, Combreaceae* and *Flacourtiaceae.*

The list enumerates dicotyledonous woods only, although the palms, bamboos and screw-pines yield poles, posts and other materials for structural work. Of the conifers, while several species are natives of the islands, they are so scattered or they occur in such inaccessible places in the mountains that they are practically unknown in the markets.

An interesting discussion is given of growth-rings, and we learn that they "seem to be characteristic of some of our woods only." "It also appears that many trees exhibit rings of seasonal growth when they are young, but not afterwards." We are told that a series of observations on the manner and rate of formation of growth-rings in tropical trees is now under way. We can not speak in too high praise of the kind of work done in the preparation of this paper.

THE SYSTEMATIC BOTANY OF THE LICHENS

Ten years ago Fünfstück began the volume dealing with the lichens in Engler and Prantl's "Natürlichen Pflanzenfamilien," and now we have the closing Lieferung with title-page and index. Including the index the volume covers 250 pages, and when bound will constitute one of the smaller books of the series. The illustrations, of which there are 125, are of the high order of excellence which we have come to expect in this publication.

It is estimated that there are about 4,000 species of lichens, nearly all of which belong to the subclass *Ascolichenes,* only seventeen belonging to the *Hymenolichenes.* The *Gasterolichenes,* indicated on page 49, are withdrawn on page 239, as the result of recent investigations. Throughout the volume the lichens are regarded as fungi in symbiosis with algae, in accordance with the prevailing views as to the nature of these organisms.

The general plan of classification adopted by Zahlbruckner, who wrote the systematic part, is as follows:

Subclass Ascolichenes,
- Order *Pyrenocarpeae,* with thirteen families, from *Moriolaceae* to *Verrucariaceae,* and *Mycoporaceae.*
- Order *Gymnocarpeae,*
  - Suborder *Coniocarpineae,* with three families, from *Caliciaceae* to *Sphaerophoraceae.*
  - Suborder *Graphidineae,* with five families, from *Arthoniaceae* to *Roccellaceae.*
  - Suborder *Cyclocarpineae,* with twenty families, among which are *Lecidiaceae, Cladoniaceae, Collemataceae, Peltigeraceae, Parmeliaceae, Usneaceae, Theloschistaceae, Physciaceae,* etc.

Subclass Hymenolichenes,
- with but one family of three genera—*Cora, Corella* and *Dictynema.*

A valuable feature of the work is the indication under each family and genus of the nature of the particular algae ("gonidia") associated with the fungal symbiont.

STILL MORE SPECIES OF CRATAEGUS

That the description of additional forms of *Crataegus* under the name of "species" has not yet come to an end is shown quite emphatically by an article entitled "*Crataegus* in Southern Michigan," by Professor Sargent, in the Report of the Michigan Geological Survey for the year 1906. From material collected in two localities in the eastern part of the state, and one in the western, fifty-five species are described, twenty-five of which are new to science. Eighteen of the remaining thirty species are of recent separation by Ashe, mostly from one locality. We are told that "Southern Michigan forms the western extension of what is perhaps the richest *Crataegus* region in the world." And further, "Judging from the material which I have seen from other parts of the lower peninsula and which is too incomplete for critical study, it seems probable that there are still a large number of unnamed species." With the prospect of seventy-five to eighty or more species of hawthorns in southern Michigan alone, the botanists of that state may confidently be expected to join the ranks of those who would restore the idea of species to its old significance.

Eventually most of these "species" will probably be sorted and arranged as interesting forms and varieties. As such they will be useful to the critical collector and field botanist. Possibly they may serve as examples of the "elementary species" of some recent writers, or of the "incipient" or "nascent" species of others. They are *not* the species of Gray, Torrey, Bentham, DeCandolle, or Linné.

CALIFORNIA COMPOSITES

In marked contrast to the preceding paper is that of Mr. H. M. Hall, under the title of "Compositae of Southern California," in the University of California Publications (Vol. 3, No. 1, Dec. 28, 1907). The author, although dealing with about five hundred species, finds few new ones. The reason for this is suggested by the author's remark in the introductory chapter, where he says, "It should be noted that the number of species could be greatly augmented by recognizing numerous forms which have been described and given specific names, but which have been reduced to synonymy in this paper." A little later he gives his opinion "that the exaltation of trivial forms, distinguished only by one or two variable characters, to the rank of species is conducive neither to clearness nor to scientific accuracy." What he says further is so well said that it may be quoted with profit at this time when we are thinking seriously of the question of the nature and limits of species. "A rational system of classification should bring out the natural relationship between the various forms; should, in other words, represent the cleavage of the larger groups into their component parts as it has taken place in nature. Much of our recent work, however, has unfortunately consisted of a mere cutting across the grain, the result being a mass of chips—the so-called species—each being a purely artificial product and bearing no evident relationship to the others. This is commonly the result of hasty work where the perpetrator has been too busy to work out natural affinities through a comparison of intergrading forms accompanied by field study."

The Compositae of southern California as understood by the author are distributed by tribes as follows: *Eupatorieae*, 9 species; *Astereae*, 113; *Inuleae*, 25; *Ambrosieae*, 18; *Heliantheae*, 34; *Madieae*, 29; *Helenieae*, 86; *Anthemidieae*, 19; *Senecioneae*, 25; *Cynareae*, 17; *Mutisieae*, 2; *Cichorieae*, 68. These plants are distributed over six "life-zones," viz., Alpine, Hudsonian, Canadian, Transition, Upper Sonoran and Lower Sonoran, and the author discusses briefly the distribution of particular species in these zones. In passing we may notice that it is in the Transition zone that are found the extensive forests of yellow pine (*Pinus ponderosa*) and white fir (*Abies concolor*), while the Upper Sonoran zone "is essentially co-limital with the chaparrel belt." In looking over the list we observe that there are no species of either *Eupatorium* or *Lacinaria* (*Liatris*), and that there are of *Solidago* 4 species; *Aster*, 17; *Erigeron*, 14; *Ambrosia*, 2; *Franseria*, 8; *Xanthium*, 2; *Helianthus*, 6; *Senecio*, 11; *Carduus*, 6.

Charles E. Bessey
The University of Nebraska

THE AMERICAN NATURE-STUDY SOCIETY

The American Nature-Study Society was organized at Chicago on January 2, 1908. Its purposes, as stated in the adopted constitution, are: (1) To promote critical investigation of all phases of nature-study (as distinguished from technical science) in schools, especially all studies of nature in elementary schools; and (2) to work for the establishment in schools of such nature-study as has been demonstrated valuable and practicable for elementary education.

Its membership consists of teachers and others who are interested in nature-study for schools and whose applications for membership have been approved by the council. The annual membership fee is one dollar, payable before February 1, or upon election to membership in case of new members.

The council for 1908 consists of the following officers:

President—L. H. Bailey, Cornell University.

Vice-presidents—C. F. Hodge, Clark University; F. L. Stevens, North Carolina College of Agriculture; V. L. Kellogg, Stanford University; W. Lochhead, Macdonald College, Quebec; F. L. Charles, DeKalb (Ill.) Normal School.

Secretary-Treasurer—M. A. Bigelow, Teachers College, Columbia University.

Directors (for two years)—D. J. Crosby, U. S. Department of Agriculture; C. R. Mann, University of Chicago; S. Coulter, Purdue University; H. W. Fairbanks, Berkeley, Cal.; M. F. Guyer, University of Cincinnati; (for one year)—O. W. Caldwell, University of Chicago; G. H. Trafton, Passaic, N. J.; F. L. Clements, University of Minnesota; Ruth Marshall, University of Nebraska; C. R. Downing, Marquette (Mich.) Normal School.

The constitution adopted provides for an official monthly journal to be published under the direction of the council; and the well-established journal of nature-study, *The Nature-Study Review,* will be transferred to the society. The annual subscription price ($1.00) of this journal is included in the membership fee of the society ($1.00) provided that this fee is paid in advance; but subscribers to *The Review* are not enrolled as members of the society unless elected after filing application. For the purpose of stimulating local interest, sections of the society will be organized in various states and cities. Annual meetings will be held, usually in connection with the national scientific or educational societies. A directory of members will soon be published and revised annually.

The Chicago meeting was well attended by scientific men and dozens of others who were unable to be present expressed great interest in the movement. It is very important that at least one hundred fellows of the American Association for the Advancement of Science should be enrolled as members of the American Nature-Study Society. Their influence is greatly needed in the Nature-Study Society, directly, and indirectly, in establishing desirable relations with the American Association for the Advancement of Science.

For full information concerning the society, or in sending in applications for membership, address M. A. Bigelow, Secretary, Teachers College, New York City.

SCIENTIFIC NOTES AND NEWS

M. Henri Poincaré, the eminent mathematician, has been elected a member of the French Academy, in the place of the late M. Berthelot.

The Bruce gold medal of the Astronomical Society of the Pacific has been awarded to Professor Edward C. Pickering, director of Harvard College Observatory, for distinguished services to astronomy. This is the seventh award of the medal, the earlier medalists being Professor Simon Newcomb, Professor Arthur Auwers, Sir David Gill, Professor G. V. Schiaparelli, Sir William Huggins and the late Professor Hermann Carl Vogel.

The council of the Royal Society of Arts has awarded the gold medal of the Shaw trust for industrial hygiene to Professor W. Galloway, in recognition of his researches into the action of coal dust in colliery explosions.

M. Bouquet de la Grye has been elected president of the Bureau des Longitudes for 1908, M. Poincaré vice-president and M. Bigourdan secretary.

Dr. C. Chree, F.R.S., has been elected president of the Physical Society of London.

The University of Edinburgh purposes to confer its doctorate of laws on Sir Norman Lockyer, director of the Solar Physics Observatory, South Kensington, and editor of *Nature.*

The jubilee of Calcutta University will be celebrated on March 14, when the degree of doctor of science will be conferred as follows:

The Hon. Dr. Justice Mukerjee, vice-chancellor of the Calcutta University; Professor A. Schüster, F.R.S.; the Rev. Father E. Lafont, S.J., C.I.E., late rector of St. Xavier's College, Calcutta; Mr. T. H. Holland, F.R.S., director of the Geological Survey of India; Dr. G. Thibaut, C.I.E.

Mr. Norman Taylor, who has been an aid in the New York Botanical Garden for several years, has been appointed custodian of the plantations.

Mr. Benjamin Kidd has been appointed to deliver the Herbert Spencer lecture for 1908 before the University of Oxford in May or June next. Three lectures have already been given, namely, in 1905 by Mr. Frederic Harrison, in 1906 by Mr. Auberon Herbert and in 1907 by Mr. Francis Galton, F.R.S.

At the Royal Institution on March 7, Professor J. J. Thomson, of Cambridge University, gave the first of six lectures on "Electric Discharges through Gases."

Professor Hans Gadow, of the University of Cambridge, England, will give a series of six illustrated lectures at the University of Illinois from March 16 to 21. The general subject of the lectures will be "Coloration of Amphibians, Reptiles and Birds."

The anniversary meeting of the Geological Society of London was held on February 21, when officers were elected as follows: President, Professor W. J. Sollas, F.R.S.; vice-presidents, Mr. Frederick W. Rudler, I.S.O., Dr. Aubrey Strahan, F.R.S., Dr. J. J. H. Teall, F.R.S., and Dr. A. Smith Woodward, F.R.S.; secretaries, Professor E. J. Garwood and Professor W. W. Watts, F.R.S.; foreign secretary, Sir Archibald Geikie, F.R.S.; treasurer, Mr. Horace W. Monckton, F.L.S. The following awards of medals and funds were made in accordance with the announcement already made: The Wollaston medal to Professor Paul von Groth, of Munich; the Murchison medal to Professor A. C. Seward; the Lyell medal to Mr. Richard Dixon Oldham; the Wollaston fund to Mr. H. H. Thomas; the Murchison fund to Miss Ethel G. Skeat; and the Lyell fund to Mr. H. J. Osborne White and Mr. T. F. Sibly.

The second in the series of university lectures at Western Reserve University was given by President Charles Sumner Howe, of the Case School of Applied Science, on March 3. President Howe's subject was "The more recent developments in astronomy."

On the evening of March 6, Professor George B. Shattuck, of Vassar College, lectured before the Stamford Scientific Society on "A Cruise in the West Indies."

Dr. LeRoy McMaster, of Washington University, gave a lecture on the "Detection of Ozone, Nitrogen Peroxide and Hydrogen Peroxide in Gas Mixtures" at the monthly meeting of the St. Louis Section of the American Chemical Society, held on February 10 at the Academy of Science building, St. Louis.

Harvard University has received $9,753.64, representing the subscriptions of sixty-two friends of the late Professor Charles Follen Folsom, of the Medical School. At the desire of the subscribers the money is to be used to found in the medical school a teaching fellowship in hygiene or mental diseases, the incumbent to receive the income of the fund. Additional subscriptions not yet paid in will increase the fund by $1,430 within the next year. Professor Folsom graduated from the university in 1862 and until 1885 was a teacher in various capacities in the medical school. From 1891 to 1903 he was a member of the board of overseers.

At the commemoration day exercises of Johns Hopkins University, on February 22, a portrait of Henry Newell Martin, formerly professor of biology, was presented to the university by his old students. The presentation speech was made by Dr. William H. Howell, dean of the medical school.

Dr. D. B. St. John Roosa, president of the Post-graduate Medical School of New York City, known for his work on diseases of the eye and ear, died on March 8, at the age of seventy years.

Mr. W. A. Shenstone, F.R.S., senior science master at Clifton College, known for his researches in chemistry, has died at the age of fifty-eight years.

Professor Ivan Stožir, founder and formerly director of the Royal Meteorological Observatory at Agram, Hungary, died on February 12.

A conference of imperial and colonial meteorologists has been convened by the Royal Society of Canada, to meet at Ottawa in May.

The Prehistoric Society of France will hold its annual meeting at Chambéry from August 24 to 30.

The Second Congress of the American School Hygiene Association will convene in Atlantic City, New Jersey, on April 17 and 18, 1908. A program is being prepared which includes papers on legislation relative to school hygiene; medical and sanitary inspection of schools and school children; treatment following the medical inspection of school children; nursing systems in public schools; and other subjects of allied nature. Papers have been promised by Dr. Martin Friedrich, health officer, Cleveland, Ohio; Dr. John J. Cronin, assistant chief medical inspector, New York City; Dr. C. Ward Crampton, assistant physical director, public schools, New York City; Joseph P. Chamberlain, lawyer, San Francisco; R. C. Sturgis, chairman, schoolhouse committee, Boston; Dr. Adolf Meyer, director Pathological Institute, State Commission in Lunacy, New York; Dr. Henry D. Holton, secretary, State Board of Health, Vermont; Dr. George L. Meylan, adjunct professor of physical education, Columbia University; Joseph Lee, Boston; A. C. Vandiveer, counsel, Medical Society, County of New York; Dr. Charles Harrington, secretary, Massachusetts State Board of Health; Samuel G. Dixon, commissioner of health, Harrisburg, Pennsylvania; Dr. Myles Standish, professor of ophthalmology, Harvard Medical School, and Hon. Curtis Guild, Jr., governor of Massachusetts.

According to *Terrestrial Magnetism and Atmospheric Electricity* the superintendent of the Coast and Geodetic Survey has decided to continue the operation of the magnetic observatory at Baldwin, Kansas, which it had been the intention to discontinue at the end of the year 1907. On account of the usefulness and the needs of continuous magnetic records in this region of the United States it is proposed now to continue the Baldwin observatory until it is possible to construct and establish another observatory in its place somewhere west of the Mississippi River.

We learn from the *Journal of the American Medical Association* that a delegation of 200 members of the Medico-Chirurgical Faculty of Maryland was given a public hearing on February 12 by the legislature at Annapolis, to urge the passage of the bill asking for an appropriation of $100,000 for the erection of a public-health institution and medical library building in Baltimore. Speeches were made in favor of the bill by Drs. Charles O'Donovan, president of the faculty; William H. Welch, of Johns Hopkins Medical School; Edward N. Brush, superintendent of Sheppard and Enoch Pratt Hospital, Towson, and Dr. Clotworthy Birnie, Taneytown, formerly a member of the legislature.

The twenty-first annual exhibition by the department of microscopy of the Brooklyn Institute of Arts and Sciences will be held on Saturday evening, March 14, 1908, at the galleries of the Art Building, 174 Montague Street, from 7:45 to 11 o'clock. It will include a display of objects viewed with the microscope, also apparatus, photomicrographs, lantern slides of microscopic objects and other matter pertaining to microscopy. Admission is by ticket, which may be secured by application at the office of the institute or of the president of the department, J. J. Schoonhonn, 34 Second Place, Brooklyn, N. Y.

The University of Washington will send a botanical field party to Alaska during the present summer under the direction of Dr. T. C. Frye, of the department of botany. The general plan is to leave Seattle about July 1, and go as far north as Skagway. From the chief cities as a base excursions will be made into the mountains, to glaciers, to mines and along the sea shore. The work will close in Alaska six weeks from date of sailing from Seattle. The expense will be $20 incidental fee, about $70 steamer fare, and the living expenses which are estimated at $80 for the six weeks, making the total about $175. The work will be the collection of Alaskan plants, the study of adaptation to environment from seashore to perpetual snow, and from fresh water to dry rock. Lectures will be given on plant ecology, with occasional talks on other subjects.

The University of Washington will open its marine station at Friday Harbor, Washington, for the fifth annual session, on June 22, 1908. The length of the session will be six weeks. The staff will consist of Dr. Charles W. Prentiss, of the department of zoology of the University of Washington, Dr. Robert B. Wylie, of the department of botany of the University of Iowa, and Professor Charles O. Chambers, of Pacific University, Forest Grove, Oregon. The chief features of the station are its location in the heart of an evergreen forest in the winter rain belt, the abundance of marine plants and animals, its constant use of the dredge, and its low fees.

The Physics Club of New York at its regular meeting, held March 7, 1908, unanimously adopted the following resolution:

Resolved, That a uniform course in physics for all schools is both undesirable and unattainable. We therefore recommend:

1. That syllabuses should deal with the barest outline of general principles, leaving each teacher free to fill up the course according to his best judgment.

2. That examinations for college entrance should be confined to the general principles specified in the syllabus, and that a teacher's certificate should be accepted for other material—this might well take the form of a rather full statement of the work done.

Volume VI., No. 1, of the University of California Publications in American Archeology and Ethnology is by S. A. Barrett on "Ethno-geography of the Pomo and Neighboring Indians." It is intended both as a background and preliminary for future studies of the ethnology of the Pomo Indians of California, and as the first of a series of investigations describing the territorial limits, tribes of villages, and internal dialectic divisions of each of the groups or families of Indians in California. Besides the Pomo, the paper treats of the contiguous families between San Francisco Bay and latitude 40, the Pacific Ocean and the Sacramento River. The author finds seven markedly distinct dialects among the Pomo, and at least as many more among the other families in the territory considered. The degree of affinity and difference between these dialects is shown in vocabularies of about three hundred words, which are superior to any previously existing material of the same kind, not only in representing all forms of speech in the region, but in being collected by one observer according to the same method. The boundaries of the territory of the Pomo and the other families, and of each dialect, are described in detail and shown on a large map. Tribes in the ordinary sense of the word are declared to have been wanting, the only political unit having been the small village. Of such villages several hundred are listed, each given under its native name and located as exactly as possible. The Pomo territory was not extensive, but included several regions of quite different environments, such as the coast, the Clear Lake region, the open valleys, and the timbered mountain ranges. The effect of these varying environments on the mode of life and customs of what must at one time have been the same people, as proved by language, is fully discussed.

In the House of Commons on February 17, as we learn from *Nature,* Mr. Mallet asked the secretary of state for war whether he was aware of the public service rendered by a commission of the Royal Society, at the request of the war office and the admiralty, in discovering the cause of Malta fever, from which many hundreds annually of our soldiers and sailors on that island until recently suffered; and whether, in view of the importance of this discovery in the annals of preventive medicine, inasmuch as at the present moment the disease had been entirely stamped out, he would consider the desirability of giving the thanks of the government to the Royal Society for this instance of the successful application of British scientific research? In his reply to this question Mr. Haldane said: "I am aware of the great service rendered by the commission in question. The commission's investigations and the adoption of preventive measures as the outcome of its recommendations have been followed by the practical disappearance of Malta fever from the garrison of the island. I think that the Royal Society is well aware how genuine is the appreciation of the government. We owe much to the Royal Society's commission for the successful issue of this remarkable investigation, and for the excellent results which have followed. These results illustrate the enormous importance of bringing science into our business of government."

The coal purchases of the United States government aggregate in value nearly $6,300,000 annually, and it became apparent some time ago that a more uniform basis for buying coal was urgently needed. Until after the establishment of the fuel-testing plant of the United States Geological Survey at St. Louis, in 1904, reliable information in regard to the character of the coals of the United States was difficult to obtain. Coal has been purchased by the government, as well as by the general public, on the mere statement of the selling agent as to its quality or on the reputation of the mine or district from which it was obtained; and if it did not prove to be satisfactory there was no standard for settlement or justification for canceling the contract. If a consumer thought he had cause to find fault with the quality of the fuel he received he was in many cases assured that it must be good because, like all the other coal sent him, it came from a mine with an established reputation. All the other products of mines—gold, silver, copper, and even lead, zinc and iron ores—are purchased to a great extent on the basis of their value as shown by chemical analysis; of coal this is now true only in a small degree, but the number of contracts made on this basis is increasing from year to year. The United States Geological Survey has been charged with the duty of analyzing and testing the coals used by the government, and a summary of the information on this subject obtained to date, including samples of the specifications for coal contracts that are now in use and analyses of some of the coals purchased during the winter of 1906–7, prepared by Mr. D. T. Randall, has just been published as Bulletin No. 339. This bulletin is distributed free of charge and may be obtained on application to the director of the survey at Washington, D. C. Samples of the specifications used by many of the large commercial consumers of coal are also given.

Porto Rico will soon have its only national forest under administration. Mr. M. Rothkugel, of the United States Forest Service, has sailed from New York for the island to make a study of forest conditions and outline a plan of management of the Loquillo National Forest. The Loquillo is the only national forest in the insular possessions of the United States, and, while it was created in 1903, provisions for its administration were not made until early in January, when the comptroller of the treasury affirmed the jurisdiction of the Department of Agriculture over the forest. The forest takes in a little less than 66,000 acres and is located in the northeastern part of the island. Mr. Rothkugel, on reaching Porto Rico, will confer with Governor Post, and will spend three months studying conditions and making his plans and will report to Forester Gifford Pinchot. While in Porto Rico he will select and appoint native rangers, picking men who have a thorough knowledge of forest conditions in Porto Rico.

The people of Ireland pay $5,000,000 a year for the timber which is imported from other countries. This is the penalty of failure to protect its forests. Ireland has only 1½ per cent. of its land in timber and much of that small area is covered with scrub growth of little value. At the same time 23 per cent. of the island is uncultivated. Few inhabited countries have been so extensively deforested. The work of changing conditions for the better has been entered upon however, and scientific forestry will be applied. Consul General Alfred K. Moe, of Dublin, Ireland, reports the progress that has been made looking to the preservation of the few remaining forests and the reforestation of vast areas. The Irish Department of Agriculture maintains a forest school at Avondale which will have charge of the tree planting. A special study has been made of Lord Fitzwilliam's estate which was planted to timber fifty years ago. A popular objection to reforestation in Ireland has been that forest plantations offer less employment to labor than equal areas of agricultural land. It was shown, however, that Lord Fitzwilliam's forest, although planted on poor soil, not valuable for agriculture, had employed four times as much labor as has been employed upon the agricultural land and was more profitable to the owner. Within the past year timber to the value of $50,000 has been sold, and much remains to be cut.

According to Consul-general William H. Michael, of Calcutta, it is proposed by the British India government to link the five rivers—the Indus, Jelum, Chenab, Beas, Ravi and Sutlej—together in such manner as to equalize the flow of water when one river or more is in flood and thus supply the whole canal system connected with these rivers. Mr. Michael continues: "By this arrangement the Punjab (the meaning of Punjab is five rivers) will be given a water supply for irrigation sufficient at all times. The decision of the government of India to adopt the northern alignment for the Sind-Bombay connection railroad, partly on military grounds and partly owing to the objections raised by the Rao of Cutch to the southern alignment, puts an end, for the present at least, to cooperation between the irrigation department and the railway company, which was expected to effect great benefit in that part of the Punjab through which the lines would have run. In time, when the great irrigation projects in the Punjab, now in course of construction, shall have been completed, the irrigation department will take up the scheme of drawing and rendering fit for cultivation the lowlands and salt marshes which make up what is known as the Runn of Cutch. It is claimed that the irrigation department has work in hand on plans that have been adopted to engage its time, energies and available capital for thirty years.

The collection of anthropoid apes in the Regent's Park Gardens is, says the London *Times,* the finest ever brought together. Within the last few days it has been further increased by the kindness of Dr. J. C. Graham, who has presented a fine orang (*Simia satyrus*), probably about six years old. The animal, which has been a pet, is in good condition, and already on friendly terms with its keeper, whose experiences with anthropoids goes back to the arrival of the first gorilla in 1887 and the experiments of Professor Romanes in teaching Sally, the famous chimpanzee, to count. Jacob, as the new arrival was called by its former owner, is not as yet on exhibition, but is kept in the basement, owing to want of room in the upper hall, which contains only four large cages, though their division has been discussed. Although somewhat upset by the process of transfer from the traveling box to the temporary cage, he soon resigned himself to the new surroundings, and feeds well. He has for a near neighbor Delia, a young orang presented by Dr. Graham in 1905, and well known to visitors from its being taken out to exercise in fine weather by the keepers. The name Delia is not in this case feminine, as one might be inclined to consider it, but geographical, having reference to the district of Deli, in the northeast of Sumatra. In the hall is Sandy, the very fine orang presented by Dr. Ridley, which arrived early in September, 1905, and had lived for seven years in the Botanical Gardens at Singapore. In addition to these orangs the society possesses nearly a dozen chimpanzees and four gibbons.

UNIVERSITY AND EDUCATIONAL NEWS

Harvard University has received $25,000 from Mr. Larz Anderson, '88, of Brookline, and Mrs. Anderson, for the building fund of the Dental School. Work on the new building will be begun very shortly.

At the inauguration on March 4 of Dr. Edward Dwight Eaton as president of Beloit College, he announced that Mr. Andrew Carnegie had given the institution $50,000 to insure the gift of $150,000 from the general educational board, and to endow a chair of political economy and finance.

By the will of Mrs. Louisa S. Baker, bequests of $6,000 and $4,000 are made to the Massachusetts Agricultural College and Amherst College, respectively, the income of which funds should be used to help deserving students.

Dr. J. W. H. Traill, professor of botany, Aberdeen University, has given to the university £1,000, to found a bursary for science students.

Bowne Hall of Chemistry, erected for Syracuse University by Mr. Samuel W. Bowne, of New York, at a cost of $200,000, was opened last week.

At a meeting of the trustees of Columbia University on March 2, the budget for 1908–9 was passed. The total appropriation is $1,552,563.79. $1,138,992.79 is set apart for educational administration and instruction, $176,630 for the care of the buildings and grounds, $71,479 for the library, $29,312 for the business administration of the corporation, $47,420 for annuities and $88,730 for interest on the debt.

According to the New York *Evening Post* McGill University has received from the insurance companies in connection with the fires in the engineering and medical buildings $636,000. The cost of the new engineering building, together with the additions to the Workman building, are estimated at $572,000. It is estimated that the new medical building will cost from $500,000 to $600,000.

The presidents of the nine colleges and universities of Wisconsin met recently at the University of Wisconsin upon invitation of President Charles R. Van Hise, and organized the Association of Colleges and Universities of Wisconsin. President Van Hise was elected president, and President R. C. Hughes, of Ripon College, was chosen secretary. The chief topic of discussion was the scope of academic work in relation to university, graduate and professional courses. It was decided that each institution should give instruction only in those fields in which it was adequately equipped to do the work well. The several institutions represented agreed to cooperate to the fullest possible extent in advancing the higher educational interests of the state.

At the meeting of the council of the University of Paris on February 24 the vice-rector presented to that body a loving cup, a gift made by the University of London to the University of Paris as a souvenir of the hospitality it received last summer. The cup is silver-gilt, repoussé and chisseled, and is nearly three feet high. The lid is surmounted by an allegorical figure, while the body of the cup bears on its outside the arms of the Universities of Paris and London, two escutcheons emblematic of the French Republic and Great Britain, and three figures symbolic of science, letters and art. The cup was designed and executed by Messrs. Ramsden and Carr.

At the Johns Hopkins University, Dr. John B. Watson has been appointed professor of experimental and comparative psychology, and Dr. Edward F. Buchner, professor of education and philosophy. Dr. Watson succeeds Professor George M. Stratton, who has been called to the University of California. He is a graduate of Furman University, S. C., and received the degree of doctor of philosophy from the University of Chicago in 1903. He has since been an instructor in that institution and now holds the position of assistant professor of experimental psychology. Dr. Buchner received his doctor's degree from Yale University in 1903, and until 1897 held a position there as lecturer and instructor. He has since been professor of analytical psychology in New York University and professor of philosophy and education in the University of Alabama.

Promotions at Columbia University, to take effect on July 1, are as follows: From instructor to adjunct professor, Dr. S. Alfred Mitchell, astronomy; Dr. Carlton C. Curtis, botany; E. L. Kurtz, mining. From adjunct professor to professor, Dr. William R. Shepherd and Dr. James T. Shotwell, history; Henry B. Mitchell, mathematics; Charles E. Lucke and Walter Rautenstrauch, mechanical engineering.

At the College of the City of New York, appointments have been made as follows: John P. Turner, of Vanderbilt University, tutor in mathematics; William S. Lord, of the University of Maine, tutor in mathematics; Dr. Robert Boyd, of the College of Physicians and Surgeons, instructor in vertebrate zoology.

SCIENCE

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FRIDAY, MARCH 20, 1908

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THE AMERICAN SOCIETY OF ZOOLOGISTS

I.

THE fifth annual meeting of the Eastern Branch of the American Society of Zoologists, and the eighteenth since its establishment as the American Morphological Society, was held at the Sheffield Scientific School of Yale University on December 26, 27 and 28, 1907.

The following officers were elected:

President—William Morton Wheeler, American Museum of Natural History.

Vice-president—Herbert S. Jennings, Johns Hopkins University.

Secretary-Treasurer—Lorande Loss Woodruff, Yale University.

Member of the Executive Committee—Gilman A. Drew, University of Maine.

Eight investigators were elected to membership, making the total membership of the Eastern Branch 143.

The society voted to contribute 100 francs to the Lamarck Memorial Fund.

The following papers were presented:

Some Stages in the Life History of Hæmogregarina stephanowi, Danilewskya, of Turtle's Blood: C. W. HAHN.

This hæmosporidian was discovered by Danilewsky in 1885. Through the work of Saccharoff, Labbe, Langman, Simond, Börner, Siegel, Brumt and DuCloux we know that it is closely related to *Lankestrella minima* of the frog, which has been the subject of more extensive research. But the results of the investigation which is here reported go to show that the structure and life history of *H. stephanowi* can not be considered a very close parallel to those of *L. minima* as described by Hintze (1902). We find a sexual generation made up of micro- and macrogametocytes with corresponding gametes, a zygote resulting from this conjugation, and a zygocyst with from 24 to 32 sporozoites, also an asexual generation arising from sporozoites and repeating itself again and again by schizogony, in which from two to twenty merozoites are produced. This cycle is completed entirely within the vertebrate host.

We have worked out a basis of relationship in the changes which the nucleus regularly undergoes after each division. It passes through about eight different structural conditions in its reconstruction, whether it be during the cleavage of the zygocyst, the schizont, or the gametocytes or in the growth of the gametocytes and schizonts. After division the nucleus is either in the form of a homogeneous dense karyosome, or it proceeds to assume this condition. A number of spaces appear in the karyosome, giving rise to a coarse network. This network becomes a fine structure with enlarged nodes, the latter becoming definite chromatin bodies. The network is in direct communication with the nuclear membrane. In the next step, both nuclear membrane and achromatic network are lost and the chromatin bodies, about sixteen in number, lie apparently free in the cytoplasm. They become dumbbell shaped and divide, giving rise to about thirty-two daughter chromatin bodies. These either diminish rapidly in size, while an achromatic matrix replaces them, or move apart in two groups and then give place to the matrix. The latter becomes the karyosome of the next cycle.

We have reason to believe there is an alternation of the sexual with the asexual generation in this animal. In several carefully studied cases, one generation is present almost to the exclusion of the other. Associated with this condition is another which lends support to the theory of alternation of generations. Schizonts, microgametocytes, and macrogametocytes which develop from merozoites that are associated with zygocysts, are markedly different in structure from these same types when they grow from merozoites that are associated with gametocytes, gamet cysts and gamets, *i. e.*, sexual stages. Moreover, the last-named merozoites are produced by schizonts incapable of dividing more than once or twice, while the first-mentioned merozoites are the progeny of very prolific schizonts. It has been convenient to distinguish the schizonts, microgametocytes and macrogametocytes of the prolific type as "primary," and the others as "secondary" individuals.

Blackhead, a Coccidial Disease of Turkeys: Leon J. Cole, Yale University, and Philip B. Hadley, Brown University.

Variation, Correlation and Growth in Paramecium: H. S. Jennings, Johns Hopkins University.

Sexual Reproduction in Amœba: M. M. Metcalf.

Effects of Alcohol on the Division-Rate of Infusoria: Lorande Loss Woodruff, Yale University.

The experiments summarized were conducted for considerable periods on two species of protozoa, *Paramecium* and *Stylonychia*, whose status in the life-cycle was known through long cultures, and on a sufficiently large number of individuals to afford reliable averages. It is believed, therefore, that the results obtained afford clear evidence of the general effect of alcohol on the division-rate and, therefore, on the metabolism of the organisms studied.

The evidence thus brought forward shows clearly that:

1. Minute doses of alcohol (1/2,500) will decrease the rate of division at one period of the life-cycle, and increase it at another period of the life-cycle.

2. When alcohol (1/2,500) increases the division-rate, the effect is not continuous, but gradually diminishes, and finally the rate of division falls below that of the control series and remains there.

3. An increase (doubling) of the amount of alcohol administered, however, will again cause a more rapid cell division for a limited period, but again this effect is not constant and the rate of division falls below the control. Up to the present time (December 26, 1907) the alcohol has been increased in amount (doubled) three times, always with the same result.

4. Treatment with alcohol lowers the resistance of the organisms to copper sulphate.

The Acclimatization of Stentor to Alcohol: J. Frank Daniel, Johns Hopkins University.

Solutions of alcohol above 4 per cent. were found to be early destructive of the protoplasm of *Stentor cœruleus*. In a strength of 1 per cent. or lower, however, the animal lived without apparent injury.

At the end of four days stentors kept in a weak solution had so adjusted themselves as to be able to live in a slightly stronger percentage; further, when killed in a strength of 6 per cent. they gave an average resistance period of twice the control value.

By rearing these ciliates in a weak solution of alcohol plus water of very great purity the factor of food may be eliminated. In such a medium they gained markedly in resistance, thus demonstrating that the lengthened period of resistance was due to the direct effect of the alcohol upon the protoplasm and not to an indirect effect upon the food conditions of the culture.

In solutions weaker than 0.4 per cent. no acclimatization was indicated until after the second day. Those kept in a constant strength of either 0.5 per cent. or 1 per cent., however, showed a clear adjustment at the end of the first day, as, for example, reared in 0.5 per cent. and tested in 6 per cent., average resistance 127 seconds, control value 99 seconds; in 1 per cent., 166 seconds, with a control of 120 seconds. In all cases there was a noticeable increase on either the fourth or the fifth day which marked the maximum of resistance for the series. Following this maximum there was a gradual decline, the cause for which is, as yet, undetermined.

Inheritance in Protozoa: H. S. Jennings, Johns Hopkins University.

Some Maturation Stages of the Mouse Egg: J. A. Long.

E. L. Mark presented some of the conclusions reached by Mr. J. A. Long—a student in Harvard University—especially as to the number of chromosomes. It was imagined a year ago that possibly the number found by Sobotta and confirmed by Kirkham (twenty-four somatic, or twelve reduced) differed from the number counted by Tafani and the author (twenty, reduced) because different breeds or strains of mice actually presented different conditions in this respect. But the courtesy of Professor Coe in loaning some of Dr. Kirkham's preparations for study has led to the belief that differences in the number of chromosomes counted is due rather to the complications of form and grouping presented by the chromosomes than to any difference in the actual number of them.

A critical study of a large number of preparations—between five hundred and a thousand—has shown that, while the chromosomes present a variety of forms at different stages, they are really—as might have been expected—(1) in the first maturation spindle tetrads, of which there are only twenty present; and (2) in the second maturation spindle dyads. Each dyad is, of course, composed of two monads, but the monads composing a dyad are often deeply constricted, each having a marked dumb-bell shape, so that the whole dyad simulates a tetrad. Since all dyads do not necessarily show this dumb-bell condition of their component monads, the counting is rendered difficult; but the recognition of the possibility of this condition is essential to a satisfactory counting of the chromosomes. These the author maintains are twenty, not twenty-four. Preparations showing the conditions described and illustrated on the blackboard were shown.

The author also is of opinion that the first polar cell gradually atrophies, and by gradual diminution in size finally disappears.

The Maturation of the Egg of the Rat: W. R. Coe, Yale University.

The eggs both of the common brown rat and its albinic variety have been studied in numerous preparations, many of which were made by Dr. W. B. Kirkham. In the formation of the polar bodies, the eggs of the rat agree closely with those of the mouse, the development of which have recently become well known by the publication during the past year of the researches of Kirkham and of Lams and Doorme. As in the case of the mouse and most other mammals which have been studied, the egg of the rat invariably forms two polar bodies, the first of which is produced in the ovary, while the second is formed in the Fallopian tube immediately after the entrance of the spermatozoon into the egg. At the time of ovulation the egg has therefore already formed its first polar body, and the second polar spindle has become fully developed. The entrance of the spermatozoon stimulates the egg cell, and the second polar body is immediately extruded. Eggs which have formed the first polar body, but which for some reason fail to be discharged from the ovary at the time of ovulation, degenerate and eventually break up into fragments, simulating an irregular, abnormal cleavage. These degenerative changes are brought about, at least in part, by the abnormal activities of the previously formed second polar spindle.

The first polar spindle is easily distinguished from the second by the nature of the chromosomes, the former containing, as Kirkham has described for the mouse egg, tetrads which differ considerably in size, and which often split precociously into dyads, while the latter contains either dyads or the separated and often rodlike univalent chromosomes. Both spindles may show at their poles one to three or more dark granules, usually of irregular shape, which may be looked upon as centrioles.

As in the mouse, also, the second polar body can usually be distinguished from the first by the arrangement of the chromosomes. In the first polar body these chromosomes are usually scattered irregularly, while in the second polar body they are commonly fused together into a dense nuclear mass even before the complete separation of the polar body from the egg substance.

The egg of the rat, furthermore, resembles that of the mouse and differs from most other mammalian eggs in that in the vast majority of cases the first polar body has disappeared before the egg reaches the Fallopian tube. Eggs in the course of fertilization and cleavage, therefore, are usually accompanied by but a single polar body, namely, the second.

The entire substance of the spermatozoon enters the egg, the head quickly forming a typical sperm nucleus, while the tail stains intensely and occupies a position close beneath the vitelline membrane for more than half the circumference of the egg.

A Contribution Towards an Experimental Analysis of the Karyokinetic Figure: Frank R. Lillie, University of Chicago. (To be published in the proceedings of the Central Branch.)

The Accessory Chromosome of Anasa Tristis: Edmund B. Wilson, Columbia University.

Certain contradictions in the literature have led the author during the past year to make an exhaustive re-examination of the history of the accessory chromosome in *Anasa tristis,* paying particular attention to a comparison of sections, smears and material in the unfixed, unstained condition. These various methods give thoroughly consistent results, which appear with an elementary clearness that excludes all obscurity of doubt. All the essential facts in this species are as the author previously described them, and are uniformly and consistently as follows:

In *Anasa tristis* the fundamental somatic number is in the male 21 and in the female 22. During the growth period of the spermatocytes the unpaired or accessory chromosome retains the form of a condensed chromosome-nucleolus until the early prophases of the first division. It then elongates to form a longitudinally split rod, again condenses to form the eccentric chromosome of the first division, and divides equationally in this division. In the second division the grouping of the chromosomes usually changes, and an eccentric position is no longer characteristic of the odd chromosome. During the division this chromosome passes undivided to one pole, which receives eleven chromosomes, while the other pole receives ten. The spermatozoa are, therefore, of two classes, equal in number; and comparison of the male and female groups shows that the eleven-chromosome class must be female-producing, the ten-chromosome class male-producing. These results have in the meantime been independently confirmed by a number of other cytologists.

Abnormal Development of Frog Embryos as a Result of Treatment of Ova and Sperm with Roentgen Rays: J. H. McGregor, Columbia University.

Wood-frogs (*Rana sylvatica*) were taken at the breeding season when about to discharge the sexual products and exposed to moderately strong Roentgen radiations for periods varying from twenty minutes to two hours, after which each one was placed in a dish of water with a frog of the other sex. In the series of experiments were cases where both were exposed, and others where only the male or only the female was exposed. In all cases the frogs paired promptly and all the females deposited eggs.

The study of the development of the eggs yielded some interesting results, which may be stated in very general terms as follows: Where only the female was exposed, the male being normal, all the eggs developed, about 5 per cent. of them developing various abnormalities. Where the female was normal, the male only exposed; only about 5 per cent. of the eggs were fertilized and of these the majority developed various deformities during early stages. When both were exposed the result was practically the same as when the male alone was treated.

The deformities were of various types, among which may be noted bladder-like distension of cœlom, tumor-like proliferations on various parts of the body, double tails, and atrophy of certain parts of the brain. Of two larvæ which lived five weeks one had no eyes, the other only one. At the time of exposure of the frogs the eggs were probably in the first polar-body stage, the spermatozoa practically ripe. The cytological study of the material has not been completed.

The Effects of a Centrifugal Force on the Eggs of Cumingia: T. H. Morgan, Columbia University.

Rapid rotation drives the yolk to one pole of the egg, the nucleoplasm to the opposite. The polar spindle lies in the protoplasm of the middle zone of the egg, and its orientation is little affected by the centrifuging. The polar bodies may be given off at any point of the surface. The cleavage is like that of the normal egg in all respects, even when all the yolk lies in the smaller of the first two cells. This shows that the determinate type of cleavage is not affected by the distribution of the yolk, nucleoplasm or pigment, or by the stratification. In this last respect the results are different from those in the centrifuged eggs of the sea urchin, because, while in *Cumingia* the position of the nuclear spindle is not changed by the centrifuging, in the sea urchin the female pronucleus is driven into the axis of stratification. In general, a resting nucleus may be forced to the lighter pole of the cell, owing to the presence in the nucleus of nuclear sap, but the chromosomes and the spindle are more difficult to move, since they have nearly the same specific gravity as the cytoplasm. When they move they do so as a whole, which shows that the spindle figure when present is a definite structure. Embryos develop from the stratified eggs of *Cumingia,* but whether normal embryos develop for all possible distributions of the different materials of the egg has not as yet been positively determined.

Degeneration in its Relation to Classification: Charles B. Wilson.

On examining the writings of those investigators who have dealt with the group of copepods it is found that nearly every part of the copepod's body has been used by one or another as a basis of classification. There are nearly as many different schemes of classification as there are authors. Is there anything, aside from the inherent excellence of the writings themselves, which will assist us in deciding their scientific merit? Can we say that any one of the schemes is more rational and logical than the others?

In endeavoring to answer this question it seems to me that we must take into account first of all the fact that considerably more than half of the group live as parasites or semi-parasites on other animals. One of the most common results of parasitism is degeneration, in consequence of which an organ loses its function, then its size and shape, and finally may entirely disappear. No one questions for a moment the influence which development should have upon classification; any scheme which left development out of consideration would be branded at once as worthless. Why should not degeneration, which is the reversal of development, prove of equal value, especially in a group where it is so finely illustrated as in the copepods?

There are several things which strongly recommend it. It proceeds even more slowly than development, so that we are enabled to follow every step in the process, and almost never need be at a loss. In development it often happens that several new organs appear at a single moult about equally advanced, and it is very difficult to decide which are of the greatest value from a systematic point of view. The newly hatched nauplius has three pairs of appendages, the first and second antennæ and the mandibles. At the moult from the nauplius into the metanauplius we find in addition two pairs of maxillæ, often two pairs of maxillipeds, and sometimes one or more pairs of swimming legs. To which of the three nauplius appendages should preference be given, and if the mouth-parts be chosen as a basis of classification which of them possesses the greater value?

Degeneration quietly eliminates these appendages one by one; why may not its testimony be taken when the case is so difficult of decision otherwise?

Again development requires that we obtain the eggs and rear the young through successive stages; any one who has tried this on the copepods realizes how very difficult it is. And even when accomplished, many of the conditions are of necessity abnormal, and in consequence might produce abnormal results.

Degeneration, on the other hand, is produced upon the adults in their native habitat and surrounded by their usual conditions. We can obtain and study the results with comparative ease; we are not obliged to reproduce any of the conditions.

Degeneration thus determines in the copepods which of the appendages are the most stable and the least susceptible to change; it selects the first antennæ from among the nauplius appendages and of the mouth-parts the mandibles as the most stable and the first maxillæ as the least so. Consequently that classification is the best which is the most fully based on these stable elements. We find such an one originally proposed by Thorell in 1861, corrected by Claus in 1862, by Gerstaecker in 1881, and finally by Canu in 1892.

Wound-reparation and Polarity in Tentacles of Actinians: Herbert W. Rand, Harvard University.

At the Bermuda Biological Station for Research, in the summer of 1907, I studied the reactions resulting from cutting the tentacles of certain large actinians (*Condylactis* and *Aiptasia*). If a piece of tentacle is removed by a transverse cut, within a few minutes the open cut end of the stump is closed by a concentric inbending of the wall of the tentacle. The newly closed end is hemispherical except for the presence of a small cylindrical nipple-like projection at its center. This closure is effected by contraction of the circular muscle fibers. The "nipple" results from extreme contraction of the circular fibers immediately proximad of the plane of cutting. Within a day or two after the cutting there ensues a rearrangement of the elements of the tissues in the vicinity of the cut, whereby results a permanent closure which is not dependent upon muscular contraction. Thus, the reparation of the wound exhibits two phases. A temporary repair is effected by active muscular contraction pending the slower reorganization of the tissues by which the muscular tension at the cut end is relieved and a permanent repair established.

The closing of a distal cut end and the formation of a "nipple" in the manner described above take place in a tentacle after it has been severed from the column. This fact can not be interpreted as indicating autonomy of fragments of the organism. The piece of tentacle is a fragment of the actinian, but it is not a fragment of the actinian organization because in it are embodied the essential features of the entire organization.

When an excised tentacle is cut transversely into several pieces, each piece shows a definite polarity in that its two ends assume distinctly different forms. Thus, in any transverse zone of the tentacle two modes of response to transverse cutting are potentially present. In the event of transection either one or the other mode of behavior will be exhibited, depending upon whether that zone comes to lie at a proximal or a distal cut end. No structural basis for this polarity has been found.

An Experimental Study of the Rate of Regeneration in Cassiopea xamachana: Chas. R. Stockard, Cornell Medical School.

When a peripheral ring of tissue is removed from the disc of *Cassiopea* the cut surface promptly begins to regenerate a new rim. The nearer the cut is made to the center of the medusa-disc, up to a certain limit, the faster will the resulting regeneration take place.

Regeneration from variously shaped cut surfaces proceeds in exactly the same manner as has been described in experiments on the fins of fishes. Thus the same principles of regeneration seem to apply to the formation of new tissue from appendages and the true body surface of animals. Further, a common principle or law regulating the rates of regeneration may probably run through the animal kingdom, since forms at almost opposite ends of the series, the fish and medusa, regenerate in a similar manner.

A bias-cut strip of the entire periphery of the medusa-disc and the remaining central portion gives a preparation in which the influences due to the level of the cut may be contrasted with those due to degree of injury. Influences due to the level are alone indicated by the ensuing growth. Regeneration in either direction, towards the periphery or towards the disc-center, proceeds at approximately the same rate from the same level.

Ring preparations made from these medusæ are splendid objects for the study of the influences due to functional activity. Portions of the ring which are entirely at rest throughout the experiments regenerate tissue at the same rate as other parts which pulsate normally. Functional activity shows no influence over the rate of regeneration in this form.

Medusæ having one or more of their eight oral-arms removed regenerate these arms at irregular rates which are not closely associated with the degree of injury. Medusæ injured to the same degree often show greater variations in their specific rates of regeneration than are found among individuals injured to different degrees. A medusa with several of its oral-arms cut away in a similar manner may regenerate the individual arms at rates differing as much as do the average rates shown among many medusæ injured to various degrees.

The influences of changed physical conditions on the rate of regeneration were tested, as well as the effects due to excesses of Na, K, Ca and Mg in the sea-water.

Regeneration of Peripheral Nerves: Ross G. Harrison, Yale University.

The nerves of one side of the tail of larvæ of *Rana sylvatica,* 2–2.5 cm. long, were cut with fine scissors just beyond the point of emergence from between the myotomes. The processes of degeneration and regeneration were then observed from day to day in one and the same nerve in the living specimen. The degenerative processes take place very rapidly. In less than twenty-four hours the medullary sheath is completely disintegrated beyond the lesion and for a very short distance central to it. In the axis-cylinder of both the medullated and the non-medullated nerves the signs of degeneration are less marked, though unmistakable, and are noticeable in even the finest and most remote twigs. The Schwann cells become less regularly spindle shaped, with a somewhat humpy surface, and do not adhere so closely to the axis-cylinder. They are also found to contain a few granules. After one or two days it is found that the two cut ends of many of the nerves have united together by a protoplasmic bridge, and in such cases the degeneration of the peripheral part of the axis-cylinder is immediately arrested, indicating that in these larvæ a primary healing of nerve fibers is possible. The medullary sheath is not rehabilitated immediately and the process of re-formation of this structure resembles that of its initial development. When the peripheral portion of a nerve fails to unite with a central stump, degeneration continues and ultimately the nerve disappears, the finer twigs disintegrating first. When a central stump fails to unite with a peripheral end, regeneration by a comparatively slow process, in a centrifugal direction, takes place. There is no indication whatever of any power of "auto-regeneration" in the nerves whose connection with the central end remains severed.

Some Singular Cases of Regeneration and Increase in a Deep-sea Coral by Agamic Endogenesis: Addison E. Verrill, Yale University.

The paper considered a cornucopia-shaped simple deep-sea coral, dredged by the U. S. Fish Commission in 57 to 179 fathoms, off the eastern coast of the United States. It was first described by Pourtales as *Parasmilia Lymani* (now *Dasmosmilia*). The walls of this coral are extremely thin and fragile, while the radial septa are strong. Therefore, when injured, it easily splits lengthwise into wedge-shaped fragments. Entire adult specimens are rarely taken. The larger fishes and crabs, living in deep water, are responsible for the breakages. Each fragment, even when very small, has the power to produce one or more buds on its inner surface, from the tissues covering the septa. If a single bud starts near the distal edge of a large fragment, it ultimately grows in such a way as to blend on the outer side with the wall and septa of the fragment, so as to appear, sometimes, like a mere repair of damages, with regulation of parts. But when the bud starts farther from the edge of the fragment, it may grow up vertically from it, later using it only as an object for its basal attachment. Several buds, sometimes as many as 6 to 8, may arise from the inner surface of a large fragment, growing up vertically or obliquely. If several buds start close together, they soon come in contact at their edges, as they grow larger, and graft themselves together, thus giving rise to bilobed or trilobed calicles in the mature corals, but when the buds stand singly, the calicles are circular. About one hundred specimens were studied, and of these there were very few that did not originate as buds, showing the fragment of the parent calicle still attached to the base.

In this coral there is, therefore, a gradual transition from the mere repair of an injury to the border of the calicle (or regeneration of parts) to complete and perfect buds. These various forms were illustrated by lantern slides.

Some Results of a Biometrical Study of Egg Production in the Domestic Fowl: Raymond Pearl and F. M. Surface.

This study is based on the statistics of egg production which have accumulated during the past ten years at the Maine Agricultural Experiment Station. During this period an exact trap nest record has been kept of the entire egg production of all laying birds during their pullet year. These records are of unique value in the analysis of the general problem of fecundity, since they furnish data on a single isolated factor—ovulation. The data here discussed are from a single breed of fowls, Barred Plymouth Rocks. They are based on returns from several thousand hens. It is hoped that a detailed account of the results will be published shortly.

Variation in Annual Egg Production.—If frequency distributions of individual variation in total annual egg production be made, they are found: (1) to be unimodal; (2) to exhibit negative skewness in all but a few cases. In these cases the variation curve is symmetrical; (3) to conform to Pearson's Type I curve when unsymmetrical, and to his Type II curve when symmetrical: (4) to exhibit a high relative degree of variation (coefficient of variation = 35 per cent. ca.).

Comparative Distribution of Birds and of Eggs produced.—In consequence of the skewness of the variation curves it results that 50 per cent. of the total number of birds produce from 60 to 76 per cent. of the total number of eggs. This is of practical consequence in breeding, since it means that a random sample of eggs will not represent a random sample of the birds which produced them, but instead will include an unduly large proportion of heavy layers.

Monthly Distribution of Egg Production.—The maximum mean egg production is in March or April. Secondary maxima occur in January, June and September. These maxima are entirely independent of the total egg production, appearing in the records of the lowest as well as the highest egg producers. If the difference between the heaviest and lightest layers in respect to the mean egg production for each month in the year be taken, it is found to be smallest in March, April and May, largest in the late summer and early autumn months. The individual variation in egg production (measured either by standard deviation or coefficient of variation) is greatest in those months when the mean production is least, and *vice versa.* There is no sensible correlation between the egg production in the pullet year and that in the second laying year.

Some Effects of Differences of Temperature and Humidity upon the Post-natal Development of the Mouse: F. B. Sumner.

White mice which were transferred at the age of two to four days to two rooms having mean temperatures of about 45° and 75° F. respectively (the relative humidity being about twice as great in the former as in the latter) were found to exhibit great differences in tail length when measured at the age of 42 days. Although the mean weight of those kept in the warm room (51 individuals) was less than 6/10 gm. greater than that of the cold room lot (44 individuals), the mean tail length was 69.3 mm. in one case, and 52 mm. in the other, *i. e.*, there was a difference of over 33 per cent. Moreover, the shortest tail in the warm-room lot was longer than the longest tail in the cold-room lot.

In a previous experiment, in the course of which 20 mice in each lot were subjected to conditions similar to those stated above for a period of from 83 to 106 days, commencing with the fourth week after birth, the difference in tail length was 7.1 mm., or 11 per cent. of the tail length of the cold-room lot. On the other hand, the mean weight and the mean body length (distance from snout to anus) in the two lots was almost identical. In this experiment, the males of the cold-room series (13 individuals) were found to have an average of 305 hairs in a given unit of skin surface (2 disks, each 1.5 mm. in diameter), while those of the warm-room lot had, on the average, 267 hairs in the same area of skin. The variability in each case was so great, however, and the number of individuals so small, that these figures may have no significance. More accurate measurements, based on a far greater number of individuals, are to be made in the near future.

Such an adaptive response as an increase in the density of the coat of hair, following a transfer to a colder environment, is popularly believed to occur in nature. On the other hand, an abridgment in tail length, as a result of cold, has been reported in the case of cats. Whether or not such somatic changes are inherited, or better, whether similar changes reappear in the offspring, is a subject under investigation by the author.

Physical Identity in Duplicate Twins: H. H. Wilder, Smith College.

Introduction.—Review of the morphology of the epidermic patterns in man, as brought out by the work of previous years, chiefly that of Inez Whipple [Wilder]. In the foot of a typical pentadactylous mammal there are eleven walking pads, surrounded by folds of skin, arranged in such a manner that the pads are embraced by the prolongations of two, three or four triradii. This formation, which is a high relief in walking mammals, becomes reduced to an approximately plane surface in primates, *i. e.*, a picture of the former relief. This loss of functional significance has, however, resulted in a more or less complete reduction of the individual features, and thus the patterns assumed by the epidermic ridges in man represent various degrees of reduction of the fundamental plan and are individually extremely variable. They also normally show little tendency to a bilateral symmetry, so that the patterns on the two hands or the two feet of a given individual are usually quite different.

Exhibition of the Prints of a Set of Twins.—[Set No. XX. of the author's collection.] These are the prints of two small boys in Portland, Me., Henry and Bernard. They are first of all remarkable in that the hands show the eleven typical patterns complete, a case so rare that it does not occur otherwise in a collection of the palm prints of about 450 individuals, including very varied human races. Aside from a striking resemblance between the four sets of members the prints show the characteristics which are usually to be noted in cases of true duplicates, viz:

(*a*) Bilaterality, so that all four palms have virtually the same pattern. The same is true of the soles.

(*b*) A remarkable reversal of the apical or finger-pattern of the index finger. The right pattern of one is an ulnar loop, while that of the other is radial; on the left hand the pattern of the first is radial while that of the other is ulnar. This condition, while not always found in twins which seem to be duplicate, has been observed in one side at least in more than half of the cases.

Conclusions.—The practical impossibility of finding so close a correspondence in any two children normally related, together with the other conditions noted, lead to the inevitable conclusion that in such twins we have a condition from the germ on that is unlike that which obtains in normal individuals. If we accept the most probable theory to account for the origin of such twins, viz., their origin from a single egg, it then follows that the general form of the epidermic patterns is predetermined in the germ immediately after fertilization, in short that in duplicate twins nature tries for us the important experiment of making two individuals out of the same germ-plasm and that the study of their palm and sole markings shows better than any other known features how great is the resemblance. Since, by a comparison of the prints, it may be seen that the resemblance is confined to the general patterns while there is no especial resemblance in the individual ridges (Galton's "minutiæ") we arrive at what may be called the limit of germinal control, *i. e.,* the point where the directive force felt in the development ceases to act, leaving further details to other forces.

Heredity in Epidermic Markings of Palms and Soles ("Friction-skin").—In a set of sole prints of a family, including three generations, the inheritance of a definite configuration over certain definite areas was followed by means of distinctive colors. In these prints a marked degree of hereditary influence was shown, especially in the inheritance of a "calcar pattern," one of the rarest features in the human foot.

The Four Inseparable Factors of Evolution, Theory of their Distinct and Combined Action in the Transformation of the Titanotheres, an Extinct Family of Hoofed Animals in the Order Perissodactyla: Henry Fairfield Osborn, Columbia University. (Published in full in Science, January 24, 1908.)

When do Variations attain Selection Value?: Bashford Dean, Columbia University.

One of the major criticisms of Darwinian natural selection showed that small fluctuating variations were not of actual value in the struggle for survival: accordingly, they would not be expected to accumulate in the direction of pronounced utility. And it is notably this criticism which lies at the base of various neo-Darwinian explanations. In the present contribution stress is laid upon the fact that variations may attain selection value without an accumulation of small and less useful stages. The stages in such cases occur, it is true, *i. e.,* as small fluctuating variations, rarely appearing suddenly, but they are meaningless in terms of selection.

This point of view was explained by a series of analogies, in which there was no ground to question the non-utility of the stages of cumulation. For the end result itself, although as highly complex as many of those which are granted selection value, could have had no significance in the struggle for survival.

Numerous analogies of this kind were cited: resemblances to human face in the pupæ of *Feniseca tarquineus* and of *Sphalgis s-signata,* on back of death's head moths, in Taira crab, on "ear bone" of whale, in seed-capsule of *Antirrhinum:* resemblances of tree hoppers to birds, of desiccation lines on seeds to ideographs, of the supraoccipital of an Indian goat to the face of *Entellus,* of the rabbit's sphenoid to a fox's head.

If such remarkably complicated resemblances could be attained by non-useful variations, it follows that some, if not many cases whose value has been debated (protective coloration, mimicry) may have had a similar accidental and meaningless origin.

Inheritance in Canaries: C. B. Davenport, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

Crest is a typical Mendelian dominant over plain head. Plain-headed canaries do not throw crests; and among crested birds of the second or later hybrid generation some may be obtained that produce only crested offspring. Baldness is a typical recessive to full head feathering. In the plumage color the yellow form is derived from the ancestral "green" canary by a dropping out of black pigment. The yellow canary carries, however, a mottling factor, so that in F_1 the green $\times$ yellow gives offspring that are yellow mottled with black, forming "green" patches of variable extent. The behavior of the plumage color in subsequent generations supports the view that the gametic formula of the "green" canary is: *Nm* [*i. e.,* black (nigrum) pigment present, mottling absent] and that of the yellow canary is *nM* [*i. e.,* black pigment absent; mottling factor present]. Hybrids between the goldfinch and canary show, in the same way, the presence of the mottling factor; but the dark patches are usually extensive. The "reversionary" character of the hybrid is due to the original pattern of the wild canary that lies latent—because of lack of pigment, in the yellow canary.

The Sense of Taste in Fishes: G. H. Parker, Harvard University.

In the common horn pout (*Amiurius nebulosus*) taste buds occur not only in the mouth and on the barbules but also over almost the whole external surface. Those on the exterior of the fish are innervated by branches of the seventh nerve. Horn-pouts will snap at a bait when it is presented to the flank of the body as well as when it is close to the mouth. The exterior of the body is also sensitive to sour, saline, and alkaline solutions, the head being more sensitive to these solutions than the trunk. In horn-pouts in which the branch of the seventh nerve distributed to the skin of the trunk has been cut, thus rendering inoperative the taste buds of the trunk, there is no longer a response to bait brought near the trunk, though the same bait is greedily taken when presented to the mouth. Such animals, however, retain their full sensitiveness to sour, saline, and alkaline solutions when applied to the skin of the trunk. That the loss of response to a bait when presented to the flank of a horn-pout after the severance of the seventh nerve is not due to shock is shown by the fact that this sensitiveness is retained by fishes in which the large lateral-line branch of the tenth nerve has been cut. After cutting the lateral branches of both the seventh and tenth nerves the only sensory nerves left intact on the flanks of the body are the branches from the spinal nerves. Since fishes in this condition respond to sour, saline and alkaline solutions, it follows that these solutions must stimulate the terminals of the spinal nerves and that these nerves must be regarded, therefore, as chemical in function, though they are not primarily concerned in the response to bait. In horn-pouts the posterior half of whose spinal cord has been destroyed but whose seventh nerve is intact, there is no response when sour, saline, and alkaline solutions, and bait are applied to the flanks near the tail. The absence of response to bait in this experiment is due, I believe, to the loss of the motor mechanism of the cord whereby the fish turns to snap at the bait and not to the loss of the spinal sensory fibers. The loss of these fibers would account for the absence of response to sour, saline and alkaline solutions. From these experiments it is to be concluded that the sense of taste in horn-pouts is complex and involves not only the seventh nerve, but also the spinal nerves.

The Organ of Claus in the Copepod Eucalanus elongatus Dana: C. O. Esterly.

E. L. Mark gave an account of some of the principal points regarding "The Organ of Claus in the Copepod *Eucalanus elongatus* Dana" which have been discovered by Dr. C. O. Esterly. There is a pair of these organs, and they are imbedded in the front part of the brain near its ventral surface. Claus, who discovered the organs in *E. attenuatus* Dana, thought they were otocysts. Esterly shows that they are not vesicular, but are solid, each composed of two cells, and that their histological conditions are so nearly identical with those of the median eye, composed of three ocelli, that they must be regarded as organs of vision rather than of audition. The retinal cells of the median eye and of these organs both present peculiar basal plates, and the cytoplasm of the cells shows a marked but fine striation, which Hesse has erroneously regarded as homologous with the "Stiftchensaum" which he discovered in the eyes of many invertebrates. Esterly regards this striation as the expression of a structural condition due to the secretive activity of the retinal cells in producing the basal plates. The "Binnenkörperchen" of Hesse, or phaosomes, are present in the organ of Claus as well as in the ocelli, and are thought to be of importance in light reception.

There are ten retinal cells in the ventral ocellus, and nine in each of the lateral ocelli composing the median eye. From the basal-plate end of each cell emerges a single nerve fiber, these twenty-eight nerve fibers constituting the single optic nerve of the median eye. Two nerves emerge from each organ of Claus, one from that surface of each retinal cell which is opposite its basal plate. In this particular the organ of Claus differs from the ocelli, the former being eyes of the inverted type, whereas the ocelli are—contrary to the opinion of Hesse—not inverted. The neurofibrillæ appear to end in the retinal cells in beaded fibers having terminal club-shaped enlargements, which often have an intimate relation to the phaosomes. This suggests a possible functional relation between the two.

Six plates of original drawings by the author and reproductions of them by the photogravure process (A. W. Elson & Co.), together with some of the preparations, were exhibited.

The Luminous Organ of a New Species of Anomalops: Ulric Dahlgren, Princeton University.

The fish was taken by the writer in moderately deep water off the north coast of Jamaica, B. W. I., in March of last year. It will be described and named by Mr. C. F. Silvester, of the Princeton museum.

The fish shows several whitish spots on parts of the body and these spots may have a luminous function. This could not be determined.

The main luminous organ consists of two large "photophores" placed one under each eye. The photophore lies close to the eyeball and may be said to be a part of the under lid. When first seen it gives the impression of being a foreign substance in the eye and the native fisherman would not believe that it was not a worm. The length of the organ was about the diameter of the eye and it was oval in form. Its color was cream white and the presence of a large blood supply directly on the surface was noticeable in the form of a reticulum of red lines on what was apparently the outer surface.

The entire organ was somewhat loosely fixed and could be rotated laterally down under an edge of integument so as to be almost entirely concealed. The part under which it slipped had a thickened edge and could be regarded as a means of suddenly shutting off the light when it was necessary not to show it.

The structure of the organ can be very well made out in a single section taken transversely to the long axis of the animal's body and therefore to the longer axis of the photophore. This shows that the largest mass of the organ consists of a close set and parallel set of simple tubular glands reaching from the outer to the inner surface of the structure. These glands are lined by a single layer of cubical cells whose distal ends terminate in an indefinite boundary between the substance of the cell and the mass of secretion that fills the lumen of the tubule.

But the secretion mass is not discharged into the water from these tubules. They open into a flat cavity, with enclosed sides, of the single (?) original invagination by which the gland was formed (presuming on the unknown embryology), and it is this thin outer layer of integument that contains the heavy blood supply.

Another system of capillaries is found between the tubules, and is evidently designed to bring a supply of food material within reach of the secreting cells, which are very active as measured by the amount of highly specialized product they secrete. The operation of the organ would appear to be as follows:

The secreting cells discharge the elaborated material (which is a "leuciferase") into the lumen of the tubular gland, which carries it up and passes it out into the outer flat spaces in contact with the inner side of the external integument. Here it is used, being consumed by the oxygen that is brought to it in the heavy blood supply of this integument. Its waste products of combustion must also be carried away by this blood and are probably extracted by the kidneys, along with the waste matter from the other body tissues.

Since the whole structure was probably derived from the stratified epithelium of the outer body surface, the secreting epithelium must be looked upon as the specialized basal layer of this invaginated region.

The whole gland lies on a layer of connective tissue which is modified to reflect light. This reflector is very efficient and when a mounted section is laid on a piece of black velvet, it alone shines out as a white line. Still outside of the reflector is found a layer of intensly black pigment. At its upper edge, this is useful in protecting the eye from the organ's light.

The thickened edge of the lower "lid" consists of an integument covering a mass of cells which appear to be nerve cells. This is probably some ganglion which is used to control the production of light.

The Poison Glands of Bufo agua: C. L. BRISTOL and G. W. BARTELMEZ.

The material was collected in Bermuda at the New York University Biological Station, the original habitat being South America. This toad has had the reputation of being poisonous to mammals, and we finally verified instances of poisoning. The poison acts only on a mucous membrane, and produces results similar to curari.

The poison glands are found only on the upper surface of the body, while mucus glands are found all over the skin, and are crowded together in large parotoid "glands" behind each ear. They are much larger than the mucus glands and extend deep down into the compact corium layer. They are surrounded by a thin layer of loose connective tissue which contains nerve fibers and a dense network of capillaries. There is an almost continuous layer of smooth muscle fibers about the gland. The cells of the glandular epithelium develop to an enormous size, and when they mature they disintegrate, their entire plasm becoming the secretion, so that when a poison gland has reached its full development it is simply a reservoir of poison. When the poison is discharged the remains of the gland are resorbed, and at the same time one of the five or six undeveloped glands, grouped around the mouth of the functioning gland grows down alongside the remains of the discharged gland, pushing it aside to occupy its former place.

(To be concluded)

EXTRACTS FROM A REPORT PRESENTED TO THE CORPORATION OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY BY ARTHUR A. NOYES, ACTING-PRESIDENT

FACULTY ORGANIZATION

The faculty has during the past year perfected its organization and has made provision for carrying on more effectively its administrative functions by the creation of the office of chairman and by the appointment of new committees on faculty business, on faculty rules, and on the courses of instruction. Our faculty, like that of many other educational institutions, has now become so large that it can not properly deal with the details of administration; but instead of establishing a single administrative board consisting of a small number of its representatives, it has gradually developed the more democratic, and, we believe, the more effective, plan of placing its numerous and varied functions under the charge of about twenty-five standing committees, which are empowered to take final action upon all special and individual cases that arise, and are expected to take the initiative in submitting to the faculty for its approval any important changes of policy or procedure that seem desirable. I would especially call your attention to the resolution in which the faculty "expresses its appreciation of the desirability of some form of advisory relation between the corporation and the faculty, and its readiness to cooperate with the corporation in the preparation of a plan for establishing such a relation."

DEVELOPMENTS IN THE WORK OF INSTRUCTION

The curricula of all the strictly engineering courses have been modified during the past two years by the omission, wholly or in part, of the second-year work in modern languages; and the time gained has been utilized to increase the amount of instruction in English and history, and to give a more thorough drill in fundamental engineering subjects, especially in applied mechanics, structures and steam engineering. It is felt that few engineers make practical use of their knowledge of modern languages, and that the general and scientific studies that have been substituted are not only more directly useful, but either have a higher cultural value or provide a better mental training.

Important progress in the development of our advanced work has been made by greatly extending and systematizing the subjects of instruction offered to candidates in fifth-year courses leading to the degree of master of science. Almost every department has announced, and is prepared to offer in the next school-year, advanced courses of a somewhat more specialized character than can be given to undergraduate students. Thus in civil engineering, further work in the design of structures (particularly those of reenforced concrete), of railroads and of hydraulic works, is offered; in mechanical engineering, further study of turbine and gas engines and of machine design is provided for; in architecture, advanced courses in the various branches of architectural design are announced; and similarly in all other departments advanced work has been arranged for. The broad significance of this form of development and its bearing on the character of our undergraduate courses I shall speak of later.

A special inducement to pursue such advanced work has been offered to graduates from other colleges by a recent vote of the faculty, which permits them to enter at once upon a course leading to the degree of master of science without previously taking our bachelor's degree. This course will, in general, extend over a period of two or three years, varying according to the previous preparation of the college student.

There are, however, no developments of any kind which are so important as those which tend to increase the effectiveness of our undergraduate instruction in meeting the needs of the individual student. I am glad to be able to tell you that this year an important step in this direction has been taken by the initiation of a plan of individual conferences between the instructor and students in certain first-year subjects. Owing to the inadequacy of the funds available for the purpose—for it involves additional instructors of first-rate ability—it has been possible this year to put this plan in force only to a limited extent in the subjects of English and mathematics. It is, we believe, of great importance that this plan be largely extended as rapidly as our facilities admit; for it is undoubtedly true that many of the students who now fail to reach our standards could overcome their difficulties if they could receive more help in learning how to study and more personal encouragement and stimulation. The conference plan also develops an attitude of cordiality and mutual helpfulness both in the instructing staff and the student body which is the essence of a healthy college spirit.

The instruction in the department of mathematics is undergoing a somewhat radical revision, in which the old divisions into advanced algebra, analytic geometry, differential and integral calculus are in large measure obliterated, and the whole subject is presented, irrespective of this traditional grouping, in a manner most economical and advantageous for the student, and with the help of a large number of concrete applications.

THE EDUCATIONAL FIELD OF THE INSTITUTE

It is well, I believe, for the corporation to take under consideration from time to time those fundamental principles which express the main purposes for which the institute exists and which should determine the educational field which it is to occupy and the directions in which it is to be developed. In this belief, I present my views for your consideration.

Its Function as an Undergraduate School

First of all, I believe that it should be clearly recognized that one of its main functions, as an independent scientific school, is to educate for the scientific and engineering professions young men who have previously received only a high-school education. It must remain in large measure a school for undergraduates, and must not allow itself through the influence of the policies of universities to become only a graduate school for the professional training of the former students of other colleges. The question here at issue is not which is more advantageous—a professional training preceded by a liberal education of an elective character or a coordination of the two in a single prescribed course—but whether or not there is a large field for education of the latter type. Some may prefer to drive tandem, with a loose rein upon the leader, and some to drive abreast; but none wishes his freedom of choice restricted. By the establishment in this community of the Graduate School of Applied Science at Harvard University, and by a similar development at other universities throughout the country, ample provision will doubtless be made, as fast as the demand arises, for the engineering education of college graduates. It should be, on the other hand, the especial care of the institute to maintain and develop that combination of liberal and professional training for undergraduate students, for which it has stood from its foundation. If ever the demand for this type of education should cease, or if ever it be demonstrated that this type when properly developed produces only engineers and scientists of an inferior grade, then, and not till then, will it be time to consider the conversion of the institute into a purely graduate school. To abandon at this stage the educational experiment which the institute is making, instead of coping with the difficulties in its problem which have become apparent, would be a betrayal of the trust which its past imposes and a severe blow to the educational development of this country. There is as yet no indication that the sources that have directly fed the streams which are inundating our technological schools are drying up, nor is there as yet any adequate experience which warrants us in diverting those streams into a different channel. It is certainly desirable that there be developed the new type of engineering education, in which cultural subjects are given as collegiate courses and the professional training in a graduate school; but this is not *our* field of educational service. Such a development is to be welcomed, in part because it is a stimulus to us to study the conditions for making our own type of education more effective. We must therefore not allow our attack upon the problems of undergraduate education to be weakened by theories as to the tendencies of professional education under university conditions, nor by inconclusive comparisons between the results attained in graduate schools of law and medicine and those that may be expected in similar schools of applied science.

The second principle which I desire to emphasize is that already indicated by my preceding words, namely, that, as an independent undergraduate school, the educational problem of the institute is necessarily of a twofold character: we have to develop a plan of education which is adapted to produce not only well-trained engineers, but also broad-minded, high-purposed men. We must aim to make the work of the students at the institute and the conditions of their life outside such as lead to a duly proportioned development in these two directions.

It is sometimes said, however, that in attempting to solve this twofold problem in a four-year undergraduate course, the institute is undertaking a hopeless task. This contention I would meet by the statement, that, whether or not it be hopeless to give a fully adequate education upon these two sides within the period of four years, it is our present problem to do this in as large a measure as is possible; for to further increase this minimum period of study would close the doors of the institutions of technological education to a large number of young men whose financial resources are already taxed to the utmost. Moreover, the careers of institute graduates warrant the conclusion that the results attained in the past are as a whole satisfactory; and when the many possibilities of further development in our educational work and the conditions of student life are considered, the future outlook for a fuller success of the four-year course is a bright one. Before conceding the necessity of an extension of this period of study, we must at least consider the possibility of utilizing in part the intermediate summer vacations, which now cover no less than one third of the whole year: but to this matter I shall return later.

Specialization in a Fifth Year

The general principle which should determine the character of our four-year course of study—a principle fully recognized by our faculty—is that a liberal education be provided such as will develop character, breadth of view, and high ideals of service, and that professional education be mainly confined to a thorough training in the principles of the fundamental sciences and in scientific method, specific engineering subjects being included only so far as the remaining time permits and as the minimum requirements of professional practise demand. It should be our aim not to turn out a specialist at the end of a four-year curriculum, but rather to provide for specialization in a fifth-year graduate course. By courageously eliminating from our fourth-year curriculum the more technical branches of instruction, however important they may be for the practising engineer, and by making more ample provision for them as subjects to be pursued in graduate courses, we shall, on the one hand, be enabled to make our undergraduate course more educational in the broadest sense, and, on the other hand, to make more evident to the student the practical importance of returning for a fifth year to acquire the more specialized knowledge of the separate engineering professions. This, then, is the direction in which, in my judgment, the courses of study at the institute should be developed: we will give in our four-year undergraduate course an even broader and deeper training than at present in cultural and fundamental scientific studies—a training which will still enable those students that are obliged to do so to enter at once upon the practise of their professions, handicapped somewhat, it may be, by the lack of technical experience, but with a sound knowledge of principles and a developed mental power which will gradually enable them to overcome this disadvantage; and, on the other hand, we will develop graduate courses of such a character as will obviously remedy this deficiency of insufficient specialization and will attract such graduates of this institution and of other scientific schools as are financially able to continue their education. We shall thus create a type of graduate school in which is offered advanced training for bachelors of science rather than for bachelors of arts.

Opportunities for College Graduates

But these are by no means the only fields which the institute should occupy. Some of the other directions in which our development must be continued or extended also deserve consideration.

We must, while not permitting any sacrifice of the instruction of our undergraduate students, encourage the graduates of colleges to enter the higher years of our regular courses and our advanced courses, and offer them such additional facilities as their different preparation demands. Future experience alone can determine whether such graduates will receive a better education in the graduate schools of universities in courses attended, often not only by themselves, but by college men without definite professional aim, or in scientific schools working side by side in the undergraduate courses with men earnestly devoted to preparation for their profession. The presence together of these two groups of men is certainly mutually advantageous: the graduate student from another institution tends to broaden the interests of his undergraduate associate; and the latter imbues the former with that spirit of hard work and seriousness of purpose which attendance at the scientific school has inspired. For these reasons we must not fail to provide suitable courses and conditions of work for the college graduates who are coming to us in constantly increasing numbers.

Five-year Courses for the Bachelors Degree

Far more important, however, than the offering of increased opportunities for college students, is a more ample provision within this institution itself for the education of such students coming directly from the preparatory schools as are able to devote more than four years to general and fundamental studies. In emphasizing the importance of maintaining our undergraduate four-year course I should be sorry to give the impression that that period is considered a fully adequate one. On the contrary, I believe the institute should at once meet the demand for a broader education of its students by a development of a three-year course in general science, which shall contain, partly as required work, and partly as electives, all or nearly all those subjects of instruction now included in the first two years of the various courses of the institute, so that the latter may be completed in two years more by students who have finished the three-year science course. This plan would enable three years instead of two to be devoted to the humanistic branches of study, to the nature sciences, and to the fundamental physical sciences. It would in large measure provide the breadth of scholarship which the college course is designed to supply, and would do this by the methods and in the atmosphere of the scientific school. Owing to the facts that a long list of electives in general studies is already offered to our third-year students, and that many of the scientific subjects that would naturally be included are already given by one or other of our science departments, this course in general science could be arranged for at comparatively small additional expense. It would be desirable, however, that one new professor be appointed, who might offer courses in philosophy, psychology and logic.

ADVANCED STUDY AND RESEARCH

Development is also of the greatest importance in the direction of larger opportunities and inducements for research work and advanced studies in the pure and applied sciences which form the basis of our curriculum. An institution of learning which does not contribute through the researches of its instructing staff and graduate students to the advancement of science can not secure the highest grade of teachers, can not keep its courses of instruction upon the plane of broad and deep scholarship, and can not retain its educational prestige. I have already spoken of one kind of advanced course which we are already developing—one which would provide the more specialized instruction in engineering subjects which industrial advances are making more and more imperative. Such a course, which hardly needs to be of more than one year's duration, leads to the degree of master of science. There is, however, a second kind of advanced course which is even more essential to the development of the highest type of scientist or engineer. This is a course in which the student, while pursuing more advanced studies in the underlying sciences, devotes himself mainly to the original investigation of problems in pure or applied science. It is investigation work of this sort which tends to develop the creative power of the man and his ability to handle new problems relating to the improvement of industrial processes and engineering methods. Such a course, when of two or three years' duration, may lead to the degree of doctor of philosophy or doctor of engineering. The institute has already made encouraging progress in this direction; but the number of students engaged in such work has thus far been small.

REDUCED TUITION AND ADDITIONAL SCHOLARSHIP AID

Next in importance to this matter of making provision for our immediate needs and future development comes the question of reduced tuition fees or increased scholarship aid. The high cost of the kind of instruction furnished by the institute made it seem necessary a few years ago to increase our tuition fee to $250. This increase will, I earnestly hope, be regarded as only a temporary expedient for which a remedy must be found at the earliest moment. The present high tuition not only is shutting out a large group of promising young men from the advantages of a scientific and engineering education, but is imposing upon another large group a financial burden which they are scarcely able to bear, and which forces them to live and to work under conditions unfavorable to their health and social development. Any of the administrative officers of the institute could recount numerous instances where men have been obliged to withdraw from the institute because they could not raise the last fifty dollars of their tuition, or where they have been living on thirty or forty cents a day in order to meet it. Our high tuition is, moreover, sending young men more and more to the other less expensive collegiate institutions. Many of these take the full courses of study there, but there is a large and increasing number who for reasons of economy replace the first year or first two years of the institute course by corresponding work at another institution, and then enter the second or the third year of the institute. There is involved in this plan a lack of continuity and of adequate preparation which is unfortunate.

While we are not interested in bringing about any large increase in the number of our students, we are concerned in drawing to us young men of the highest quality. We must, therefore, not permit the financial resources of applicants to be the principle of elimination in any greater measure than is absolutely essential. There is, in my opinion, no form of educational expenditure which produces so large a return to the community as the higher training for the scientific and engineering professions of those comparatively few young men whose character and ability are such as to enable them to rise to positions of leadership. And this type is, I believe, most commonly developed among families which have sufficient means to send their sons to the high school, but yet have trained them to work in the summers and at other odd times to earn money towards their own support. Boys from poorer families are unfortunately not likely to have the opportunity of even a high-school education or the home surroundings or antecedents which conduce to intellectual development, while those from richer families are apt to lack the earnestness of purpose and inclination to subordinate the pursuit of pleasures to thorough preparation for a life of service which is acquired by the boy who has already learned to work. It is, however, just such families of small means which are finding it exceedingly difficult, if not impossible, to meet the high expense of technological education.

This difficulty may be met in either of two ways—by a general reduction of our tuition fee or by providing larger funds for scholarship aid to individual students. Under the existing conditions a combination of the two methods seems most advisable. To reduce our tuition fee for all our students would involve such a large reduction of our income that it probably can not be immediately considered; but it might be practicable to adopt the plan of reducing the tuition fee for first-year students. The advantages of this reduction in tuition for first-year students are proportionally far greater than a corresponding reduction for those of the higher years—desirable as the latter is. It would enable a larger number of properly prepared students to enter the institute; and the most deserving of these, after they had demonstrated their ability by their first year's work, could be assisted to continue by grants from our scholarship funds and those of the state, which can not be awarded with proper discrimination to boys in advance of their coming to the institute. Moreover, as the student gets older and has had more training, it is easier for him to get remunerative employment in the summer vacations. It will, too, diminish the tendency for students to go to other institutions for a single year or two merely for reasons of economy. Finally it is the most equitable and from a financial standpoint the safest one for the institute to pursue in effecting a reduction of its tuition charges, since the first-year instruction is less costly than the more specialized instruction of the higher years. This plan would, however, remedy only in part the difficulties of our high tuition; for our scholarship funds are not adequate to meet the needs of our deserving students in the higher years. This is fairly evident merely from the statement that the scholarship grants to undergraduate students formed last year only nine per cent. of the total tuition fees paid by them. Ampler funds must, therefore, be secured either through an appeal to the generosity of private donors or through further grants from this commonwealth, which can not afford to allow the opportunity of a higher technological education to remain closed to such of its youth as are fully qualified to receive it.

REQUIRED SUMMER WORK

Coming now to matters more closely related to the work of instruction, I would first bring to your attention the extension of the required work of the institute courses for a period of four or five weeks into the summer. Such an extension can best be made, not by lengthening our present term, but by providing summer schools which our regular students are required to attend and to which they will be admitted free of charge, in the summers at the end of the first two school years. The importance of this extension of our regular work can be fully appreciated only by those who are intimately acquainted with the difficulties and defects of our present system of instruction; but the main aspects of this matter can be readily understood. The educational problem of the institute, as has already been stated, is to give to students with only a high-school preparation a liberal education, a thorough training in fundamental scientific subjects, and sufficient technical knowledge to enable them to enter at once upon the practise of their profession. Under the present conditions, as I have already said, we must for most of our students attempt to do this as far as possible in a period of four years. The opportunities of the four-year period have, however, not yet been fully utilized. Our summer vacations form one third of the whole year; and during this time most of our younger students are unoccupied or are at work in places from which they derive no educational advantage. The assignment of even four or five weeks of the summer vacations after the first and second years to those portions of our work which consist largely in the acquirement of technical skill and experience, such as laboratory practise, shop-work, drawing and work in the field and in industrial establishments, would so relieve the present overcrowded curriculum that an amount of good entirely out of proportion to the time gained could be accomplished. The time gained would, I am sure, be devoted by the faculty not to further specialization in the engineering branches, but to some increase in general studies and to more thorough training in the fundamental principles of the sciences underlying the professional work. The attempt would be made to concentrate the attention of the student upon fewer subjects at one time, to demand more thought and less learning of lessons, and to emphasize important principles through the solution of numerous problems by the student. The pressure of the studies of the school year would be somewhat diminished; while the work of the summer school, being largely in laboratory, shop or field, and concentrated upon one or two subjects, would not continue the mental strain to any great extent. The plan would involve increased expense to the institute; for it would be necessary to pay the salaries of the instructors engaged in the summer schools for an additional month. Aside from this, the only important objection to it seems to be the added tax that it imposes upon the resources of certain students in forcing them to meet the expenses of living in Boston for a longer period and in shortening the time which they can devote to remunerative work. This makes it, in my opinion, out of the question to charge an additional tuition fee for such required summer courses; but this is not a sufficient argument for postponing a step which is so essential to the effectiveness of our work.

INVESTIGATIONS BY THE INSTRUCTING STAFF

An extension of opportunities for investigation both in pure and in applied science by members of our staff and by advanced students is a matter which, though secondary to the considerations directly affecting the instruction and general welfare of undergraduate students, is nevertheless of the greatest importance in its effect on the relation of the institute to the scientific and technical development of this country. It ought to be our especial aim to get into the closest touch with the scientific problems of the manufacturer and the community, and to assist in the solution of them. Professors and instructors on our staff are already doing a vast amount of work in this direction, partly through the thesis work of students, and partly through their own employment as experts. But this work is often performed under conditions which make a thoroughgoing investigation impossible; and, because of its personal character, it fails to be identified with the institute and recognized among its contributions to scientific progress. In my opinion, we should in all departments give each of our assistants and instructors a reasonable proportion of free time for research purposes, we should afford him adequate laboratory facilities, and should then insist as a condition of his promotion and advancement in salary that he make and publish scientific or technical investigations. Almost all our instructors already have some available time that could be devoted to research work, so that the carrying out of this suggestion does not involve a proportionate increase in our staff. That time is, however, at present so limited, so disconnected, and so apt to be encroached upon by other work, that the man feels little encouragement to enter upon an investigation. If that amount of time could be increased and made definite by the assignment of days or half-days for research work, there would result not only an incalculable gain to himself as a teacher, investigator and scholar, but also added reputation to the institute because of its larger contributions to science.

ESTABLISHMENT OF RESEARCH LABORATORIES

Another method of promoting investigation work at the institute is through the the establishment of research laboratories in connection with the departments. For each such laboratory an income of about $5,000 needs to be guaranteed for at least a few years. Two laboratories have already been started which are devoted to research in physical chemistry and in sewage disposal, and their contributions to pure science in the one case and to questions of municipal sanitation in the other have attracted much attention throughout the country. The formal organization of research laboratories accomplishes much more than the same expenditure of money for uncorrelated investigations by the individual members of the departments. It calls attention to the activity of the institute in this field, raises its scientific standing, attracts advanced students, who are often just as effective research workers as inexperienced assistants, offers facilities and inducements for advanced study and investigation to our younger instructors, and forms a nucleus of development in this important direction.

SCIENTIFIC BOOKS

American Philosophy: The Early Schools. By I. Woodbridge Riley, Ph.D. New York, Dodd, Mead and Co. 1907. Pp. x + 595.

This substantial volume, the fruit of the author's three years' tenure of the Johnston research scholarship in Johns Hopkins University, constitutes the achievement of the first and most difficult part of an important undertaking, the neglect of which hitherto has been a reproach to American learning. That none have before attempted, on any adequate scale, the task which Dr. Riley is carrying through is perhaps partly due to a common impression that a history of earlier American philosophy would necessarily have the brevity of the chapter on snakes in Iceland. The first of the services rendered by the present publication is that such an impression can not well continue to prevail, in view of the evidence now given of the existence of much vigorous and independent activity in speculation and scientific inquiry even in the eighteenth century. But it has always been reasonably apparent that some sort of intellectual processes must have been continuously at work in American life from the time of the founding of the earliest colleges down to the present. Yet, in spite of a considerable literature of books and monographs on special topics, we have thus far had nothing that was properly entitled to be called an intellectual history of America—a history based on an extensive collation and first-hand study of the sources, and covering the intellectual movements of all parts of the country. The nearest approach to this hitherto has been the work of a Dominican scholar, written in French. Such a history Dr. Riley, however, has undertaken to provide. It is (what is still a thing sufficiently uncommon amongst us) an *œuvre de longue haleine* that he has proposed to himself; the present volume, which leaves off at the foreshadowings of transcendentalism, is designed to be followed by two others. What distinguishes this part of the work is the novelty of much of the material, and the thoroughness with which the author has documented himself for his task. He even seems to have read through the whole series of Harvard Dudleian lectures on natural religion since 1755—a sort of cruel and unusual punishment which one might almost have supposed contrary to law in these mild days.

The interest of the book is, of course, more historical than philosophical; but it is by no means merely antiquarian. The author has, perhaps, found no American philosopher to whose writings many are likely to resort for the solution of contemporary problems. But he has rescued from oblivion some writers whom it is still possible to read with pleasure, and he has set forth, convincingly for the most part, not merely the vicissitudes of philosophical opinion—especially in academic circles—in America, but also the causes of those vicissitudes. A large part of the book may, indeed, be regarded as a record of the rise and fall of the scientific spirit and of intellectual vitality in the colleges. It is, in the main, a melancholy story of the triumph of obscurantism and mediocrity, of the suppression of ideas and the defeat of tendencies which were destined, after all, to be recalled from their graves and to exercise a powerful influence upon the university teaching of a later generation. Thus, in the first half of the eighteenth century there was an interesting development, in Johnson and Edwards, of philosophical idealism, which, like the doctrine of the Cambridge and Oxford Platonists from which it was, in the main, descended, showed a marked tendency towards pantheism. Though Johnson's books were used as texts in King's College and the Academy in Philadelphia, his theories were born out of due time and soon perished of general neglect. Again, one hundred years ago Philadelphia and the south seemed—much more than New England—to be full of promise of great and rapid intellectual progress. As a result of the impetus given in the one case by Franklin and in the other by Jefferson, the universities and medical schools in these communities abounded in bold speculations, in openness of mind towards new hypotheses, in enthusiasm for experimental investigation, in liberal educational policies, in an especial alertness to psycho-physical problems, and in materialistic tendencies which, however open to objection on metaphysical grounds, created an atmosphere favorable to the physical and biological sciences. So we find Joseph Buchanan, in Kentucky, approximating the theory of continuous evolution from the inorganic to man, arguing for epiphenomenalism, and investigating the physiological antecedents of mental processes; we find Cooper, at the University of Virginia, elaborating a "psychology without a soul," propounding the hypothesis of the electrical character of the transmission of the nerve-impulse, and anticipating positivism; we find Benjamin Rush, at the University of Pennsylvania, lecturing systematically on the relations of mind and body, experimental psychology, abnormal psychology and psychological esthetics. Crude and one-sided these developments often were; but the spirit, and the conceptions of scientific method, that lay behind them, if they had continued to rule in American universities, would have put science and education in this country, and especially in the south, thirty or forty years ahead of their present position. These possibilities, however, soon came to naught—partly because the public mind was not ready for such ideas, partly because of the clerical power in the colleges, and largely, Dr. Riley seems to think, because of the intellectually deadening influence of the "common-sense" system of the Scotch school, which, established at Princeton early in the nineteenth century, gradually became the ruling American philosophy, as that college rose to dominance in the middle and southern states.

There are (naturally enough in so extensive a study) several minor slips that should be corrected in a subsequent edition. By an odd anachronism, Thomas Cooper (1759–1840), the son-in-law of Priestley and first professor of natural science in the University of Virginia, is confused (pp. 294, 408) with the celebrated chartist of the same name (1805–1892). It would have been a matter of some metaphysical difficulty to have been a "former chartist" in 1819. Less explicably, Priestley himself is referred to as "the great chartist." The Bridgewater Treatises can not (p. 17) have been "relegated to the back shelves" in "the latter part of the 18th century," since the earliest of them came out in 1833. The year 1797 should not be placed (p. 318) in the "era of good feeling"; the period traditionally so called came twenty years later, while the beginning of the first Adams's administration was an era of uncommonly bad feeling. Channing was in no sense a pantheist; and his Dudleian lecture of 1821 has exactly the opposite purport to that ascribed to it (pp. 207, 208). It tends to confusion to call the philosophy of Wolff (p. 320) and that of the enlightenment generally, "illuminism"; that term already has two fairly definite (and incongruous) meanings and it is not desirable that it should acquire a third. Jefferson, in the argument outlined (p. 276), so far from "desiring to give *gain de cause* to the disciples of Ocellus, Timæus, Spinoza, Diderot and D'Holbach," is engaged in refuting the atheistic philosophy which he conceives to be represented by those names. The chapter on Jefferson, in general, seems a little confused and ill-arranged; the precise character of his eventual metaphysical opinions does not altogether plainly appear. Jefferson inclined (with some agnostic hesitancy about adopting any metaphysical opinion at all) to (*a*) the doctrine that all substance is corporeal and that thought is somehow an attribute or function of body—*i. e.*, a materialistic monism; and at the same time (*b*) to the rejection of a purely mechanistic philosophy of nature, and the affirmation, on the basis of the argument from design, of the necessity of referring the origination of the world to an intelligent mind—*i. e.,* an optimistic deism. It was implied in this that God must in some sense also be corporeal. Now, this peculiar combination of ideas was characteristically that of Priestley; and (as Dr. Riley neglects to point out, in his account of the sources of Jefferson's ontological notions) the Virginian's language plainly shows that he took over this combination, and the arguments for it, from Priestley, ready-made. The author's use of the term "deism" (to which movement a whole section of the book is devoted) is confusing and inconsistent. It would take too long to discuss here the historically correct and the incorrect uses of the word; but it is surely absurd to classify equally as "deists" such strange bed-fellows as Berkeley, Bishop Butler, Cotton Mather, Addison, Charles Chauncey, Channing, Toland, Ethan Allen and Thomas Paine. These men, between them, represent all possible attitudes upon all the issues with which the term "deism" has been associated: natural *vs.* revealed religion, pantheism *vs.* transcendence of the deity, optimistic *vs.* pessimistic view of nature, uniformity of natural law *vs.* miracles and special providences, inherent dignity *vs.* natural depravity of man. There can be no possible ground for the application of a common name to such an incongruous collection. Finally, it is rather unfair to dismiss as "puerility" a passage in which an otherwise unknown eighteenth-century writer, Thomas Dobson (p. 239), points out, concisely and clearly, just that fundamental fallacy in the then popular argument from design which Clifford, many years after, still thought it worth while to explain at some length.

But though open to criticism upon these and some other details, the book as a whole is a thorough and scholarly piece of research in a territory where the author has often been obliged to blaze his own way, and a notable addition to our historical literature. It will be indispensable to all who are interested in the history of philosophy, of natural science, of education, of religious movements, of literature, and of public opinion in America.

A. O. Lovejoy

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

The Washington Academy of Sciences at its annual meeting, January 16, elected the following officers for 1908:

President—C. D. Walcott.

Vice-president representing the Anthropological Society—W. H. Holmes.

Vice-president representing the Archeological Society—J. W. Foster.

Vice-president representing the Biological Society—L. Stejneger.

Vice-president representing the Botanical Society—T. H. Kearney.

Vice-president representing the Chemical Society—F. W. Clarke.

Vice-president representing the Society of Engineers—A. P. Davis.

Vice-president representing the Entomological Society—A. D. Hopkins.

Vice-president representing the Society of Foresters—Gifford Pinchot.

Vice-president representing the Geographic Society—Willis L. Moore.

Vice-president representing the Geological Society—Geo. Otis Smith.

Vice-president representing the Historical Society—J. Dudley Morgan.

Vice-president representing the Medical Society—Henry D. Fry.

Vice-president representing the Philosophical Society—J. F. Hayford.

Corresponding Secretary—Frank Baker.

Recording Secretary—J. S. Diller.

Treasurer—Bernard R. Green.

Manager, Class of 1910—Bailey Willis.

Managers, Class of 1911—L. O. Howard, O. H. Tittmann, B. W. Evermann.

Under the auspices of the academy the president of the Anthropological Society of Washington, Dr. Aleš Hrdlička, delivered the annual address at Hubbard Memorial Hall, February 11, on "Physical Anthropology and its Aims."

The fiftieth meeting of the Washington Academy of Sciences was held at Hubbard

Memorial Hall, February 17, 1908. Dr. L. A. Bauer presided.

Professor Wallace C. Sabine, of Harvard University, delivered an address on "Some Phases of Architectural Acoustics."

The lecture hall of the Fogg Art Museum erected in 1895 was modeled after Sanders Theater in Cambridge, but failed to duplicate its excellent acoustic properties. This misfortune led the corporation of Harvard University to request Professor Sabine to investigate the matter and propose changes to remedy the difficulty.

It has been claimed by some that to secure good acoustic properties the dimensions of the room should be as 2:3:5 or similar proportion, or that the room should be elliptical, but the best and the worst auditoriums in Cambridge are both semicircular, indicating that it is by no means a matter of proportion or shape alone.

The acoustic properties of a hall involve four principal factors: distributed loudness, reverberation, resonance and interference. To adjust these four physical characteristics there are two variables, the form of the auditorium and the material of which it is constructed. The essential features of the material are its absorbing and reflective powers. Through a measurement of the reverberation it is possible to determine the absorbing and therefore the reflecting powers of a wall surface. The method of so doing was explained at some length, and the results of such measurements given.

With an organ pipe as a constant source of sound and a chronograph to record its duration after the wind was cut off, the audibility of the residual sound, the reverberation, in the lecture hall of the Fogg Museum was found to be 5.62 seconds—a condition which rendered the room intolerable as an auditorium. By putting Sanders Theater cushions upon the seats, floor and part of the wall of the lecture hall, the duration of the residual sound was reduced to 1.14 seconds. The absorbing power of these cushions was ultimately compared with that of an open window. The absorbing power determined for a few of the kinds of wall surface and of an audience are given below, expressed in square meters of open window.[1]

Hard pine wood sheathing per square meter	.061
Plaster on wood lath per square meter	.034
Glass—single thickness—per square meter	.027
Audience per square meter	.94
Isolated woman	.54
Isolated man	.48
Cretonne cloth per square meter	.15
Hair felt 2.5 cm. thick and 8 cm. from wall per square meter	.78

As a result of two years' investigation felt was placed on particular walls of the lecture hall in the Fogg Museum; so the room was rendered, not excellent, but entirely serviceable and has since been used without complaint.

With a number of given and determined factors Professor Sabine treated the subject mathematically and showed that knowing the absorbing power of the wall bounding surfaces and the dimensions of the auditorium it is possible to calculate with accuracy the reverberation if need be in advance of construction. Several examples of such calculations were given. The paper up to this point having dealt entirely with middle C, was then extended to a discussion of the whole range of the musical scale. Examples were given showing the absorbing power of wall surfaces for notes of high pitch.

Mr. Bernard R. Green, discussing the paper, remarked upon the difficulty of killing echoes and inquired as to the facts concerning the Mormon Tabernacle.

Professor Sabine replied that he had made a special journey to Salt Lake City to study the acoustic properties of the tabernacle, and found that its excellence in that respect was not a matter of "inspiration." When first built the acoustic properties were very poor. Attempts were made to remedy the difficulty by stretching wires across the room and hanging curtains, but they were of no avail. Finally, the increasing size of the congregation necessitated the construction of a gallery, which unexpectedly corrected the acoustic defects.

[1] *American Architect and Building News*, Vol. 68, pp. 3, 19, 35, 43, 59, 75 and 83.

Mr. C. K. Wead expressed his high admiration for the ingenuity of the methods used by the lecturer, the monumental patience with which the laborious experiments were carried out, and the skill with which the data have been discussed.

The ordinary man, and even the architect, generally assumes that sound-waves in a room which is only a few wave-lengths long, can be treated like light-waves; but the case is one of diffraction rather than of rectilinear propagation and of reflection by the laws of optics.

A merit of Professor Sabine's work is that he has been able to make a sort of summation of the complex phenomena in all parts of a room. His immediate result—the reverberation, or the number of seconds the sound can be heard after the wind is cut off from his standard organ pipe—is not in itself of any value; but like the percentage of carbon dioxide in the air, which was considered before the days of bacteriology to gauge the impurity of the air, this duration can be measured and it gives information about quantities far more important than itself.

J. S. Diller,
Recording Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 199th meeting of the society, held at the Cosmos Club, on Wednesday evening, January 22, the following papers were presented.

Regular Program

Deposits of Residual Iron Ore in Cuba: A. C. Spencer.

In Cuba a great part of the deep residual soils are highly ferruginous and in many localities so rich in iron as to constitute usable ores of that metal. Three districts, passing under the names Moa, Mayari and Cubitas, were described in which very large tonnages of such iron ore exist.

Certain features of the deposits are very like those of the high level laterite of India, especially the occurrence of a deep bed of yellow clay next to the basement of solid rock and the common gradation of the yellow clay into red earthy material, containing pisoliths and irregular concretions of brown iron oxide which are locally cemented into continuous but porous layers.

In one of the regions named the combined thickness of these materials varies from a few feet to more than fifty feet, and a large number of analyses have proved that both the ochreous clays and the material lying above them contain on the average about 46 per cent. of iron when dried at 212° F., so that all of the residual material is to be considered as ore. In its natural state the ore carries above 40 per cent. of water of which about 13 per cent. is said to be combined. Alumina is present in excess of the amount required for combination with the silica and is doubtless present in the form of hydrated oxide. Phosphorus is uniformly low, averaging less than .02 per cent. and chromium is always present, the average amount being somewhat less than two per cent.

The fact that chromium is characteristic of the ore is regarded as definite proof that the material has been derived from the serpentine which constitutes the underlying rock in each of the three fields.

The absence of discrete particles from the material is taken as an indication that no part of it is transported, and as strongly suggesting its accumulation in situ as the insoluble residuum of complete weathering and decay of the serpentine. The topography of the ore fields also favors the idea of a simple residual origin, since in each case the deposits constitute surficial mantles over extensive surfaces practically wanting in local relief. Though now uplifted and even warped, these surfaces are interpreted as the remnants of ancient peneplains upon which the sort of rock disintegration, favorable to deep residual deposits, would naturally take place. The geologic period during which this planation to base-level occurred can not be fixed but, in the mind of the speaker, is to be tentatively correlated with Lafayette and pre-Lafayette time.

Systematic chemical work is demanded by the whole problem of the genesis of these ores, but the best promise of immediate results would seem to be offered by an investigation of the variations in the state of hydration of the material from different depths in the deposits. Some analyses indicate the presence of hematite in addition to the hydrous oxides and the brilliant red of some of the clays near the surface of the ground leads to the same conclusion. Some of the pisoliths are attracted by the magnet showing that there has even been a certain amount of dehydration, unless indeed the presence of undecomposed magnetite, inherited from the original rock, can be shown.

The United States Geological Survey's Hydraulic Laboratory at Berkeley, California: G. K. GILBERT.

The laboratory has been established for the purpose of investigating in a quantitative way the laws controlling the transportation of detritus by running water. Initially it is determining the capacity of a stream of definite discharge to transport sand of uniform grain in a straight channel of definite width and definite slope. The apparatus includes special devices for measuring the quantity (discharge) of water, the velocity, and the amount of sand transported. In each experiment, while water is flowing uniformly through a long trough, sand is introduced from above at a uniform rate, and the water is allowed to arrange it on the bottom of the trough. After a time the sand surface assumes a stable slope adjusted to the maintenance of a velocity just sufficient to transport the amount of sand (load) fed to the water, and this slope is measured. In the next experiment a different quantity of sand is introduced and the resulting slope is measured. A series of such experiments yields a curve or equation of the relation between load and slope. The discharge is then changed and the work repeated. In this way, and by the progressive permutation of the controlled conditions, the laboratory is determining the elementary laws of the transportation of detritus, in relation to slope of channel, width of channel, size of sand grain, discharge, mean velocity of current, and bottom velocity.

The laboratory is in the immediate charge of Dr. E. C. Murphy. Space, power, and other important facilities are generously contributed by the University of California.

RALPH ARNOLD,
Secretary

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

REGULAR meetings of the Society for Experimental Biology and Medicine were held on October 16 and December 18, 1907, and February 19, 1908. The scientific program of each of the meetings is appended.[1]

Twenty-fifth Meeting

College of Physicians and Surgeons, Columbia University. October 16, 1907. President Flexner in the chair.

Members elected—Edward T. Reichert, M. J. Rosenau, Richard P. Strong.

Program

"Cardiac Insufficiency due to High Arterial Pressure," by Haven Emerson.

"Effect of Potassium Cyanide upon Metabolism," by George B. Wallace and A. N. Richards.

"Pneumothorax and Posture," by Charles A. Elsberg.

"The Hypersensitiveness of the Guinea-pig to Horse Serum," by Paul A. Lewis.

"A Sporozoan found in the Peptic Glands of the Common Mouse," by E. E. Tyzzer.

"The Rôle of Tonicity in Human Isohemagglutination," by Frederick P. Gay.

"Effects of Calcium and Magnesium Salts upon the Development of Rigor Mortis," by S. J. Meltzer and John Auer.

"Restraint and Promotion of Tumor Growth," by Simon Flexner and James W. Jobling.

"Reestablishment of Function in Transplanted Kidneys," by Alexis Carrel.

"A Depressor Reaction obtainable by Traction on the Carotid Artery," by Torald Sollmann and E. D. Brown.

"A Modification of Teichmann's Method for obtaining Hemin Crystals," with a demonstration

[1]Authors' abstracts of the papers read before the Society for Experimental Biology and Medicine are published in the *Proceedings of the Society for Experimental Biology and Medicine.* A number is issued shortly after each meeting, and costs 15 cents a copy. Copies may be obtained from the managing editor, William J. Gies, 437 West 59th Street, New York.

of specimens, by James P. Atkinson and Arthur I. Kendall.

"The Influence of Ether Anesthesia on the Excretion of Nitrogen by Dogs," by Philip B. Hawk.

"The Relative Value of Antitoxin and other Curative Substances in Antidiphtheric Serum," by Edna Steinhardt and Edwin J. Banzhaf.

Twenty-sixth Meeting

Rockefeller Institute for Medical Research, New York. December 18, 1908. President Flexner in the chair.

Members elected—Edwin J. Banzhaf, William N. Berg, H. D. Dakin, Charles A. Elsberg, Shinkishi Hatai, Charles E. Simon, S. Burt Wolbach.

Program

"The Effect of Light on Cells in Fluorescent Solutions after Addition of Potassium Cyanide," by Elizabeth Cooke and Leo Loeb.

"Physiological Age," by C. Ward Crampton.

"Gastric Peristalsis after Section of the Vagi and Splanchnic Nerves," by John Auer.

"The Effect of Stimulation of the Vagus Nerves upon the Development of Rigor Mortis of the Mammalian Heart," by Don R. Joseph and S. J. Meltzer.

"The Antagonistic Action of Calcium upon the Inhibitory Effect of Magnesium," by S. J. Meltzer and John Auer.

"Remote Result of the Transplantation of a Segment of Popliteal Artery from a Man to a Bitch," by Alexis Carrel.

"Concerning the Relation of the Coagulation Time of the Blood to Thrombosis in Phlebitis," by Harlow Brooks and B. C. Crowell.

"The Reactive Power of the White Rat to Tissue Implantation" (second communication), by Isaac Levin.

"The Hemolytic Reactions of the Blood in Dogs with Transplantable Lymphosarcoma," by Richard Weil.

"On the Circulation through the Kidneys, (I.) On Vaso-motor Reactions, (II.) The Renal Blood Flow in Relation to the Pressure in the Ureter and Bladder, (III.) The Effect of Solutions of Adrenalin," by R. Burton-Opitz and D. R. Lucas.

"Some Data regarding the Portal Circulation," by R. Burton-Opitz.

"A Clinical Viscosimeter," by R. Burton-Opitz.

"Studies in Experimental Arteriosclerosis," by Isaac Adler and O. Hensel.

"On the Influence of Various Substances, Applied Directly to the Medulla Oblongata, upon the Respiratory Rhythm in Frogs," by T. Brailsford Robertson.

"Metaplasia and Metastasis of a Rat Tumor," by Simon Flexner and J. W. Jobling.

Twenty-seventh Meeting

(Fifth Annual Business Meeting)

Schermerhorn Hall, Columbia University. February 19, 1908. Vice-president Morgan in the chair.

Members elected—L. W. Famulener, C. Stuart Gager, W. S. Halsted, W. A. Jacobs, Theodore C. Janeway, Don R. Joseph, Frank R. Lillie, Alwin M. Pappenheimer, Donald D. Van Slyke.

Officers elected:

President—Frederic S. Lee.
Vice-president—Thomas H. Morgan.
Treasurer—Graham Lusk.
Secretary—William J. Gies.

Program

An exhibition of photographs of chromosomes, with explanatory comment, by Edmund B. Wilson.

"The Production of two Kinds of Spermatozoa in Phylloxerans—Functional 'Female Producing' and Rudimentary Spermatozoa," by T. H. Morgan.

"Physiological Problems of the Geographical Distribution of *Partula* in Polynesia," with demonstration of specimens, by Henry E. Crampton.

"Note on the Isolation of Carnaubic Acid from Beef Kidneys," by Edward K. Dunham.

"The Change of Corpuscle Resistance in the Blood of Immunized Animals, Coincident with the Formation of Antibodies," by Frederick P. Gay.

"Further Observations on the Precipitation of Inorganic Colloids by Sera," by Cyrus W. Field.

"A Note on Anaphylaxis," by Edwin J. Banzhaf and L. W. Famulener.

"The Relation of Plasticity to Sex and Age in the Dancing Mouse," by Robert M. Yerkes.

"The Crystallography of Hemoglobin," by Edward T. Reichert and Amos P. Brown.

"The Germicidal Property of Milk," by M. J. Rosenau and Geo. W. McCoy.

The next regular meeting will be held on April 15.

William J. Gies,
Secretary

THE TORREY BOTANICAL CLUB

The meeting for January 29, 1908, was held in the Museum Building of the New York

Botanical Garden at 3:30 P.M. Vice-President Barnhart presided and there was an attendance of thirty-four.

The secretary presented the report of Mr. Percy Wilson, chairman of the field committee, for 1907. Twenty-five field meetings were reported scheduled through the months of May to October, inclusive, though a few of these meetings were not held, on account of inclement weather.

Biographical résumés and appreciations of Professor Underwood's life and work were read as follows:

"A Biographical Sketch of Lucien Marcus Underwood," by Carlton C. Curtis.

"Lucien Marcus Underwood: A Memorial Tribute," by Marshall A. Howe.

"The Published Work of Lucien Marcus Underwood," by John Hendley Barnhart.

"Professor Underwood's Relationship to the Work of the New York Botanical Garden, together with the Preamble and Resolutions on Professor Underwood's death, adopted by the Scientific Directors of the Garden," by N. L. Britton.

The above papers were published in full in the January, 1908, number of the *Bulletin of the Torrey Botanical Club*.

The following resolutions, presented by a committee of the club, were read and unanimously adopted:

In the death of Lucien Marcus Underwood American botany has lost one of its foremost representatives, one who was exceptionally free from prejudice and selfishness and who abhorred all superficiality and obsequiousness. The Torrey Botanical Club has lost a faithful officer and a zealous and enthusiastic supporter of all its activities and interests.

We desire to pay tribute to his superior qualifications and attainments as a man of science, and to express our profound sorrow as we attempt to realize that we shall no more feel the warm clasp of his hand, meet the glance of his sympathetic eye, or hear his cheering words of counsel and encouragement.

The Torrey Botanical Club hereby directs that this minute be entered in its proceedings and duly published with them.

C. Stuart Gager,
Secretary

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and thirty-seventh meeting of the society was held at Columbia University on Saturday, February 29, extending through the usual morning and afternoon sessions. Thirty-four members were in attendance. President H. S. White occupied the chair, being relieved at the afternoon session by Professor P. F. Smith. The following persons were elected to membership: Mr. E. G. Bill, Yale University; Mr. C. H. Currier, Brown University; Mr. W. S. Pemberton, State Normal School, Edmond, Okla.; Professor S. W. Reaves, University of Oklahoma; Mr. L. L. Silverman, University of Missouri; Mr. W. M. Smith, Lafayette College; Mr. H. W. Stager, University of California. Twelve new applications for membership were received.

The by-laws of the society were amended to provide that a member of the editorial committee of the *Transactions* should be appointed each year at the April meeting of the council and should take office on the following October 1.

The usual informal dinner was arranged for the evening and was attended by twelve of the members.

The "Annual Register" of the society, containing list of officers and members, constitution and by-laws, catalogue of library, etc., has recently been issued. Copies can be obtained from the secretary.

The following papers were read at the February meeting:

R. D. Carmichael: "On the numerical factors of certain arithmetic forms."

R. D. Carmichael: "On the remainder term in a certain development of $f(a+x)$."

F. R. Sharpe: "The Lorentzian transformation and the radiation from a moving electron."

Virgil Snyder: "Normal curves of genus 6 and their groups of birational transformations."

J. W. Young: "The geometry of chains on a complex line."

J. W. Young: "A fundamental invariant of discontinuous ζ-groups defined by a normal curve of order n in space of n dimensions."

E. B. Van Vleck: "On non-measurable point sets."

L. E. Dickson: "On higher congruences and modular invariants."

Max Mason: "Note on Jacobi's equation in the calculus of variations."

G. W. Hill: "Subjective geometry."

G. A. Bliss: "A method of deriving Euler's equation by means of an invariant integral."

C. N. Haskins: "On the second law of the mean."

Edward Kasner: "The contact transformations of mechanics."

Edward Kasner: "The plane sections of an arbitrary surface."

G. A. Miller: "Note on the periodic diurnal fractions."

F. R. Sharpe: "The inner force of a moving electron."

W. H. Roever: "Brilliant points of curves and surfaces."

Frank Irwin: "Transformations of the elements x, y, y', $\cdots$, $y^{(k)}$ that carry a union of such elements over into a union."

The San Francisco Section met at Stanford University also on February 29. The Chicago Section will meet April 17–18. The next regular meeting of the society will be held on April 25. The summer meeting will be held at the University of Illinois, September 10–11.

F. N. Cole,
Secretary

DISCUSSION AND CORRESPONDENCE

LAFAYETTE DEPOSITS IN LOUISIANA

To the Editor of Science: In your current number (February 28, 1908, page 351) Professor G. D. Harris suggests assigning the Lafayette formation to the Pleistocene, rather than the Pliocene, on the basis of associated fossils brought up in borings from depths of 1,500 feet or more. In this connection it is worth while to consider the alternative hypothesis that the beds tapped by the drill in southern Louisiana are redeposited Lafayette materials rather than original deposits. It is to be noted as tending to favor the alternative hypothesis that the Lafayette deposits are made up of residuary products gathered from the interior and laid down along shore (with little admixture of other material) during a period of continental depression, the distribution having been effected by river currents or wave action, or by both combined; so that it seems improbable that materials of this distinctive type could have been deposited far off-shore, and especially at depths of 2,000 feet or more—for to the depth of the boring noted by Professor Harris must be added the 500 or more feet of subsidence during the Lafayette period. It is also to be remembered that among the striking features of the Lafayette formation is its extensive erosion, especially in the Mississippi embayment: From a latitude above the mouth of the Missouri to the gulf the formation has been completely removed over an area averaging 50 to 75 miles in width, aggregating fully 40,000 square miles—*i. e.*, about one eighth of the total area of the formation above present tide level. Moreover, it seems certain both from evidence of remnants and from physical considerations that this was the thickest portion of the formation; so that in this district something like a fifth of the aggregate volume of the deposits must have been eroded away, largely during the post-Lafayette high-level period when that portion of the continent about the present mouth of the Mississippi stood a thousand feet or more above its present level. During this high-level period the Lafayette materials might well have been redeposited at what was then a limited depth below the surface of the gulf, with little admixture of foreign matter. Such an association would be quite consistent with Professor Harris's paleontologic evidence; and it has the advantage of consistency both with the physical conditions attending the genesis and partial degradation of the formation, and with the stratigraphic relations found farther in-shore both in the Mississippi Valley and along the middle Atlantic slope.

W J McGee

A HANDY SUBSTITUTE FOR THE BLAST BLOWPIPE IN BLOWPIPE ANALYSIS

It occurred to me that the small rubber bulb which is used to furnish the atomized alcohol for the platinum tip in an ordinary pyrography outfit, might profitably, where there is no equipment for tapping a compressed air chamber, be employed for a continued blast in blowpipe analysis.

A very satisfactory test was obtained by attaching the rubber tube of a medium-sized bulb immediately to the blowpipe and using the muscular contraction of the hand instead of the cheeks—much to the relief of the latter. The strength of the blast was surprising. A strong oxidizing flame of about two inches could be secured easily and with a small amount of gas-supply and one filling of the bulb, a steady flame was given for more than a half-minute. A larger size foot-apparatus proved much more powerful. The only difficulty was that it was not easy to make a small reducing flame. For handy and continuous work with difficultly reducible minerals—shortening many processes very much—and in giving the instructor an opportunity to teach during his personal blowpipe instruction, it has considerable practical value, besides doing away with the necessity of bringing the lips into contact with the blowpipe.

CHARLES W. BROWN
GEOLOGICAL LABORATORY,
BROWN UNIVERSITY

SPECIAL ARTICLES

TRANSPLANTATION OF FORMALDEHYDE-FIXED BLOOD VESSELS

IT has been demonstrated that segments of blood vessels may be transplanted successfully from one species of animal into another, *e. g.*, cat or rabbit into dog.[1] Consideration of these results led me to transplant segments of blood vessels that had been preserved in some fixing solution.[2]

In the case here reported abdominal vena cava of dog preserved in 2.5 per cent. formalin (in 0.9 per cent. NaCl) for 60 days was used. The day before the operation the segment, which was about 0.75 cm. long and 0.5 cm. in diameter, was removed from the formalin solution, washed in dilute ammonia, dehydrated in absolute alcohol and impregnated with paraffine oil. It was interposed between and sutured to the cut ends of the right common carotid artery of a medium-sized bitch. The diameter of the artery was considerably less than that of the venous segment.

The animal made a rapid and uneventful recovery, the wound healing promptly. Clinical examination 22 days after the operation revealed a strong pulsation on the course of the artery at the site of the transplanted segment. The following day the neck was opened and the vessel directly examined. The segment was found to be about 1.5 cm. long and .75 cm. in diameter. It pulsated strongly and the circulation through it was excellent. The walls appeared to be slightly thickened but pliable. In appearance it resembled similar segments transplanted immediately after removal. The wound was closed and the animal returned to its cage. No histological studies have as yet been made, but material is being accumulated for that purpose.

Conclusion.—A segment of dog's abdominal vena cava preserved in formaldehyde for two months and then interposed between the ends of a dog's carotid artery may adequately serve the mechanical function of an artery for more than three weeks.

C. C. GUTHRIE
PHYSIOLOGICAL LABORATORY,
WASHINGTON UNIVERSITY,
ST. LOUIS, MO.

[1] Carrel, *Journal of Experimental Medicine*, IX., p. 226, 1907; Guthrie, *American Journal of Physiology*, XIX., p. 482, 1907; Guthrie, *Proceedings American Physiological Society*, 1907.

[2] Guthrie, *American Journal of Physiology*, XIX., p. 486, 1907.

A DROUGHT-RESISTANT HICKORY

WHILE investigating the distribution of the hickories in western Arkansas, in behalf of the federal forest service, the writer recently had occasion to note the drought-resistant quality of a little-known member of the genus —a variety probably most closely related to *Hicoria glabra* var. *odorata* Sarg.[1] This form

[1] The form occurring in Arkansas does not seem to conform closely either to *H. glabra* var. *odorata* Sarg. or to *H. villosa* Ashe. The writer, however, strongly disapproves of the publication of any new species, or even varieties in this genus, until the limits of present accepted forms be more accurately established.

occurs in great abundance on the dry flinty hills of the Ozark region, where it is associated with black-jack and post oaks, and with white hickory. Both of these hill hickories are known locally as "bull hickory," there being very little to distinguish them except the foliage. The *glabra* form is the commonest tree in the hills, where it is usually rather small—occasionally twelve inches in diameter and fifty feet high—with very thick, rough bark separating into small squares like the proverbial alligator hide; a rather deep cylindrical crown of small branches, and small, lanceolate, shiny leaflets.

The reproduction of this "alligator hickory" is very good, and is especially abundant on hills which are burned over every year, these being sometimes covered with nearly pure thickets of hickory seedlings and seedling-sprouts. These are injured less by the burnings and recover more readily than the small oaks, afterward, and hence are the sole survivors where fires occur frequently. Examination of the seedlings, however, shows them to be very old, and proves beyond a doubt that their development is very much retarded by the exposure.

The drought-resistance of this hickory is even more remarkable than its fire-resisting powers. After a midsummer drought of eight weeks, both the black-jack and post oaks were in very bad condition, a large proportion of the foliage having turned brown, or the trees killed outright. The hickory, on the other hand, showed only a slight deadening of the leaves in the tops of a few trees. The explanation of this superior drought-resistance is undoubtedly to be found in the small, thick-skinned leaves which characterize the alligator hickory, and which are typical of xerophytic plants. The tendency to form a long, strong tap-root, which all hickories exhibit when growing in well-drained soil, is certainly a very potent factor here.

Such characters as these recommend the alligator hickory for planting in the prairie states, and in dry situations in more humid regions. The high technical value of the wood should in part offset the very slow growth of the tree. It is not to be expected that the hickory will attain to merchantable size in less than seventy to one hundred years. In that period it should produce a considerable quantity of spoke and handle stock of the very highest quality, if grown on soils of reasonable strength. The planting of hickory on light soils can not be recommended under any circumstances.

C. G. Bates

U. S. Forest Service,
Washington, D. C.

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

KASSNER'S METEOROLOGICAL GLOBES

Professor C. Kassner, of the Prussian Meteorological Institute and also of the *Technische Hochschule* in Berlin, has prepared two "meteorological globes" which will be of great help to teachers of geography in general, and especially to those who lay much emphasis on meteorology and climatology. These globes (diameter 34 centimeters) show, for January and for July, the temperature, pressure and winds of the world. The temperature is shown by isotherms for every 2°, and in places for every 4° C.; the isotherm of 0° C. is drawn heavier than the others; those parts of the globe which are warmer than 0° are colored red, and those colder than 0° are colored blue. Different shades of red and blue are used for different degrees of heat and cold. Isobars are drawn in blue, the isobar of 760 mm. being heavy; those below 760 mm. are broken lines; those above, solid lines. Winds are indicated in the usual way by arrows. The principal meteorological stations the world over are shown; the observatories, and the central stations of the various meteorological services are appropriately emphasized by special symbols.

By an ingenious device the globes can be turned over, while still remaining on their wooden stands, so that the southern latitudes may be readily seen. These globes will help greatly in giving a clearer conception of the actual distribution of temperatures, pressures and winds than can be gained from a study of the ordinary meteorological charts. While the globes are too small for exhibition purposes before large classes, they can be used in work with small classes with excellent results. The price is 50 Marks; the agent, Dietrich Reimer (Ernst Vohsen), in Berlin. There have been few additions to the teaching equipment in meteorology and climatology in recent years which are of more value than Kassner's meteorological globes. It is to be hoped that many of them will find places in our geographical laboratories, both in schools and in colleges.

WATERSPOUTS ON THE SWISS LAKES

Professor J. Früh has recently published an interesting paper on the waterspouts of the Swiss Lakes ("Wasserhosen auf Schweizerseen," *Jahresber. geogr.-ethnogr. Gesells. Zürich,* 1906–07, 105–127), in which a detailed account is given of the waterspout of June 19, 1905, on the Lake of Zug. This spout was 18–20 meters in diameter, and stirred up the waters of the lake within an area of 100 meters, more or less. The whirling column was hollow; had a left-handed rotation; was more than half a mile high. Its velocity of progression was somewhat over seven miles an hour, in an easterly direction. Several photographs were taken of this waterspout, three of which are reproduced in Professor Früh's article. The author has also collected accounts of what he believes to be well-authenticated waterspouts observed on the Swiss lakes. There are 22 in all, noted on nine lakes. Of these waterspouts, all were observed by day, and 14 of the 22 occurred in the (meteorological) summer. There is no evidence of any value to the effect that any of these spouts were produced by the meeting of winds coming from different directions.

A HYGROSCOPE OF A UNIQUE PATTERN

In *Symons's Monthly Meteorological Magazine* for November, 1907, John Aitken describes a simple hygroscope which he has used for many years. The petal of one of the so-called everlasting flowers is attached to a stiff hair, which serves as a pointer, and the petal and hair together are fastened on a dial, set in a metal case. The instrument is about as sensitive as a hair hygroscope; is more compact, and much cheaper. An illustration shows the construction of the hygroscope.

R. DeC. Ward

Harvard University

THE FIRST INTERNATIONAL CONGRESS FOR THE REPRESSION OF ADULTERATION OF ALIMENTARY AND PHARMACEUTICAL PRODUCTS

The First International Congress for the Repression of the Adulteration of Alimentary and Pharmaceutical Products will be held in Geneva in September, 1908. As described in the preliminary statement issued by the congress, it has been felt for many years that such a movement was desirable and necessary, but more general matters occupied the limited time of the international congresses, and while these subjects were taken up among others, they did not receive undivided attention. The feeling that such a congress is necessary has been crystallizing for a quarter of a century, and at the Fourteenth Congress of Hygiene and Demography, in Berlin, 1907, the Universal Society of the Geneva White Cross conceived the thought of initiative action. The plan for the first meeting is an exhibition of unadulterated products, and the consideration of this occasion will be the "Defining of Unadulterated Food." In every case definition will be the basis of each decision, establishing a "codex alimentarius." It is desired by the committee of organization that manufacturers, chemists and lawyers who are interested in this question, should unite in forming these definitions.

Dr. H. W. Wiley, Bureau of Chemistry, Washington, D. C., has been asked to undertake the organization of the American committee. He hopes to associate with him those in the various states who have charge of the application of the food and drug laws, to whom he has written individually, inasmuch as these should be represented if possible as a whole. For the benefit of the chemists of the country at large, as well as others of every class who desire to identify themselves with this movement, the statutes of the congress are reproduced herewith:

Article 1.—The first International Congress for the repression of alimentary and pharmaceutical adulterations will be held in Geneva in September, 1908.

Article 2.—The congress comprises three classes of members: donors, nominal members and associated members.

1. *Donors.*—Any person having contributed the sum of at least 100 francs can take part in the congress as a donor.

These members take an active part in the work of the congress and receive its publications. Their names head the list of the members of the congress.

2. *Nominal Members.*—Any person, or body, having contributed the sum of 20 francs can take part in the congress as nominal members.

Each of the bodies entered in the category of nominal members can be represented by one or more delegates. In the latter case, the amount of the participation quota has to be paid by each of them.

The nominal members take an effective part in the work of the congress and receive its publications.

3. *Associated Members.*—All persons forming part of the family of a nominal member (wife, brothers, sisters, sons, etc.) who contribute the sum of 10 francs can be associated.

The associated members enjoy, in the same way as the nominal members, all the advantages offered by public administrations on traveling fares.

They do not receive the publications of the congress, do not take part in either the voting or the discussions and can not make any communications. They are invited to the fêtes and official receptions; they may be present at the sittings.

Article 3.—Only the regular receipts, given by the secretary general and signed by him, can secure admission to the congress, as well as delivery of the admission card and the forwarding of the publications. This card will be necessary for admittance to the sittings and for participation in the advantages offered to members of the congress. Provisory receipts, delivered by local or foreign committees are not available.

Article 4.—When sending their contribution to the secretary general, Rue du Rhône, 42, Geneva, members are requested to write distinctly their surnames, christian names, rank and address, and to enclose their visiting card.

Article 5.—Besides other advantages (particularly interesting traveling fares), and in addition to the volume of preliminary reports and résumés which will be distributed long before the opening of the congress, the donors and nominal members will be entitled to the other publications and to the reports of the congress.

Article 6.—The official languages of the congress are English, French, German and Italian.

In each country the reports to be presented at the congress must be addressed to the secretary of the delegation of said country.

Article 7.—The congress will comprise:

1. A general opening meeting.
2. Meetings of sections for the reading and discussion of reports and communications.
3. General meetings (two at most) for communications and discussions which interest the sections jointly.
4. A general closing meeting.
5. Public lectures.
6. Excursions.
7. Fêtes and receptions.

The exact program of the use of the time will be published later on.

The chairman has the direction of the sitting; he gives a member the hearing of the assembly or prevents him speaking according to parliamentary rules.

Article 8.—Not more than fifteen minutes are allowed for a reading or a speech, and the members who take part in the discussion must not speak longer than five minutes each. Speakers are requested to give, the same day, a manuscript résumé of the observations they have made in the course of a meeting to the secretary of each section.

Article 9.—The study of the questions submitted to the deliberations of the congress is divided into sections.

The committee of each of the sections will be appointed by the organizing commission, but it will be completed by the sections, so as to add foreign colleagues to the French members.

Each section will sum up its work in the form of propositions or conclusions which will be presented in a written form at the plenary sittings.

The right of amendment will not be diminished, but only such propositions as are written and sent to the committee will be discussed.

Article 10.—In its closing meeting the congress will fix the town of its next assembly.

Dr. Wiley will undertake to forward names and contributions to the secretary general, together with suggested definitions, in case intending members wish the material transmitted in this way, in order that there may be an American record of members in this country. In case the dues are thus sent to Washington for transmission to Geneva, a check for $20 for donating members, $4 for nominal members, and $2.50 for associate members should be sent, to cover dues, exchange and postage. To those preferring to send directly, Dr. Wiley will send the blank furnished by the congress, on application. It is particularly desired that as many as are able submit definitions for food and drug products, as it is profitable to accumulate as much material as possible, to establish a broad basis for decisions.

Papers on food and drug products are also solicited, and may be sent directly to the appropriate sections or forwarded to Dr. Wiley for transmittal. It is hoped that a large membership in the congress may be secured from the United States.

RECENT REFERENCES TO LAMARCK

The increased interest in the work of Lamarck is nowhere better evinced than in the number of Lamarckian items which one finds in current journals. In the *Revue Scientifique* (December, 1907) there appears an article on his early career, in *La Nature* (December 21, 1907) a careful study of his paternal family, in the *Journal des Savants* on some of his unpublished writings. And Dr. C. R. Eastman, of Harvard, has now brought to light a manuscript of Lamarck which has in part at least remained unpublished. This document was obtained (probably purchased in Paris) by Professor Alexander Agassiz and was by him presented (1896) to the Museum of Comparative Zoology. It consists of a series of essays, two psychological ("Système de Gall," 40 pp., "Idée et Imagination," 33 pp.), one purely philosophical ("Apperçu analytique des connaissances humaines, avec des divisions et des réflexions tendant à montrer leur dègrè de certitude, leur source, leur branches principales," 12 pp.) and three zoological ("Questions zoologiques dont la solution est de première importance," 4 pp., "Discussion sur les caractères essentiels des animaux et sur la définition qui pent les embrasser généralement," 12 pp., "Histoire naturelle" (scope of), 4 pp.). Following these are numerous drawings, doubtless from the hand of Lamarck, some in crude outline, as his "monads," some in color, of which one is a beautifully executed figure of a holothurian. At the instance of Dr. Eastman the manuscript has recently been placed in the hands of Professor Bashford Dean, of Columbia University, for detailed examination and publication.

SCIENTIFIC NOTES AND NEWS

President Eliot, of Harvard University, will deliver six lectures at Northwestern University on the Norman W. Harris Foundation. His general subject will be University Administration, and the dates and titles of the separate lectures as follows: Lecture I., "The Trustees." Thursday evening, April 9, at 8 o'clock. Lecture II., "An Inspecting and Concurring body—Alumni Influence." Friday evening, April 10, at 8 o'clock. Lecture III., "The University Faculty." Saturday morning, April 11, at 10 o'clock. Lecture IV., "The Elective System—Academic Distinctions." Saturday evening, April 11, at 8 o'clock. Lecture V., "Methods of Instruction—Social Organization." Monday evening, April 13, at 8 o'clock. Lecture VI., "Administration—The University President." Tuesday evening, April 14, at 8 o'clock.

Professor W. M. Davis, of Harvard University, and Professor A. P. Brigham, of Colgate University, will give several lectures on "The Geography of North America" in the School of Geography to be held at Oxford University from August 10 to 28.

Sir Oliver Lodge's presidential address to the Faraday Society, to be given on March 24, will have as its subject "Some Aspects of the Work of Lord Kelvin."

A banquet has been tendered to Dr. Robert Koch by the profession in Berlin. A portrait medallion was presented him, the first of a series of medallions of prominent living German physicians.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election as fellows: Mr. W. Barlow, the Earl of Berkeley, Mr. Dugald

Clerk, Professor A. Dendy, Professor H. H. Dixon, Mr. J. Stanley Gardiner, Professor W. Gowland, Mr. J. H. Grace, Professor D. J. Hamilton, Mr. C. I. Forsyth Major, Mr. E. N. Nevill, Mr. W. H. Rivers, the Hon. Bertrand Russell, Dr. Otto Stapf, and Dr. J. F. Thorpe.

Among those recently elected members of the Athenæum Club, under the provision which enables the committee to elect a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services," is Dr. John Rose Bradford, F.R.S., physician to University College Hospital, London, and professor of medicine in the medical school.

Officers of the London Institute of Chemistry have been elected as follows: *President,* Dr. P. F. Frankland, F.R.S.; *Vice-presidents,* Dr. M. O. Forster, F.R.S., Mr. Oscar Guttmann, M.I.C.E., Mr. Egbert Grant Hooper, Mr. David Howard, Mr. Herbert Jackson, and Sir William Ramsay, F.R.S. *Hon. Treasurer,* Mr. A. G. Salamon.

Dr. Arthur Keith, lecturer on anatomy at the London Hospital Medical College, has been appointed conservator of the museum of the Royal College of Surgeons, in succession to the late Professor C. Stewart.

A meeting was held in Birmingham on March 5, as we learn from the London *Times,* to consider what steps should be taken to assist Dr. Hall-Edwards, the surgeon radiographer who recently had his hand removed in consequence of dermatitis caused by the Röntgen rays. Sir Oliver Lodge presided, and proposed that a fund should be raised which should be invested, and that a committee be appointed to control it. Dr. Hall-Edwards had been a genuine enthusiast on the subject, and his painful condition was the result of his persistent and vigorous work in the cause. He had received a communication to the effect that the king was interested in the matter and in sympathy with Dr. Hall-Edwards, but if a pension were granted it could only be a small one. The Bishop of Birmingham supported the motion, which was carried, and at the close of the meeting it was announced that £309 had been promised.

Drs. Eduardo Liceaga, José Terres, Manuel Toussaint and Octavio Gonzales Fabela have been appointed a commission by the National Medical Academy of Mexico to decide whether the theses in typhus fever submitted to that body deserve the $10,000 prize offered by the government.

Dr. Reginald Heber Fitz, Hersey professor of the theory and practise of physic in the Harvard Medical School, will retire from teaching at the close of the present academic year.

Professor Bosanquet has announced his intention to resign the chair of moral philosophy at St. Andrew's University at the end of the current academical year.

It is proposed to make a grant of £30 from the Worts fund to Mr. A. R. Hinks, of Trinity College, Cambridge, towards defraying his expenses in traveling on the continent of Europe with the view of investigating the methods used in the study of astronomy and geodesy in certain observatories and institutions.

Mr. Frank Leverett, of the United States Geological Survey, is now in Europe, with the purpose of making, in connection with his studies in the United States, a comparative study of the glacial formations of Europe. This study will embrace the deposits in and around the Alps, as well as those of the Scandinavian ice-field in Scandinavia, Germany and Russia, and the British deposits.

Professor W. Sampson Handley gave the Hunterian lecture on "The Natural Cure of Cancer" at the Royal College of Surgeons on March 13.

The council of the British Academy have appointed the Rev. Professor S. R. Driver, fellow of the academy, regius professor of Hebrew in the University of Oxford, to deliver the inaugural course of Schweich lectures under the Leopold Schweich Fund, recently endowed, "for the furtherance of research in the archeology, art, history, languages and literature of ancient civilization, with reference to Biblical study." Dr. Driver will deliver three lectures on "Archeological Research in Relation to Biblical Study."

THE following course of scientific lectures was given during February at Morningside College, Sioux City, Iowa: Dr. Lynds Jones, of Oberlin College, on "Bird Studies on the Washington Coast"; Dr. Frank R. Lillie, of the University of Chicago, on "The Nature and Physical Basis of Heredity"; Dr. T. H. Macbride, of the University of Iowa, on "The City Beautiful."

THE Philosophical Club of the University of Minnesota has arranged a series of lectures on Aspects of Evolution. The probable program is as follows: "Evolution in Chemistry," Professor Frankforter, February 27; "Evolution in Astronomy," Professor Leavenworth, March 5; "Evolution in Geology," Professor Sardeson, March 12; "Evolution in Biology," Professor Clements, March 19; "Evolution in Psychology," Professor Miner, March 26; "Evolution in Ethics," Professor Wilde, April 2; "Evolution in Philosophy," Professor Swenson, April 9.

THE Chicago chapter of the Sigma Xi Society held its usual winter session on March 4, 1908. At the regular business meeting nine new members were admitted, and a report was presented by Professor S. W. Williston of the business transacted at the convention of the society held January 2. The address of the evening was given by President H. P. Judson on the subject "Research in the University."

IN the Physiological Laboratory at Breslau there has been unveiled, with due ceremony, a marble bust of Purkinje, the eminent physiologist.

TELEGRAPHIC advices from Zacapa, Guatemala, announce the sudden death from a tropical fever of Dr. William Ashbrook Kellerman, professor of botany at the Ohio State University, on March 8. Dr. Kellerman was the head of a party engaged in the study of the flora of Guatemala, especially the parasitic fungi. The expedition, his fourth to that country, was reported to have been very successful and his safe return was soon expected.

SIR ALFRED COOPER, a distinguished London surgeon, has died at the age of seventy years.

THE death is also announced of Professor Laurent, professor of mathematical analysis in the Paris Ecole Polytechnique and Institut National Agronomique.

THERE will be a civil service examination on April 15 and 16 for the position of scientific assistant in the Department of Agriculture, at salaries ranging from $840 to $2,000 per annum, depending upon the experience and qualifications of appointees. As a result of this examination certification will be made to fill the following-named vacancies: scientific assistant in plant breeding, $1,400 per annum, Bureau of Plant Industry (experience in corn breeding in semi-arid or arid regions); scientific assistant in soil bacteriology, $1,400 per annum, Bureau of Plant Industry. On April 22 there will be an examination for the position of assistant in grain standardization (male), Bureau of Plant Industry, Department of Agriculture, at salaries ranging from $1,000 to $1,800 per annum.

PRINCE ROLAND BONAPARTE has placed at the disposal of the Paris Academy of Sciences a sum of $20,000 to be used for grants for scientific research.

MR. PETER WHITE, Marquette, has made a gift of $1,000 to the library of the University of Michigan, Ann Arbor, for the purpose of purchasing rare medical books.

THE valuable collection of more than 2,000 dermatological casts, owned by the late Professor Lassar, has been presented by his widow to the city of Hamburg, his native town. The collection is to be installed in the St. George Hospital.

THE Mount Sinai Hospital, New York City, announces the establishment of the George Blumenthal, Jr., fellowship in pathology with a stipend of $500 a year.

MESSRS. WITHERRY & Co. will publish very shortly an account by Mr. M. J. Nicoll of three long voyages on the Earl of Crawford's yacht "Valhalla." The author describes the bird and other animal life of many islands seldom or never before explored. The valuable collections made by Mr. Nicoll during the voyages have been presented to the Natural History Museum by Lord Crawford, who is one of the trustees of that institution.

About thirty members of the New York Physics Club are attending the free course of lectures given to them by the Department of Electrical Engineering at Columbia University. These will be followed by a course of lectures in thermodynamics given by Professor Charles E. Lucke, of the department of mechanical engineering, from 4 to 5 P.M., on Tuesdays in April. All teachers of physics are invited to attend these lectures.

The Harvard Engineering Society will hold its tenth annual dinner at the Union on March 21. Professor Hollis will preside, and the following gentlemen will speak: President Eliot, Frederick P. Fish '75, E. A. S. Clarke '84, president of the Lackawanna Steel Company; George A. Kimball, chief engineer of the Boston Elevated Railway Company; H. L. Smyth '83, professor of mining and metallurgy; George A. McKay, president of the Harvard Engineering Society; and others. In connection with the dinner it is proposed to organize an Association of Harvard Engineers, and a meeting for this purpose will be held at the Union on the same day.

Professor Kamerlingh Ohnes, of Leiden, announces that he has converted helium into a solid. The last evaporating parts are said to show considerable vapor pressures, as if the liquid state is jumped over.

We learn from the London *Times* that at a meeting of the Royal Society held on the fifth ult. Professor Thorpe, of the Government Laboratory, presented a communication on "The Atomic Weight of Radium," in which he gave the results of an investigation he had been commissioned to make by a committee of the society. About two years ago the Royal Society received a considerable amount of the residues from the uranium workings of the mines at Joachimsthal, in Bohemia, belonging to the Austrian government, in which material Madame Curie first detected the existence of radium. These residues have been worked up, partly in France, and partly in London by Dr. Thorpe, who extracted from them the radium chloride which served for his determination of the atomic weight of this rare element. Dr. Thorpe finds from his experiments that the atomic weight of radium is 227, which is in almost exact agreement with the number recently published by Madame Curie.

UNIVERSITY AND EDUCATIONAL NEWS

An anonymous benefactor, considering that the year 1909, in which biologists have decided to celebrate in Cambridge the centenary of Darwin's birth, is a suitable occasion for founding a chair of biology, has offered a sum of £300 a year towards this purpose on condition that it shall be the duty of the professor to teach or make researches in heredity. The council of the senate proposes to create a professorship in biology for a period of five years at an annual stipend of £700.

The chancellor, Lord Rosebery, will visit University College on the afternoon of March 26, and will formally open the new libraries and the new south wing, which includes lecture rooms for the faculty of arts, the departments of geology, hygiene and experimental psychology, also large extensions of the departments of applied mathematics, of mechanical, electrical and municipal engineering, and accommodation for the new hydraulic laboratory.

Col. E. A. Wall, of Salt Lake City, has established a research fellowship ($500) in the State School of Mines, the engineering department of the University of Utah, located at Salt Lake City. This fellowship is awarded annually in June to some graduate student of ability to promote research work in mining, ore-dressing, or metallurgy.

Professor Charles L. Beach, of the University of Vermont, has been elected president of the Connecticut Agricultural College at Storrs.

M. Camille Matignon has been appointed professor of mineral chemistry at the Collège de France in succession to M. H. Le Châtelier, who recently accepted the chair of general chemistry at the Sorbonne.

SCIENCE

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FRIDAY, MARCH 27, 1908

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CHEMICAL POSITIONS IN THE GOVERNMENT SERVICE[1]

WHEN we enter the profession of chemistry our chief interest is centered on the conditions that obtain in the various fields of chemical activity. In the case of those who retain their youth by contact with student life, that interest does not lessen.

Frequent inquiries covering a broad scope are made by students and recent graduates in chemistry, and teachers, to whom they naturally turn for advice, are constantly asking for material that will enable them to supply this information. Inquiries made at the Department of Agriculture regarding opportunities for chemical work are mainly from students who are nearing the completion of their college course, or from teachers who are directing the studies of others. Often the inquiry relates to the character of work which the student should undertake in order to fit himself for a position in the department. Unfortunately the information is rarely sought with a view to increasing the equipment of men who have received broad fundamental training. The purpose is usually to substitute for a portion of a regular course in chemistry, some special study that will afford a temporary advantage.

. . fer these inquiries as my apology for discussing in a few minutes a subject that would require a volume for its adequate treatment. It is my purpose to

[1] Address before Section C of the American Association for the Advancement of Science, Chicago, January 2, 1908.

discuss very briefly the nature of the work done in those laboratories of the various departments of the federal government to which appointments are made with some frequency. I shall consider the subject only from the standpoint of the opportunities of the chemist seeking a position and shall not include those laboratories to which appointments are rarely made.

In 1885 this subject was discussed by Professor F. W. Clarke in his address as retiring president of the Chemical Society of Washington—now the Washington Section of the American Chemical Society.[2] The following quotation from his address is of much historic interest:

> My first visit to Washington was in the autumn of 1873. At that time chemistry had gained but a precarious foothold in the public work. In the agricultural department, one chemist, McMurtrie, sometimes with and often without an assistant, occupied a small laboratory, and carried forward his investigations with very slender resources. At the Smithsonian Institution, Dr. Endlich, then in charge of the mineral collections, attended to general chemistry routine and made occasional assays. Then, as now, the speculative constituent tormented his member of congress and the institution with ores taken from granite bowlders; with fossils to be assayed for silver or tin; with iron pyrites rich in imaginary gold, or with alleged coal which proved to be nothing but black tourmaline. With such trivialities the time of the chemist was often frittered away, to the detriment of science and the benefit of nobody. In a basement room of the Smithsonian, dimly lighted and badly ventilated, Dr. Loew, with few reagents or appliances, made analyses of rocks and ores for the Wheeler Survey. At the Army Medical Museum, Doctors Craig and Mew examined drugs for the War Department. The Patent Office, of course, employed a staff of chemists, but they had no laboratory, and their functions were critical rather than productive. In addition, the government had just started a laboratory connected with the Custom House at New York, and maintained another at Brooklyn for the purposes of the Navy. At West Point and Annapolis, chemistry was taught as an incidental study, but not by laboratory methods; and at Newport one or two chemists were engaged in the torpedo service.

[2] Bull. 1, Chemical Society of Washington.

Professor Clarke then gave a brief account of the progress that had been made in the twelve years following the date mentioned.

At the present time, of the nine departments, only three have no chemical laboratories—the Department of State, the Department of Justice, and the Post-Office Department.

TREASURY DEPARTMENT

The laboratory of the supervising architect's office is charged with the examination of metals, alloys, cements and miscellaneous structural materials. Its work is largely of a routine nature resembling in a general way that of a railroad testing laboratory.

The division of chemistry of the Bureau of Internal Revenue is charged with the analysis of all samples submitted under internal revenue laws. These include the determination of alcohol in distilled beverages, the examination of remedies containing alcohol to determine whether their medicinal principles are sufficient to exempt them from internal revenue tax, the examination of oleomargarine and adulterated butter and of such samples of mixed flour and filled cheese as are taken in connection with the laws regarding the taxation of those products. The laboratory also examines supplies furnished other branches of the department under contract and supervises the work of subordinate laboratories at collectors' or agents' offices.

The scientific work of the Public Health and Marine Hospital Service is concentrated in the hygienic laboratory. The chemical division of this laboratory was organized in 1905. Its principal object is to cooperate with the other divisions of the laboratory in the solution of problems pertaining to the public health, and to undertake such routine chemical work as may be required by the United States

Public Health and Marine Hospital Service at large.

As illustrative of the scope of the laboratory may be mentioned the chemical study of the water from the several sources used for drinking purposes in the District of Columbia; the examination of drugs and of pathological specimens, such as urine, gastric contents, etc., and a number of biochemical studies particularly on subjects related to experimental medicine and pathology.

Chemical laboratories are maintained in connection with the offices of the United States Customs Appraisers at the ports of New York, Boston, Philadelphia, New Orleans, Chicago and San Francisco. With the exception of that at New York, the chief work of these laboratories is the polarization of sugar. At the present time a laboratory is also maintained at Kansas City for the assay of imported ores. Approximately, seventy per cent. of the importations of the entire country are entered at New York, and in addition to the analyses of such goods, many of the chemical problems of other ports are referred to the New York laboratory. Again, many shipments of exported goods, manufactured of imported materials under drawback regulations are examined.

The work of a customs laboratory covers a very wide range and includes all imported products in the classification and valuation of which the laboratory can assist.[3] The examination required is usually superficial, frequently but a single determination being necessary. It is apparent that the work of such a laboratory is essentially routine, but that new problems requiring originality and resource must frequently arise.

NAVY

The Navy Department maintains laboratories at the Washington, New York, Boston, Norfolk and Mare Island Navy Yards, at the Newport Torpedo Station and the Naval Proving Ground at Indian Head, Maryland. At the Navy Yard laboratories a wide range of products is examined including steel, iron, all kinds of alloys entering into the construction of guns and carriages, and supplies needed in machine shops and on the boats of the Navy. These supplies include lubricating and other oils, coke and coal, rubber goods for different purposes, paints, cements and other building materials, water and office supplies.

INTERIOR DEPARTMENT

The chemical laboratory of the Geological Survey examines rocks, minerals, clays, ores, waters, coal, etc., for the purpose of assisting in the geological problems of the survey and to determine the extent of the diffusion of the elements in nature. In this laboratory many important researches of quite varied character are conducted.

The technical branch of the survey also maintains laboratories, especially at Pittsburg, for the examination of coal and structural materials.

The water supply branch of the survey maintains a laboratory for the investigation of waters and has the cooperation of chemists at a number of points in the United States. Their work is largely the analysis of river waters in connection with irrigation problems, sanitary problems and the measurement of the amount of material removed from the soil by streams.

DEPARTMENT OF AGRICULTURE

Among the investigations now being conducted by the Bureau of Chemistry of the Department of Agriculture, the following may be mentioned: The study of the composition, character, and methods of manufacture and preservation of food, both from an economic standpoint and to de-

[3] Moore, *Jour. Soc. Chem. Ind.*, 1900, 19, 323–4.

termine their influence upon nutrition and health; the inspection in connection with the enforcement of the federal food and drugs act, of foods and drugs sold in interstate commerce and in the District of Columbia and the territories; the study of the influence of environment upon the composition of agricultural products; the study of conditions relating to the several saccharine products such as syrup, molasses, sugar and honey; the chemical questions relating to the dairy industry; the effect of trade wastes on forests and agricultural products as, for instance, the effect of smelter fumes on vegetation and animals; the influence of chemical preservatives and colors on nutrition and health; the influence of cold storage preservation on the composition of foods; chemical-technical problems relating to the leather and paper industries; and certain studies in enological technology.

The functions of the bureau also include a wide range of routine work. In addition to the analyses of products coming naturally within the scope of the department of Agriculture, the bureau is especially authorized by congress to examine the supplies of other departments of the government such as foods for the Army, Navy and Panama Canal Commission; post-mark and cancelling inks, inking pads, glue, glycerin, soap, lubricating oils, and linoleum used by the Post-Office Department; disinfectants, lubricating oils and coals used by the government hospital for the insane; dry colors, oils, glue, soap, steel, and miscellaneous supplies used by the Bureau of Engraving and Printing; gums, oils, and alloys used by the Government Printing Office; writing inks, typewriter ribbons, carbon papers, etc., used in the various executive departments where permanence of records is essential; paints, oils, varnishes, chemical glassware and other apparatus used in the Department of Agriculture, and assistance is occasionally given the Treasury Department in the examination of materials regarding which there has arisen a question as to classification for dutiable purposes.

For purposes of administration the bureau is divided into two divisions, seven laboratories and four sections in Washington, and sixteen food and drug inspection laboratories and two sections for special investigations are maintained in other cities.

The Biochemic Laboratory of the Bureau of Animal Industry is charged with the examination of stock dips and with other chemical studies relating to the work of the bureau. The work of the laboratory includes a large number of routine analyses for which branch laboratories are maintained in various parts of the United States. Much routine and research work connected with biochemical problems is also conducted.

The chief effort of the chemical laboratories of the Bureau of Soils has been the application of the methods of physical chemistry to the problems of the soil. The routine work of the laboratories includes the examination of soils, fertilizers and irrigation and drainage waters to meet the demands of the field forces of the bureau. The following investigations serve to illustrate the nature of the research work that has been done: The solubility of the mineral and organic components of the soil and the physical-chemical characteristics of the resulting solution; the study and practical application of the chemistry of alkali, common carbonates and gypsum, the reclamation and utilization of mine runnings and waste waters for irrigating purposes; and studies relating to humus, the iron compounds of the soil, absorption and toxicity.

The forest service of the Department of Agriculture maintains a chemical laboratory whose province it is to study the chemical composition of wood in all forms including studies on wood distillation, the analysis and standardization of timber preservatives, the estimation of the tannin and cellulose content of wood and bark, bleaching experiments, etc., and to conduct investigations covering the utilization of various woods and saw-mill waste for paper pulp and allied products. One of the important objects of this laboratory is to experiment on the pulp-making possibilities of various woods with a view to obtaining: First, a pulp with which it will be practicable to replace spruce pulp, the supply of which has notably diminished; second, other pulps that may have properties particularly adapted to the manufacture of special kinds of paper; third, a pulp of marketable value as a by-product from the waste material from saw mill and lumbering operations.

The Office of Experiment Stations of the Department of Agriculture does not maintain a laboratory but employs a number of men with chemical training in connection with the publication of the *Experiment Station Record* and other publications relating to chemical matters. The work of this office is of special interest because of its intimate connection with the forty-eight state agricultural experiment stations of the United States. Although these stations are in part maintained by funds appropriated by congress they are not under the supervision of the federal government, and for that reason can not receive more than a passing notice in this connection.

COMMERCE AND LABOR

The chemical laboratory of the Bureau of Standards has a considerable amount of routine work in the examination of supplies—chiefly for the Department of Commerce and Labor. Its principal work, however, is of a research character including, among other lines, the preparation and examination of substances employed in the construction of standard electrical cells and the investigation of methods used in technical analysis and in the examination of chemical reagents for the purpose of improving their standards of purity.

I have stated briefly the aim and character of the work done in those government laboratories to which appointments are most frequently made, and have given as complete an idea as I could in the time at my disposal of the opportunity they offer for study and research.

Practically all appointments are made from the eligible lists of the Civil Service Commission. The only exceptions are those of chemists whose training and experience peculiarly qualifies them to undertake some special problems and whose appointments are temporary. The examinations from which such eligible lists are established may be broadly divided into four classes.

1. *Those occasioned by vacancies in positions of unusual responsibility or requiring exceptional training and experience.* Examinations of this type are frequently "non-assembled" and no practical questions are asked. Applicants are rated on the courses of study they have completed and especially on the work they have done. The degree of doctor of philosophy or its equivalent is commonly essential to eligible rating in educational requirements. Under educational qualifications it is obvious that only that work can be recognized for which credit has been received from reputable colleges or universities. Unfortunate as it may be, it is impossible to rate statements of applicants regarding independent study or regarding partial courses in educational institutions from which no credit has been received. Experience is rated, especially in the case of younger men, on

the basis of work done under the direction of, or in connection with, experienced chemists, and in laboratories of known reputation. The fragmentary work of teachers who, immediately after their graduation, are thrown upon their own resources and make occasional investigations or analyses in their spare time, can not be rated in an examination unless its value can be demonstrated by the applicant by means of references to publications or otherwise. Such experience is not to be compared with that of chemists whose entire time is devoted to research or analytical work and whose chief effort is given to the study of new problems, the economy of time, the increase of the volume and accuracy of their work, and the improvement of their laboratory technique.

Emphasis is frequently placed on the original contributions applicants have made to scientific literature, which serves as a measure of their ability to meet new conditions and to report the results of their investigations. The evidence they produce of executive ability is rated and their experience in the particular line for which the examination is given. This type of examination gives the most satisfactory results, and is usually given to fill positions paying a salary of $2,000 or more.

2. *Examinations for experienced and skilled analysts.* In such examination are rated the educational qualifications of the candidates and their experience, particularly in analytical chemistry. Education and experience are usually rated together.

Practical questions are also given in examinations of this type. The questions are chosen with a view to affording a fair test for chemists who have been in practical work for a number of years and to include fundamental principles and methods. The statement is frequently made that examinations place experienced chemists at a disadvantage as compared with recent graduates. While this is true, to a certain extent, the questions given in this type of examination call for a familiarity with analytical chemistry which is rarely acquired by the student and are of a type that any efficient analytical chemist should be able to answer. Moreover, the emphasis placed on education and experience when rating these papers is sufficient to make it practically impossible for a graduate who has not had analytical experience to obtain an eligible rating. The degree of bachelor of science or its equivalent and postgraduate study or practical experience are usually necessary to obtain eligible rating. A special course, incomplete in itself or not preceded by the full training of the secondary schools, will not answer. A mark of seventy per cent. in education and experience is often required for admission to examinations of this type. In such cases a statement of that fact is made in the published announcements. Even when such requirement is not made, the rating given for a degree following a course of two or even three years is so low that such an applicant must make an unusual showing in his replies to the practical questions to obtain an eligible rating in this examination. An application is useless from one whose only collegiate training was a two or three year course, the entrance requirements of which are inferior to those of reputable institutions giving the degree of bachelor of science.

The applicants who stand among the first on the eligible list established by an examination of this type are commonly paid a salary of from $1,400 to $1,800. Other appointments at a lower salary are also frequently made from the same lists.

3. *Examinations to establish an eligible list from which subordinate appointments may be made.* These examinations are given for the purpose of affording an opportunity to recent graduates in chemistry

whose practical experience has been limited. Those who have had practical experience of course receive a higher rating in education and experience, but a passing mark in education and experience is given for a degree of Bachelor of Science or its equivalent from a creditable institution giving a course in chemistry of approximately three years with nine recitation hours a week—three laboratory hours being equivalent to one recitation hour. A higher rating is given those who have had postgraduate experience. In this class of examinations an eligible rating in education and experience is not required, but a low rating in that subject may be compensated by a high mark in practical questions. The practical questions asked in these examinations are of a different character from those of the second class, and it is believed that they are better adapted to the class of chemists for whom they are intended. It is from the eligible list established by this examination that the great mass of appointments to subordinate positions in the various laboratories is made. The salaries paid usually range from $840 to $1,200 per annum.

4. *Examinations for analysts qualified in a special (sometimes narrow) field of work.* Examinations of this class are relatively infrequent and are held for the purpose of supplying needs that sometimes arise in some of the laboratories of the government service for men competent to perform analytical work in some narrow field, but whose services in other branches of chemistry will not be required. The eligible lists so created are not commonly used for appointments in other branches of the service.

It must not be understood that there is a definite system of examinations and that each examination is made to fit into one of the types given above. An examination is usually called to fill a particular vacancy, although it is understood that after that vacancy is filled the list may be used to make other appointments for which the same or lower qualifications are required in the same or other departments. It would not be within the civil service rules, however, to appoint an assistant to the laboratory of the supervising architect's office who has passed an examination calling for widely different qualifications; for instance, an examination in dairy chemistry.

Transfer from one laboratory to another within the same department is possible at any time when the good of the service does not suffer thereby. Such transfers are sometimes made but are rather unusual. Transfers from one department to another are unusual and can not be made within three years of the date of appointment.

Examinations for chemical positions are not given regularly as is true of examination for clerks. They are given at irregular intervals as need arises, sometimes as many as six or eight chemical examinations of various character occurring in a single year. The civil service commission publishes an announcement of each examination and sends it to all applicants. These announcements are also sent to educational institutions throughout the country. They are also published in Science. No information regarding examinations is given except that stated on the announcement just mentioned. No definte information is given regarding the character of the questions that will be asked. No copies of questions asked in former examinations are supplied. No information can be given out by the laboratory for which the examination is called other than that contained in the published civil service announcement. It is held that variation from this principle would give an unfair advantage to those who happen to receive it. It is believed that the class of men desired are able to pass the examinations without special preparation, and it is not desired to afford any particular opportunity for such preparation.

With the exception of a few small laboratories where the field work is limited and promotion is not offered, the great majority of appointments to the various government laboratories are to subordinate positions and higher positions are filled by promotion whenever possible. Special qualifications are, therefore, not usually required.

I wish to emphasize the fact that every appointee should have pursued a broad general course of study. The argument is frequently made, and it is doubtless true, that the work for which the majority of appointments are primarily made, that is, the ordinary routine work of the laboratory, could be as well performed at the beginning by men who are not college graduates, and frequently by men whose training in chemistry itself has been very incomplete. It is found, however, that while such men may be satisfactory at the beginning, their potential power is limited. Men with special training are frequently desired for the purpose of conducting special investigations. This special training, however, should have been received in post-graduate study. The ability to conduct research work that is constantly required, the resource essential to emergencies and even the initiative required by those who take a responsible part in the routine work of the laboratory are rarely secured except in men with broad fundamental training.

W. D. Bigelow

THE AMERICAN SOCIETY OF ZOOLOGISTS

II.

A Comparison of the Cephalic Organs in Certain Sipunculids: John H. Gerould, Dartmouth College.

A comparison was made between the cephalic organs in *Phascolosoma verrillii*—an undescribed species from Vineyard Sound and Buzzards Bay, covered with prominent papillæ and characterized by having only a single pair of retractor muscles (ventral)—and the corresponding organs in *Sipunculus nudus* and in other forms.

P. verrillii has not only the ciliated nuchal organ of other *Phascolosomas* (*P. gouldii, P. vulgare*) but also a *cerebral organ,* that lies superficially between the nuchal organ and the mouth. In a young (postlarval) individual it forms a rounded elevation of surface epithelium dorsal to the mouth, but ventral, or oral, to the nuchal organ. In the adult (*P. verrillii, P. gouldii*) it becomes less conspicuous and elongated transversely in the frontal plane. It is closely connected with the brain (supra-esophageal ganglion) by a pair of large lateral cords containing (1) a pair of ocular tubes, which open dorso-laterally upon the surface of the cerebral organ, and (2), mesial to each ocular tube, the special neurones and a pair of sensory pits of the cerebral organ itself.

The cerebral organ in *Sipunculus nudus,* as Ward and, later, Metalnikoff have shown, projects into the bottom of a long tube which, opening upon the dorsal surface of the body slightly behind the tentacles, runs backward and inward to the cerebral organ. The latter and the corresponding organ upon the surface of the head in *Phascolosoma* have precisely similar relations to the brain; and ocular tubes open upon the surface of the cerebral organ in both forms. *Phymosoma* (*Physcosoma*) *varians,* as described by Shipley, shows an intermediate stage between the primitive condition in *Phascolosoma,* in which the cerebral organ is superficial, and that in *Sipunculus.*

Ocular tubes with pigmented walls were found in a specimen of *Sipunculus nudus* from Beaufort, N. C., opening ventrolaterally upon the surface of the cerebral organ and running backward into the substance of the brain. The photic organs of *Sipunculus,* which hitherto have not been positively recognized, resemble those of *Phymosoma,* as described by Shipley; those of *Phascolosoma verrillii* differ from them in being relatively much larger and more highly developed, having in the middle of the ocular tube a spindle-shaped lens. The walls of the posterior part of each ocular tube are composed of long conical pigmented cells, of which the bases abut against the tube, the apices radiate into the surrounding tissues of the brain. Neurones with cylindrical distal ends, covered with longitudinal fibrillæ, lie in a group behind and below the posterior end of each ocular tube. They are probably adapted to receive photic stimuli, the impulse being transmitted from them, mainly over bipolar neurones, directly to the retractor muscles. The reaction time of these muscles to photic stimuli, in *P. vulgare* at least, is notably less than that of the longitudinal muscles of the body wall.

Parallel Development in Trematodes: H. S. Pratt, Haverford College.

When a genus of trematodes is widely distributed over the earth it is probable that the species constituting it are not necessarily closely allied, but have, in certain cases at least, acquired a similar structure because they have been subjected to similar conditions of life through long periods of time. Thus the four species of the genus *Fasciola* inhabit the gall-passages of large herbivorous mammals in the four largest continents, and the ten species of the genus *Pneumonœces* living in the lungs of frogs and toads are almost as widely distributed. It is hard to see how the species in each of these genera, as well as in others that might be mentioned, could be descended from a common ancestor and have migrated from a common center to the localities where they are at present found, since the conditions of existence of a trematode, bearing as it does a fixed and very definite relation to two hosts, make migration a difficult matter for it. On the other hand, trematodes living in the livers of large herbivores or in the lungs of frogs and toads, even in very different parts of the world, have been subjected to identical and constant environmental conditions while passing through their phyletic developmental stages, with the result that they are now so similar in structure that they are classified in each of these cases in the same genus.

The Distribution of the Amphipods occurring in Bermuda: B. W. Kunkel, Yale University.

The most interesting fact regarding the occurrence of the littoral amphipods of Bermuda is the large number of species which are also found in the Mediterranean. Of the 45 species, representative of 27 genera, which have been found in Bermudian waters, besides one species of *Cyamus* reported by Verrill from a whale landed at St. Georges, nearly one half (20–21) are common Mediterranean forms. Only four Bermuda species, which are not endemic, are wanting in the Mediterranean. Twenty species are apparently peculiar to Bermuda.

The amphipods of the West Indies and Central America, with which the Bermuda forms probably are most closely related, have not been at all carefully studied, so that at the present time it is impossible to draw any conclusions regarding the exact relationship of the two faunæ.

Next to the Mediterranean, the region which presents the greatest number of species in common with Bermuda is Great Britain with 14 species; then follows the coast of France, Spain, and the Netherlands with 11; and then Scandinavia with 10 species. From Oceania have been collected 10 or 11 species which are known also in Bermuda, from the Red sea 7, and from the Indian Ocean 5. Six of the Bermuda species are essentially world wide in their distribution.

Individual Action of the Ganglia of the Razor-shell Clam, Ensis directus: Gilman A. Drew, University of Maine.

Although accessory ganglia are reported to occur on the cerebro-visceral connectives of Solen, serial sections and dissections have not shown them in this form.

Both cerebral and visceral ganglia are able to receive sensory impulses and to send out motor impulses, when isolated from other ganglia. When the cerebro-pedal connectives are cut, stimulation of the surface of the foot causes only local contractions. The foot as a whole does not respond. This seems to indicate either that the pedal ganglia have no motor cells or that the sensory neurons from the foot are continued through the pedal ganglia to the cerebral without endings or collaterals. The latter arrangement seems more probable for the following reasons: (1) Many ganglion cells are present in the pedal ganglia and sensory cells alone would hardly be expected in such a muscular organ as the foot. (2) Cutting the cerebro-pedal connectives causes tetanic contractions of the whole foot and not single twitches. (3) With both cerebro-pedal connectives cut, stimulation of one connective causes complete contraction of the whole foot, an action that is very different from that obtained by stimulating the pedal nerves of one side after they have been separated from the ganglia. This seems to show that the stimulus is received by the ganglia and referred by association fibers to the motor cells that control the movements of the entire foot.

The Physiology of the Stomach of Higher Crustacea: Leonard W. Williams.

The cardiac canals described by the author in the lobster's stomach have been found also in *Astacus, Cambarus, Nethrops, Squilla* and in the fiddler, common, spider and hermit crabs. The lower canal alone exists in the isopod *Idothea* and in the amphipod *Talorchestia.* The general occurrence of these canals in higher crustacea, as well as in larval lobsters, indicates their physiological importance. It is believed that they bring to the pyloric cushions or pads the nutrient fluid and suspended particles which are freed by the gastric mill and which enter the canals between the closely interlocking bristles of the side and floor of the cardiac sac. In the pyloric cushions, the fluid is again filtered and then enters the large digestive gland ("liver"), while the particles caught in the cushion are carried backward into the hind gut.

Relation of Instinct to Intelligence in Birds: Francis H. Herrick, Western Reserve University.

The Breeding Habits of the Loggerhead Turtle and Some Early Instincts of the Young: Davenport Hooker, Yale University.

The breeding season of the loggerhead turtle lasts through the months of April, May and June. There seems to be basis for belief that two nests are laid in a season by each female. The number of eggs laid is approximately one hundred. The period of incubation lasts about fifty days.

Experimentation on the newly-hatched young gave results which may be briefly stated as follows: (1) They have an inherent tendency to descend inclines and are positively phototropic. Both tendencies may act together, the first, however, slightly dominating the second. By means of these tendencies the young turtles find the water. (2) After twelve hours at the outside, their phototropism is lost. (3) Swimming and floating are congenital instincts, but diving is a process which must be learned. (4) After entering the water, there is a definite period of "getting out to sea," as it were, followed by a definite period of rest. (5) The edibility of each object encountered is tested, *i. e.*, there is no instinctive selection of a particular food.

The Experimental Control of Asymmetry at Different Stages in the Development of the Lobster: V. E. EMMEL, Harvard Medical School.

A series of experiments were made at the following stages in the development of the lobster: (1) the second larval stage, (2) the fourth stage, (3) fifth stage, (4) twelfth stage or year-old lobsters. All of these experiments attempt to determine to what extent asymmetrical differentiation of the chelæ can be controlled by the amputation of one chela, thus giving the remaining chela the greater opportunity for growth.

The results of these various experiments support the following conclusions:

1. That in the first four larval stages of the lobster, the development of right or left asymmetry can be controlled by the amputation of one of the chelæ.

2. During the fifth stage the controlling influence of such amputations disappears.

3. In later stages when the asymmetry of the chelæ has become normally established, the amputation of neither one nor both chelæ will produce a reversal of asymmetry.

4. And finally, since up to the fifth stage either right or left asymmetry of the chelæ can be produced at the will of the experimenter, this asymmetry does not appear, therefore, to be directly predetermined or inherited, but may be controlled by factors arising in the course of development. What these factors are, has not been determined, but the present results do not indicate that they are "an inverse organization" of the egg, or an "alteration in the localization of germinal substances."

The Specific Gravity of the Constituent Parts of the Egg of Chætopterus and the Effect of Centrifuging on the Polarity of the Egg: F. R. LILLIE, University of Chicago. (To be published in the Proceedings of the Central Branch.)

Instance of a New Species of Crustacean, apparently in Process of Evolution: ADDISON E. VERRILL, Yale University.

An account was given of a peculiar race of the grapsoid genus, *Sesarma*, studied in Bermuda, in 1901. The common species in Bermuda (*S. Ricordi*) lives ordinarily at and just above high-tide level, within easy reach of water. It is often seen running actively about among the stones and dead seaweeds. It may almost always be found under masses of *Sargassum* cast up on the shores, as well as under stones.

The new form seems to be a subspecies of a variety of *S. Ricordi*, which may be actually in process of development into a genuine species, by natural selection and physiological isolation.

It was found living under stones in dry upland fields and nearly barren waste lands with thin soil, where the scanty vegetation consisted of wiry grasses and dwarfed shrubs and weeds. It was associated with a few species of ants, beetles, cockroaches, spiders, land-shells, etc. When the stones were turned over it usually ran away very actively and sought shelter under other stones, but did not seek the water, as most species do. Its general appearance was very unlike *S. Ricordi*.

The carapace appears more rough and

uneven than in the ordinary form, for it is more strongly areolated and the branchial areas are more swollen, so that the vertical thickness is greater and the reticulated areas of the sides are broader, giving a larger surface for aeration of the water, and indicating larger gill-cavities and gills. The dorsal surface of the carapace is covered with more numerous and larger granules, bearing numerous short dark hairs, very evident under a lens of low power, and capable of holding adherent dirt.

The ambulatory legs are distinctly larger and longer than in the common form. The proportion of the merus joints of these legs to the breadth of the carapace is 1:1.36. In *Ricordi,* 1:1.5.

The colors, when living, appear dull or sordid yellowish brown, or mud-color, due partly to adherent dirt, but often specked or mottled with red or reddish brown.

It is not improbable that it has the habit of eating different food from its parent species, and also a somewhat different breeding season, so that the two forms may no longer interbreed. This could not be determined at the season of the year when we were in Bermuda.

The young crabs, moulting from the megalops at the shore, have evidently inherited the instinct to seek the higher and drier localities, where they probably have fewer enemies. The modifications that have taken place are in accordance with the change in habitat. The increased hairiness of the carapace and legs serves to retain the dirt that aids materially in their concealment when exposed. Probably they feed mostly at night. The larger gill capacity and longer legs have evident advantages.

That it is not a casual or transitory variation is evident from the fact that there are, in the museum of Yale University, several good, characteristic, adult specimens sent to us before 1866 (perhaps collected as early as 1855), by J. Matthew Jones, Esq., who resided in Bermuda for many years, during the colder seasons, and whose first book on Bermuda was published in 1859.

The evolution and habits of this race of crabs would furnish a good subject for investigation by some one connected with the Bermuda Biological Station. The varietal or subspecific name, *terrestris,* indicating its marked terrestrial habits, is given to it by the author.

The Meaning of the Color Variations of Litorina palliata: F. B. Sumner and Jas. W. Underwood.

This mollusk offers a striking example of apparent protective coloration, nearly all of its varieties harmonizing beautifully with one or another part of the rock weed on which it dwells. This resemblance relates not only to the general color, but to the shape of the shells, which, on their natural background, strongly suggest the floats of the weed. On analysis, however, the popular explanation of the phenomenon as due to the natural selection of the more favorably colored individuals, seems far from certain. (1) There is no tendency whatever for the mollusk to choose a background resembling its own particular color rather than one conspicuously unlike it. (2) In nature, the red and brown shells are found statistically to be present in about the same proportions on the *Ascophyllum* as on the *Fucus,* although the latter alone displays red or brown tints in its foliage. (3) The green element in the color of many of the shells, which is an important factor in bringing about the harmony with their surroundings, is found to be due to certain algæ inhabiting their superficial layers. It is thus an entirely adventitious color, and these same algæ are found in abundance on other shells, dead or alive. (4) Another mollusk of this genus, *Litorina rudis,* displays nearly all of the color variations to be found in *palliata,* yet *rudis* lives on the bare rocks, and is very seldom found upon the weed. (5) Experiments (still incomplete), in which the mollusks were exposed to the attacks of the tautog, point to the conclusion that this fish is nearly or quite as likely to pick out one of the mollusks from a background of a harmonious color as from one which is not in the least harmonious.

Some Experiments in Heredity in Mice: T. H. MORGAN, Columbia University.

A wild "sport" of the house mouse, having a pure white belly, slightly yellowish flanks, and gray dorsal surface, was crossed with the principal types of domesticated breeds (black, chocolate, white) having uniform or self-colored coat. The white belly dominates in the first generation, although the spotted coat of domesticated races is recessive to the uniform coat. Thus the same character, viz., spotted coat, is dominant in one form and recessive in the other. When the sport with white belly is crossed with domesticated spotted mice the white-bellied character dominates. Crosses between the sport and yellow mice give some yellows. These are whitish below, but appear to show no more white than do ordinary yellows, so that it is not possible to ascribe the result to the dominance of the sport. The absence of a sharp line in the yellow hybrids between the yellow and white would seem rather to indicate that the yellow coat as a whole dominates the spotted coat of the sport, which seems paradoxical in the light of the relation of the spotted coat of the sport to the uniform coat of other colors. Cuénot's important experiments with yellow mice have shown that mice of this color always throw mice of other colors in definite proportions. He accounts for the result on the basis of selective fertilization—a yellow-bearing germ cell never fertilizing another yellow-bearing germ cell, but always one bearing another color. The following result shows that the peculiar behavior of the yellow color in inheritance is not due to selective fertilization, but to a different condition. A yellow mouse crossed with a black-and-white waltzer of pure strain, produced some yellows. A pair of these yellows inbred gave yellow, black, chocolate and albino mice. The result shows on analysis that the yellow germ cells must carry other colors, as well as yellow, and that these colors reappear in the next generation.

The Limb Muscles of Necturus, and their Bearing upon the Question of Limb Homology: H. H. WILDER, Smith College.

The bones and muscles of the distal half of both fore and hind limbs in *Necturus* were reviewed by means of charts and drawings. These show a remarkable degree of correspondence, extending often to minor details, but there is no such correspondence in the proximal portion (proximal to elbow and knee).

This almost perfect correspondence in the case of what is perhaps the most primitive land vertebrate is of far more significance than if we had found it in some modified form, and suggests very forcibly the serial homology between the limbs of the same side, and in the normal position (syntropism). Certainly, if we recognize an homology between the very variant appendages of the decapods, we can hardly refuse it in the case of this primitive salamander. There is at present the greatest need of a universal set of terms to be applied equally to similar parts in the fore and hind limbs of vertebrates, but this manifestly rests upon the establishment of a scheme of limb homology that can be generally agreed upon.

That such a nomenclature is possible for *Necturus* was demonstrated by the employment of one in the descriptive part of the present paper. The confusion resulting from a lack of such a set of terms was shown by the reading of the first paragraph from a recent paper by Baum (*Anat. Anz.*).

Distribution and Variations of the Deep-sea Stony Corals from off the Coast of the United States: Addison E. Verrill, Yale University.

In this paper distribution was given of the fourteen species of stony corals (*Madreporaria*) dredged by the U. S. Fish Commission in deep water, from off Cape Hatteras to the Newfoundland Banks, with illustrations of some of the more notable variations by means of lantern slides. Several of the species descend to depths below 1,000 fathoms; one was taken in 1,742 fathoms. Most of those from the greater depths have a very wide geographical range, some of them being found from the Gulf of Mexico to the Arctic Ocean, and on both sides of the Atlantic. Among those from the greater depths are the following: *Flabellum Goodei,* 164 to 1,178 fathoms, from over 100 stations; *F. angulatum,* 906 to 1,742 fathoms, most abundant at 1,396, 1,434 and 1,722 fathoms, taken at 14 stations; *Caryophyllia communis,* from 636 to 1,356 fathoms, 13 stations; *Desmophyllum cristagalli,* from 1,054 to 1,060 fathoms, 2 stations.

Habits, Reactions and Mating Instincts of the "Walkingstick," Aplopus mayeri: Chas. R. Stockard, Cornell Medical School.

The habits of *Aplopus* on its food-plant *Suriana maritima* are as protectively adapted as is its singular stick-like appearance. In color and form the large female resembles the stems of this plant, the males are greenish and inconspicuous among the leafed twigs, while the eggs are peculiarly similar to the seed of *Suriana* in size and color. This insect is nocturnal, moving only occasionally in the daylight. It walks in a slow stiff manner, often swinging its body from side to side, suggesting the motion of a branch shaken by the wind. To escape its enemies the insect may drop from its position and become lost among the lower branches, or may fall entirely to the ground and lie motionless, feigning death for several minutes.

Aplopi respond to light and darkness, being more sensitive to the former. When they are blinded by painting their eyes they still respond, though slower than when normal.

These insects during the day, while inactive, may be made to assume an endless variety of awkward positions, any of which may be maintained for some time. They may actually be piled over one another with their backs down and legs extended in the air as if they were inanimate sticks. This stick-like indifference often causes them to be passed unnoticed by enemies.

When the animal walks its antennæ are circled in front of the head as if feeling the way. On removing the antennæ the first pair of legs are used as "feelers," if these are now cut away the legs of the second pair are pressed into service and alternately waved about as "feelers." When such a four-legged antennaless individual has its eyes blinded it becomes confused and turns in a circle, but improves in its movements with practise.

A portion of the abdomen of a mature female was attached to a stick supported on wire legs thus forming an imitation female. Males in a dark room were found to mate in a normal manner with this abdomen on the stick. Such an experiment makes it evident that a courtship or psychical response is not essential between the sexes in mating.

Some Notable Cases of Radical Variation and Regeneration in Starfishes and Ophiurans: Addison E. Verrill, Yale University. (Read by title.)

The following demonstrations were exhibited:

Some Maturation Stages of the Mouse Egg: J. A. Long (by E. L. Mark).

Preparations showing the Maturation, Fertilization, and Cleavage of the Eggs of the Mouse and Rat: Wesley R. Coe and W. B. Kirkham.

The Organ of Claus in the Copepod Eucalanus: C. O. Esterly (by E. L. Mark).

Photographs of Triplet Calves: Raymond Pearl.

Photographs of Wing of Fowl with Three Extra Digits: Gilman A. Drew.

A Series of Embryos of the Loggerhead Turtle: Davenport Hooker.

Model of a Portion of the Lumen of the Spermatophoric Gland of the Squid: L. W. Williams.

Color Variations of Litorina palliata: F. B. Sumner and J. W. Underwood.

Morphological Variation during the Life-Cycle of Infusoria: Lorande Loss Woodruff.

Lorande Loss Woodruff,
Secretary

Yale University

THE AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS

The first annual session of the American Society of Biological Chemists was held at the University of Chicago during convocation week, from December 30, 1907, to January 2, 1908, inclusive. Four meetings were held, with the scientific programs indicated below:

First Meeting

Physiology Building. Monday afternoon, December 30, 1907.

Presiding officer: The president, Russell H. Chittenden.

Program

"The Rate of Oxidation of the Sugars in an Acid Medium," by H. H. Bunzel (by invitation).

"On the Efficiency of Thymol and Refrigeration for the Preservation of Urine, as shown by Comparative Analyses for the Various Nitrogenous Constituents at the End of 24, 48, 72 and 96 hours," by P. B. Hawk and H. S. Grindley.

"Comparative Tests of Spiro's and Folin's Methods for the Determination of Ammonia and Urea," by Paul E. Howe and P. B. Hawk.

"A Study of the Relative Therapeutic Value of Antitoxic Globulin Solution and the Whole Serum," by Edwin J. Banzhaf (by invitation).

"The Quantitative Changes during Immunization in the Blood of Horses and the Relation of the Serum Globulin to Diphtheria and Tetanus Antitoxin Content," by Edwin J. Banzhaf and Robert B. Gibson.

"The Compressibility of Gelatin Solutions and of Muscle," by Lawrence J. Henderson and F. N. Brink.

"The Efficiency of the Neutrality Regulation in the Animal Organism," by Lawrence J. Henderson.

"On Glycosuria," by Hugh McGuigan.

"A Comparison of Waymouth Reid's and Schenck's Methods for the Estimation of Sugar in Blood," by J. J. R. Macleod.

"Eosinophilia and Indicanuria," by C. H. Neilson.

Second Meeting

Physiology Building. Tuesday morning, December 31, 1907. Joint session with the American Physiological Society.

Presiding officers: The president of the American Society of Biological Chemists, Russell H. Chittenden, and the president of the American Physiological Society, William H. Howell.

Program

"Protein Metabolism in Fasting," by Otto Folin.

"Experimental Glycosuria," by J. J. R. Macleod.

"Further Observations on the Parenteral Utilization of Carbohydrates," by Lafayette B. Mendel.

"Preliminary Report of Certain Investigations as to the Nature of Peptones," by Howard D. Haskins.

"The Spontaneous Oxidation of Some Cell Constituents," by Albert P. Mathews, O. Riddle and S. Walker.

"The Fats and Lipoids of Malignant Renal Hypernephromas," by H. Gideon Wells.

"Protein Metabolism in the Dog. II. The Influence of Low Caloric Values of Nitrogen on Metabolism," by Emil Osterberg and Charles G. L. Wolf.

"Further Communication on the Effect of Vagus Inhibition on the Output of Potassium from the Heart," by W. H. Howell and W. W. Duke.

"On the Chemical Study of Mental Disorders," by Waldemar Koch.

"Concerning the Pharmacological Action of Potassium Iodide," by L. B. Stookey and V. Gardner.

"On the Composition of Normal Lymph from the Neck Lymphatics of the Horse," by J. R. Greer (by invitation).

"The Presence of Glucose in Saliva," by J. G. Ryan (by invitation).

"The Antagonistic Action of Calcium upon the Inhibitory Effect of Magnesium," with a demonstration, by S. J. Meltzer and John Auer.

Third Meeting

Kent Chemical Building. Wednesday morning, January 1, 1908. Joint session with the Biological Section of the American Chemical Society in affiliation with Section C (Chemistry) of the American Association for the Advancement of Science.

Presiding officers: The president of the American Chemical Society, Marston Taylor Bogert, and the president of the American Society of Biological Chemists and chairman of the Biological Section of the American Chemical Society, Russell H. Chittenden.

Program

President's Address: "Some of the Present-day Problems of Biological Chemistry," by Russell H. Chittenden. (Published in Science, XXVII., p. 241, 1908.)

"On the Passage of Substances into the Human System by Osmosis," by Louis Kahlenberg.

"The Isolation and Toxic Properties of an Organic Soil Constituent," by Oswald Schreiner and Edmund C. Shorey.

"Toxic Substances Arising during Plant Metabolism," by Oswald Schreiner and M. X. Sullivan.

"Bacterial Growth and Chemical Changes in Milk Kept at Low Temperatures," by M. E. Pennington.

"The Chemical and the Physiological Properties of a Solution of Hydrochloric Acid and Sodium Chloride," by Amos W. Peters.

"Endo and Ekto Invertase of the Date," by A. E. Vinson.

"Glycocoll as a Product of Uricolysis," by L. B. Stookey.

"A Study of the Influence of Potassium Cyanide on the Excretion of Nitrogenous Substances in the Urine of Dogs," by William H. Welker.

"A Demonstration of a Method (with apparatus) of showing the Electric Charges of Colloids," by A. B. Macallum.

"The Protein of Tumors," by S. P. Beebe.

"Iodic Determination in the Thyroid Gland," by S. P. Beebe and L. W. Riggs.

"On the Action of Nitric Acid on Nucleic Acids," by Walter Jones.

"On the Occurrence of a Phytin Splitting Enzyme in Animal Tissues," by E. V. McCollum and E. B. Hart.

"Nitrogen in Protein Bodies," by Thomas B. Osborne and C. A. Brantlecht.

Fourth Meeting

Physiology Building. Thursday morning, January 2, 1908.

Presiding officers: The president, Russell H. Chittenden, and the vice-president and president-elect, John J. Abel.

Program

"The Extraintestinal Origin of Hydrobilirubin," by A. E. Austin and Mabel D. Ordway.

"On the Alleged Formation of Bile Pigments and Bile Acids by the Action of Trypsin on Hemoglobin," by Frederick S. Hollis (by invitation).

"On the Excretion of Hexamethylentetramin in the Bile and Pancreatic Juice," by S. J. Crowe (by invitation).

"The Digestive Gland of the Crawfish," by H. C. Bradley (by invitation).

"On the Effect of Certain Conditions upon Postmortem Autolysis," by Holmes C. Jackson.

"The Peroxidase Reaction of Milk," by J. H. Kastle and M. B. Porch.

"The Effect of Castration on Metabolism," by Francis H. McCrudden.

"Experiments upon the Metabolism of Phosphorus in Man," by H. C. Sherman.

"On Turgor Pressure in Wounded Plant Tissues," by Herbert M. Richards.

"The Probability of a Radiotropic Response," by C. Stuart Gager.

"A Further Study of Solution Tension and Toxicity in Lipolysis," by Raymond H. Pond.

"Notes on the Chemical Nature of Egg Cases of Two Species of Sharks," by Louis Hussakof and William H. Welker.

"A Comparative Study of the Hydrolysis of Different Proteins in Pepsin-acid Solutions," by William N. Berg.

"Further Observations on Protein Salts," by William J. Gies.

"Further Studies on the Application of Folin's Creatin and Creatinin Methods to Meats and Meat Extracts," by A. D. Emmett and H. S. Grindley.

"The Determination of Ammonia in Meat and Meat Products," by F. W. Gill and H. S. Grindley.

"The Blood Clot of Limulus," by Carl L. Alsberg.

"On the Decomposition of Nucleic Acids by Nuclease," by Walter Jones.

Names of the Members Present at One or More of the Meetings.—John J. Abel, Carl L. Alsberg, Henry P. Armsby, A. E. Austin, Edwin J. Banzhaf, Silas P. Beebe, Harold C. Bradley, Russell H. Chittenden, Otto Folin, Robert B. Gibson, William J. Gies, H. S. Grindley, Howard D. Haskins, Philip B. Hawk, Lawrence J. Henderson, Reid Hunt, Holmes C. Jackson, Waldemar Koch, William F. Koelker, Arthur S. Loevenhart, John H. Long, Graham Lusk, Hugh McGuigan, A. B. Macallum, J. J. R. Macleod, Albert P. Mathews, Lafayette B. Mendel, Frederick G. Novy, Thomas B. Osborne, Mary E. Pennington, Oswald Schreiner, Victor C. Vaughan, Ralph W. Webster, H. Gideon Wells.

Abstract of the Executive Proceedings

Constitution.—A constitution, issued from the secretary's office several months prior to the meeting, and which had been provisionally approved by a vote of the members taken by correspondence, was formally ratified, and supersedes the articles of agreement originally adopted for the government of the society.

New members—Edwin J. Banzhaf, Harold C. Bradley, Albert C. Crawford, Mary E. Pennington, Oswald Schreiner, Carl Voegtlin, Ralph W. Webster, Harvey W. Wiley.

Officers for the Year 1908–9:

President—John J. Abel.

Vice-president—Otto Folin.

Treasurer—Lafayette B. Mendel.

Secretary—William J. Gies.

Additional Members of the Council—A. B. Macallum, Albert P. Mathews, Frederick G. Novy.

Nominating Committee—S. P. Beebe, Francis G. Benedict, Reid Hunt, P. A. Levene, A. S. Loevenhart, John H. Long, Graham Lusk, Thomas B. Osborne, H. Gideon Wells.

Time and place of the next annual meeting were referred to the council, with instruction to determine both.

Report of the Committee on Protein Nomenclature. See "recommendations" to be printed in Science.

William J. Gies,
Secretary

SCIENTIFIC BOOKS

In Wildest Africa. By C. G. Schillings. Translated by Frederic Whyte. With over 300 photographic studies direct from the author's negatives, taken by day and night, and other illustrations. Pp. xvi + 716. New York and London, Harper & Brothers. 1907.

It is safe to say that all who read Herr Schillings's first book on the African wilderness, called "With Flashlight and Rifle," or in its American edition "Flashlights in the Jungle," hoped to see more of his "nature documents," and to hear more of his unique experiences on the great velt of German East Africa. It is also safe to say that they will not be disappointed in the attractive volume "In Wildest Africa," which has recently appeared. In this work the author has added many side lights as well as "flashlights" to his theme—the vanishing fauna of the Dark Continent.

Herr Schillings's first volume, which I reviewed at some length in these columns,[1] was

[1] Science, Vol. XXIII., April 6, 1906.

highly praised, as it deserved to be, both on account of the narrative which embodied the results of years of effort, and for the remarkable photographs which showed for the first time the big beasts of Africa as they really appear in the swamps, the mountains and upon the ever-changing velt. Naturally the first volume contained the best of the author's pictures, but the reader will find almost as large a fund of interesting materials in the second.

As Schillings remarks, the "twilight of the gods" long ago settled down upon the animals of South Africa and the Cape region, while now "an everlasting night is closing upon all the life and movement of the far away regions of the north and east," which he has attempted to describe. Probably the most remarkable fauna of the modern world, which the savage races handed over to the white man practically intact, and which they had inherited from a remote geological age—embracing such unique animals as the African elephant, the two-horned and white rhinoceroses, the hippopotamus, the lion and leopard, the zebra, not to mention the ostrich, the gnu and a great variety of antelope—is rapidly passing before the onslaughts of the traders in ivory and skins, and foreign sportsmen, the armed natives and the devastating Boers.

Schillings believes that all these great beasts and many smaller ones are destined to go with the advance of trade and the white settlements, and that in another century every skull, skeleton, and skin will be almost worth its weight in gold. The wilderness can not be patrolled, but let all nations cooperate in making and enforcing as far as possible effective laws, in establishing asylums and sanctuaries as game-preserves, in stocking our museums with all the material which the naturalist needs for zoological study, in learning the habits of these wonderful beasts before they have vanished, in securing drawings, measurements and especially photographs, true to wild nature, to hand on as a legacy to future generations. Thus might be expressed the thesis which the author eloquently defends.

The varied fauna of South Africa has all but vanished, as our author remarks, unsung and unfamed, before any great master could put on canvas or in words its record for all time. "May," says he, "the master soon appear who will be able to give us a noble and true picture of the East Africa Nyíka, in all its vast proportions." Many passages could be quoted to show that the desired "master" had arisen in Schillings himself. At any rate he has all the requisite enthusiasm, energy and desire for truth, combining indeed the resources of hunter, artist, explorer, naturalist and philosopher.

In reviewing the earlier work referred to, I spoke of the charm which a certain indistinctness lends to many of his photographs, suggesting the work of a painter like Corot. Others have noticed this and have compared some of his pictures of birds to the designs of Japanese artists. Schillings discusses this matter freely, and says that he was pleased to find that this unavoidable effect of the intense heat and dazzling light, or in some cases of the long exposure required for the telophoto lens, was not in all respects disadvantageous. In many cases it eliminates the hard and unnatural character of the photograph, and gives us true pictures, that is a series of superimposed surfaces, without lines of any kind, which have no place in nature. This is not to be confused with the blurred effect of objects in motion, and is objectionable only when greater detail is desired. As illustrations of this the reader should compare the picture of gnus and zebra resting under the shade of a tree (p. 241), a herd of black hoofed antelope on the edge of a forest (p. 217), and especially a large troop of zebra and gnus herded in the midst of foliage, which from a pictorial standpoint are extremely fine. As to birds, the silhouette of pearl hens in an acacia tree (p. 397), or even the picture of flamingoes on the wing (p. 253) could be effectively copied without change for an ornamental screen. The same comment would apply to admirable studies of giraffe seen stalking over the velt (p. 577) and to other subjects which could be mentioned.

Among the interesting facts recorded we note the following: The remarkable abundance of life which at the time of his visit existed in some of the small lakes of the Kilimanjaro region, where hippopotami disported at as close quarters as in a zoological garden—to the observer, who was of course hidden; the only bird-song heard which suggested Europe was that of the African nightingale, the northern relative of which has been known to nest in Africa; seven pounds of stones and pebbles were taken from the stomach of a crocodile, and the author suggests that they are swallowed as an aid in sinking, but must these animals then regurgitate ballast whenever they wish to rise? The swamp-pools harbor an almost incredible number of fish, in spite of the hosts of fish-eating birds and crocodiles which prey upon them. Here no doubt is a great store of new and interesting material awaiting the ichthyologist. The elephants are not dependent upon grass, but will literally strip a tree of its bark or of its branches when hard pressed, and are sometimes found in company with the giraffe, the most timid of all the big animals, which never fights unless surrounded. The writer thinks that the okapi is certain to survive its larger relative. The largest tusks of the African elephant yet recorded came from German East Africa, weighed together 450 pounds, and were sold to an American for five thousand dollars. The rhinoceros not only occasionally breaks a horn, but sheds both of its ponderous weapons at intervals, whether in freedom or in captivity. The organ shrike, which sings under the blazing sun of midday, mates for life. The question is asked why the eyes of beasts of prey shine out in the darkness, and the author remarks that he has "never been able to get any precise scientific explanation of the phenomenon." We supposed that the eyes of no animal ever shone in absolute darkness, and that the glistening so often seen and recorded by the camera was solely due to the interference of reflected light in that peculiar layer of the choroid coat called the tapetum lucidum, and which the eye of the cat or the dog illustrates as perfectly as that of a lion or hyena.

We share the writer's admiration for President Roosevelt, when he speaks of his efforts for the preservation of game in America, but think he is in error when he adds: "The establishment of the Yellowstone National Park was largely the President's work," since this park was dedicated in 1872, when our president was a lad of fifteen, and enlarged in 1891, or ten years before he entered the White House.

The destruction of wild animals, at first, no doubt, a necessity, seems to have become a confirmed habit if not a second nature of the Boers, their only contribution to zoology thus far being a lot of ugly and ridiculous names. Thus the gnu is called "wildebeest"; the cow-antelope "hartbeest," because it is tenacious of life; the hyena was called the "wolf," and the giraffe the "kameel"!

Herr Schillings was wont to resort to certain hilltops and tall trees from which, as from an observatory, he could watch the panorama of wild life unfold upon the plains. The numbers and variety of animals which sometimes passed under his eye were wonderful. He has drawn many striking pictures of the shifting scenes of this wilderness-drama, and the reader will enjoy his vivid descriptions of the velt under the changing lights, and the varying sounds of the forest at all times of the day and night.

In the two concluding chapters Schillings describes the difficulties of photography in a country in which water is often the greatest of all luxuries, as precious as life itself, even when obtained from small mud-pools, where everything "undulates and shimmers, bathed in a dazzling sea of light," where light-colored objects often appear deep black, where distances are so deceptive that when but a few hundred paces away it is often impossible to distinguish a rhinoceros from an ostrich or the termites' nest, and where the labors of the night worker are usually rewarded by a fresh attack of malarial fever. In most of the cases of flashlight photography the animals were made to take their own pictures at favorite drinking pools, or around some bait or lure, by means of strings secured to upright stakes and to the camera. For success the flash must be powerful; it must be absolutely simultaneous with the exposure, and the right animal must fire the charge and come into range in doing so. This may sound easy, but if so, the reader is likely to alter his opinion after reading Herr Schillings's interesting narrative. We should have omitted all the illustrations of "failures" of one kind or another, as quite unnecessary to the description of the methods.

The translation seems to be well done, and but few and trifling errors have been noticed. The moral of the work, like the matter of it is admirable, and may be expressed in brief—avoid all ruthless and unnecessary destruction of the beauties of nature wherever found!

Francis H. Herrick

Aposporie et Sexualité chez les Mousses. El. and Em. Marchal. Bull. Ac. roy. Belg. Cl. Sciences, No. 7, pp. 765–789.

In a paper already reviewed in Science, the Marchals have shown that the individual capsules of certain diœcious mosses contain both male and female spores and that regenerations from the leaves, protonemata or from other parts of the gametophyte give rise to the same sex as the plant from which they were derived. In the present paper they give the results of a careful investigation by means of pure cultures of the sexual condition in the sporophytes of the diœcious mosses—*Bryum cæspiticium, Mnium hornum* and *Bryum argenteum.* They find that regenerations from the capsule or from its stalk, *i. e.*, from any part of the sporophyte, give rise to bisexual protonemata from each of which are developed three types of leafy axes: (1) Those apparently male containing only antheridia, (2) those obviously hermaphroditic containing both antheridia and archegonia, (3) those apparently female containing only archegonia. Shoots with only antheridia were most common, those with both antheridia and archegonia were considerably less abundant while those with only archegonia were distinctly rare. That the three different types of shoots were potentially hermaphroditic was shown by regenerations from their leaves. These gave in repeated cultures of *Bryum cæspiticium* approximately the same ratio of shoots apparently male, hermaphroditic and female as were obtained directly by regeneration from the sporophyte and it is concluded that the hermaphroditic condition can be thus indefinitely propagated by vegetative means.

It may be pointed out that this transformation of a dioecious species of the mosses into an hermaphroditic growth brought about by the Marchals is similar to what the reviewer has already accomplished in essentially the same manner with the mould *Phycomyces nitens.* The hermaphroditic growth obtained from this species when propagated by cuttings retains its bisexual character often to a dozen or more vegetative generations but eventually the bisexual character is lost and with the disappearance of one sex, the growth is not to be distinguished from a pure unisexual race, male or female as the case may be. The hermaphroditic growths of the mosses resemble those of *Phycomyces* in that they differ in their sexual polarity. Thus while one regeneration from the sporophyte of *Bryum cæspiticium* showed a marked male polarity and produced one shoot with antheridia and archegonia to 51 with only antheridia, a second regeneration from the sporophyte of this same species showed an equality of the sexes and of 21 shoots, produced 17 with archegonia and antheridia, 2 with only antheridia and 2 with only archegonia. In view of the behavior of *Phycomyces,* the Marchals seem hardly justified in concluding from an examination of only two generations that the hermaphroditic condition obtained in the mosses can be propagated for an indefinite period.

A determination of the chromosome number and the sexual conditions which result from the union of gametes arising from their artificially produced hermaphrodites is promised by the Marchals in the near future.

Mention of some unpublished work on the zygospores of *Phycomyces* may not be out of place in this connection. Zygospores formed by hermaphroditic growths of this species, which the reviewer has recently brought to germination, do not differ, in the sexual relations of the offspring to which they give rise, from zygospores formed between diœcious growths. It seems impossible therefore to fix the hermaphroditic condition since a complete return to the diœcious condition normal to the species results in the first sexual generation.

It will be of interest to see how closely the further discoveries in the mosses follow the conditions worked out in such an unrelated form as *Phycomyces*.

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A STUDY OF VISUAL FIXATION

Professor Raymond Dodge begins a series of "Studies from the Psychological Laboratory of Wesleyan University" with "An Experimental Study of Visual Fixation." The *Psychological Review* prints the number as its Monograph Supplement for November, 1907.

Professor Dodge finds that the involuntary movements of the eyes during supposed fixation are, in part, compensatory to head and body movements; in part, however, they are "normal and physical disturbances" of fixation, due to irregular head and body movements for which compensation is inadequate. The compensatory eye movements are united with the movements of head and body "into a thoroughly organized motor system," furnishing a coordinating mechanism capable of "explaining the intimate correspondence between tactual and visual space." Visual motives for the fixation movements are found in retinal fatigue and in the correction of inadequate binocular coordination.

In studying control of fixation movements, Professor Dodge remeasured the ocular reaction time, using Professor Holt's method with the alternating arc light, the fall of the exposure screen giving the stimulus simultaneously with the actinic beam, the latter being reflected from the cornea to the falling plate of the camera. The alternations of the current thus gave a time record in a series of dots. Interruptions by a tuning-fork would give greater accuracy. Plates of pot blue glass "stopped down" the arc light to a comfortable glow without materially reducing the effect on the camera plate. The slow reaction time determined by earlier experimenters was confirmed, but a minimum of 130 σ was reached. The head reaction was quicker than that of the eye.

Successive fixations of the same word were found to vary widely in location of the point of regard, but were called "perfect fixations" when the object of interest was "brought to a retinal area of clear vision." The functional center of the retina is larger or smaller according to the character of the object and according to the corresponding extent of the area of clear vision.

Fixation is called "adequate" when it is sufficiently long and accurate to condition a "cleared-up" perception of the object of regard. Renewing his criticism of the short exposure-times of Zeitler and Messmer, Professor Dodge measures the exposure-time needed for the "clearing up" of words presented upon various pre- and post-exposure fields, and concludes that "the shortest adequate fixation pauses in reading are between 70 σ and 100 σ."

In further experiments he measured the effect of peripheral factors, such as words seen peripherally in reading, in modifying the total consciousness without properly "clearing up." The movement is from general to special effects, phrase, sentence and paragraph, episode and plot, forming "a dynamic background" for each new word-complex as it clears up.

Professor Dodge raises the question whether the spatial relations of the total visual field are determined by its relations to the fovea, or whether the object of regard is not "rather determined in its spatial relations by its apparent position in the total visual field"; and after criticism of the theory of retinal local signs, he proposes a substitute theory of "genetic organization of the retinal elements." While the argument here is not wholly satisfying, the new facts that are being brought forward in this field make it certain that a better theory is to shake out eventually, and Professor Dodge's view is worth a careful reading.

The appendix to the article reviews the technique of recording the eye-movements by photographic registration, and describes the apparatus used in the Wesleyan experiments.

By some unaccountable error Professor Dodge represents the foveal and macular fields of regard as less than one fifth their actual size, as calculated by the present writer upon data given by Helmholtz and Kölliker. While the author was evidently influenced by this mistaken notion of the relation between the central and peripheral fields, his main contentions are probably not invalidated by the error. The failure to state the reading distance, in his measurements of the effects of peripheral stimulation upon speech reactions, greatly lessens the value of these data to other experimenters.

In spite of errors, however, the article's positive contribution is important, and there are several clever minor experiments which deserve recognition did space permit.

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SCIENTIFIC JOURNALS AND ARTICLES

The Zoological Bulletin of the Pennsylvania Department of Agriculture for December, 1907, is devoted to the lizards of Pennsylvania, a somewhat brief topic, since only five species occur in the state. Besides the keys to genera and species, and detailed descriptions, there is a study of the food, based on the examination of as many stomachs as were available. The showing is favorable to the lizards as friends of the farmer. The paper is prefaced by a discussion of lizards reported in the human stomach, and it is hoped that this may do something to counteract the very common belief that such cases actually occur.

The Museums Journal of Great Britain for January has a good paper, by H. C. Sorby, "On the Preservation of Marine Animals with their Natural Color." The best results were obtained by the use of anhydrous glycerine, in some instances a layer of almond oil being placed on the top of the glycerine. Sponges, sundry worms, mollusks and fishes subjected to this treatment retained their colors perfectly at the end of seven years. Alex. Hutcheson describes "An Early Dundee Museum," and O. Gylling, in reply to a criticism by Mr. Bather, explains that the unpleasant features of certain groups in the Malmo Museum are due to the principle of showing the animals in characteristic situations, or when displayed in traps, as an incident of their extensive utilization by man. The balance of the number is devoted to reviews and notes. Among these last is one in which Professor Ray Lankester attacks "Newspaper Natural History" with a seriousness that raises a smile. Incidentally, Professor Lankester commits an error himself in saying that "*Elephas columbi* and the mammoth are as nearly as possible of the same size," for *E. columbi* stood a foot to eighteen inches taller than his northern relative.

The Bulletin of the Charleston Museum for March gives a "Synopsis of the Bird Records of the Natural History Society for the Year 1907."

The Museum News of the Brooklyn Institute is mainly devoted to articles on the libraries of the Central and Children's Museums. The former is a reference library of art, ethnology and natural history, the latter is somewhat unique, for, in addition to being for the use of the staff, it acts as a school reference library for teachers and pupils, endeavors to supply information to the general public, and seeks to interest school children in the various subjects included in the scope of the museum.

The Free Public Library of New Bedford has just issued a catalogue of its "Collection of Books, Pamphlets, Log Books, Pictures, etc., illustrating the Whale Fishery." It is particularly rich in log books, and these should contain much information regarding the distribution and former abundance of whales. The collection has been largely increased since the issue of the catalogue.

The contents of the December issue of *Terrestrial Magnetism and Atmospheric Electricity* are as follows:

Portrait of Maurits Snellen—Frontispiece.

"The Penetrating Radiation," by W. W. Strong.

"Helwan Magnetic Observatory, Egypt," by B. F. E. Keeling.

"Results of Magnetic Observations made by the United States Coast and Geodetic Survey at the

Time of the Total Solar Eclipse of August 30, 1905," by O. H. Tittmann.

"Preliminary Note on an 'International Magnetic Standard,'" by L. A. Baner.

"The Life and Work of Maurits Snellen," by E. van Everdingen.

"Die Magnetische Observatorien des Preussischen Meteorologischen Instituts," by Adolf Schmidt.

"Mean Values of the Magnetic Elements at Observatories," compiled by J. A. Fleming.

Letters to Editor: "Principal Magnetic Storms recorded at the Cheltenham Magnetic Observatory," by O. H. Tittmann; "Concerning Publication 'Caractère magnétique de chaque jour,'" by E. van Everdingen.

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 645th meeting was held February 15, 1908, President Bauer presiding.

Professor Simon Newcomb read a paper upon "The Climate of Mars."

The establishment of Stefan's law of radiation, as proportional at ordinary temperatures, to the fourth power of the absolute temperature, makes possible an estimate of the temperature of an opaque planet more reliable than was possible formerly. Christiansen, Poynting and Lowell have applied the law to estimate the temperature of Mars. The speaker stated that the method in which these investigators had made their results to depend upon the albedo of the planet, and the absorbent power of its atmosphere did not seem to him well adapted to the case. He based his own conclusions upon Kirchhoff's law of the equality between radiating and reflecting power of matter for each separate wave-length of heat, which law is, itself, a corollary from the second law of thermodynamics. Making abstraction of an atmosphere, there is a certain normal temperature of a planet which would be independent of this albedo, except when the latter was different for different parts of the spectrum. The effect of this difference is probably small. Assuming Mars to reflect the lower rays of the spectrum more strongly than the higher ones, there would be somewhat higher temperature than the normal one. The effect of an atmosphere like ours would be to make the planet rather warmer than the normal. This effect would be produced in two ways, one of which is the effect of absorption by the sun's heat which mix up the lower strata with the higher one. This results in the earth being warmer than it would be in the absence of an atmosphere. Since Mars has only an extremely thin atmosphere, the effect in raising its temperature is much less than in the case of the earth.

As the result of his estimates it was said that, in general, the surface of Mars must be in general below the freezing point of water except in the equatorial zone. It does not seem possible that the polar regions can ever rise to the temperature of melting ice. Before approaching this temperature the radiation, as given by Stefan's law, would exceed the heat absorbed from the solar radiation so that a fall of temperature should be the result. The disappearance of the white polar caps is easily accounted for through evaporation of ice at the lowest temperatures, especially under so small an atmospheric pressure as prevails on Mars.

The second paper of the evening was presented by Dr. C. G. Abbot, of the Smithsonian Astrophysical Observatory, upon "The Variability of the Sun."

If two observers at opposite sides of the earth, and greatly different altitudes, should both determine the intensity of solar radiation at mean solar distance by a process sound in theory, and both should decide independently that the average value of the "solar-constant" is 2.10 calories per square centimeter per minute, but that on March 1 of a certain year it was 2.20 while on March 1 of the following year it was but 2.00—then it is probable that interest and support would be forthcoming to push the task of "solar-constant" determination steadily and perseveringly enough to determine the extent and character of the sun's variation.

The evidence of solar variation thus far attained is not so strong as this, but is strong enough to warrant a persevering study of the subject. Measurements on Mount Wilson in

California by the Smithsonian Astrophysical Observatory indicate that in the two periods June–October, inclusive of 1905 and 1906 there were variations of the "solar constant" between 1.95 and 2.14 calories. Some of these apparent variations were of short duration, as ten days for example, others of several months.

All the determinations, 130 in number, are by the method of high and low sun measurement with homogeneous rays. The probable error of a single good determination (and nearly all were excellent) is about one per cent. But it is urged that the method though apparently sound in theory may in fact fail to estimate properly the transparency of the air. Supporting evidence of the soundness of the work is as follows:

The mean value of the "solar-constant" observed on Mt. Wilson in 1905–6 is 2.03. The mean value observed in Washington 1902–6 is 2.06. There is one mile difference in altitude, 3,000 miles in longitude, and in the one case the average maximum solar intensity at the earth's surface is about 1.60, and in the other only 1.20. This close agreement outside the atmosphere seems strongly confirmatory of the accuracy of the means of estimating the transparency of the air.

On seven days in 1905 and 1906 practically simultaneous measurements were made at Washington and Mt. Wilson. The Washington results were systematically a little higher, about 3 per cent. in fact. Allowing for this small systematic difference the remaining average deviation is only 1.5 per cent.

Considering Mt. Wilson work again, there is no relation either direct or inverse which holds consistently between the variations of the "solar-constant" and the variable elements of the air, such as its transparency at different wave-lengths and its humidity. The fluctuations of the "solar constant" observed are not hap-hazard in character, but several days or weeks of observation lead gradually up to a maximum or down to a minimum.

If it were in fact true that "solar-constant" measurements on Mt. Wilson are competent to indicate variations of 1 per cent. in solar radiation the real change of several per cent. due to the elipticity of the earth's orbit ought to be plainly shown. This is the case in both 1905 and 1906.

Confirmation from the earth's temperature.

With the aid of numerous measurements made on Mt. Wilson of the reflection of clouds at different angles and of the brightness and transparency of the sky, the value of the earth's albedo has been determined to be 37 per cent. Combining this with the mean value of the "solar constant" (2.1 calories in round numbers) there remains $1.32\,\pi R^2$ calories available to warm the earth as a planet. This would maintain a perfect radiator or "absolutely black body" at 256° absolute temperature. The radiating surface of the earth as a planet is not its solid and liquid surface, for clouds during half the time cut off terrestrial rays entirely. During the other half, as the measurements of Rubens and Aschkinass, Langley, Keeler, Very and Nichols suffice to indicate, the water vapor is sufficient to cut off nine tenths of the terrestrial rays. Accordingly the earth's radiating layer may be set at about 4,000 meters above sea level, where the mean temperature is about 263° absolute. If this layer were a perfect radiator, its maximum emission would be $1.45\,\pi R^2$ calories, so that the solar constant can not exceed 2.33 calories unless the albedo exceeds 37 per cent. This maximum possible value is in reasonable accord with 2.1, the adopted value, and differs no more than would be expected in view of the uncertain temperature and radiating power of the earth's radiating layer.

A statistical comparison of the monthly temperatures for the last quarter century of 47 inland stations distributed as well as possible over the world indicates variations, often more than four times the probable error, in the mean temperature of the world. These changes of temperature, amounting to several degrees centigrade, may be caused by variations of the sun.

The magnitude of temperature changes caused by solar changes of short period is much greater for inland than for coast or island stations. This accounts in part for the failure of Mr. Newcomb to find decisive indications of cosmical temperature influence in his recent study of temperature. Furthermore, coast and island stations do not respond simultaneously or always in the same direction to changes of solar radiation, as is shown by a comparison of monthly changes at stations in latitude 5° N. with the monthly changes of insolation. This consideration accounts still further for Mr. Newcomb's failure to find evidence of cosmical temperature influence.

The disagreement of Mr. Langley's often quoted value, 3.0 calories, for the "solar-constant," with that here adopted (2.1 calories) is due entirely to a supposed failure of the exponential transmission formula for homogeneous radiation. There is no sound evidence of such failure, and therefore we must accept Mr. Langley's direct results of 2.06 at Lone Pine, or 2.22 at Mountain Camp, or still better their mean 2.14, as his value of the "solar constant." Thus the method of homogeneous rays as employed at sea level (Washington), at 940 meters (Lone Pine), at 1,800 meters (Mt. Wilson), at 3,500 meters (Mount Whitney) yields values of the solar constant agreeing within the limits of accuracy of the observations and of the real variability of the sun.

R. L. FARIS,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 439th meeting was held February 8, 1908, President Stejneger in the chair.

Dr. L. O. Howard gave a lantern slide lecture on "Some New Parasitic Work." He mentioned some recent observations on parasites imported from Europe for the purpose of destroying *Porthetria dispar* and *Euproctis chrysorrhœa* in New England, detailing especially the interesting habits of *Pteromalus egregius* Först., and the success which has been achieved in forcing extra generations in the laboratory in the winter. He also spoke particularly of the *Trichogramma* and *Telenomus* egg-parasites of *chrysorrhœa* and the methods used in breeding these forms artificially. He further spoke of new and important work being carried on by his assistants in Texas and Louisiana in breeding native parasites of the cotton boll weevil; and also of the biology of *Lysiphlebus tritici,* an abundant parasite of the *Toxoptera graminum.* He announced that the *Lysiphlebus* has recently been discovered to be parthenogenetic. Some recent work by F. M. Webster, of the Bureau of Entomology, U. S. Department of Agriculture, and his assistants, with the parasites of *Cecidomyia destructor* was described. The principal parasite, *Polygnotus hiemalis* Forbes, has been found to be polyembryonic, and a *Tetranychus* has been found to be hyperparasitic in the cells of the *Polygnotus.* The paper was introduced by some general considerations in regard to parasitism with insects.

In reply to a question Dr. Howard said that the campaign against the gypsy moth had thus far produced no visible effect on the abundance of the species, but immediate success was not predicted. While the state of Massachusetts may be impatient of results, they may be four or five, or even ten years in coming and of course may possibly never come at all. He is hopeful, however, that among the forty to fifty species of its parasites means will be found to hold the moth in check, though American parasites of these parasites may enter into the problem.

The next paper, entitled "List of Plants for Aquatic Gardens," was by Mr. H. W. Clark, and was illustrated with lantern slides.

In looking through the literature at hand on water gardens, a number of desirable aquatic and marsh plants were found unmentioned. Among the charads, several species are very attractive, their symmetrical forms, dainty green colors and bright red fruits adding much to the beauty of the pond-bottom. *Chara robbinsii* is a delicate densely branched form growing in shallow water or at the water's edge, sometimes partly exposed. *Chara foliolosa* is a robust but very symmetrical form. There are several other charas equally desirable. *Nitella batrachosperma* is a minute but beautiful plant, the branches being clustered in little dark green globes along a slender, almost invisible stem.

Among the mosses the sphagnums would be very desirable for the water's edge. Some forms are quite attractive, but their chief value lies in the fact that they furnish the natural substratum for many interesting plants such as pitcherplants, *Droseras* and the like.

Riccia lutescens is a very attractive little plant, the fronds floating on the surface like little green butterflies. Their ordinary method of reproduction by dividing into halves makes them especially interesting.

The swamp horsetail, *Equisetum fluviatile,* frequently grows over considerable areas in shallow places and a patch of these plants adds to the landscape a peculiar and ancient charm. This horsetail grows quite tall, and is symmetrically and abundantly branched.

The selaginellas are graceful creeping plants counted worthy of greenhouse room, and are frequently regarded as greenhouse plants. About some of the lakes of northern Indiana the attractive little *Selaginella apus* is quite common in black ground near shore, and remains green the winter through.

Among the pondweeds, three of the most desirable species, *Potamogeton amplifolius,* attractive for its large leaves and graceful form; *P. perfoliatus,* an erect symmetrical plant; and *P. robbinsii,* a prostrate plumose form, are especially worthy of consideration.

Of the grasses, the holy grass, *Savastana odorata,* a species growing in moist ground and quite conspicuous by reason of its yellow stamens, would be a valuable species. In addition to its showiness, it is delightfully fragrant.

It is a matter of surprise that in connection with aquatic gardens no one has mentioned the reed *Phragmites phragmites.* In addition to being one of the stateliest and most handsome of grasses, its place along watersides is established by tradition reaching back to the time of the Greeks.

The sedges furnish a large number of interesting and valuable species. The low cyperus, *Cyperus diandrus,* is common along lake beaches and is an attractive little plant, *Cyperus strigosus,* which grows in wet grassy places is a striking and handsome plant; if cut green the beautiful heads may be kept indefinitely. *Kyllingia pumila* is fragrant as well as attractive and grows in quite wet places. *Scirpus cyperineus* is an exceedingly stately and handsome sedge. Chief in attractiveness of the sedges, and indeed among all plants, are the species of cotton grass. The slender cotton grass, *E. gracile* is very effective, especially when in patches. The fruit, which is conspicuous in early summer, consists of little silken white tassels, three or more to the stem, and give the appearance in the distance of lodged snow-flakes. *E. virginicum,* which comes into fruit later in the season—from August to September—is also very striking and effective.

In the genus *Carex,* two of the most attractive forms are found in wet places; these are *Carex asa-grayi* with a globular head, and *Carex comosa* with an elongate, bristling head. *Carex leptalea* has a small head, but is attractive on account of the contrastive white and green colors to be found in the scales and perigynea.

One of the most desirable aquatics for planting about the margins of ponds is *Spathyœma fœtida.* This plant is "in bad odor" chiefly because of a bad name. The name "skunk-cabbage" does much more to keep it unpopular than anything else. In some parts of the country it is known as "quick will"; another name in some parts of the country is "Midas' ears." They have been seen on sale at the Washington (D. C.) market as "swamp lilies" and are said to have been sold on the streets of New York as "rare orchids from the Philippines."

By Thanksgiving the spathe of the "quick will" is already formed and colored, ready to be pushed up above the ground at the first sign of spring. The spathe of this flower is exceedingly variable in color, ranging from pure yellow to deep reddish purple. They are also exceedingly variable in form, some of the spathes being long-pointed, others short and round. They frequently come double. This variability in nature suggests that they would vary into desirable forms under cultivation and selection.

Among the duckweeds are the most minute of the flowering plants, and it would add interest to one's pond to have in it a plant which, flower and all, is no larger than a pinhead. Our two species of *Wolffia* are interesting on this account.

Another interesting minute form, *Wolffiella floridiana,* usually escapes observation both on account of its small size and its habit of being usually submersed. It consists of small strap-shaped fronds which frequently cohere, forming stellate objects. This plant would find plenty of room in a saucer and the growing of it might lead to interesting observations as the flower and fruit are as yet unknown.

M. C. Marsh,
Recording Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the meeting of January 7, 1908, Dr. D. S. Lamb exhibited a calvarium showing ostitis deformans, a disease found only in the white race, and anthropologically interesting.

Doctor H. Pittier read a paper on "The Native Tribes of Costa Rica." Doctor Pittier described the general conditions of environment governing the natives of Costa Rica and stated that the tribes at present are as numerous as in early times. A brief account was given of the customs of the natives.

Mr. G. N. Collins illustrated with slides his "Notes on the Indians of Chiapas." The Soki and Tzotzil Indians of Pantepec were especially referred to and a brief account given of the modes of subsistence, architecture, arts and customs.

Dr. O. F. Cook, in his paper "Notes on Guatemalan Indians," spoke of the great number of natives in that country. The Indians of Alta Vera Paz were particularly examined. Many slides illustrating the deforesting, reforesting, cornfields and cottonfields were shown. Doctor Cook believes that the high interior did not encourage habitation till comparatively recent times. A series of views illustrating the cotton cloth industry was received with interest. The appearance and customs of the Kekchi and Cahabon Indians inhabiting this portion of Guatemala were discussed.

Walter Hough,
General Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The 44th meeting was held November 23, 1907. Vice-president Piper presided and twenty-three members were present.

The first paper, by Dr. R. E. B. McKenney, "Botanical and Other Notes on Bocas del Toro," was a description of the plant life of the province of the republic of Panama bordering the Caribbean Sea, adjacent to the republic of Costa Rica, and an account of banana culture in that region.

The conditions on the two sides of the isthmus are quite different. On the Atlantic side there is no distinct dry season, but less rain falls in February and March than in the latter part of the year. In the winter months the average temperatures vary from 88° F. to 92° or 93°, and in the summer months from 92° to 95°, with the minimum temperatures of 60° and 65° respectively. In the Pacific province of Chiriqui, which is separated from Bocas del Toro by the mountain range forming the backbone of the isthmus, the temperature ranges are nearly the same, but there is a distinct dry season during five or six months of the year when the vegetation becomes parched and dry. The pastures are burned over annually. On the Atlantic side the vegetation is luxuriant, with almost impenetrable jungles, mangrove swamps along the seacoast and thickets of giant stemless palms; and farther inland forests of palms and exogenous trees of many species overgrown with aroids and other climbers. On the Pacific side there are stretches of grass and sharply outlined patches of shrubbery, agaves and various genera of cactus.

The most important industry of Bocas del Toro is banana culture. Formerly many hawks-bill turtles were caught in the adjacent waters for the sake of their shells, and fifteen years ago the exportation of tortoise shell from this region was commercially important. Settlers attracted by the turtle fisheries began to plant bananas in isolated patches, and soon there were extensive plantations. These plantations have been purchased by the United Fruit Company, which has also large possessions in the neighboring republic of Costa Rica. Dr. McKenney gave an interesting account of the methods followed in propagating and cultivating bananas, the gathering of the fruit and its shipment to the United States. He also spoke of the various ways in which the fruit is prepared for food by the natives and its preservation by drying. During the past few years many of the banana plants of this region have been suffering from a disease, which Dr. McKenney has been studying. His results have not yet been published.

The second paper, by W. M. Scott and J. B. Rorer, was an account of the "Apple Leaf-spot Disease," the result of experiments made by the authors during the past season at Bentonville, Arkansas, in connection with spraying demonstration work. For the first time it has been conclusively demonstrated that the reddish-brown spots on apple leaves, which cause premature defoliation and ultimately the death of the trees, are caused by *Sphæropsis malorum* Peck, and that *Conithyrium pirina* (Sacc.) Sheldon, to which the disease was attributed by Alwood and others, is merely saprophytic and has nothing to do with those spots. Pure cultures of both fungi were obtained from spots on apple leaves and spores from these cultures were used for inoculation tests. Twenty-four out of thirty apple leaves sprayed with sterile water containing spores of *Sphæropsis malorum* developed a large number of spots two weeks later, while leaves sprayed with sterile water containing spores of *Coniothyrium pirina* developed no spots. The latter fungus, however, was found growing on the dead areas caused by the *Sphæropsis*, as well as on spots produced by other causes.

The third topic was the "Method of Preparing and Preserving Type Material," by H. B. Derr. Botanical specimens exhibited by lecturers and handed about in classes are liable to serious injury. Several methods have been devised to protect such specimens, as well as type material which is subject to frequent examination. Thus far all have been unsatisfactory. Mr. Derr exhibited several cases containing specimens of barley from Sweden and hybrids of wheat and rye, which were mounted so that they could be examined carefully and at the same time were protected from injury. The cases consisted of a rectangular wooden frame, the sides of which were dove-tailed together, holding in a groove near the front a pane of glass and having a removable back lined with a sheet of raw cotton, or antiseptic cotton, upon which the specimen was laid.

This ended the scientific program. During the supper which followed various topics of botanical interest were discussed, and attention was called to several recent publications. While seated at the table the members of the society were addressed by Mr. Tong, one of the guests of the evening, a Chinese student engaged in the study of rice culture in the United States.

The 45th meeting was held December 21, 1907, Vice-president C. V. Piper presiding.

The first regular topic on the program was a "Pot-pourri of Rusts and Smuts," by Dr. E. M. Freeman. Dr. Freeman described various types of smuts and called attention to the present problems relating to them, particularly those in connection with the natural modes of infection. He gave an account of a series of tests of infection of barley at different stages of flowering, reviewing briefly the work of Biffin and others on the problems of resistance to smut. Dr. Freeman also gave an account of a long series of cross-inoculations of the uredospores of stem rust on various grains, which was in effect a continuance of a paper previously presented to the society on the same subject. The work hitherto done in this country has been chiefly on treatments for prevention of infection. Very little has been done on life-histories of smuts. The speaker discussed four types of smut life-histories:

(*a*) *Corn Smut*.—Infection is not specialized to any one kind of meristem, but any part may be affected. Infection may take place in later stages of extraseminal life of corn plant.

(*b*) *Bunt of Wheat.*—Seedling infection. Infection is specialized to stem top meristem. It occurs only in earliest stages of extraseminal life of host plant.

(*c*) *Loose Smuts of Wheat and Barley.*—Floral or intraseminal infection. Infection also specialized to the stem, the growing point of the meristem. It occurs in an early stage of intraseminal life of host plant.

(*a*) *Fungus of Lolium temulentum.*—Method and occurrence of infection as in type (*c*), but spore formation probably abandoned and the beginnings of a symbiosis possibly established.

Many problems relating to the details of type (*c*) are yet unsolved, as for instance, the behavior of spores in regard to stigmas, and the results of different periods of infection.

The second paper on the program was by Professor Bruce Fink: "Present Problems in American Lichenology." Professor Fink called attention to the lack of workers in the field of American lichenology, caused in all probability by the fact that the subject has little economic significance. The literature on this branch is unarranged and even uncollected, and the speaker is now engaged in studying the literature bearing on the subject. Up to the present time he has collected about 500 titles. The structure of the lichens interferes with the ordinary technique of sectioning and staining, but these difficulties are not more serious than those met with in the study of fungi, which have been for the most part overcome. There is great confusion in the nomenclature and classification of lichens; and no agreement has been reached as to the limits of genera and the way in which types can be fixed. Lichens are the first vegetation appearing on unoccupied land, and are of fundamental importance ecologically. Their relation to soil and subsequent vegetation has, however, been little studied. The old problem of the relation of the symbionts in the lichens, whether mutually beneficial or antagonistic, is still unsolved. With the exception of the area about New Bedford, Massachusetts, very few localities have been carefully studied in relation to their lichen flora. Professor Fink has himself listed some 500 species from Minnesota. He concluded his paper with a plea for greater popularization of the study of lichenology.

This ended the evening's program. At the luncheon which was served Dr. Freeman addressed the society informally, taking leave of his associates on the eve of his departure for his new post at the University of Minnesota.

W. E. Safford,
Corresponding Secretary

DISCUSSION AND CORRESPONDENCE

INHERITANCE OF FLUCTUATING VARIATIONS

To the Editor of Science: In the issue of Science for January 31 Professor Bigelow asks Dr. Ortmann how he would account for correlation between parents and offspring in cases of fluctuating variations, if variations of this type are not transmitted. I do not wish to answer this question for Dr. Ortmann, but I do wish to call attention to some confusion in the use of the term "fluctuating variation." It is necessary for us to agree on its meaning in order to avoid misunderstandings. Let us consider for a moment the different types of variation and decide on which of them may properly be included under the term "fluctuating variations." In the first place, there are some variations which I think we will all agree are not included. Two of these relate to real evolutionary changes. First, organisms in their phylogenetic development acquire new characters. We may mention the horns of cattle as an example. The development of hair or feathers as an external covering is another example. Even these characters may be looked upon as, in a sense, modifications of previously existing ones. Second, a character already present may undergo permanent change. In this way we get the various shapes of leaves, say of the genus *Quercus*. We may also include here the loss of certain characters which were formerly possessed. For instance, red swine have lost the power of producing black pigment. It is conceivable that very little of the variation we find in a generation of individuals from the same parents is due to any of the causes mentioned above.

But variation as between individuals of the same generation may be, to some extent, due to what has been aptly termed "place effect." This is especially true when a species is transported to new environment, a good deal of variation occurring which seems to be due to change in environment, such variation may partake partially of the nature of fluctuating variation, but this is a special case which we do not need to consider here.

This leaves two distinct types of variation due to wholly different causes which have hitherto been more or less confused. By some writers they have both been included under "fluctuating variations." The first of them is well exemplified in a field of corn, where ordinarily hardly any two individuals are alike. It is fully demonstrated by the work of Nilsson, in Europe, and Shull, in this country, which will be referred to below, that by far the greater part of the variation of our corn field is due to the fact that we have in the various individuals almost countless combinations of Mendelian characters and that these combinations change with each new generation. The same thing is true on a smaller scale with all species that cross-fertilize under any conditions, and even with close fertilization this condition exists to a greater or less degree. If we require a corn plant to close fertilize, by this process we permit the formation of a few individuals which are perfectly homozygote; *i. e.,* the inheritance of the individual from the two parents becomes exactly alike. Then if we take the pains to seek out these homozygotes and propagate them, allowing no cross-fertilization, we completely eliminate the type of variation here referred to and get forms that vary only in response to the immediate environment. Variation due to this re-combination of characters with each generation would naturally show correlation between parent and offspring, but when we have eliminated this type of variation such correlation would no longer exist.

Species that never cross-fertilize or that do so very rarely, and plants that are not allowed to do so, have been shown by careful study by Nilsson, Shull, Hopkins and others to consist of mixtures of strains which when separated show no variation except that due to environment, or rather the larger part of the species exhibits this condition, for even in such species there may be a small admixture of heterozygotes.

Nilsson in Europe and Shull in this country have obtained these perfectly homozygote individuals, Nilsson working with wheat and many other species, and Shull with corn. The individuals of a generation are as much alike as identical twins. These are the so-called elementary species, this term being applied through a misconception of their nature. (This subject will be fully discussed in another place.)

Finally we have variation due to the immediate environment of the individual. For instance, a variation in food supply may cause two individuals having identically the same inheritance to differ in size and in other characteristics.

Dr. Shull confines the term "fluctuating variations" wholly to variations of the last-mentioned type. He rigidly excludes variations due to the heterozygote nature of the parents. I fully agree with him in this use of the term. When we so limit it, we may then say that fluctuating variations are not transmitted.

W. J. Spillman
U. S. Department of Agriculture

SPECIAL ARTICLES

THE DERIVATION OF FECHNER'S LAW

About eighty years ago E. H. Weber observed that the least perceptible increment to a stimulus affecting several of the sense organs, under fixed subjective conditions of attention, expectation and fatigue, bore a definite relation to the amount of that stimulus.

G. T. Fechner, thirty years later, extended Weber's observations and formulated his results in mathematical terms. Calling the stimulus L and the least perceptible increment δL, then Fechner's statement of what he termed Weber's Law is that $\delta L/L =$ constant.

This law appears to hold over a wide range of ordinary working intensities, breaking down only for very low and for excessively intense stimulation.

Fechner proceeded further by assuming that the above constant was proportional to the corresponding increment δB to the sensation. Hence $\delta L/L = c\delta B$ and by integration

$$B = c\ (\log L - \log L_0).$$

In this form or in similar forms differing only in the choice of integration constant, Fechner's law has been accepted by psychologists for half a century.

There are two very serious if not fatal defects in this deduction. In the first place, the increments δL and δB are finite quantities and by no means infinitesimal increments approaching zero as a limit, such as would be required for such an integration. The least perceptible increment to the stimulus (δL) is determined by the sensibility of the sensory organ concerned. At the threshold value it is as large as L itself, while at moderate intensities it bears a fixed ratio to L. The value of δB is entirely arbitrary, dependent upon the unit chosen in which to measure it. It may be greater than unity in special cases. In the second place, c is not a constant but a function of L. At low intensities approaching the threshold value it varies rapidly with L.

There appears to be no direct method for overcoming these defects. A method of avoiding them altogether has however occurred to the writer and been applied to the visual case in a way that may be perfectly satisfactory to psychologist and mathematician alike.

Consider any physical instrument—a galvanometer for instance, capable of indicating on a scale the amount of an external stimulus affecting it. The derivative of scale reading with respect to the stimulus will be a measure of the sensibility of the instrument at all parts of the scale. Conversely, the general integral of sensibility will give the scale reading as a function of the stimulus.

In the visual case we have sensibility to find scale reading. The best data on sensibility are those of König and Brodhun[1] covering about twenty different intensities for each of six different wave-lengths. The writer has elsewhere[2] shown that these data may be represented by the function

$$P = \delta L/L = P_m + (1 - P_m)(L_0/L)^n$$

where P_m is the minimum value of P, L_0 is the threshold value in light units and n a number varying from one third to two thirds with wave-length. The reciprocal of the least perceptible increment δL or $1/LP$ is a measure of the desired sensibility of the eye to differences of intensity. Hence we have for the scale reading or, in this case, the visual sensation of brightness,

$$B = \int K\frac{dL}{PL} = \frac{K}{P_m}\log\left[1 + P_m(L^nL_0^{-n} - 1)\right]^{1/n}$$

where K is a constant dependent upon the unit of sensibility chosen.

This general form includes Weber's law and Fechner's law as special cases for moderate intensities, but holds for low intensities down to the threshold of vision. Weber's law $\delta L/L =$ constant may be extended to cover low intensities by writing

$$\delta L/L = P_m + (1 - P_m)L^{-n}L_0^n.$$

P. G. NUTTING

BUREAU OF STANDARDS,
WASHINGTON, D. C.,
December, 1907

[1] *Berlin Sitz.*, 1888, 917–931.

[2] Bull. Bureau of Standards 3, 62.

ASTRONOMICAL NOTES

FLUCTUATIONS IN THE SUN'S THERMAL RADIATION[1]

Many scientists have attempted in the past to show that periodical fluctuations occur in meteorological phenomena, presumably dependent on changes in the solar radiations. The two most plausible periods of solar change are the sun-spot period, whose mean value is about eleven years, and the time of the synodic rotation. Professor Newcomb develops analytical methods for the investigation of fluctuations in a fixed period, and also when the

[1] Simon Newcomb, "A Search for Fluctuations in the Sun's Thermal Radiation through their Influence on Terrestrial Temperature," Transactions of the American Philosophical Society, N. S., Vol. 21, V.

period is ill marked or wanting. These methods are then applied to the determination of the relation of changes in temperature to the sun-spot period, the synodic period, and to several others.

Köppen, from a study of meteorological observations in various regions of the globe, made from 1767 to 1877, arrived at the conclusion that the temperature of the tropical regions was lower by 0°.7 C. near the time of maximum sun-spots than near the time of minimum. Brückner has more recently shown some evidence of a period of thirty-five years in meteorological phenomena, including temperature.

Professor Newcomb arrives at the following conclusions: "The reality of the 11-year fluctuations seems to be placed beyond serious doubt, the amplitude being several times its probable error." But, "Its amount is too small to produce any important direct effect upon meteorological phenomena." The fluctuation is about one half that found by Köppen, or less than half a degree Fahrenheit. The reality of the 35-year period was not established.

The above results were obtained by the use of annual mean departures. From a study of monthly mean departures the conclusion is reached that "The evidence is rather weak in favor of very minute fluctuations in the sun's radiation for periods greater than one month and less than several years. If they exist, they are too small to produce any noticeable meteorological effect." The most probable period of these possible fluctuations is about six years. "Apart from this regular fluctuation with the solar spots, and this possible more or less irregular fluctuation in a period of a few years, *the sun's radiation is subject to no change sufficient to produce any measurable effect upon terrestrial temperatures.*" Ten-day and five-day departures were also studied. "There is a certain suspicion, but no conclusive evidence, of a tendency in the terrestrial temperature to fluctuate in a period corresponding to that of the sun's synodic rotation. If the fluctuations are real they affect our temperatures only a small fraction of one tenth of a degree."

These results obtained by Newcomb are in direct opposition to results obtained by Langley and published in the *Astrophysical Journal* for June, 1904. Langley's bolometer observations appeared to show that early in 1903 a marked diminution in the solar radiation took place, amounting perhaps to about ten per cent. The bolometer results appeared to be confirmed by synchronous temperature observations at widely different stations. If Newcomb's results are accepted as conclusive, it follows that the bolometer as well as the temperature observations which Langley used were influenced by terrestrial causes, though this, in the case of the bolometer, was guarded against with extreme care. This seems the more probable since several of the meteorological stations which were used by Langley in verifying his results were in high latitudes, rather than in low latitudes, where any changes in the solar radiation would be most felt. At such stations during that year only small changes of temperature appear to have taken place.

THE RETURN OF HALLEY'S COMET

An event of extreme interest, not only to astronomers, but to the world at large, will soon take place. This is the return of the periodic comet made famous by the genius of Halley.

Before Halley's time comets had been regarded as chance visitors to our solar system, except when they were looked upon as special messengers of divine wrath. Newton, however, showed that comets were subject to the law of gravitation. By mapping the paths of many comets, Halley found that three of them apparently had the same orbit, that is, they were different apparitions of the same object. He observed this comet in 1682 and predicted its return again after 76 years. He knew that he could not live to witness the event, and his words concerning it are rightly famous: "If it should return according to our predictions, about the year 1758, impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman." It returned in March, 1759, a few months later than Halley expected, and only seventeen years after his death. Pontécoulant was one of at least five mathematicians who computed the last return of Halley's comet in 1835. It reached perihelion within a few days of the predicted time. Pontécoulant also made the necessary computations for the next return, and published his results in 1864. His date for perihelion is May 24, 1910. It was to be expected that before the time for its return various astronomers would be sufficiently interested in the problem to redetermine the elements. So far this appears to have been undertaken only by the English astronomers, Cowell and Crommelin. It is interesting to know that the results which they obtain are in substantial agreement with those of Pontécoulant, so that the comet may be confidently expected to reach perihelion passage in May, 1910. Astronomers will not wait till that time, however, for their first view of the comet. Professor O. C. Wendell has published in the February number of *Popular Astronomy* an ephemeris based on the elements of Pontécoulant. From this it appears that at the present time the comet is less distant from the sun than Saturn. Its position, in the northern edge of the constellation Orion, is favorable for observation, but it is doubtful if even the great telescopes of the present day can reach it at present. Owing to the form of its orbit and its distance, the comet is moving in nearly a direct line toward the sun, and as viewed from that luminary would appear to stand nearly stationary in the sky. Owing to the motion of the earth, however, it will sway, during the next year and a half, backward and forward on the borders of Orion, Monoceros, Gemini and Taurus. About the first of October, 1909, its apparent motion will become very rapid as it approaches the sun. After April of the present year it will be unfavorably placed for several months. Next year the conditions will be somewhat similar, except that by January, 1909, the distance of the comet from the earth will be only that of the orbit of Jupiter. By October, 1909, the distance will have decreased to about 300 millions of miles, and by that time, if not before, the comet will probably have been "picked up" photographically or visually.

The mean period of Halley's comet is 76 or 77 years, but, owing to the powerful perturbations of the great planets, this period varies much. Cowell and Crommelin state that the revolution of 1222 to 1301 was the longest on record, taking 79 years and 2 months, while the present round is the shortest, only 74 years and 5.5 months. It is believed that apparitions of this comet have been recorded during the last 2,000 years, but the identity of the earliest appearances has not yet been certainly established.

S. I. Bailey
Harvard College Observatory

BOTANICAL NOTES

Trees and Lightning

In the "Notes from the Royal Botanic Garden of Edinburgh" (No. XIV.) Dr. A. W. Borthwick discusses some of the effects of lightning strokes upon various kinds of trees. He begins by referring to the "widespread popular belief that certain trees are less liable than others to be struck by lightning, and that during a thunderstorm it is quite safe to stand under a beech for example, while the danger under a resinous tree or an oak is respectively fifteen or fifty times greater." This and other questions, as of the exact nature of the injury done to the tissue of the tree, the author takes up and examines with care. He concludes with reference to the first point "that no tree is immune" since "lightning will select one species quite as readily as another," and "that the beech is struck quite as frequently as any other species." Apparently the taller trees in a neighborhood are the ones most liable to be struck. Contrary to what is believed by some people the cells are not "ruptured or torn by the formation of steam, as might happen if the heating by the electric current was very great. The cells collapse and shrink up, but are never torn." The root system does not seem to be ever damaged by lightning.

As to Birdseye Maple

Many a botanist has puzzled over the question of the nature and cause of the peculiar structure of the wood in what is called "birdseye maple." Looked at with a lens the fibers of the wood are seen to bend out and around the "eyes," and this gives the peculiar effect. But why there is this bending of the fibers is what has baffled solution. In the "Notes from the Royal Botanic Garden of Edinburgh" (No. XVI.) Dr. A. W. Borthwick publishes the results of some of his studies of birdseye structure in various kinds of wood. He reaches the conclusion that this structure is due to the formation of adventitious roots upon the stem, and that these arise from abnormal medullary rays. In none of the cases examined (with possibly one exception) were such roots due to mechanical injury, or the attacks of fungi or insects. Dr. Borthwick was not able to determine "the conditions which govern the production of the adventitious roots," but he is certain that "moisture plays an important rôle in their subsequent development, as it is only in the moistest situation that they persist for any time after they pierce the periderm."

AN ENGLISH KEY TO THE SYLLOGE FUNGORUM

Several years ago Professor Doctor Clements, then of the University of Nebraska, and now of the University of Minnesota, and Mr. Raymond J. Pool, now instructor in botany in the University of Nebraska, undertook the preparation of a key to the orders, families and genera of fungi as found in Saccardo's "Sylloge Fungorum." This was typewritten, and used in the classes in mycology in the University of Nebraska. Originally it included only the fungi of the first eight volumes of Saccardo, but it has now been revised and enlarged so as to include the Discomycetes of Abteilung III. (Rehm's) of Rabenhorst's "Kryptogamen Flora." It includes also an index of families, which refers to all of the volumes of Saccardo. At the end of the volume (which covers 137 pages) is added a "Lexicon Mycologicum" in which are given the meanings of all the Latin words used in the Sylloge. The practical value of such a work as this to the student who is troubled in his attempts at using the Latin keys and descriptions in the Sylloge is quite obvious. Even for those who are fairly good classical scholars it has proved useful in saving much time in doubtful translations.

A few bound copies (typewritten) are still obtainable for $2.85 postpaid, from the Department of Botany of the University of Nebraska.

BOTANICAL CHARTS

Under the title of "Tabulae Botanicae" the Berlin publishers Gebrüder Borntraeger began two years ago the publication of a set of botanical charts of marked excellence. Now that seven charts have appeared it is quite safe to estimate their value to teachers of botany. The charts are of large size (1 by 1.5 meters), and the figures are so large and so distinct that even in a large lecture room they may be easily seen by students. There is no crowding of the figures (one of the common faults of obtanical charts) and, as a consequence, students are in no danger of being confused in their study of the objects represented. Another pleasing feature is the fact that these are not copies of figures commonly found in botanical text-books.

The first and second charts are devoted to the *Myxobacteriaceae,* the third to the *Acrasieae,* the fourth to the Myxomycetes, the fifth to stomata, and the sixth and seventh to the *Mucorineae.* The drawings (by R. Erlich, of Berlin) are all accurately done, and the coloring is most excellent. The editors are Doctor E. Baur, and Doctor E. Jahn, of Germany, in collaboration with Dr. A. F. Blakeslee, of the United States, and A. Guilliermond, of France. The undertaking is thus international, and accordingly the very helpful accompanying text is printed in the German, English and French languages. The high worth of these charts should insure their wide sale, especially when it is known that the price per chart when mounted on cloth, and nailed to wooden strips, all ready for use, is a little more than two dollars (eight and a half Marks). They are by far the best botanical charts for lecture-room use that we have yet seen.

SHORT NOTES ON PAPERS

AGNES CHASE discusses two genera (*Hymenachne* and *Sacciolepis*) of *Paniceae* in the Proceedings of the Biological Society of Washington (January 23, 1908), enumerating their species, which are mainly tropical.

In his list of the "Sedges of Jamaica," published in the Bulletin of the Department of Agriculture [of Jamaica] Dr. N. L. Britton enumerates 37 species of *Cyperus;* of *Eleocharis* 8; *Stenophyllus* 2; *Fimbristylis* 5; *Abildgaardia* 1; *Scirpus* 3; *Eriophorum* 1; *Fuirena* 2; *Dichromena* 3; *Rynchospora* 13; *Cladium* 1; *Scleria* 9; *Uncinia* 1; *Carex* 5. We record with pleasure that the author did not find it necessary to make any new species!

With this may be noticed the late C. B. Clarke's "Cyperaceae of Costa Rica" (Contrib. N. S. Nat. Herb. X., 6) in which *Kyllingia* has 5 species credited to it; *Pycreus* 6; *Cyperus* 14; *Mariscus* 11; *Torulinium* 1; *Eleocharis* 13; *Fimbristylis* 6; *Bulbostylis* 3; *Scirpus* 2; *Fuirena* 1; *Dulichium* 1; *Dichromena* 2; *Rynchospora* 16; *Scleria* 11; *Calyptrocarya* 1; *Uncinia* 2; *Carex* 6; *Hypolytrium* 1; *Mapania* 2. Three new species are described in as many genera (*Cyperus, Rynchospora, Carex*). In spite of the rule of the Vienna Congress these descriptions are in English! Why should not our National Herbarium observe this salutary rule?

E. Manson Bailey, colonial botanist, continues his "Contributions to the Flora of Queensland" in the *Queensland Agricultural Journal* (February, March, June, September, 1907) adding materially to our knowledge of the flora of that far-away land.

Professor Ramaley publishes in the December (1907) University of Colorado Studies a valuable paper on the "Woody Plants of Boulder County." The eastern third of the county extends out upon the elevated plains (about 5,000 feet altitude), while the remainder is mountainous and rises to 10,000 and even 14,000 feet. Upon this area of a little more than 700 square miles the author finds 112 species of woody plants. Nine conifers are recorded, five cottonwoods, thirteen willows, one alder, three birches, one hackberry, and three maples. Neither oaks, elms nor ashes occur in the county.

Professor Doctor J. C. Arthur continues his cultures of Uredineae in order to determine their identity, and their alternate hosts, publishing his results (for 1906) in the *Journal of Mycology* for September, 1907, and (for 1907) in the same journal for January, 1908. By these studies he is slowly unraveling the heteroecismal puzzle of the plant rusts.

Two interesting cytological papers by Professor Doctor E. W. Olive deserve mention here, viz.; "Cell and Nuclear Division in *Basidiobolus*" (in *Annales Mycologici,* Vol. V., No. 5, 1907), and "Cytological Studies on *Ceratiomyxa*" (in *Trans. Wis. Acad. Sci. Arts and Letters,* Vol. XV.). Each is accompanied with a fine plate.

Another recent cytological paper on "Nuclear Structure and Spore formation in *Microsphaera alni*" is by M. C. Sands (in *Trans. Wis. Acad. Sci. Arts and Letters,* Vol. XV.). A good plate accompanies the text.

H. B. Humphrey contributes an interesting paper—"Studies in the Physiology and Morphology of some California Hepaticae"—(*Proc. Wash. Acad. Sci.,* Vol. X.) in which among other things he describes various endophytic parasites which he has observed in certain species.

In the July, 1907, *Philippine Journal of Science,* where we have learned to look for valuable contributions, Oakes Ames, under the title "Orchidaceae Halconenses" enumerates the orchids collected near Mount Halcon on the island of Mindoro of the Philippine archipelago. He catalogues 102 species (39 of which are new), representing 39 genera.

J. H. White describes "Polystely in Roots of Orchidaceae" in the University of Toronto Studies (Biological Series, No. 6), showing that there are two types of roots among terrestrial orchids—the monostelic and the polystelic. The paper is illustrated by six plates.

"The Sporangium of the Ophioglossales" by L. L. Burlingame (with two plates), "Differentiation of Sporocarps in Azolla" by Wanda M. Pfeiffer (with two plates), and "Twin Hybrids" by Professor Hugo De

Vries, are reprints of recent papers originally published in the *Botanical Gazette*. In the last named paper the author calls attention to the fact that in making certain crosses of evening primroses two types of hybrids result from the same parents.

In the *Columbia University Quarterly* for December, 1907, N. L. Britton contributes an appreciative sketch of the life and work of the lamented Professor Doctor Lucien M. Underwood. A fine photograph accompanies the paper.

Charles E. Bessey

The University of Nebraska

THE UNIVERSITY OF OVIEDO

The rector of the University of Oviedo in Spain has notified universities, colleges and schools, and the learned world generally, of the celebration of the 300th anniversary of the opening of that university which will take place in September next under the auspices of King Alfonso and the Prince of the Asturias, and he invites the professors of universities and others interested to attend the ceremonies of the occasion which will occupy ten days, from the twentieth to the thirtieth of the month. The documents accompanying the invitation consist of a list of subjects of the orations to be delivered and a program of the exercises arranged for the occasion. These include the ceremony of the unveiling of the statue of the founder, Fernando Valdés y Salas, Archbishop of Seville, which will be performed with religious solemnities; excursions to celebrated places in the neighborhood; a pedagogical exhibition with school festivals; lectures and sessions of various societies; distribution of prizes; theatrical performances, etc. It is interesting to note that the university authorities express a special desire that Spanish Americans should visit Oviedo on this occasion, not only because of their community of blood and language, but also because the sons of the Asturias have left such deep impressions of their lives and deeds in the Spanish countries of the new world.

The invitation to the other university authorities (which is in Latin) concludes as follows: "It is difficult for us to say how pleasant a duty it is to invite you to our celebration. The founders of your university, as of ours, may be likened to Saviours sent from Heaven to redeem the uncivilized nations of the earth, whose education, inaugurated by them, is entrusted to us to-day, to-morrow it will be carried on by others, and so on, continuously, until that last and highest stage of development shall have been reached when man shall be enabled by this means to become more God-like in his nature. Since this result concerns you no less than us at this university, I feel that I can approach you with full confidence, urging that your university may be represented in some way at our festival, and if a person should come in your name let him be assured that he will receive the warm welcome of a friend and comrade."

SUMMER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At the convocation of the American Association for the Advancement of Science in Chicago, the council decided to have the summer meeting held at Dartmouth College, Hanover, N. H., during the week beginning June 29. Subsequently to this action, the Dartmouth Scientific Association in Hanover appointed the following committee of arrangements, the several members of which are expected to act in the interest of the respective sections of the association as indicated below.

Section A, Mathematics and Astronomy, J. M. Poor.

Section B, Physics, Professor G. F. Hull.

Section C, Chemistry, Professor C. E. Bolser.

Section D, Mechanical Science and Engineering, Professor R. Fletcher (chairman).

Section E, Geology and Geography, Professor C. H. Hitchcock.

Section F, Zoology, Professor W. Patten.

Section G, Botany, Professor R. G. Lyman.

Section H, Anthropology, Professor D. E. Wells; Psychology, Professor H. H. Horne.

Section I, Social and Economic Science, Professor D. E. Wells.

Section K, Physiology and Experimental Medicine, Professor C. C. Stuart.

Section L, Education, Professor H. H. Horne.

This committee desires the cooperation of the secretaries of the respective sections and suggests that each secretary of a section correspond with the member of the committee named above in connection with his section. The first point is to learn whether the section will hold a summer meeting at Hanover. If that is decided in the affirmative, the section representative will be pleased to correspond as to the arrangements. Address at Hanover, N. H.

The chairman of the committee announces that an invitation has been received from the president of the Blue Mountain Forest Association, Mr. Austin Corbin, for members of the American Association for the Advancement of Science to visit the Blue Mountain Forest, otherwise known as the Corbin Blue Mountain Park or Preserve covering about 40,000 acres, where the celebrated herds of buffalo, deer, mountain goats, boars, etc., may be seen. The western entrance to this reservation is about sixteen miles from Hanover, and it may be feasible to arrange for such a visit with a party not too large. Whether this is expedient or not will depend somewhat on the advices received as to how many may wish to make this trip.

SCIENTIFIC NOTES AND NEWS

DR. J. J. THOMSON, Cavendish professor of experimental physics, at Cambridge, will preside at the meeting of the British Association for the Advancement of Science to be held in Winnepeg next year.

THE Turin Academy of Science has conferred the Bressa prize of about $2,000 on Dr. Ernest Rutherford, professor of physics at Victoria University, Manchester.

PRESIDENT ELIOT, of Harvard University, has been appointed Grand Officer of the Order of the Crown of Italy by King Victor Emmanuel. President Eliot celebrated his seventy-fourth birthday on March 20.

MR. THOMAS A. EDISON has so far recovered from the recent operation for mastoiditis and aural abscesses that he has been able to go to his Florida place at Fort Myers.

PROFESSOR S. E. CHAILLÉ, professor of physiology and comparative anatomy and dean of the medical department of Tulane University, has been awarded a retiring pension by the Carnegie foundation. Professor Chaillé was born in 1830 and graduated from Harvard University in 1851.

PROFESSOR S. A. LATTIMORE, head of the department of chemistry at the University of Rochester, will retire in June, after forty years of service as professor of chemistry in that institution, and having reached the age of eighty years.

MR. F. B. WEEKS, who has been connected with the U. S. Geological Survey for the past eighteen years, has recently resigned. His address for two or three months while completing certain reports for the survey will be 1201 Euclid Street, Washington, D. C.

PROFESSOR A. SCHUBERG, of Heidelberg, has been made head of the department of protozoa investigation in the Royal Bureau of Health at Berlin.

ANDREW L. WINTON, for many years chemist at the Connecticut Agricultural Experiment Station, has been appointed chief of the food and drug laboratory of the U. S. Department of Agriculture for the city of Chicago.

AT the termination of the course on national forests the senior class of the Forest School of Yale University presented Mr. William B. Greeley with a loving cup. Mr. Greeley will leave New Haven soon and resume his work at Hot Springs, Cal., as supervisor of the South Sierra National Forest.

AT the University of Kansas the board of regents has granted leave of absence to Professor C. H. Ashton, of the department of mathematics and to Professor E. F. Stimpson, of the department of physics. Professor Ashton will spend sixteen months in Europe at the University of Munich; Professor Stimpson will study at some eastern university for a year.

DR. F. M. ANDREWS, associate professor of botany at Indiana University, has received the research table of the Smithsonian Institution at the Naples Zoological Station for the months of April and May.

AT the recent meeting of the faculty of arts and sciences of Harvard University the following professors were appointed to represent Harvard at coming meetings of European learned societies: Professor E. H. Hall, of the physics department, who is now in Europe, at the celebration of the one-hundredth anniversary of the Reconstitution de l'Academie des Sciences, Agriculture, Arts et Belles-Lettres d'Aix, at Aix-en-Provence in April; Professor C. R. Lanman, of the department of Indic philology, and Professor G. F. Moore, of the Semitic department, at the Congrès Internationale des Orientalistes, at Copenhagen in August; Professor G. F. Moore at the Third International Congress for the History of Religions, at Oxford, in September.

During the coming summer Professor J. E. Wolff and Dr. G. R. Mansfield, of the geological department of Harvard University, intend to conduct a course in the form of a field expedition in the Rocky Mountains of southern Montana. The party will meet at Bozeman, Montana, some time in July, and after collecting its outfit there will move south and southwest by way of Virginia City and Alder Gulch through Ruby Canyon, into the Henry Lake country. It will return through the Medicine River Valley. The whole trip will occupy about five weeks.

The death is announced of Professor Austin C. Apgar, vice-principal of the New Jersey State Normal School, and the author of several books on geography and natural history.

Dr. A. Howitt, author of important anthropological works on the natives of Australia, died on March 8, at Melbourne, at the age of seventy-seven years.

Sir Denzil Ibbetson, eminent for his contributions to the ethnology of India, has died at the age of sixty-one years.

Dr. William Edward Wilson, F.R.S., died on March 6 at the age of fifty-seven years. Dr. Wilson had erected an astronomical observatory and an astrophysical laboratory on his estate in Westmeath, Ireland, and had there carried forward astronomical and astrophysical researches of great importance on radiant heat and light.

Dr. H. C. Sorby, F.R.S., known for his researches on the microscopical structure of rocks and metals and for the active part he has taken in developing science, literature and art in the city of Sheffield, died on March 9, in his eighty-second year.

Dr. Ludwig Wedekind, professor of mathematics at the Technical Institute of Carlsruhe, has died at the age of sixty-nine years.

Professor Wm. T. Sedgwick, professor of biology at the Massachusetts Institute of Technology, will give the annual address before the Medical School of Yale University at commencement, his subject being "Preventive Medicine and the Public Health."

Professor E. F. Nichols, of Columbia University, delivered a lecture before the Society of Sigma Xi, at Yale University, on March 9. The subject of the lecture was "The pressure due to light and its consequences," and the lecturer introduced a number of experiments as illustrations.

Professor Theodore W. Richards, of Harvard University, has completed a course of lectures before the Lowell Institute, on "The Early History and Recent Development of the Atomic Theory." The titles of the separate lectures were as follows:

February 17—"Dalton's Atomic Theory and its Relation to that of the Ancient Philosophers."

February 20—"Avogadro's Molecular Theory and its Relation to Dalton's Atomic Theory."

February 24—"Atomic Weights and Faraday's Law."

February 27—"Molecular Structure."

March 2—"The Periodic System of the Elements, and the Kinetic Theory of Gases."

March 5—"Atomic Volumes, and the Significance of their Changes."

March 9—"Atomic Compressibilities and the Heat of Chemical Reaction."

March 12—"The Hypothesis of Electrolytic Dissociation and the Possible Decomposition of the Chemical 'Atom.'"

In the bill making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1909, and just introduced into the House, the total sum appropriated is $11,431,346. Of this amount the following sums are appropriated to what may be termed the scientific bureaus and offices of the department: Forest Service, $3,796,200; Weather

Bureau, \$1,662,260; Bureau of Plant Industry, \$1,331,076; Bureau of Animal Industry, \$1,330,860; Bureau of Chemistry, \$791,720; Bureau of Entomology, \$434,960; Office of Experiment Stations \$230,620; Bureau of Statistics, \$221,440; Bureau of Soils, \$204,700; Office of Public Roads, \$87,390; Bureau of Biological Survey, \$62,000, making a total of \$10,254,226.

Dr. Judson B. Black, M.P. for Hants, N. S., has proposed a resolution in the Canadian House of Commons, calling on the government to perfect an organization and create a department of public health, whereby all matters in connection with the health of the dominion would be consolidated under one responsible head, instead of, as at present, being scattered through five or six other departments. All the medical men in the house spoke strongly favoring the resolution.

It is intended to establish an institute for tropical medicine at Townsville, in Northern Queensland. The general management will be undertaken by the three Australian Universities having medical schools—Sydney, Melbourne and Adelaide. The federal government of Australia has agreed to subsidize the work at the rate of £450 per annum, and the government of Queensland will give £250; and these sums will be increased by private subscriptions. The managers of the Townsville Hospital will set aside a building for a laboratory, free of charge.

A cooperative agreement has been made between the Department of the Interior and the Department of Agriculture, under which the forest service is to take charge of all forest work on Indian reservations.

The Fifth Pan-American Medical Congress is to meet at Guatemala, from August 6 to 10, 1908, and arrangements are being made for twenty-one sections. English, Spanish, French and Portuguese are the congress languages, and papers intended for the congress should be in the hands of the secretary, Dr. José Azurdia, Escuela de Medicina de Guatemala, before July 15.

The steamer *Nimrod*, of Lieutenant Shackleton's expedition, has returned to New Zealand from the Antarctic. The expedition has met with very trying experiences owing to fierce blizzards and intense cold. The *Nimrod* is expected to return to the Antarctic next January to fetch the expedition, and she should be back in England some time in the latter part of 1909. The ship is so badly strained that she has had to go into dock for repairs. The *Nimrod* has landed the following invalids: Dr. Mitchell, Mr. Mackintosh and Mr. Cotton.

The second International Conference on Sleeping Sickness met on March 9 at the Foreign Office, London. The conference, which was convened at the suggestion of the British government, was expected to last for about a week. The complete list of delegates of the seven countries represented at the conference is as follows:

Germany—Dr. Robert Koch, Herr H. de Jacobs, Dr. Steudel.

Spain—The Marquis de Villalobar, Dr. F. Murillo Palacios.

Congo Free State—Colonel Lantonnois, Dr. van Campenhout.

France—M. Le Myre de Vilers, M. Ronssin, Dr. Kermorgant, Dr. Cureau, Dr. Giard.

Great Britain—Lord Fitzmaurice, Sir W. Foster, Mr. A. Walrond Clarke, Mr. H. J. Read, Sir Patrick Manson, Dr. Rose Bradford, Sir R. Boyce, Colonel D. Bruce.

Italy—Professor Rocco Santoliquido, Professor Adolfo Cotta.

Portugal—Dr. Ayres Kopke.

The conference being regarded as a continuation of the first conference, Lord Fitzmaurice again presided. The proceedings were informal and brief, the whole sitting lasting only about an hour. The conference was opened by Lord Fitzmaurice, who cordially welcomed the delegates on behalf of the British government. The delegates then began the discussion of the draft general acts drawn up by the British and German governments, and Professor Rocco Santoliquido, the principal Italian delegate, delivered a long address setting forth the views of his government as to the steps to be taken for combating sleeping sickness.

When the Royal Commission on Experiments on Animals was appointed, a meeting was held of delegates of scientific and medical societies, and a committee was formed (Professor Starling's committee) to ensure that the evidence as to the value and necessity of these experiments should be presented to the Royal Commission in proper order. The work of Professor Starling's committee came to an end when the commission ceased to require further evidence. At a meeting of the committee it was decided to form a society, called the Research Defence Society, to make generally known the facts about experiments on animals, and to offer steady opposition to the anti-vivisection societies. Among those who have already joined the society are eminent men of science, leading hospital authorities, and distinguished physicians and surgeons. The society hopes to be able to give information to all inquirers, to publish articles, to send speakers when required to debates, and to be of assistance to all who want to have a clear knowledge of the facts of the case.

UNIVERSITY AND EDUCATIONAL NEWS

Plans for two new buildings have been accepted by the board of trustees of the University of Illinois. One is a physics laboratory, to cost $250,000, the other an extension of the natural history building, to cost $150,000. The physics building will be three stories in height. The site is directly east of the engineering hall. There are to be two lecture rooms, both on the ground floor, one seating 300 and the other 125 persons. The east wing will be used largely for smaller laboratories, and the west wing for the larger laboratories for electrical measurements. Plans for the extension to the natural history building will more than double the size of the structure. The building will house the department of geology, the State Geological Survey, the general administration offices of the university and of the college, the department of mathematics, and provide additional classrooms for some other departments.

Mr. Johnathan Thomas, a member of the board of trustees, has given Washburn College, Topeka, Kansas, a sum of money sufficient to build and equip a modern gymnasium. Work on the building will be begun as soon as plans are perfected.

Mr. W. W. Astor has offered to give a sum of $50,000 in addition to the $50,000 he had already subscribed, to the endowment fund of Oxford University. The gifts are conditional on the sum of $500,000 being raised.

Mr. James Robert Turle, of London, has bequeathed about $50,000 to the London School of Medicine for Women, and about $40,000 and half the residue of his estate to the Bedford College for women. He also leaves other public bequests.

It is now definitely settled that the Andover Seminary will be removed to Cambridge, and affiliated with Harvard University. The Andover seminary has an endowment of over $1,000,000 and five professors, but very few students.

It is reported that the Rev. Dr. S. Parks Cadman, pastor of the congregational church in Brooklyn, has been elected president of Wesleyan University in succession to the Rev. Dr. Bradford P. Raymond.

Dr. Carl E. Seashore, professor of psychology, has been elected dean of the Graduate College in the State University of Iowa.

Gordon M. Bentley, instructor in zoology at the University of Tennessee, has been promoted to an assistant professorship.

Miss E. N. Thomas, assistant in the department of botany, University College, London, has been appointed lecturer and head of the department of botany, in the Bedford College for Women.

Dr. Otto Mügge, professor of geology and mineralogy at Königsberg, has accepted a call to Göttingen.

Dr. Walter Kaufmann, associate professor of physics at Bonn, has accepted a call to the chair of physics at Königsberg.

Dr. Friedrich Loeffler, professor at Greifswald, has been called to the chair of hygiene in the Berlin Veterinary School in the place of the late Professor Ostertag.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, APRIL 3, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE OUTLOOK OF THE SECTION FOR EDUCATION[1]

IT is not expected of the presiding officer of this new section that he will make any extended address at this time. In fact those good friends who have had longer experience than I in the American Association and who proposed that I say a few words by way of introducing Section L to the association, very thoughtfully added the intimation that brevity in this speech would be altogether appropriate. Each presiding officer of a section may speak his mind at length in the regular vice-presidential address, delivered at the meeting following that at which he has presided. That address is in the nature of a valedictory oration. The first in the line of vice-presidents of any section has the sole opportunity of serving also as salutatorian for his section. It is an advantage over his successors which he is bound in honor not to abuse.

One thing, however, ought not to be left unsaid. The new section is glad that it is, and I should not fairly represent it if I did not express to the parent society its appreciation of the high purpose that called it into being. Its satisfaction in this regard is shared, I am sure, by the great body of school men throughout the land.

We see in this act of the American Association a sign that the alliance of science with education, more or less clearly dis-

[1] Address of the vice-president at the Chicago meeting.

cerned for generations past, is now an accomplished fact in these United States. That alliance would seem to many so much a matter of course that they will find it difficult to see any new significance in this step of the association. But there are those who, whether they approve or disapprove, will see in it a notable and characteristic stage in the movement of our civilization.

The conception of the unity of education was with us preliminary to this alliance. So long as there were in the minds of men two distinct forms of education, an elementary education altogether traditional and conservative in character, and a higher education liberal in spirit and concerned with the continuous renewal of knowledge, so long, in a word, as the higher and the lower education served diverse ends, running counter to each other, just so long that alliance could not be consummated. The higher education was already represented in such societies as this through the members of its several scientific departments; and popular education might be left to go its unscientific way, serving the purpose of a more refined system of police, as Daniel Webster described it.

Our national instinct, even more than our national convictions, has been working for generations against any such rift in our national education. We have made straight the way from every country school and every kindergarten to the highest universities. This fact is clear and has been widely noted. The related fact has been less often remarked, that in making a plain way for our pupils from the lowest schools to the highest, we have made a plain way for all learning from the highest schools to the lowest. The distinction between school sciences and real sciences is altogether repugnant to our civilization. We are not willing that any good knowledge shall be the guarded secret of an intellectual class. With regard only for such metes and bounds as are natural and inevitable, we are determined that all learning shall be for all the people. It is hard enough at best to bring science home to the unlearned without taking from it its scientific character. But we are committed to the removal of all artificial hindrances to its free course. We are devoted to the effort to bring real and uncorrupted knowledge home to all; and this new educational organization is a new declaration of that purpose and a new agency for carrying it into effect.

The alliance of science and education is more than an alliance. In our national life these two are one and can not be put asunder. It is sometimes said that scientific research is a thing apart from education; that those engaged in such research, in order to do their best, must keep themselves as free as possible from the temptation to give instruction. The eminent director of the Carnegie Institution has declared that it is not an educational institution over which he presides. The better agricultural experiment stations of the country, newly endowed under the Adams act of 1906, are seeking by all legitimate means to secure for members of their several staffs sufficient freedom from lecture engagements to enable them to carry on investigations that require long patience and the severest concentration. Each new foundation providing for research apart from any requirement of regular hours of teaching is welcomed as a new factor in our real scientific development. No one of these things is incompatible with that intimate and inevitable connection of science with education. Such provision for free-handed research is indeed requisite, if science is to do its full part in the great alliance. It is not that each individual investigator shall be expected to give some formal instruction. That is a subordinate question with which we are not now concerned. The connection of our science with our education goes deeper; for he who contributes to our science contributes, *ipso facto,* to our education. In this larger sense the Carnegie Institution and all other agencies of scientific research are educational institutions, and could not, if they would, abstain from educational service. In such an educational system as ours, no spring of new knowledge can be opened of which the streams will not find their way down through the different grades of education, as far as they may have proper use and application. The great significance of a fully coherent system of schools lies in this fact, that it not only enables individual pupils to rise according to their several capacities, but that it also gives to every scientific discovery free course among our people, according to the degree of its usefulness and of its human interest.

But in this free circulation of knowledge we are not yet perfect. If the connection were already free and open in every direction, a large part of the work of this section would be already done. We have, in fact, only as yet brought part and part of our educational system together, established the first of their more intimate connections, given first assurance that our democratic dream is passing over into reality. The task yet before us is greater than that which has been finished, and to those who plan most largely for the future, that which we now see is only a faint promise of that which may be foreseen.

It goes without saying that the mere spread of scientific information, the popular science of a generation ago, is but the smallest part of what the scientific alliance will mean to education. Scientific method, the scientific spirit, appreciation of scientific achievement, the abiding expectation that the processes of life and labor will be brought more and more under the guidance of positive knowledge; these are some of the things that education has gained and is to gain in larger measure from this relationship. In every walk in life men are to learn to observe more accurately, to pay more respect to objective evidence, to care more and more for truth, until they welcome it even against their dearest prejudice. The moral gain is greatest of all. And that is reinforced by the closely knit successive stages of developing thought and method which science has to offer, luring the learner on and on to larger reaches of organized knowledge and up into full-rounded and majestic sciences.

I do not forget that education has other alliances. Its relations with art in all its forms of beauty and use, its relations with philosophy, its relations with religion and with democracy, are not to be ignored. But all of these relations are to be tempered and steadied by scientific knowledge; and for this age, beyond any preceding age, the union with science is of commanding and immeasurable significance.

There are three ways in which this section, reinforced by the great organization of which it forms a part, can render the scientific alliance of increasing value to our education.

In the first place, it can provide for the discussion and investigation of questions relative to the teaching of the sciences. The internal method of any science depends upon the materials with which it deals. That method is in most instances well established before the use of the science in instruction comes under serious consideration. The method of instruction, with which the educator is concerned, is conditioned, on the one hand, by the method of the finished science, and, on the other hand, by the relative ignorance and immaturity of the learner. To strike the right compromise between these two sides at any stage of instruction, and then to advance from the learner's first standpoint toward the pure method of the science, by stages that shall keep the learner's effort at the safest and steadiest tension, this is a problem which presents endless variations and calls for the closest pedagogic scrutiny.

In the second place, there is the scientific treatment of the whole range of educational procedure. The same science which is to be present and influential in the teaching of our pupils is to have a large part in the training of their teachers and in the effort of teachers and of educational theorists to give new shaping and definition to the whole work of education. Our educational doctrine is quick to respond in these days to promptings from the scientific side. But here as elsewhere the severe standards of scientific method are maintained only with the greatest difficulty. In every borderland between pure science and the things that are keenly felt and valued in human life, this difficulty rises to its highest pitch. Education is a field in which the sense of human values is intense, and it is accordingly a field in which especial care must be exercised to discriminate between science and the shadow image of science. No other educational organization, I think, is so favorably placed as this education section, to exercise that fine and severe discrimination. It owes, accordingly, a sacred duty to the educational interests of the land as well as to the great association of which it is a part, to hold its standard of scientific work up to the highest level. This duty and this opportunity, more than any other single thing, is its reason for existing.

The relations of the section to the council of the association, under the well-framed plan of this organization, must be of the greatest significance from the point of view of scientific standards. So, too, its relations to other sections and to the affiliated societies. For a century, more or less, education has walked hand in hand with psychology. This close companionship is undoubtedly to be strengthened and elevated by these new opportunities of intercourse. We may hope that both sides may be gainers in this relationship. But there is no one of the sections and societies in which education has not a direct and vital interest, and from all of them this youngest section confidently expects to receive help and stimulus.

Moreover, while concerning itself with scientific standards, this section will be reminded that the whole question of scientific and pedagogic standards in our institutions of learning is pressing for solution. It can not be doubted that in many directions our educational standards are too low. They are also in a large part indeterminate. To have its part in raising and defining these standards is a high purpose which this section may rightly cherish. It can hardly be doubted that this is to be one of the greatest tasks in our field within the next decade. Our sense of its urgency is quickened by the fact that we not only need new standards at home, but we can not be content to be in an attitude of mere deference and acceptance as regards the educational standards of the whole world. We must have our part in the main current of world education and do our part in the making of world standards.

In the third place, there is the problem of the organization of science and education in their relations to government and public policy. Year by year governments concern themselves more with the affairs of peace and industry and the culture of human character. Year by year, in both peace and war, they put larger dependence upon the knowledge of the scientist; and education, with science and the arts, is its main dependence in exalting peace above war, and in promoting the vital concerns of a peaceful society. In legislation, in administration, in the making of new provision for the betterment of life, there are larger responsibilities falling every year upon those agencies of human culture which this section and this association represent. It will devolve upon us here to consider changes such as these, and devise and recommend ways in which the larger duties and opportunities may be met.

There is not time to enlarge upon these considerations. But they are laid before you in the briefest possible compass, with the conviction that here is real work to be done, which will count for positive gains to our national life.

Elmer Ellsworth Brown
Bureau of Education,
Washington, D. C.

SECTION L, EDUCATION[1]

The first meeting of the new section for education of the American Association for the Advancement of Science was held on Tuesday, December 31, at 10 A.M. The meeting was called to order by the vice-president, Commissioner E. E. Brown, who, in a brief address, welcomed the members present and urged that the section always maintain the high ideals of education as a science for whose advancement the section had been formed. Three independent sessions of the section, and two joint sessions with other organizations were held. One of these joint sessions was with the American Psychological Association, and the other with the American Society of Naturalists. An open address was delivered before a large audience composed of members from all sections by Vice-president Brown on the topic "The Outlook of the Section for Education." This address is printed in full in the current number of Science. The officers chosen for the coming year are:

Vice-president—Professor John Dewey, Columbia University.

Secretary—Professor C. R. Mann, the University of Chicago.

Member of the Council—President C. S. Howe, Case School of Applied Science.

Member of the General Committee—Professor D. P. MacMillan, Chicago.

Members of the Sectional Committee—C. H. Judd, C. S. Howe, T. M. Balliet, E. L. Thorndike, C. M. Woodward.

At the sessions of the section the following papers were presented:

The Ethical Judgments of School Children: Professor H. A. Aikens, Western Reserve University, Cleveland, Ohio.

The Practise Curve as an Educational Method: Professor J. McKeen Cattell, Columbia University.

Practise curves were exhibited showing the improvement which occurred in learning to use the typewriter and in memorizing German words. The practise was continued as long as 365 consecutive days by two observers. Curves were also shown measuring the extent to which practise in one direction causes improvement in other directions. In such experiments the learner works as hard as possible for a short time each day and knows exactly what he accomplishes, and the plan seems to have some advantages as an educational method. The greatest possible concentration and exertion for a short time is probably the best way to learn, and the child is led to this by his efforts to improve his record. The experiment can be so arranged that all the elementary subjects—reading, writing, spelling and arithmetic—are required in the experiment and are in definite relation to a task in which the child becomes interested. There is a fair competition with other students which may be emphasized as far as is desirable, but the main com-

[1] Chicago, December 31, 1907–January 2, 1908.

petition of the child is with himself; he knows exactly what progress he makes and does the best he can to improve.

Practise Curves in Learning: W. F. Dearborn, University of Wisconsin.

The report concerned, first, the daily improvement made by twelve subjects in the ability to memorize rapidly the meanings of from thirty to fifty French or German words and passages of English poetry and prose. The subjects were college juniors and seniors and the practise was made daily for twenty days. The various subjects were then tested after intervals of from two weeks to ninety-five days to determine the relative permanence of that memorized before the marked gains of the practise compared with that memorized towards the end of the practise.

After practise, and in most cases after the first five or six days, it took less than one half the original time to do the same amount of work. There was a gain of time ranging from 53 per cent. to 62 per cent. in the learning of vocabulary, and 55 per cent. to 82 per cent. in the learning of poetry and prose.

The permanence of the practise gain was tested by determining the time necessary to relearn the first two and the last two lists of vocabulary and passages of poetry and prose. Two weeks after the end of practise three subjects relearned the last tests or passages in somewhat less time than the first (three subjects), after four weeks it took from one third to one half as long again to relearn the last passages as to learn the first (three subjects), after three months' time it took one half as long again to relearn the last passages. The permanence of the more rapid acquisitions was, therefore, less than that learned at a greater expenditure of time. However, the total time spent in learning and relearning in the last part of the practise is much less than that required in the earlier part—from 30 to 50 per cent. less.

This practise method is evidently well suited to some sorts of learning, especially where permanence of results is not a prime consideration, *e. g.*, in learning a declamation, and also where there is frequent opportunity for renewing acquaintance with the subject-matter. It is probably well suited to the learning of the vocabulary of a foreign language.

The Effect of Practise on the Range of Visual Attention: Professor Guy Montrose Whipple, University of Missouri.

The object of the investigation, which was prosecuted in the Educational Laboratory of Cornell University, was to determine the feasibility of producing measurable augmentation of the range of visual attention in adults by continued daily practise, and to determine by introspection the manner in which such augmentation, if present, was brought about.

Preliminary tests with 0.1 sec. exposure of simple geometrical drawings, digits and letters indicated that observers very quickly reached a physiological limit beyond which further progress was impossible.

Extended tests with 3 sec. exposure by means of a pendulum tachistoscope of varied forms of test-material—groups of dots, pictures, nonsense syllables, drawings, stanzas of poetry, etc., and with a 6 sec. exposure of groups of miscellaneous objects placed upon a table, indicated little or no improvement in the range of visual attention with practise, but revealed marked individual differences between different observers for different kinds of material. The factors which condition the range were determined with some exactness by an analysis of the results in the light of introspective evidence. The net result, pedagogically, is that it is not worth while, as has often been erroneously asserted, to conduct specific school exercises for training the range of attention. A detailed account will be published later.

A Method of Concentration in Teaching Medicine: Professor W. T. Porter, Harvard University.

The Grading of Students: Professor Max Meyer, University of Missouri.

Scales of Measurements in Education: Professor E. L. Thorndike, Teachers College, New York.

Professor Thorndike showed a scale of merit in handwriting, established empirically by gradings of several thousand samples of handwriting. Such a scale makes it possible for any specimen of handwriting to be graded rapidly and with any necessary precision. It also permits students of education who use it to give grades that shall have the same significance, no matter by whom given, and to present a measurement of the quality of handwriting attained by a given school in a brief and unambiguous set of figures.

The Place and Content of a Course in Biology in the High School: G. W. Hunter, DeWitt Clinton High School, New York.

Statistics show that over 50 per cent. of the pupils in high schools in New York City leave before the end of the second year. Science work has won its right for existence in the curricula of the high school; a science having utilitarian value should be the one placed in the first year of a high school course of study.

The biological sciences are best fitted for the above purpose. Biology gives training in scientific method. It provides the child material which will be useful in preparation for future citizenship. It allows, in its various phases, of application to human affairs. Its informational content is of immense and farreaching practical utility.

A recommended course treats of the general principles of physiology of plants and animals, with special application of these data to the human race. Types are utilized to illustrate certain general biologic principles rather than to show classification. Emphasis is placed on the humanitarian and utilitarian aspect of biology as seen in its economic phases. More stress is laid on the informational and cultural content and less on the teaching of scientific method as such. Nature-study methods are used to some extent in observational work.

Such a course should not be offered as college entrance requirement, but should be supplemented by a year of either botany or zoology in the latter years of the high school.

The Scientific Basis of High School Studies: Professor C. DeGarmo, Cornell University.

This paper will appear in full in a future number of the *School Review.*

The Pedagogy of the Danish People's High Schools: Professor J. A. Bergström, Indiana University.

The Teaching of Spelling as a Scientific Problem: Professor Henry Suzzallo, Teachers College, New York.

An Experiment in the Teaching of Homonyms: Principal H. C. Pearson, Horace Mann School, New York.

This experiment was recently carried on in the Horace Mann Elementary School, in order to determine the relative efficiency of two common methods of teaching homonyms, one that of teaching a pair of homonyms together such as *pair* and *pear,* and the other of teaching two such words separately. The plan of the experiment was to have one section of a given grade teach homonyms by one method, and the other section of the same grade by another method, care being taken to have all the factors in the teaching alike except the point of difference that we were trying to reach. The results of the investigation were submitted to careful statistical analysis and showed that the method of teaching homonyms together was more efficient in the third, fourth, fifth, sixth and seventh grades.

It is hoped that experiments of a similar nature will be conducted in other schools, so that the validity of the conclusions of this experiment may be more accurately determined.

Psychological Experts in Public School Systems: The Experience of Chicago: Dr. D. P. MacMillan, Director of the Department of Child Study, City School System, Chicago.

Dr. MacMillan traced the idea of establishing psychological experts in public school systems, showing that the demand for this came from persons who were not psychological experts, although their cause was ably championed by Professor Royce in 1898 before the National Educational Association.

In Chicago this matter was under discussion by the Board of Education during the years 1896–8. Several plans were discussed, but it was finally decided to organize a special department of the board whose officers should devote their entire time to this work. This was done in 1899, and the functions of the new department were defined as follows:

1. Research work. (*a*) Collecting anthropometric and psycho-physical data for the purpose of establishing norms and for determining such relationship as may be of service in pedagogy. (*b*) Applying accurate scientific methods to specific pedagogic problems, particularly methods of teaching and determination of the pedagogic value of various studies.

2. Examination of individual pupils with the object of advising parents and teachers as to their pedagogic management.

3. Instruction of teachers in child study and psychology.

The work of the department during the ten years of its activity was then described in some detail, and it was clearly shown that it is altogether feasible for consulting psychologists to carry on within school systems the line of activity which educational zealots and far-sighted scientists entertained and projected for them. The general recognition of the value of establishing such departments is in line with the most modern and progressive tendencies in education, and if the plan were adopted by a number of the larger school systems, untold benefits to the public school system would result.

Objective Measurements of the Efficiency of School Systems: Dr. J. D. Burks, Albany Training School for Teachers.

Reasons for the Existence of Schools of Education in American Universities: Professor C. W. A. Luckey, University of Nebraska.

The average attendance at the meetings was forty. Much interest was shown in the papers, and many of them were discussed at length. It was the consensus of opinion that this opening meeting of the new section was a great success and that it augured well for the future of the organization.

C. R. Mann,
Secretary

THE AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES

A meeting of delegates of associations interested in the formation of an American Federation of Teachers of the Mathematical and the Natural Sciences was held in

Chicago on January 1, 1908. There were present 23 representatives of 13 associations, as follows: Association of Physics Teachers of Washington City, 1; Association of Mathematics Teachers of New England, 1; Central Association of Science and Mathematics Teachers, 6; Colorado Mathematical Society, 1; Connecticut Association of Science Teachers, 1; Indiana State Science Teachers Association, 2; Kansas State Association, Mathematics Section, 1; Michigan Schoolmasters' Club, Mathematics, Physics and Biology Sections, 3; Nebraska State Association, Physical Science Section, 2; New England Association of Chemistry Teachers, 2; New York State Science Teachers' Association, 1; North Dakota Association of Science Teachers, 1; Northeastern Ohio Association of Science and Mathematics Teachers, 1.

In the absence of the chairman, the meeting was called to order by the secretary, and Professor F. S. Woods, of Boston, was elected chairman *pro tem.*

The minutes of the last meeting having been printed and distributed, their reading was dispensed with.

The report of the executive committee was then read and accepted. The recommendations in that report were taken up for consideration. In accordance with those recommendations, the articles of federation were slightly amended, passed *seriatim,* and then passed as a whole in the following form:

1. The associations of teachers of science and of mathematics shall form as soon as possible an organization to be known as the American Federation of Teachers of the Mathematical and the Natural Sciences.

2. Associations only are eligible to membership in the federation. Any association whose purpose is the study of the problems of science and mathematics teaching, and whose number of active members is twenty-five or more, shall be eligible to membership.

3. By joining the federation, an association in no way loses its individuality, nor its right to conduct its work in its own territory in its own way.

4. An association joins the federation by appointing delegates to a body to be known as the Council of the American Federation, by having its delegates accepted by the council, and by paying to the treasurer of the council the dues as specified in number 6.

5. Each association shall have one delegate for every fifty members; but each association shall have at least one delegate.

6. Each association shall pay to the council annual dues of five cents per member of the association, in order to defray the necessary expenses of correspondence by the council. The fiscal year shall date from September 1 each year. The council is authorized to increase the per capita assessment of associations, not to exceed ten cents, if found necessary.

7. The delegates shall hold office for three years and be eligible for reelection. At the time of its organization, the council shall divide its members into three classes, one of which shall retire at the end of each year. The council shall notify each association each year how many delegates are to be elected by it then.

8. The council shall elect its own officers, namely, president and secretary-treasurer, who shall hold office for one year and be twice eligible for reelection. These officers, together with three others elected annually, shall constitute the executive committee of the council.

9. The work of the council shall be carried on mainly by correspondence, but an annual meeting shall be held, at such time and place as the executive committee shall select. At any meeting the members of the council who are present shall constitute a quorum for the transaction of business; but if less than one third of the members are present, all business so transacted shall be ratified by correspondence.

10. The duties of the council shall consist in devising methods by which the associations may work together for the betterment of the teaching of science and of mathematics. The council shall act toward each association in a purely advisory capacity, no association being bound by the terms of the federation to follow the suggestions of the council if it does not wish to do so.

11. All publications issued in the name of the federation shall be approved and authorized by the executive committee.

12. The council shall publish each year a de-

tailed statement of receipts and expenditures, and a brief outline of the work done during the fiscal year. This statement shall be sent annually to the officers of each association in the federation.

On recommendation of the executive committee it was voted that, pending the report of the committee on policy as to publication, the executive committee be authorized to print the reports and documents of the federation in such of the established journals as it may select.

At the meeting in 1906 in New York no officers were elected, but only an executive committee appointed. The articles of federation having now been formally approved by the meeting, the following officers were elected for the year 1908:

President—H. W. Tyler, Association of Mathematics Teachers of New England.

Secretary-treasurer—C. R. Mann, Central Association of Science and Mathematics Teachers.

Additional Members of the Executive Committee—R. E. Dodge, New York State Science Teachers' Association; F. N. Peters, Missouri Society of Teachers of Mathematics and Science; J. T. Rorer, Association of Mathematics Teachers of the Middle States and Maryland.

It was announced that the application of the federation for affiliation with the American Association for the Advancement of Science had been approved by that body, and that this affiliation entitled the federation to elect a representative to the council of that body. On nomination, duly seconded, the president of the federation, Professor H. W. Tyler, was elected as the representative of the federation to the council of the American Association for the Advancement of Science.

The questions: What can be accomplished by the federation that can not be accomplished by existing machinery? and, What does an association gain by joining the federation? were raised and discussed at length. Instead of trying to reproduce this discussion, the executive committee is preparing a statement of the purposes and proposed policy of the federation, and this will be issued in the near future.

The meeting adjourned, subject to the call of the executive committee.

C. R. Mann,
Secretary

The University of Chicago

THE COLLEGE AND THE UNIVERSITY[1]

The American university of to-day is a compound of two divergent and more or less antagonistic elements, which in the current academic languages, we call the college and the university. The college is in theory a place for general culture, for training the mind, broadening the intellectual horizon, and, so far as may be, making, by tasks physical, moral and mental, a man or woman better fitted for the work of the world. The university is a place of training for one's specific duties in life. Its functions include training for professional work, whatever the profession may be. Its general method is that of instruction through investigation, and its relation to the student is in many ways different from the task-setting work of the college. It demands for its teachers a somewhat different talent, that of creative work, and of the power and the will in one way or another to add to the sum of human knowledge.

Our colleges are English in their origin. Our universities are German in their inspiration and method. Thus far in America the one has in a way antagonized the other. There has been a tendency to build up the university work by neglect of the collegiate work. Very many institutions have given instruction in professional or technical subjects of university grade to students who have had no collegiate training, often even no work of the still lower grade we call secondary instruction. On

[1] Extract from the Report of the President of Stanford University for 1906–7.

the other hand, the college has gradually pushed itself upward, relegating its lower years to the secondary school, and absorbing two of the years which would naturally belong to the university. In most of our larger institutions the fourth collegiate year is frankly given to investigation or to the beginnings of university work. In fact, though not in name, it belongs to the university rather than to the college. In a general way the admission to the German university—or graduation from the secondary school, Gymnasium or Real-Schule—corresponds with the end of the sophomore year in the best organized American colleges. In England, where the university as such is still in a state of probation, the conditions are not very different, so far as degree of advancement on the part of the student is concerned.

Recognizing these conditions, there is a strong movement in Germany to introduce the American college, to set off the last years of the Gymnasium or Real-Schule, as an intermediate stage between the local preparatory school and the school of technical training and investigation.

In America there is a tendency to separate the college into two parts, the junior college, of two years, in which the work is still collegiate, and the university college, in which the work of the university begins. This separation, first accomplished at the University of Chicago, is still little more than a name. About the University of Chicago many collegiate institutions have become junior colleges, that is, institutions which recommend some or all of their students to the universities at the end of the sophomore year. This arrangement is in many ways desirable. It is better for the university to be as far as possible free from the necessity of junior college instruction. It is better for the student at this period to enter an institution with large faculty and large resources. Furthermore, if the junior college has the teachers and conditions it ought to have, it is in very many cases better that the student should take his early training there, rather than as a member of the enormous mass of freshmen and sophomores our great colleges are now carrying.

It is safe to prophesy that before many years the American university will abandon the junior college work, relegating it to the college on the one hand and to the graduate courses of the secondary schools on the other. Under these conditions its discipline and its methods of instruction will approximate those of the universities of Germany and other countries of Europe. Under these conditions the assistant professor of to-day will mostly find professorships in colleges; the professor will be an original scholar and investigator as well as a teacher, and the rule of Lehrfreiheit and Lernfreiheit will be established as a matter of course. It goes without saying that university conditions in America will differ in many ways from those of Germany. It is not likely that American legislative bodies will make a degree from the university a necessity for professional work, or its absence a bar to preferment. The trained man in America will have to take his chances with the rest, and for a time the "practical man," or even the ignoramus, may seem to distance him. But in so far as training is genuine, it will justify itself in every walk in life, and its value in the long run will be the more appreciated that it has no official attestation.

Thus far Stanford University has been a large college, well ordered for the most part, giving good instruction and with the highest collegiate standards. Its university work, though not extensive, has justly commanded respect.

The present condition of the university does not represent the original aim of the founders nor the ideal of the president. It has been the necessary result of limitation of funds, the long delay of litigation and the final settlement of the estate, and the recent unwelcome disturbance of the earthquake.

The elimination of these factors makes it necessary to look forward to the future. Is Stanford University to be a college or a university, or a compound of both? In my judgment the last can not be a permanent condition in any of our large institutions. Collegiate instruction is relatively cheap. It is given well in upwards of two hundred institutions in America, and more or less badly in as many more.

University work on a large scale is expensive. If properly undertaken, it is the choice privilege of the few institutions that are generously endowed, or that are the educational pride of wealthy states.

Among these Stanford University must stand. Its great endowment was given for that purpose, and its freedom from outside control enables it to undertake lines of work, and long-continued series of investigation, efforts of the highest intellectual type, which would not find support in public institutions with their natural tendency towards the demanding of immediate results.

In 1892 Governor Stanford said repeatedly that he wanted this institution to combine the technical work of Cornell University with the highest post-graduate work or work of investigation, at that time represented by Johns Hopkins University; that he wished it to be a university in the highest sense, "beginning," to use his own words, "where the state university leaves off." I may say in passing that at that time the University of California was chiefly an undergraduate college. In its present expansion, it has largely begun where it then "left off," and we may admit that it has already gone much farther in the realization of the ideals of Governor Stanford than Stanford University has yet gone. But we have time before us, and most things are possible with time and patience.

To make a university, in the world-sense, of Stanford University the following elements seem to me essential:

The elimination, as soon as possible—let us say in the course of five years—of the junior college, by the addition of two years to the entrance requirements. This need not necessarily raise the requirements for the bachelor's degree, which would then be, as now, two years of approved university work beyond the work of the junior college. These requirements are high enough. There is much to be said in favor of lowering them to the level of completion of the junior college course. This would correspond to the bachelor's degree of twenty to thirty years ago.

With this should follow the extension of the university as such and the intensification of the higher work. Especially medicine should be added to its scope of instruction, and other lines of advanced work would naturally follow if the university were relieved from the burden of elementary instruction—of work which is done more or less well in every part of the country.

Unlike the German universities the American universities must include instruction in the various professions of engineering. This is in Europe generally relegated to a separate institution, the Polytechnicum. The development of the creative phases of engineering is costly, and yet of the highest importance to the material progress of the country. Besides the increase of equipment, the library must be greatly enlarged, a process at present going on at a generous rate. It will also be necessary to provide adequate means for the publication of results of scientific, literary and other forms of research. The means for beginning this work have been already provided by your honorable board.

It will also be necessary to provide means for fellowships and scholarships. The present writer has been strongly opposed to the present fellowship system in America, believing that its evil of hiring men to study in a certain place often outweighs its advantage of furnishing promising men with means of making the most of their period of training. But in a matter of this kind it is not possible for a single institution to stand aloof from its associates, and to demand an adequate return in laboratory or other assistance from each fellow will tend to minimize these evils of the system.

SCIENTIFIC BOOKS

Anatomy of the Brain and Spinal Cord, with Special Reference to Mechanism and Function. By Harris E. Santee, M.D., Ph.D. Fourth edition, revised and enlarged. Philadelphia, P. Blakiston's Son & Co. 1907.

In this fourth edition, Dr. Santee has so enlarged upon the previous editions as to make a book of 451 pages, including an excellent index, and has added a considerable number of illustrations. His confessed endeavor has been to present the present knowledge of the anatomy of the human central nervous system. To do this, he states that he has gleaned, as far as possible, from "original sources" and he gives special credit to the works of McMurrich, Cunningham, Morris's "Anatomy," the reference books of Barker, and to Dr. A. W. Campbell's recent "Histological Studies of Cerebral Localization."

Published in this country, we already have an exhaustive compendium of the literature up to that time, in Barker's "Nervous System" and, in its contemporary, the work of Gordinier, we have a very excellent and serviceable text-book. Dr. Santee's book is less exhaustive as to the anatomy of the nervous system than either of these and one of its aims is to include added findings which go to make up the present status of our knowledge. It is designed as a text-book for medical students primarily. In the preface it is stated that the special objects in view throughout the book are the "location of functional centers and the tracing of their afferent, associative, and efferent connections." Attention is very wisely given, in the general text, to the embryology when such will aid the student in comprehending the adult structures, and, at the end of the book, a special chapter is wholly devoted to the origin and differentiation of the brain and spinal cord.

In arrangement of subject-matter, the author has presented the structures in the order which he thinks convenient to the dissector, though the book is manifestly for use, not in the dissecting room, but in the laboratory, where properly hardened (and therefore long removed) brains and spinal cords may be used, supplemented with the study of stained sections under magnification. The order begins with the meninges of the encephalon, then passes to the cerebrum and rhombencephalon with their various subdivisions, then takes up the meninges of the spinal cord, followed by a study of the cord itself, and ends with a chapter on the tracing of impulses and the chapter on embryology.

While the dura mater of the base of the cranium almost of necessity has to be studied in the dissecting room, the spinal cord is more easily and safely removed with its dura intact, and usually it is thought that all the membranes are best studied and their significance better grasped while, or after, studying the superficial characters of the structures they envelope. In the study of related mechanisms, it is usually considered pedagogically wisest to proceed from the simpler to the more complex structures. The spinal cord, being much less voluminous and its architecture much more easily grasped, as well as having functional precedence in most of the activities of the general body, is considered first by the student in most laboratories.

In the total 128 illustrations, Dr. Santee has displayed good judgment in the choice of those taken from other works, fifty-three of these being taken from McMurrich, Gordinier and Morris's "Anatomy" alone. In a few cases, however, the choice is not so fortunate. For example, in Fig. 51, taken from Burbaker, there are four anatomical misrepresentations. Some of the illustrations labeled "*original*" but little resemble anything found in nature; others of these are strikingly familiar.

The period of transition from the use of the old polyglot nomenclature into that of the BNA is rapidly passing and Dr. Santee has adopted the BNA quite extensively. It would have been amply justifiable and highly commendable had he used the BNA consistently throughout his book, confining himself either to the original Latin terms or to their English equivalents as he preferred. The marked inconsistency with which he uses the nomenclature often gives an impression of crudeness which is unfortunate. In the headings of the paragraphs, often one heading is in the BNA, followed by one or two in the English equivalents of the Latin for no obvious reason, and then may follow a heading in neither the BNA nor its equivalent. Occasionally there is a split use of Latin and English, such as "*columna of the fornix*," "*anterior columna*" (of the spinal cord). The lay-term, "*gray matter*," "*white matter*," is frequently used instead of the much more satisfactory BNA term, *gray substance;* and the gross divisions of the longitudinally running fibers of the spinal cord are referred to as *columus* instead of using the more expressive BNA term *funiculus*, a bundle of bundles (fasciculi). The posterior median sulcus of the spinal cord is given the old misnomer of *fissure* when it does not become a fissure, nor is it so called in the BNA, until the medulla oblongata is reached. On the other hand, certain BNA terms are used which are now quite commonly modified by anatomists; for example, *posterior* and *anterior* instead of the much preferable *dorsal* and *ventral* roots, etc. The term, *cerebral nerves*, might be satisfactorily modified by substituting with the word, *cranial* or *encephalic*, since only four of the twelve pairs, including the questionably typical optic nerves, are attached to the cerebrum. Also, such terms as "*rubro-spinal tract*," "*relay stations*," and "*excito-reflex fibers*" are crude as well as unsatisfactory, and such an expression as "*Ganglionar Gray Matter of the Cerebellum*" is a rather indefinite way of designating the cerebellar nuclei and smacks of tautology as well, since, strictly speaking, all nervous gray substance is ganglionic and all ganglia are gray substance.

The descriptive anatomy, especially that pertaining to the contours and macroscopic features of the central nervous system, is excellently good and is gone into with considerable detail. The finer microscopic and the functional anatomy can not be so generously accepted throughout. From the nature of the subject, no author can deal with the detailed functional significance of the various structures of the nervous system, especially those of the encephalon, in a way acceptable to all readers.

The description of the neuroglia is wholly that given prior to the year 1895.

For more than twenty years it has seemed to be the ardent desire of practising physicians to divide the prosencephalon into isolated, definitely bounded, functional "*centers*." Dr. Santee has apparently accepted without question a large number of the conclusions with which this literature is filled and states them with a positiveness often more or less unwarranted for the purposes of a text-book. There are given boundary distinctions between questionably separate "*emissive motor centers*" and "*psychic motor centers*," "*receptive common sensory centers*" and "*psychic common sensory centers*," and instead of the more elastic term, *area*, we are given definitely the location in the cerebral cortex of a *speech center*, a *writing center*, a *center of stereognosis*, an *intonation center*, a *naming center*, a *center of abstract concept*, etc. The word *psychic*, qualifying the name of a "center," makes it more admissible, for this word may imply any multitude of phenomena whose nature, extent and functional anatomy are not understood. The more conservative works think it wiser to confine definite statements as to cerebral localization of function to those *areas* of the cortex which, by direct experimental or traumatic stimulation, or by repeated cases of identically similar lesions, are definitely indicated to be concerned with the given functions. The general motor and sensory (somæsthetic) *areas* are known with practical certainty, and experiments have enabled us to subdivide them for different parts of the body; and the areas concerned more than any others with the four special sense organs are generally accepted, though not given definite boundaries. But to go much further, our knowledge will have to advance past the stage, not yet reached, when cerebral tumors may be positively diagnosed both as to existence and especially as to exact position, and when positive interpretations may be made of the varied symptoms accompanying many of the smaller brain lesions.

Further, purely histological studies of cerebral localization are practically worthless as to the existence of "centers." The function of an organ or part of an organ must be previously known, for function can not be inferred from anatomy. With microscopic anatomy especially, one would be more helpless than, for example, he would be with a steam engine or its parts, unknown and seen for the first time. Just as the leaves of a tree are not exactly alike, so are no two gyri, of the same or of different cerebra, exactly alike as to contour, depth of sulci or thickness of pallium. These superficial differences are as marked as internal or structural differences. If analyzed far enough, no two sections of a gyrus will be found identical and, by carefully comparing sections of adjacent gyri, differences of structure are easily distinguishable. All gyri peculiarly situated, and therefore peculiarly shaped, show peculiar structural differences. If a well-defined difference of function of a whole or a part of an organ is positively known, functional significance may then be assumed and attributed to the structural differences, and such assumptions may or may not be correct as the history of the study of many organs shows. Many of the differences in number, size and lamination of the cell bodies, and therefore of the axones, of the various gyri may be more truly explained as due to different intracranial physical conditions present during the processes of growth. The existence of the gyri and their superficial differences are explained in this way.

The execution of the book is fine. The paper is good, the print neat and clear, and the reproduction of the illustrations is excellent.

The intent of a book of this kind is to aid the student in making a more detailed study of the nervous system than is expected with the ordinary text-books of anatomy. Dr. Santee will agree that in making such advanced studies, the student should be urged in every possible way to consult frequently the literature of the subject, yet, no bibliography is given nor is there given an index of authors consulted during the preparation of the book.

Irving Hardesty

Berkeley, California

Introduction to Higher Algebra. By Maxime Bôcher, Professor of Mathematics in Harvard University. Prepared for publication with the cooperation of Mr. E. P. R. Duval, Instructor in Mathematics in the University of Wisconsin. New York, The Macmillan Company. 1907. Pp. xi + 321.

Analytic geometry is one of the most useful solvents of algebraic difficulties. Among other important solvents of compounds of higher algebra are the group theory, the differential calculus, and the theory of numbers. In the present work analytic geometry is so frequently employed that a good elementary knowledge of this subject is an indispensable prerequisite. Group theory is used very much less frequently and the necessary concepts of this subject are developed very briefly but clearly. The Galois theory of algebraic equations and the explicit theory of congruences are entirely omitted and invariants are treated very briefly. The omission of such important matters seems justified by the title, as it is not intended to be a compendium, but really an introduction to higher algebra.

The reader should, however, not get the impression that he is dealing with a work which is like other so-called higher algebras published in this country. On the contrary, Professor Bôcher's book bears closer resemblance to Weber's "Lehrbuch der Algebra" or Serret's "Cours d'algèbre supérieure" even if it is much less comprehensive than these classic works. It exhibits the same masterly grasp and improvements in the presentation of fundamental matters. For instance, the theory of linear dependence is treated here in a more complete and satisfactory manner than in any other text-book. Another special feature of this work is the thorough treatment of quadratic forms, culminating in the important but not easily accessible theory of elementary divisors.

The book is intended "for students who have had two or three years' training in the elements of higher mathematics, particularly in analytic geometry and the calculus," and is based upon the courses of the author's lectures delivered at Harvard University. The mode of treatment is in accord with the modern tendency not to be satisfied with results which are true "in general"; that is, which are true except in some isolated cases. In using such results it is always necessary first to inquire whether the case to which we desire to apply them is not really one of the exceptional ones, and hence they are very much less desirable than the theorems which have no exceptions. This mode of treatment is a consequence of the effort to actually prove things instead of being content with some more or less plausible intuitions which so often pass for proofs. The scope and contents of the work may be inferred from the following list of the headings of its twenty-two chapters; Polynomials and their most fundamental properties, a few properties of determinants, the theory of linear dependence, linear equations, some theorems concerning the rank of a matrix, linear transformations and the combination of matrices, first principles and illustrations of invariants, bilinear forms, geometric introduction to quadratic forms, quadratic forms, real quadratic forms, the system of a quadratic form and one or more linear forms, pairs of quadratic forms, some properties of polynomials in general, factors and common factors of polynomials in one variable and of binary forms, factors of polynomials in two or more variables, general theorems on integral rational invariants, symmetric polynomials, polynomials symmetric in pairs of variables, elementary divisors and the equivalence of λ-matrices, the equivalence and classification of pairs of bilinear forms and of collineations, the equivalence and classification of pairs of quadratic forms.

G. A. Miller

University of Illinois

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Experimental Zoology, Vol. V., No. 2 (December, 1907), contains the following papers: "Regeneration of Compound Eyes in Crustacea," by Mary Isabelle Steele. The small hermit crab (*Eupagurus longicarpus*), the shrimp (*Palæmonetes vulgaris*) and the sand shrimp (*Crangon vulgaris*) were used for experiment material. Each individual had either a part or the whole of one or both eyes removed. Results obtained after removing part of the eye show: that hermit crabs may regenerate a perfect eye even after the destruction of as much as half the optic ganglion; that *Palæmonetes* does not regenerate an eye if the optic ganglion has been at all injured; and that *Crangon* regenerates an eye much more slowly than either of the other species, and only after little or no injury to the optic ganglion. After removal of the eye so that the entire optic ganglion is destroyed, the hermit crabs and *Crangon* may regenerate an antenna-like organ in place of the excised eye. *Palæmonetes* does not show any sort of true regeneration unless the optic ganglion has been left intact. The results of the whole series of experiments tend to show that the regeneration which takes place from any level is largely influenced by the presence or absence of the whole or a part of the optic ganglion. "On Some Phenomena of Coalescence and Regeneration in Sponges," by H. V. Wilson. Cells of siliceous sponges (*Microciona*) when separated by pressure from the skeleton are able to recombine, forming a plasmodial mass which differentiates anew into a perfect sponge. "Equilibrium of Animal Form," by Hans Przibram. "The Effect of Degree of Injury, Successive Injury and Functional Activity upon Regeneration in the Scyphomedusan, *Cassiopea Xamachana*," by Charles Zeleny. The present study is a part of a series of experiments whose object is the investigation of some of the internal factors controlling regeneration in several representative forms. It is found that removal of six of the eight oral arms in *Cassiopea* constitutes the most favorable degree of injury for the regeneration of each arm, and that from this optimum there is a decrease in both directions. The data for successive injury show a greater rate of regeneration of the margin of the disk after the second removal than after the first. A comparison of the rate of regeneration of the margin in cases where the disk was made to pulsate rhythmically with cases without pulsation shows no advantage in favor of the pulsating ones, but rather a retardation. "Studies in Adaptation—I., The Sense of Sight in Spiders," by Alexander Petrunkevitch. This article shows the relation between the position of the eyes on the cephalothorax and the particular locomotion in hunting spiders, and by the application of a new method makes possible the determination of the maximum angles and of the limit of vision for each eye.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 200th meeting of the society, held in the Cosmos Club, on Wednesday evening, February 12, the following papers were presented:

Regular Program

The Barringer Hill (Texas) Pegmatite Dike: Frank L. Hess.

This dike by its resistance to erosion has formed a low hill in the flood plain of the Colorado River, and was named for the discoverer. The minerals of the dike have unusually large dimensions, the quartz occurring in masses 40 feet in diameter; the feldspar in masses 30 feet across, with individual crystals having edges 34 inches long; while fluorite crystals enclosed in quartz show edges a foot long. A great variety of rare-earth metal minerals occur in the dike, of which the yttria bearing minerals, fergusonite and gadolinite are mined commercially. Allanite occurs in masses weighing over 300 pounds, fergusonite up to 65 pounds and gadolinite up to 200 pounds. So far, no other important occurrences of the rare-earth metal minerals have been found in the neighborhood.

The Structure of the Marble Belt of Fannin County, Georgia: Laurence LaForge.

The marble occurs in two lines of exposures, occupying a double valley from one to three and one half miles in width, cut about 250 feet below the general level of the region, and with a low central ridge of mica slates. Owing to strike faults, there is not a complete section, nor do the formations occur in complete normal sequence anywhere in the immediate region, and attempts to unravel the structure were unsuccessful until the key was furnished by the sequence of the formations determined by Mr. Keith in the Nantahala Quadrangle in North Carolina.

The structure shows the valley to be in general synclinal, but with a subordinate axial anticline, the two lines of marble thus occupying the lateral synclinal axes, and the slate of the central ridge belonging in a formation underlying the marble. Both the central anticline and the lateral synclines are broken by thrust faults, so that the marble occurs in discontinuous patches, and on the western side of the valley one and sometimes two of the underlying formations are faulted out. Nothing is known of the actual dip of the faults, but certain considerations lead to the conclusion that they are steeply inclined, and that the western fault is overthrust from the west, the other two being overthrust from the east.

Oxygen Values and Coal Alteration: Mr. David White.

Elimination of oxygen is the preeminently important feature from the standpoints both of coal efficiency and coal development. This deoxygenation, largely accomplished during the first or biochemical (putrefaction) stage of coal formation, continues during the second, or dynamochemical stage. A comparative study of ultimate analyses shows that in practically all kinds of coals, the oxygen and the ash are of approximately equal anti-calorific value, *i. e.*, of nearly equal importance as impurities from the heat standpoint. Consequently, since the carbon-oxygen ratios of coals with the same ash closely correspond in their numerical sequence to the order of the calorific values of those coals, it follows that coals with varying ash will, if arranged according to the ratios of carbon divided by oxygen-plus ash, $C \div (O + \text{Ash})$ stand in a sequence closely approaching that of their calorimetrically ascertained efficiencies. Of 250 coals tabulated in accordance with the latter ratios few depart as much as three per cent. from the mean corresponding to their respective ratios, and the greater number are within one per cent. The widest departures are found among the brown lignites and peats and the coals undergoing anthracitization. The comparative study shows that the anti-calorific value of the oxygen is apparently about twice as great as has been supposed. In fact, per cent. for per cent., oxygen and ash as impurities are of so nearly equal value according to the calorimetric tests of the coals as to be practically interchangeable so far as concerns the heating power of the fuel. Since the demonstration is based upon the analyses of the air-dried samples in which the water content varies widely, it would appear that the oxygen of the moisture is not far different in anti-calorific value from that of the oxygen in hydrocarbon combination. The negative value of one per cent. of oxygen, or ash, in ordinary bituminous coals is probably between 70 and 80 calories.

A further study of the analyses suggests that the quality of coking may be due to the presence of gelosic algal, or sapropelic, matter in the original ingredients of the fuel. Since fuels in which such matter has been microscopically observed generally fuse, usually with swelling, on combustion; and since the researches of Renault and Bertrand have proved the agency of gelatinous micro-algæ in storing up bitumen, it would appear probable that coals possessing the necessary quantity of such ingredients would exhibit both fusibility and enrichment by bitumen. Consequently, fuels which are shown by a relatively high per cent. of hydrogen to have been enriched by bitumen, if such enrichment is due to the presence of the above mentioned ingredients, will also possess the fusibility essential to coking, provided that the ash is not too great. The comparative study of the analyses shows that, until the point of rapid dynamic devolatilization of the semi-anthracitic stage is approached, coals which exhibit a high proportion of hydrogen as compared to oxygen (H/O) and which, therefore, may be regarded as enriched by bitumen, generally possess coking fusibility. It thus appears that the above hypothesis is supported by chemical analyses, although it may not be regarded as proven short of microscopical detection of gelosic (sapropelic) elements. In the main body of coals, between semi-bituminous and lignites, it would seem possible to forecast the coking quality from the hydrogen-oxygen ratios, moisture-free basis, of the coals.

Philip S. Smith,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 646th meeting was held February 29, President Bauer presiding.

Mr. John E. Burbank presented the first paper of the evening, entitled "Microseismic Tremors and their Apparent Connection with Barometric Variations."

This paper discussed a now well-known type of seismic motion which consists of short period waves of very small amplitude, lasting, generally, for hours and sometimes for three or four days. These waves show alternate maxima and minima like the phenomena of beats in acoustics.

The seismograph at the Cheltenham Magnetic Observatory recorded 75 cases between September 1, 1906, and January 31, 1908. The most pronounced tremors occurred when a deep barometric depression passed from land to sea, or *vice versa*. No marked depression passed over the coast line, between Portland, Me., and New Orleans, La., during this interval of time without being accompanied by tremors which were recorded at Cheltenham. When the center of a depression passed over the coast line near Cheltenham the tremors were much more pronounced. These tremors also occurred, but with less intensity, when a pronounced high area passed over the coast line. They also occurred when the barometric changes were such as to cause sudden pressure changes over a large extent of coast line. No tremors accompany barometric depressions or sudden changes which take place wholly over land, even when comparatively near Cheltenham. The period of these minute waves is about 3.3 seconds and has no definite relation to the periods of the pendulums themselves, which varied between 18 and 28 seconds. Two cases were noted when the period was 5.0 seconds.

It was pointed out that a barometric depression when over land ought to raise the earth's surface on account of the reduced pressure, and when over the ocean the water should rise so that the pressure on the ocean bed would be practically unchanged. Any load applied to, or removed from the earth's crust by a barometric change would have an abrupt margin at the shore line.

At the conclusion of Mr. Burbank's paper Mr. W. J. Humphrey presented two papers; the first paper being entitled "Anode and Cathode Arc Spectra."

In the case of direct current arcs the spectral analysis of the light from the regions of the two poles gives very different results. When the carbons contain only small amounts of metals or their salts the metallic lines are practically confined to parts of the arc near the negative pole, while the carbon or cyanogen bands are most pronounced near the positive pole. This difference has been ascribed by some observers to a kind of electrolysis in the arc, causing an accumulation of the metallic particles on and about the negative pole. Others have considered it due to a similar accumulation of the metallic particles, due not to electrolysis, but to distillation, and to convection.

The author does not accept any of these theories as being both necessary and sufficient to fully account for the phenomena observed. He accepts the theory, largely due to J. J. Thomson, that the arc consists mainly of negative corpuscles moving with great velocity from the negative to the positive pole, together with an approximately equal number of positive ions moving much slower in the opposite direction. Ionization takes place mainly next the positive pole, and the positive ion or "rest-atom" drifts under the voltage of the arc towards the negative pole, where presumably the corpuscles are most numerous and have their greatest velocity.

The shocks then of these "rest-atoms" by the swiftly moving corpuscles is supposed to be the cause of the spectrum lines, which are concentrated about the negative pole simply because this is the place where the corpuscles are most numerous and most energetic.

Mr. Humphrey's second paper was devoted to the subject "The Luminous Particle a Strong Magnet."

Attention is called to the fact that, so far as we know, a magnetic field can act only on some other magnetic field; that an electric current is accompanied by a magnetic field; and that a moving electric charge is an electric current. From this it is argued that the luminous atom, whose spectral lines are changed by a magnetic field, must have a magnetic field of its own, due to negative corpuscles in some sort of orbital motion.

Attention is also called to the fact, shown by Langevin, that a ring of electrons or corpuscles when acted on by a changing magnetic field will correspondingly change its angular velocity, but not its orbital radius. This supposedly leads to a fixed self-induction for the ring, and makes it possible to calculate the electromotive force generated in the ring by any given change in the magnetic field in which the atom chances to be placed, and also the resulting current.

If the atom is constructed in general as the above experimental facts would lead us to believe, then the change in wave-length of a spectral line, when produced in a magnetic field, will bear the same relation to the undisturbed wave-length that the strength of the disturbing magnetic field does to the field of the atom itself.

This gives at once the experimentally established Zeeman law, that the change in wave-length, divided by the strength of the disturbing magnetic field times the square of the undisturbed wave-length, is a constant; and, by substituting known values for three of the four terms, the magnetic strength of the atom is found to be some thousands of times that of the most powerful electromagnet.

R. L. Faris,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 440th meeting was held February 22, 1908, President Stejneger in the chair.

Dr. B. W. Evermann read a paper on "Testing the Water of Small Lakes for Oxygen." The U. S. Bureau of Fisheries has for several years been devoting a portion of its appropriations to the physical and biological survey of the streams and lakes of the states and territories.

These surveys have been directed primarily to the securing of accurate knowledge regarding the fishes and other animals native to each stream or lake, the physical and biological conditions under which they thrive, and the fitness of the waters for other species whose introduction is or may be proposed.

Recently, the bureau began the examination of small lakes with particular reference to the amount of absorbed oxygen contained in their waters. Several such lakes have been examined in Wisconsin (in cooperation with the Wisconsin Natural History Survey) and several in northern Indiana. At Lake Maxinkuckee, besides dissolved oxygen, temperature and depth, the determinations included titrations for normal carbonates, bicarbonates and free carbonic acid. The surface water for a depth of a few meters was about air-saturated with oxygen. Below six meters the oxygen falls rapidly and at twelve or thirteen meters disappears entirely from the water. The dead plankton falling from the upper strata is sufficient to keep the oxygen in the depths consumed by oxidation. Protection from storms and winds which agitate the water is a factor in the lack of oxygen in such lakes.

Dr. C. Dwight Marsh referred to the effect of wind in the distribution of oxygen in lakes. While one class of lakes are shallow and hold oxygen at all depths, and another are deep and have no oxygen in the depths, there is still a third class which are deep and yet contain oxygen at their greatest depths. This last class consists usually of lakes which by their large size or exposure favor the creation of bottom currents originating in the action of wind, as by the piling up of water at one end of the lake, and the subsequent return of equilibrium.

Mr. A. H. Howell read the next paper, which was on "The Destruction of the Cotton Boll Weevil by Insectivorous Birds." This paper was based in part on Bulletins of the U. S. Department of Agriculture and in part on unpublished material. His subject was illustrated by lantern slides and by the skins of the weevil-eating birds. In reply to questions, Mr. Howell said the cotton caterpillar, itself an enemy of the cotton boll weevil, was eaten and preferred to the latter by the birds, and that the weevil, though a tough chitinous insect, was probably digested within a few hours in the stomachs of birds.

Dr. Evermann said Mr. Howell's paper emphasized the necessity of international control of migratory birds. The enactment of the Shiras bill affecting birds, mammals and fishes would be a step in this direction.

The third paper was by Mr. F. V. Coville, on "A Mistletoe Destructive to the Douglas Fir."

M. C. Marsh,
Recording Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The 46th meeting was held February 1, 1908. Vice-president C. V. Piper presided and thirty-five members were present.

The first paper was by Mr. W. J. Spillman: "Five Types of Variation under the Chromosome Theory." Mr. Spillman started with the assumption that the development of the individual from the fertilized egg is a matter of the assimilation of food and the conversion of food materials into tissues; and that if we understood all the metabolic processes that occur in the body we might possibly be able to understand why a given egg develops into a specific organism. At present we do not know a great deal about the exact locality in which various processes occur or the cause or nature of the changes which do occur, but there are reasons to believe that the chromatin is of highest importance in assimilatory processes. The cytoplasm also, at least in some of the cells of the body, must also take an important part. Inheritance is easier to understand than development. The gamete, composed of certain substances built into more or less definite structures, is so organized that by assimilation of food the cell is able to reproduce itself. Important differences frequently appear when we pass from one generation to the next.

1. One of the most important, and by far the most common cause of variation, lies in the new groupings of hereditary characters which occur when two gametes unite, the preparation for the new grouping having been made in the formation of the gametes. Any definite structures in the cell which have important functions in the metabolism of food and which retain their identity in passing from one cell to another may determine important differences between parent and offspring. The facts of Mendelian inheritance indicate that there are such definite structures which become rearranged with the production of new gametes and their subsequent union. We may include here all variation due to recombinations of Mendelian unit characters.

2. The definite structures of the cell, which because of their composition bear definite relations to metabolic processes, may, by change in composition or in environment, change in their relation to the metabolic processes. Speaking in a general way, the development of the numerous varieties of domesticated species seems to have arisen from the loss of functions formerly possessed by definite structures within the cell, perhaps in the main the chromosomes. The author, to support this supposition, gave illustrations of the variation in color in domesticated hogs, and called attention to de Vries' application of the same theory to explain the origin of the numerous varieties of cultivated plants.

3. New functions may be acquired by cell organs causing new characters to appear. It is supposed that evolutionary progress in the main is of this character. Such changes may be slow and gradual or instantaneous.

4. Change of environment may cause marked changes, as in the case of the cassava plant, which loses its prussic acid when brought from the tropics to Louisiana. Hard wheat taken to the Pacific coast becomes soft in a few years. Champion tomatoes from seed grown in Pennsylvania produce Champion tomatoes in Louisiana, but the seed produced in Louisiana yield a very different type of tomato. These variations are probably due to changes in metabolic activities, perhaps in the chromatin and in the cytoplasm. Such changes may be reversible or not. This particular phase of variation offers to the student an inviting field in which too little work has been done.

5. Loss or gain of chromosomes resulting from accidents in cell division may cause important variations. Recent investigation indicates that we may find here an explanation of the so-called mutations of de Vries.

Professor Spillman's paper was followed by a prolonged discussion.

The second paper, "A Root Disease of Tobacco," by Mr. W. W. Gilbert, was an account of the disease caused by the fungus *Thielavia basicola,* which is the subject of a forthcoming bulletin of the Bureau of Plant Industry.

Under the title "Some Peculiar Seedlings" Professor J. B. S. Norton described a series of experiments in germinating immature seeds of the cowpea. From the time of fading of the flowers he collected seeds at intervals of three days. He found that those which were three weeks from the seed, about one tenth normal size, sprouted and produced slender but normal plants.

Mr. J. H. Painter, of the United States National Museum, then gave an account of

"The Present State of the Study of the Flora of the District of Columbia."

The last paper on the program was by Mr. Charles J. Brand, of the Bureau of Plant Industry, who discussed a new variety of alfalfa (*Medicago sativa* L. var. *polia* Brand) based on plants grown from seed of Peruvian origin, quite distinct from forms of the species hitherto known. Inasmuch as the plant promises to be of considerable agricultural importance, Mr. Brand raised the question of the desirability of applying varietal names in the taxonomic sense to distinct forms of our important crop plants. The paper, which included a discussion of previously recognized varieties, aroused an interesting and spirited discussion.

W. E. Safford,
Corresponding Secretary

THE TORREY BOTANICAL CLUB

The club was called to order on February 26, 1908, at the Museum of the New York Botanical Garden at 3:45 P.M. Ten persons were present.

The scientific program was as follows:

Remarks on the Genus Boletus: William A. Murrill.

This paper will be published in the March (1908) number of *Torreya*.

Some Fern Hybrids: Ralph C. Benedict.

The object of this paper was to present general facts regarding fern hybrids, to indicate the apparent significance of the facts, and to show examples of some native hybrids.

The literature on the subject seems to be very scanty, and consists principally of scattered descriptions of natural and horticultural hybrids. Lowe ("Fern Growing") has given a general discussion of the subject, but his work is of a horticultural, rather than of a scientific, value. The most conclusive experiments are those carried on by Miss Margaret Slosson, in which she reproduced culturally *Asplenium ebenoides* (*A. platyneuron* × *Camptosorus rhizophyllus*) and *Dryopteris cristata* × *marginalis* Davenport, two suspected hybrids, which occur in nature. Recently, at least one more cross has been artificially produced by Mr. Amedee Hans, of Stamford, Conn., between *Dryopteris Filix-mas* and *D. marginalis*. This, however, has not yet been found wild.

Study of these three authenticated hybrids shows that they agree in general with the hybrids of some flowering plants. They are sterile, usually larger than the parents, sometimes abnormal, and in many characters intermediate to a greater or less degree between the parent species. In view of these facts, it seems reasonable to interpret as hybrids other forms (principally in *Dryopteris*) which are sterile and similarly intermediate between two species.

Some of these are very characteristic and might be considered separate species. At least two have been so described. This view, however, is untenable because of their sterility, and their distribution, rare or occasional with the parent species, or at least in a locality where these grow or have grown. That they are mutations seems very doubtful, because the actual differences are so great, and especially since in these differences they resemble the other reputed parent. For example, sterile intermediates are known between *Dryopteris marginalis* and six other species. Some resemble *marginalis* most, some the other species, but all agree in possessing distinctive characters of each of two species. For similar reasons, these forms can not be satisfactorily explained on ecological grounds.

If it is objected that fern hybrids must, because of the conditions required for the transference of spermatozoids, be too rare to account for these plants which are rather common, it may be said that *Dryopteris cristata* × *marginalis*, one of the authenticated crosses, is the commonest of them all. It may be expected in any swampy woodland where the parent species occur. This being the case, we are bound to expect the other forms to be found at least occasionally, and it seems only logical to conclude that such intermediate sterile forms as are analogous in general characters to *D. cristata* × *marginalis*, belong in the same category, and are likewise hybrids.

In the region in which the writer has studied these plants, *Dryopteris* is represented by six specific units which seem to hybridize more or less readily, representing a total of fifteen possible combinations of two species. Of these fifteen, two are already described. Of the remaining, probably eleven have been found, and descriptions for most of these are in preparation, some by Miss Slosson, some by Dr. Philip Dowell and some by Mr. Benedict.

Both papers were discussed at length.

C. Stuart Gager,
Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

The sixth regular meeting of the session of 1907–8 was held at the Chemists' Club, 108 West 55th Street, on March 6.

The annual election of officers, to assume their duties at the close of the June meeting following, was held with the following result:

Chairman—Leo H. Baekeland.

Vice-chairman—F. J. Pond.

Secretary and Treasurer—C. M. Joyce.

Executive Committee—H. C. Sherman, Geo. C. Stone, Morris Loeb, Arthur B. Lamb.

The following papers were read:

"The Electrolytic Determination of Bismuth," by F. J. Metzger and H. T. Beans.

"Some Principles in Laboratory Construction," by Chas. Baskerville.

"A Method of Analyzing Shellac," by P. C. McIlhiney.

"Studies in Nitration, IV.: Melting-point Curves of Binary Mixtures of Ortho-, Meta- and Paranitranilines: A New Method for the Determination of Such Mixtures," by J. Bishop Tingle and H. F. Rolker.

C. M. Joyce,
Secretary

DISCUSSION AND CORRESPONDENCE

COOPERATION IN SCIENTIFIC BIBLIOGRAPHY

The recent report of Dr. H. H. Field, founder of the Concilium Bibliographicum of Zurich, Switzerland, contains a discussion of the relations which this central international agency for recording and making accessible information regarding publications in certain sciences bears to publishers and editors in these fields, which is of wide interest to all who wish to forward the success of this most valuable aid to science.

This bibliographical institute was founded officially by the International Congresses of Zoology and Physiology and for a decade has been subsidized by the Swiss Confederation, the city and canton of Zurich, the Swiss Bureau of Education, the French Zoological Society and learned societies in other countries. It is the work of the Concilium to examine the scientific periodical literature of the world, and also that which appears in reports, memoirs, bulletins of irregular and discontinuous publication, as well as the formal volumes of the regular book trade, and prepare accurate bibliographical lists of the same. The Concilium issues at present a series of bibliographical cards in zoology and another in physiology. The cards in zoology cover also the fields of general biology, microscopy, paleontology and anatomy. To these sciences which lie on the dividing line between medicine and the natural sciences it is intended to add progressively new branches. Movements have been started looking toward the extension of this work into other fields of science and the Concilium has come to be considered as the natural center about which all work of this nature tends to group itself. Alliances are even now being sought by the leading bibliographies in botany, anthropology, geology and mineralogy. Further extensions into the field of medicine are also sought, while negotiations regarding forestry and electro-chemistry are pending. Dr. Field very justly calls attention to the fact that the usefulness of the Concilium in making known new publications is not limited to printed matter appearing under its immediate editorship; to wit, in the "Bibliographia Zoologica" and "Physiologica" and the bibliography cards founded thereon. The work here done is the starting point for the reviews and summaries which appear later in the *Zoologischer Jahresbericht* and the much belated *Archiv für Naturgeschichte*. The recorders of *Zoological Record* and the *Année Biologique* depend also to no small degree upon the Concilium for their finding lists for the literature reviewed in their annual summaries. "Applied to a practical case, this means that a publisher who sends the Concilium a press copy of a treatise on 'The Reactions of Unicellular Organisms to Light,' for example, insures thereby immediate mention of the work in the card catalogue, the 'Bibliographia Zoologica,' the 'Bibliographia Physiologica' and the bibliography of Protista. He may also be assured that the work will not be overlooked by the annual reviews: *Zoological Record, Zoologischer Jahresbericht, Archiv für Naturgeschichte, Jahresbericht über die Fortschritte der Physiologie, Jahrbücher der Medizin, Année Biologique,* etc."

The Concilium examines all the literature which it lists in its bibliographies and depends in part for the completeness of its work upon the cooperation of authors, editors and publishers who send their work or publications to its office at Zurich. The Concilium has no funds for the purchase of periodicals or books for this purpose of bibliographical record. It should be noted in this connection that the publication of the bibliographical analysis of a zoological work includes not only the formal listing of the title, but the printing of the names of all new genera, a report upon the number of new species or varieties proposed in its pages, and in some cases a brief statement of the nature of the contents of the paper. Furthermore, the paper or book is cited, it may be, not once merely, but often again for a number of times upon cards, by title, or in the "Bibliographica Zoologica," by number, in connection with each subdivision of the subject upon which the contents of the book or paper touch. For example, a paper upon the "Plankton of the Illinois River" would be cited under the headings of geographical distribution, invertebrata, and it might be under a half dozen or more subdivisions of the animal kingdom. It is thus no small service which the Concilium renders authors and publishers in extending publicity throughout the scientific world by such an extended analysis of the contents of the work. The service which the Concilium renders in this regard saves in the aggregate a large amount of time for the investigators in the zoological and allied fields. It is evident that the completeness of the bibliographies issued by the Concilium and the promptness with which the references are published can be greatly facilitated by a hearty cooperation between the authors, editors and publishers, and Dr. Field's most helpful institution. In discussing this question of cooperation Dr. Field writes as follows:

According to a recent writer (Dr. Vaughan), this preeminence of the Concilium has been won in spite of the fact that in 1901 only 70 per cent. of the world literature (on sponges) was recorded. This percentage may be perhaps considered low; but it must not be forgotten that at that time the Concilium had not solicited in any general way the cooperation of publishers and editors. The material that was sent to Zurich came from those who had casually learned of the work and sent press copies on their own initiative. It is evident that, when the cooperation of publishers becomes more universal, the scientific public and the reviewers will rely still more on the information obtained from the Concilium, so that the usefulness of the agency as a means of publicity will correspondingly increase.

In the early debates regarding the foundation of the Concilium, it was contended that the institution might rely in part on financial contributions from publishers. The project of securing revenue from such a source was, however, deemed impractical, not because the services rendered were too slight to justify soliciting aid, but because of the difficulty of levying contributions. Completeness of the references is essential to the institution and no penalty of exclusion could be put into force against those who declined to give their quota. No work of interest could ever be excluded for fiscal reasons. On the other hand, it was thought unnecessary to provide funds for the purchase of works to be catalogued and no part of the subsidies can be so used. It is definitely assumed that all publishers will be glad from enlightened self-interest to make their publications accessible in Zurich. The Concilium agrees that all matter sent for review shall under no circumstances be offered for sale, so that there is no danger of a single purchaser being lost in consequence of copies sent to us. It is highly desirable that books and periodicals shall be kept by the Concilium for later consultation. In the case of publications with valuable plates, the latter may be withheld, provided they are described in the text. Expensive works will be returned on request. With octavo publications it is assumed that the request to return "uncut" applies only to the tops of the books, for every page must be accessible to the recorders.

It is quite impossible to explain exactly what classes of books are required for the work. We therefore wish to receive from each publisher his book-lists as they appear. From these we shall make a selection. In cases of doubtful admissibility, we shall order the book for examination. It is, however, understood that, in so doing, we undertake no obligation to cite a work which is not found to fall properly within the scope of our bibliographies.

Already the English publishers have signified their willingness to cooperate and recent visits to a number of American firms elicited an equally favorable attitude. The Concilium has in press a list of some 2,800 periodicals arranged by countries. It is proposed to state for each country, as an appendix to the list of journals received, the publishing firms which maintain regular relations with the Concilium. For this reason we desire each publisher whom this circular may reach to signify his intention of cooperating and his willingness to have his name given in such a list. At the end of each year each publisher will receive cards showing which of his books have been cited. Authors will also further the work if they will assure themselves that their publications reach Zurich. When once the custom is fairly established, it will be found useful to all concerned, and the publisher, while acting in his own interest, will do a great service for the advancement of knowledge.

The preliminary list of the 2,800 periodicals which Dr. Field has published in his present report includes about 450 from the United States. Of these 450 publications of repeated or periodical nature less than 175 reach the Concilium regularly. The other 275 must be consulted elsewhere, if at all, or written for with resulting increased cost and loss of time, or one must depend on the chance courtesy of the individual authors. A cursory inspection of the list of the American journals which are "insufficiently easy of access" to the Concilium includes many medical journals of the subscription class, but by no means all of such journals, a surprisingly large number of the research publications of our universities, such, for example, as the "Bryn Mawr Monographs"; "Biological Lectures of Woods Holl"; "Bulletin of the Laboratory of Natural History, University of Iowa"; "Bulletin, Syracuse University"; "Columbia University Biological Series"; "Memoirs of the Biological Laboratory, Johns Hopkins University"; "Princeton University Patagonia Expedition"; several series issued by the University of California, and others. Some of our oldest and most widely known learned societies, as well as more recently organized ones, are not on the list of fully cooperating institutions, such, for example, as the American Philosophical Society, the Linnean Society of New York, the New England Zoological Club, Essex Institute, and the Philadelphia, Chicago, Michigan, Ohio and Kansas Academies and even the National Academy of Sciences at Washington. Many of our agricultural experiment stations fail to send the publications and even the Biological Survey, Bureau of Animal Industry and some other bureaus of the Department of Agriculture at Washington are not fully cooperating. In like manner many of our state natural history and geological surveys and boards of agriculture which publish more or less matter which falls within the scope of the bibliographies of the Concilium fail to send their publications.

An opportunity to advance the cause of science is here afforded to all American publishing agencies, and to American publishers to bring their publications very effectively and in permanent form before scientific workers throughout the world. It is to be hoped that the spirit of cooperation which has dominated the Concilium from its foundation will be extended more widely among our American institutions and that individual workers in the various biological and medical fields will take pains to see that all serial publications in their control are sent regularly in the future to the Concilium Bibliographicum, Zurich, Switzerland.

Charles Atwood Kofoid
University of California,
February 28, 1908

THE INHERITANCE OF FLUCTUATING VARIATION

Dr. R. P. Bigelow has asked,[1] how I would

[1] Science, January 31, 1908, p. 192.

account for the correlation between parent and offspring in characters subject to fluctuating variation, if such variations are not transmitted. In reply to this I wish to say, that *I do account* for this by the assumption of hereditary transmission: however, such cases should be carefully ascertained, preferably by experiment, in order to remove all reasonable doubt as to the fact of the reappearance, in the offspring, of such fluctuating variations, which appeared first in the parents.

I have expressed the opinion that *normally*, in fluctuating variation, this will not be the case, simply because it is to be assumed that the cause of the fluctuating variation will not persist through many generations, so that any tendency toward inheritance, even if present, will soon be counterbalanced and paralyzed by the opposite tendency of variation. Permanent, hereditary variations are only to be expected if the variation of the environment keeps on in the same direction, that is to say, when it ceases to be a "fluctuation," and becomes a "mutation" (in von Waagen's sense).

Recently, Dr. D. T. MacDougal[2] has proposed to settle the question of "inheritance of acquired characters" by experiment, and, *by restoring at the end of the experiment the original conditions,* he intends to show "whether the changes in question are irreversible or not." However, I do not think that the "inheritance of acquired characters" will be disproved, when the effect of the changed conditions "finally disappears, when the inciting causes are removed." Indeed, *this should be the case.* MacDougal hints at the existence of examples, in which the "effect endures for a few generations," and this is all we reasonably may expect under such conditions; and if the experiment has been made on scientific lines, we are fully justified to quote such cases in support of the "inheritance of acquired characters."

MacDougal (p. 122) finds that the phrase "inheritance of acquired characters" is so vague that he has difficulties in properly defining it. But the conditional definition he gives, that it might mean "that an organism makes *adaptive*[3] response to its environment . . . and that the continuance of the stimulus . . . results in heritable and *irreversible*[3] modifications" is surely incorrect. To my knowledge, none of the advocates of the theory of the "inheritance of acquired characters," in its modern form, ever expressed the opinion that the responses of an organism to the environment are always "adaptive," or that they are "irreversible," when transmitted. The phrase "inheritance of acquired characters" does not need any special definition, since it means exactly what the words say, and since none of the words has an ambiguous meaning, preeminently so in its application to biology.

A. E. Ortmann

Carnegie Museum,
Pittsburg, Pa.,
February 10, 1908

[2] Science, January 24, 1908, p. 123.

[3] The italics are mine.

TO REDUCE SEASICKNESS TO A MINIMUM

Reduce the system to an alkaline condition. This must be done under the advice of a physician. The urine must be tested two or three weeks before going on board ship. The normal urinary acidity is from thirty to forty degrees. If below thirty, the acid is not eliminated. If above forty, the kidneys are not carrying away all that is in the system. In either case it should be reduced by giving saline waters and antacid treatment. The indican, if any, must also be reduced. Clean out the system thoroughly. Before going on board ship or before the ship leaves the dock, take a strip of soft flannel about six inches wide and three yards long, wrap it around the abdomen and stomach tightly. This will prevent the movement of the internal organs which affect the nervous system. Eat little on board ship and avoid all acids, fruits, salads, beers, wines, etc. Those persons having acid diathesis must not drink lemonade, tea or coffee. Hot water is to be preferred.

Eugene S. Talbot, M.D.

SPECIAL ARTICLES

COMPETITIVE ATHLETICS AND SCHOLARSHIP

One of the most important considerations for schools and colleges in this whole problem of athletic control is that of scholarship.

This paper is an attempt to answer some of the questions which have arisen regarding the scholarship of students on teams representing educational institutions and the effect of competitive athletics on scholarship. It will also endeavor to show what are some of the causes which produce this result and to suggest remedies therefor.

The materials were largely collected in 1898, but no use was made of them until December, 1905.

The questions which will mostly concern us are: (*A*) Is there a material difference in scholastic standing between the students who represent our schools and colleges on athletic teams and those who do not? (*B*) If there is such a difference, whether in favor of or against the athlete, is it due to competitive athletics immediately or remotely, or to the natural mental powers, or disposition of athletes? (*C*) If there is a material difference, whether due to competitive athletics or natural powers, what should be our attitude toward it? The major part of this paper will be devoted to matters of fact indicated in (*A*) and (*B*).

(*A*) Is the scholarship of athletes on varsity teams materially different from that of their classmates?

Historical.—The bibliography of this subject, which has to do with facts, or statistics, was, until quite recently, very meager, although there is scarcely an educator of note but has expressed his opinion upon it on one side or the other. Of the few contributions which deal with facts we select the following as bearing most directly on our theme.

In 1889 Professor E. L. Richards, of Yale University, wrote in the *Popular Science Monthly* that, having examined the records of 2,425 students, he found the athletes to fall slightly behind the non-athletes in scholarship.

The bursar of the University of Pennsylvania some seven years ago published the statement that for that year the scholarship of the athlete at the University of Pennsylvania fell below that of the student body about 4 per cent., an amount which he considered negligible.

In Science for July, 1906, is an article on "Intercollegiate Athletics and Scholarship" by Professor William Trufant Foster, of Bowdoin College. This deals in a comprehensive and scientific manner with the facts regarding the scholarship of athletes and non-athletes in colleges and schools.

Professor Foster found by a careful examination of the scholarship records at Bates College for the five years 1900–1901 to 1904–1905, that the average annual difference in rank between the students playing on the baseball and football teams varied from four to eight per cent. with an average difference for the whole period of "5.6 per cent., always in favor of the men who have not taken part in intercollegiate games." In this investigation the grades were made up by twenty-five instructors. There were 132 athletes and 620 non-athletes.

In a similar study of the football and baseball men, just completed at Bowdoin College, Professor Foster found for the five years from 1899–1900 to 1903–1904 an average annual difference in favor of the non-athletes varying from .95 per cent. to 5.21 per cent. with an average difference for the whole period of 2.8 per cent. These figures represent each year the scholarship records of 280 men. They were compiled by students in education at Bowdoin.

He reports further that all the secondary schools from which he had adequate returns showed similar records. These schools are quite varied in character. At Brighton Academy the ranks for four years show that the athletes are one per cent. behind; at Thomaston High School for four years the athletes fall three per cent. below the others; at Westbrook Seminary, a private school, the athletes are slightly below the others; at Hebron Academy the athletes for three years fell five per cent. below the non-athletes.

Professor Foster concludes:

The facts were gathered by twenty men of varied opinions on the question, who were not endeavoring to make the figures from any theory or support any opinion. So far as the facts go they are authentic.

Method.—In 1898 the writer commenced an investigation into the relative scholarship standing of athletes and non-athletes in Amherst College. This investigation embraced at first the classes from 1886 to 1897, inclusive, later those from 1898 to 1903 were added. The athletic class was restricted to the players and substitutes on varsity baseball, football and track teams. In each case the books of the registrar were the sources of information and in every case the grade of a student at graduation, or for the entire time he was in college, was taken as his rank throughout. Where a comparison was made of athlete's grades in terms when he was playing and when he was not playing, as in the second part of the investigation, the term averages are of course used.

The registrar's books seem to us a fair index of the men's educational attainments. They represent the consensus of many different instructors wherein the personal equation is largely averaged out. If anything the figures will favor the athlete, for surely the majority of instructors are in favor of athletics.

No account has been taken of delinquencies, as those of past years could not be ascertained. The mark given in the subject when it, or its substitute, was made up, was alone used. This method is favorable to the lower rank men. It especially favors them in the comparison between their rank in playing and non-playing periods.

In the cases of those students who did not last out the fall term and who had delinquencies on the books no record was made of them or a passing grade given. This too is favorable to the low-grade men.

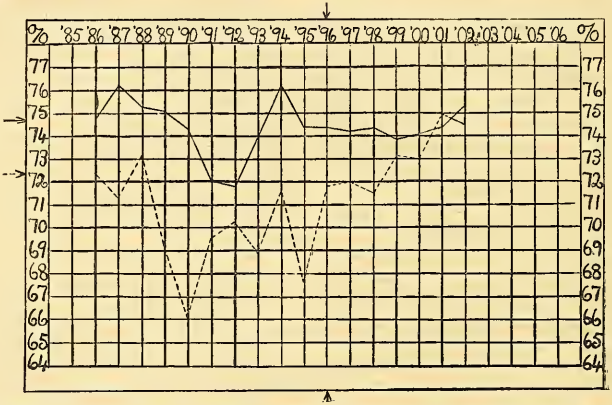

CHART I. Showing the scholastic standing of students at Amherst College on the varsity teams as compared with those not on teams, 1886–1903.

The writer undertook this investigation in the expectation, partly because of his own participation in competitive athletics and his remembrance of individual cases of high scholarship among the athletes of his day, that the athlete would make a good showing. There certainly was no prejudice on his part *against* the athlete.

It is to be remembered that at present we are not discussing the athlete's intellectual *ability*. All will agree that college marks are not an infallible index of that. We are considering now what he accomplished intellectually in the work prescribed by his instructors. It should also be borne in mind continually that the comparison is not of the students taking normal physical exercise with those who do not, but of those in strenuous athletic competition with those not so engaged.

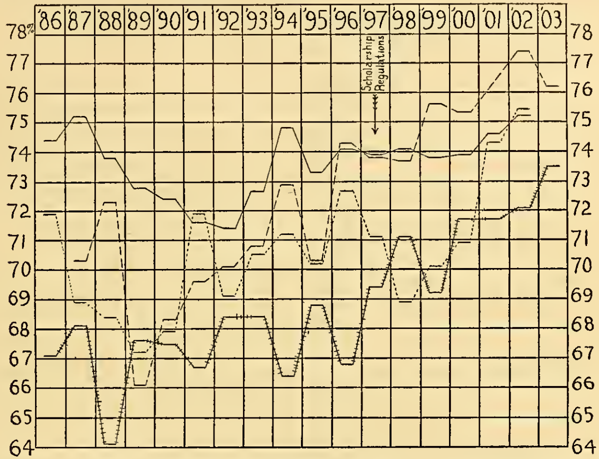

CHART II. Showing the scholastic standing of students at Amherst College on the varsity track, baseball and football teams as compared with the rest of the student body in the years 1886 to 1903.

——— non-athletic — — — track team .... base ball team ǂǂǂǂǂǂǂ foot ball team

The averages of the three teams mentioned have been taken separately and conjointly for the years 1886 to 1903 and are indicated graphically on the accompanying charts, I. and II., in comparison with the averages of the non-athletic students. On each of these charts the years are indicated at the top and the grades at the sides. So the rise or fall of the lines shows a commensurate rise or drop in scholarship.

In Chart I., which contains the conjoint averages of all three teams, comprising 318 different athletes and 1,692 different non-athletes, a total of over 2,000 different men, it will be noted that the average scholarship of non-athletes in college varies between 72 and 76 in the different years, while that of the athletes lies between 66 and 75. The averages for the whole period are: of non-athletes 74.4 per cent., and of athletes 70.4 per cent., a difference of four per cent. The most remarkable fact shown by the comparison, however, is that in the whole eighteen years the average of athletes rises above that of non-athletes but once, and that once after the scholarship rules for athletes were made and enforced in 1896. (See arrows on the chart.)

In Chart II., where the team averages are plotted separately, the additional information is brought out that on the average the track team stands highest, the baseball about one per cent. below, and the football some two per cent. below that, the football team never equaling the average of the non-athletes in college the same year.

The statistics at Amherst thus corroborate those published by Professor Foster from Bates, Bowdoin and the Maine preparatory schools. They agree also with the opinions in letters recently received from preparatory schools and universities in answer to a questionnaire. From this mass of statistics it may be safely predicated thus early in our study that, unless special means are employed to debar low-stand men or keep them up in their studies, or both, the men on varsity teams will be found below their classmates in scholarship.

Some will object to this that, while the facts are true regarding the rank and file of athletes, the great athletes, who stand head and shoulders above their team mates, will generally be found to be great scholars also.

An unusual opportunity was given at Amherst to test the validity of this statement in 1905. An all-Amherst football team was selected by competent judges and published in the college paper. Of the eleven men chosen four were above the college average in rank, seven below it, and the average of the team fell about five per cent. below the average of the non-athletes. While these figures do not prove the assertion that great athletes are not up to college average, it does furnish interesting evidence to refute the statement made above, and is a result quite the reverse from that at which President Hyde arrived in his study of fifteen years ago, in which he found that the best athletes were the best scholars of the athletic class.

Granting that the men on varsity teams are below their classmates in rank, is the four per cent. difference worthy of consideration? The bursar of the University of Pennsylvania considers it negligible; Professor Foster thinks it "so small as to overthrow two thirds of the *a priori* assumptions regarding the *excessive* injury of intercollegiate games to the scholarship of the men who play." If it is negligible, then an inquiry into whether this inferiority is the result of athletics would scarce repay us.

An analysis of these averages of athletic men is of interest as showing in part why they are lower than those of their classmates and whether the disparity may be summarily dismissed.

Such an analysis we have shown on Chart III. by distributing the athletes according to their rank, after Galton's method.

At the bottom of the chart will be seen the grades from 45 per cent. to 95 per cent. At the sides are percents from 0 to 26. The per cent. of athletes who attain each grade is indicated by a dotted horizontal line drawn above that grade at the proper level. The height of this line, then, will indicate the number of athletes per hundred who attained the subjacent grade.

Continuous horizontal lines have also been drawn on this chart to show the distribution of the grades of the non-athletic students. The chart represents 212 different athletes appearing a total of 531 times, because some of them were members of more than one team. The ranks of athletes in the later classes were added to these, but they made no material difference in the result.

The most evident thing shown by this chart is that the low averages of the athletic men are due to their greater per cent. of low grade and their lesser per cent. of high-grade men. This is especially noticeable between 50 and 65 per cent., where there were two or three times as many athletes per 100 as non-athletes, and between 85 and 95 per cent., where there are over three times as many non-athletes as athletes. Between 65 per cent. and 80 per cent., comprising three fifths of the whole class, there is not much difference in the number at each grade.

This marked inequality between athletes and non-athletes is due mostly to the football men. About six times as many football men have grades between 55 and 60 as the non-athletic class, and seven times as many non-athletes have grades from 85 to 90 as have football men. The track men make the best showing and the baseball men are intermediate in the averages.

Is it worth while for us, then, to go farther. Having seen that a difference of about four per cent. exists between the scholarship of the athlete and his classmates, and in favor of the latter, and having also, by this analysis, ascertained to what kind of marks it is due, will it repay us to find out whether this inferiority is due to competitive athletics directly or indirectly, or to natural inability, or disinclination to learn: in short, is the game worth the candle?

The most impressive thing in the results obtained is not that there is an average difference of four per cent. between the two classes, but that the athletes fall below so uniformly. When the three teams were traced separately it was found that in the fourteen years from '86 to '99 inclusive, out of forty-two possibilities only one team equaled and one exceled the general average of the non-athletic students, really one case against forty. This means that there is some underlying constant factor depressing the grades of the athlete which we should know if we are to act intelligently. This does not postulate that if we find intercollegiate competition the cause of it we shall abolish it or even control it. Other things are to be considered.

Again, four per cent. means about one sixth of the variation in college marks, say from 65 to 90, a difference which means more than even educators fancy. This particular four per cent., say from 72 to 76, includes about 25 per cent. of all students, a drop of four per cent. then puts a quarter of the class above them. As an example of how soon a drop in scholarship is appreciated and how much it means to a college I would cite the consensus of the faculty on various classes. A class is

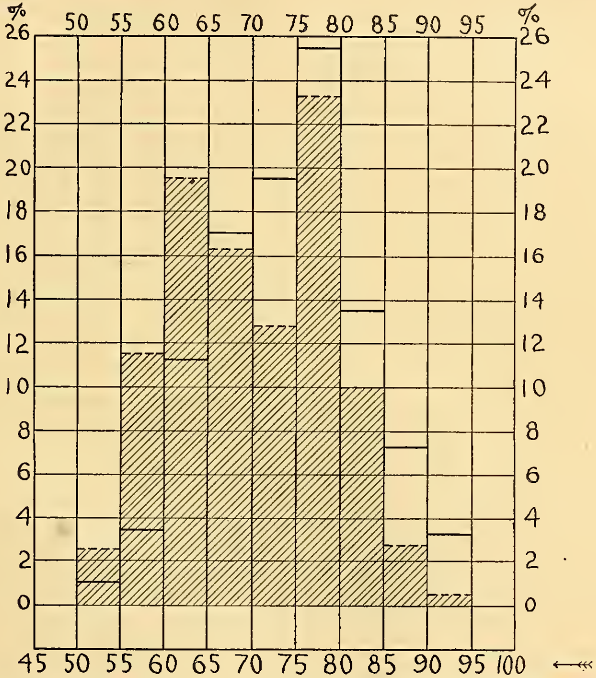

Chart III. Showing the percentage of varsity athletes who attain various scholastic grades as compared with the percentage of other students who attain the same grades.

called good, in scholarship, or poor, by common consent, when there is a difference of not more than two or three per cent. With but one exception every college professor whom I have asked says that there is a marked drop throughout the class in scholarship from the winter to the spring term and yet our Amherst statistics show a deterioration of less than one per cent. in that term.

Further, the drop of four per cent. in any considerable group of students naturally, and in this case does, in fact, bring a considerable number of students toward the failing line and so throws more work on the teachers. "There is in every garden an outside row which needs a lot of hoeing." If it is wise to attempt to reduce this four per cent. by a scholarship rule for athletes the labors will be somewhat reduced.

Once more, the effect of much poor work in the class-room is somewhat demoralizing, especially when it is done largely by one group at certain seasons, making them seem a privileged class. Assuming, then, for our argument that it is worth while to further question the cause of this difference, let us ask ourselves first, do the competitive athletics cause the drop of four per cent? To get light on this subject we have taken the averages of men on various teams in terms when competing and when not competing. This has been a rather difficult task, as the men frequently are on different teams. The men have been taken in order in the four classes, 1897, 1898, 1899 and 1900.

The results are as follows:

	Average Scholarship Standing—		
	In Terms Playing	Not Playing	Difference
Football men	72.63	75.70	3.07—
Baseball men	69.62	74.25	4.63—
Track men	70.91	70.87	.04+

These figures indicate that both the football and baseball men drop off noticeably in their work during the terms in which they are competing, while the track men keep at about the same level.

It may be objected, regarding the figures for baseball and track men, that there is, as indicated previously, a noticeable dropping off in work on the part of all students during the spring term. To ascertain what that really is we have averaged the scholarship work of non-athletic men each of the terms of the college years under consideration and find for these:

Fall terms	76.62
Winter terms	77.42
Spring terms	76.79

There is to be seen here a drop of .63 from the winter to the spring term, but the fall term averages are even lower, .80 per cent. below those of the winter term. When, however we take the averages of the winter and spring terms to compare with the fall one, as in estimating the scholarship of football men, there is but slight difference and the same is true when we average the fall and winter terms to compare with spring in considering baseball men's rank.

Thus much of this difference in rank between athletes and non-athletes may be ascribed to the competition and not to inherent mental inferiority or to seasonal effects.

Our paper has brought us then to these conclusions: first, that the average scholarship of men competing on varsity football, baseball and track teams in various schools and colleges is, if uncontrolled, below that of their fellows by an amount approximating four per cent., that it is lowest in the football, next in the baseball and highest in the track team; that this difference is due to the large number of low-rank men on these teams and the small number of high-rank men as compared with the non-athletic students; and that the low rank of these athletes may, in the case of foot- and baseball, in large measure, be ascribed to the effect of being on these teams and not primarily to incapacity.

Would it be better to keep the standard of scholarship up on these teams, at the expense of depriving some of the members of this stimulus to exercise—if not to study. What is it wise to do?

If the enforcement of such a standard would deprive any considerable number of students of the opportunity for judicious exercise the question would be an open one for the physical educator, but we are not speaking of all athletes. Only those who make the teams are subject to the strenuous requirements thereof and they, as a class, need the exercise and stimulus the least. The application of a scholarship rule to keep up the standard of scholarship then seems to us beyond a question desirable. What its effect may be is to be seen in Chart I., where the line of average scholarship in athletics rises about up to, and once above the general college average.

None of these sports, in our opinion, is it wise to abolish: they are too valuable. The responsibility is upon the faculties of our educational institutions to control them.

The number of intercollegiate or interscholastic games may be reduced, the trips cut down, or the varsity season deferred so as to last but a month and promote dissemination of sports, in the way suggested by Mr. Derby in a recent *Outlook*, but the most potent regulation is through scholarship rules.

The raising of these standards is in the hands of the faculty; it does not take great mentality, but plain old-fashioned courage to do this. If each of our colleges and schools would set and maintain such high standards for itself that any league agreements would be well outside them, then the educational ideals would be preserved.

PAUL C. PHILLIPS

THE SO-CALLED VOLCANO IN THE SANTA MONICA MOUNTAINS, NEAR LOS ANGELES, CALIFORNIA

THE California papers have recently contained accounts of a so-called volcano in one of the canyons of the Santa Monica Mountains near Los Angeles. Reports of a similar kind have frequently been made heretofore with reference to points in Santa Barbara County, where fire has started in the petroleum-bearing shale near the surface; and the fire recently observed in the Santa Monica Mountains is due to the same cause. Occurrences of this kind have been described in a recent article in the *Journal of Geology*.[1] Mr. H. R. Johnson, of the U. S. Geological Survey, now stationed at Los Angeles, visited the locality of the Santa Monica occurrence March 3, and the following notes concerning it were obtained at the time of this examination.

The "volcano" is situated about 200 yards up Pulgas Canyon from the ocean, two and one half miles northwest of Santa Monica, and about fifteen miles west-northwest of Los Angeles. Here a little point of Monterey (middle Miocene) shale jutting into the creek exhibits several small openings, from which very strong sulphurous fumes, light bluish-gray in color, are issuing. At distances of from six inches to a foot or more from the surface in the vicinity of these holes the shale is at a dull cherry-red heat, the temperature being high enough to immediately ignite bits of wood forced into it. The ground, which is here covered by shale fragments and small amounts of humus for a radius of 75 or 100 feet around this group of openings, is uncomfortably hot for the feet and at some places is too hot for even a momentary contact with the hand. At one point an oily condensation, which smelt like hot asphalt, was noted.

The shales show an interesting progressive discoloration which will be described, beginning at the outer edge of the area of alteration. Normally of a dirty yellowish-gray calcareous phase, they are first blackened by the heat, then given that intense peach-blow red which is to be seen in all of those localities in the Santa Maria oil district and elsewhere at which this peculiar type of metamorphism has taken place, while the last stage of oxidation seems to result in a crumbling greenish-gray ashy material. The finding of fragments of scoriaceous shale at the burnt area has recently been reported, but the writer saw none personally. Neither did he see any bursts of flame, which it is said have been seen at the locality, although it is very likely that such might be visible at night.

[1] "Metamorphism by Combustion of the Hydrocarbons in the Oil-bearing Shale of California," by Ralph Arnold and Robert Anderson, *Journal of Geology*, Vol. 15, No. 8, November–December, 1907.

Concerning the geology in the immediate vicinity, the canyon walls, above and below the occurrence, show sharply flexed Monterey (middle Miocene) shales. Just at the fire the structure is synclinal, the axis of the fold trending about parallel with the coast. The canary yellow discoloration of the shale due to sulphur is well developed, and exactly opposite the fire a sulphur spring trickles from the bank. At other points in and near this canyon the shales are impregnated with oil.

There is some doubt as to the origin of the fire. As no brush grows in the vicinity, and no one is living near, the origin can not well be ascribed to ignition from burning refuse on the surface. There has been a thunder storm within the month, before which time people passing up this canyon did not observe anything unusual at this point except a strong odor which was attributed to the sulphur spring. It, therefore, seems likely that the fire was ignited by lightning or else is a case of spontaneous combustion.

This unique variety of metamorphism has been at work locally in many regions of bituminous rocks in California, where a process of combustion of the hydrocarbon contents has altered the naturally white, soft shale to a rock of brilliant rose or brick-red color, and rendered it in cases hard and vesicular like scoriaceous lava. The resemblance of the products to those of volcanoes and the existence of centers like solfataras where the process of burning has been going on during the last half-century, has given rise, as in the present instance, to the statement that there were living volcanic vents in California. Though the combustion is usually local in its effects, the number and wide distribution of the occurrences of burnt shale lend importance to the phenomenon. The presence of burnt shale at depths varying from 90 to 1,040 feet below the surface, as discovered in the drilling of oil wells, proves that the burning has taken place deep down within the oil-bearing formation, as well as at the surface where it has been more commonly found. And, further, the discovery of fragments of it at one place at a depth of at least 10 feet below the surface in bedded deposits of Pleistocene age proves that such action has gone on in ages past.

The Monterey shale, of middle Miocene age, is the principal oil-bearing formation of the state, and the process of burning has had its chief effect upon portions of this formation. It is composed almost exclusively of soft and hard, thin-bedded, siliceous shales, which are largely of diatomaceous origin.

The particular shale area in which the phenomenon described is taking place forms an extensive belt underlying the Los Angeles-Santa Monica plain on the south side of the Santa Monica Mountains. Where exposed this shale is usually petroliferous, and is the source of the petroleum in the wonderfully productive Salt Lake oil field west of Los Angeles. The nearest wells, however, are eight or nine miles distant from the burning area. Although it has been impossible to put out such fires by artificial means in the instances heretofore attempted, such phenomena, as previously stated, have remained more or less restricted. Considering the surroundings and geographic position of the present area the probabilities are against any damage resulting from the burning shale.

Ralph S. Arnold
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Washington, D. C.
Los Angeles, California

JOINT RECOMMENDATIONS OF THE PHYSIOLOGICAL AND BIOCHEMICAL COMMITTEES ON PROTEIN NOMENCLATURE[1]

Since a chemical basis for the nomenclature of the proteins is at present not possible, it seemed important to recommend few changes in the names and definitions of generally accepted groups, even though, in many cases, these are not wholly satisfactory. The recommendations are as follows:

First.—The word *proteid* should be abandoned.

Second.—The word *protein* should designate that group of substances which consists, so

[1] Published by order of the American Physiological and American Biochemical Societies, in joint session at the University of Chicago, on Tuesday, December 31, 1907.

far as at present is known, essentially of combinations of α-amino acids and their derivatives, *e. g.*, α-aminoacetic acid or glycocoll; α-amino propionic acid or alanin; phenyl-α-amino propionic acid or phenylalanin; guanidin-amino valerianic acid or arginin; etc., and are therefore essentially polypeptids.

Third.—That the following terms be used to designate the various *groups of proteins:*

I. Simple Proteins.—Protein substances which yield only α-amino acids or their derivatives on hydrolysis.

Although no means are at present available whereby the chemical individuality of any protein can be established, a number of simple proteins have been isolated from animal and vegetable tissues which have been so well characterized by constancy of ultimate composition and uniformity of physical properties that they may be treated as chemical individuals until further knowledge makes it possible to characterize them more definitely.

The various groups of simple proteins may be designated as follows:

(*a*) *Albumins.*—Simple proteins soluble in pure water and coagulable by heat.

(*b*) *Globulins.*—Simple proteins insoluble in pure water but soluble in neutral solutions of salts of strong bases with strong acids.[2]

(*c*) *Glutelins.*—Simple proteins insoluble in all neutral solvents but readily soluble in *very* dilute acids and alkalies.[3]

(*d*) *Alcohol-soluble Proteins.*—Simple proteins soluble in relatively strong alcohol (70–80 per cent.), but insoluble in water, absolute alcohol, and other neutral solvents.[4]

(*e*) *Albuminoids.*—Simple proteins which possess essentially the same chemical structure as the other proteins, but are characterized by great insolubility in all neutral solvents.[5]

(*f*) *Histones.*—Soluble in water and insoluble in very dilute ammonia and, in the absence of ammonium salts, insoluble even in an excess of ammonia; yield precipitates with solutions of other proteins and a coagulum on heating which is easily soluble in very dilute acids. On hydrolysis they yield a large number of amino acids, among which the basic ones predominate.

(*g*) *Protamins.*—Simpler polypeptids than the proteins included in the preceding groups. They are soluble in water, uncoagulable by heat, have the property of precipitating aqueous solutions of other proteins, possess strong basic properties and form stable salts with strong mineral acids. They yield comparatively few amino acids, among which the basic amino acids greatly predominate.

II. Conjugated Proteins.—Substances which contain the protein molecule united to some other molecule or molecules otherwise than as a salt.

(*a*) *Nucleoproteins.*—Compounds of one or more protein molecules with nucleic acid.

(*b*) *Glycoproteins.*—Compounds of the protein molecule with a substance or substances containing a carbohydrate group other than a nucleic acid.

(*c*) *Phosphoproteins.*—Compounds of the protein molecule with some, as yet undefined, phosphorus containing substance other than a nucleic acid or lecithins.[6]

(*d*) *Hemoglobins.*—Compounds of the protein molecule with hematin or some similar substance.

(*e*) *Lecithoproteins.*—Compounds of the

[2] The precipitation limits with ammonium sulphate should not be made a basis for distinguishing the albumins from the globulins.

[3] Such substances occur in abundance in the seeds of cereals and doubtless represent a well-defined natural group of simple proteins.

[4] The sub-classes defined (*a*, *b*, *c*, *d*) are exemplified by proteins obtained from both plants and animals. The use of appropriate prefixes will suffice to indicate the origin of the compounds, *e. g.*, ovoglobulin, myoalbumin, etc.

[5] These form the principal organic constituents of the skeletal structure of animals and also their external covering and its appendages. This definition does not provide for gelatin, which is, however, an artificial derivative of collagen.

[6] The accumulated chemical evidence distinctly points to the propriety of classifying the phosphoproteins as conjugated compounds, *i. e.*, they are possibly esters of some phosphoric acid or acids and protein.

protein molecule with lecithins (lecithans, phosphatids).

III. Derived Proteins.

1. Primary Protein Derivatives.—Derivatives of the protein molecule apparently formed through hydrolytic changes which involve only slight alterations of the protein molecule.

(*a*) *Proteans.*—Insoluble products which apparently result from the incipient action of water, very dilute acids or enzymes.

(*b*) *Metaproteins.*—Products of the further action of acids and alkalies whereby the molecule is so far altered as to form products soluble in very weak acids and alkalies, but insoluble in neutral fluids.

This group will thus include the familiar "acid proteins" and "alkali proteins," not the salts of proteins with acids.

(*c*) *Coagulated Proteins.*—Insoluble products which result from (1) the action of heat on their solutions, or (2) the action of alcohols on the protein.

2. Secondary Protein Derivatives.[7]—Products of the further hydrolytic cleavage of the protein molecule.

(*a*) *Proteoses.*—Soluble in water, uncoagulated by heat, and precipitated by saturating their solutions with ammonium sulphate or zinc sulphate.[8]

(*b*) *Peptones.*—Soluble in water, uncoagulated by heat, but not precipitated by saturating their solutions with ammonium sulphate.[9]

(*c*) *Peptids.*—Definitely characterized combinations of two or more amino acids, the carboxyl group of one being united with the amino group of the other, with the elimination of a molecule of water.[10]

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William J. Gies,
Waldemar Koch,
T. B. Osborne,
For the American Society of Biological Chemists
T. B. Osborne,
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J. A. Mandel,
A. P. Mathews,
Lafayette B. Mendel,
For the American Physiological Society

Chicago,
December 31, 1907

[7] The term secondary hydrolytic derivatives is used because the formation of the primary derivatives usually precedes the formation of these secondary derivatives.

[8] As thus defined, this term does not strictly cover all the protein derivatives commonly called proteoses, *e. g.*, heteroproteose and dysproteose.

[9] In this group the kyrins may be included. For the present we believe that it will be helpful to retain this term as defined, reserving the expression peptid for the simpler compounds of *definite* structure, such as dipeptids, etc.

[10] The peptones are undoubtedly peptids or mixtures of peptids, the latter term being at present used to designate those of definite structure.

ORGANIZATION OF A UTAH ACADEMY OF SCIENCES

At a meeting of the Utah science teachers, held in Provo during the holidays, steps were taken toward the organization of a Utah Academy of Sciences. After an informal discussion of some length Dr. Ira D. Cardiff, professor of botany, University of Utah, was elected president and Mr. Geo. W. Bailey, of Weber Academy, secretary. A committee was appointed to draft a constitution and arrange for a future meeting. The committee was composed of the president and the following: Dr. J. A. Widtsoe, president of the Agricultural College; Dr. S. H. Goodwin, president of the Proctor Academy; Dr. W. C. Ebaugh, professor of chemistry, University of Utah; Dr. D. E. Ball, professor of zoology, Agricultural College; Dr. John Sundwall, professor of anatomy, University of Utah; Dr. L. H. Hartman, professor of physics, University of Utah; Professor Marcus E. Jones, botanist, Salt Lake City; Mr. Robert Forrester, geologist, Salt Lake City; Mr. Ernest M. Hall, instructor in biology, L. D. S. High School; Mr. A. O. Garrett, instructor in botany, Salt Lake High School. The committee met in Salt Lake City in February, arranged for a meeting to be held in Salt Lake City, April 3, 4 and 6 and drew up a constitution to be submitted at that meeting. At the April meetings eight or ten papers will be given by men engaged in various lines of scientific work in the state. On the evening of the sixth, the new organization will be addressed by President David Starr Jordan, of Stanford University. All those interested in scientific work in the state are invited to attend the meetings.

THIRD SESSION OF THE GRADUATE SCHOOL OF AGRICULTURE

The third session of the Graduate School of Agriculture, of which Dr. A. C. True is dean, will be held at Ithaca and Geneva, New York, beginning July 6, 1908, and continuing four weeks. Instruction adapted to the needs of graduate students will be given under the general heads of biochemistry, agronomy, horticulture, dairy husbandry and dairying, poultry, veterinary medicine and entomology. The following is an incomplete list of the faculty for this session:

Biochemistry.—Professor Dr. N. Zuntz, professor of animal physiology, Royal Agricultural College, Berlin, Germany; Professor L. B. Mendel, professor of physiological chemistry, Yale University; Dr. H. P. Armsby, director of Institute of Animal Nutrition, Pennsylvania State College; Dr. C. F. Langworthy, expert in nutrition, U. S. Office of Experiment Stations; Professor H. S. Grindley, professor of chemistry, University of Illinois; Professor H. C. Sherman, professor of analytical chemistry, Columbia University.

Agronomy.—A. D. Hall, director of the Rothamsted Experimental Station, England; Professor Milton Whitney, chief, U. S. Bureau of Soils; H. A. Harding, bacteriologist, New York Agricultural Experiment Station; Professor T. L. Lyon, professor of experimental agronomy, Cornell University; Professor W. J. Spillman, agriculturist, U. S. Bureau of Plant Industry; Dr. Samuel Fortier, chief of irrigation investigations, U. S. Office of Experiment Stations; C. G. Elliott, chief of drainage investigations, U. S. Office of Experiment Stations; Professor H. J. Webber, professor of experimental plant biology, Cornell University; E. G. Montgomery, instructor in agronomy, University of Nebraska.

Horticulture.—Professor J. C. Whitten, professor of horticulture, University of Missouri; Professor F. A. Waugh, professor of horticulture, Massachusetts Agricultural College; Professor S. A. Beach, vice dean, division of agriculture, and professor of horticulture, Iowa State College; Professor U. P. Hedrick, horticulturist, New York Agricultural Experiment Station; Professor John Craig, professor of horticulture, Cornell University; Professor B. M. Duggar, professor of plant physiology in its relations with agriculture, Cornell University; G. H. Powell, pomologist, U. S. Bureau of Plant Industry; W. T. Swingle, physiologist in charge, plant life history investigations, U. S. Bureau of Plant Industry; Dr. L. J. Briggs, physicist in charge, physical laboratory, U. S. Bureau of Plant Industry; Dr. Erwin F. Smith, pathologist in charge, Laboratory of Plant Pathology, U. S. Bureau of Plant Industry.

Dairy Husbandry and Dairying.—Dr. W. H. Jordan, director of the New York Agricultural Experiment Station; Professor T. L. Hæcker, professor of dairy husbandry, University of Minnesota; Dr. H. L. Russell, dean of the College of Agriculture, University of Wisconsin; Dr. E. Davenport, dean of the College of Agriculture, University of Illinois; Professor H. H. Wing, professor of animal husbandry, Cornell University; Professor R. A. Pearson, professor of dairy industry, Cornell University; Dr. L. L. Van Slyke, chemist, New York Agricultural Experiment Station; E. H. Webster, chief, Dairy Division, U. S. Bureau of Animal Industry.

Poultry.—Professor S. H. Gage, professor of microscopy, histology and embryology, Cornell University; Professor G. S. Hopkins, professor of veterinary anatomy and anatomical methods, New York State Veterinary College; Professor P. A. Fish, professor of veterinary physiology, pharmacology and therapeutics, New York State Veterinary College; Professor C. B. Davenport, department of experimental evolution, Carnegie Institution; Professor J. E. Rice, professor of poultry husbandry, Cornell University. W. R. Graham, manager and lecturer, poultry department, Ontario Agricultural College.

Veterinary Medicine.—Professor James Law, director of the New York State Veterinary College, and professor of principles and practise of veterinary medicine, veterinary sanitary science and parasitism; Professor V. A. Moore, professor of comparative and veterinary pathology and bacteriology, and of meat inspection, New York State Veterinary College. Professor J. W. Connaway, professor of veterinary science, University of Missouri.

Entomology.—Dr. L. O. Howard, chief, U. S. Bureau of Entomology; Professor S. A. Forbes, professor of zoology, University of Illinois; Professor M. V. Slingerland, assistant professor of economic entomology, Cornell University; P. J. Parrott, entomologist, New York Agricultural Experiment Station; Dr. James G. Needham, assistant professor of limnology, Cornell University; Dr. A. D. MacGillivray, assistant professor of entomology, Cornell University; Dr. W. A. Riley, assistant professor of entomology, Cornell University; Professor E. Dwight Sanderson, director and entomologist, New Hampshire Agricultural Experiment Station.

SCIENTIFIC NOTES AND NEWS

The annual session of the National Academy of Sciences will be held in Washington, D. C., beginning Tuesday, April 21, at 11 A.M. The place of meeting will be the Smithsonian Institution. Dr. Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington, invites the members interested to inspect the laboratory on April 22, at 4:30 P.M. The members of the academy are invited by the Smithsonian Institution to attend the Hamilton lecture in the Hubbard Memorial Hall on Wednesday evening, April 22, 1908, at 8:30. The lecture will be given by Professor George E. Hale, of the Solar Research Observatory, Mount Wilson, California; his subject being "Some Recent Advances in our Knowledge of the Sun."

The American Philosophical Society, Philadelphia, will hold a general meeting on April 23, 24 and 25. The opening session will be held on Thursday afternoon, April 23, at 2:30 o'clock, in the hall of the society in Independence Square. The morning sessions are from 10:30 A.M. to 1 P.M., and the afternoon sessions from 2:30 to 5. Luncheon for the members will be served in the rooms of the society on Friday and Saturday. A reception will be held in the hall of the Historical Society of Pennsylvania on Friday evening, April 24, at the conclusion of a lecture by Professor Henry F. Osborn on "Results of the American Museum Exploration in the Fayûm Desert of Northern Egypt." The annual dinner of the society will be held at the Bellevue-Stratford, on Saturday evening, at 7:30 o'clock.

Provision will be made by the Canadian government in the estimates for the coming financial year for a grant of $25,000 by the Dominion parliament towards the expenses of the visit of the British Association to Winnipeg. The city of Winnipeg proposes to make a grant of $5,000. The week of the meeting will probably be from August 25 to September 1, 1909.

Dr. W. M. Davis, Sturgis-Hooper professor of geology, has been selected by the German government as Harvard visiting professor at the University of Berlin for the academic year 1908–9. Professor Davis's term of service will probably fall in the second semester.

Major General A. W. Greely, eminent for his arctic explorations and his services to meteorology, having reached the age of sixty-four years on March 27, was transferred to the retired list in accordance with law.

Professor Alfred Marshall, of Cambridge University, who succeeded the late Professor Henry Fawcett in the year 1884, intends to resign the professorship of political economy, at the beginning of the Easter term.

Dr. Theobald Smith, professor of comparative pathology at Harvard University, has been elected honorary fellow of the Society of Tropical Medicine and Hygiene of London and honorary member of the recently organized Société de Pathologie Exotique, Institut Pasteur, Paris.

Dr. A. A. Michelson, professor of physics in the University of Chicago, has been elected an honorary member of the Royal Irish Academy.

Among those on whom the University of Aberdeen has decided to confer the honorary degree of LL.D., at the graduation ceremony in April, is Professor W. D. Halliburton, F.R.S., of King's College, London.

Dr. Leo S. Rowe, of the faculty of the Wharton school of finance and economy of the University of Pennsylvania, has received the honorary degree of doctor of laws from the National University of La Plata.

Dr. D. P. Penhallow, professor of botany in McGill University, has been elected a governor's fellow, to serve on the corporation in the place of the late Dr. Harrington.

Dr. and Mrs. N. L. Britton and Dr. Arthur Hollick, of the New York Botanical Garden, sailed for Kingston, Jamaica, on February 22. They planned to make collections at the western end of the island, and a Bahamian schooner has been chartered for this purpose. It is expected that a stop will be made in eastern Cuba on the return voyage early in April.

Professor V. L. Kellogg, of Stanford University, will be in Europe from April to December of this year. His address is care French, Lemon and Co., Florence, Italy.

Professor Herbert F. Roberts, of the Kansas State Agricultural College and Experiment Station, leaves for Europe in May, returning about the middle of September. He is commissioned from the Kansas Experiment Station to inspect the wheat regions of central and southern Europe in search of superior sorts of hard wheats for introduction into Kansas.

Dr. J. E. Clark, professor of chemistry in the Central University of Kentucky, sailed on March 14 for Naples, to remain abroad till next fall. He expects to spend three months at the University of Berlin.

Dr. A. S. Alexander, professor of veterinary science in the College of Agriculture of the University of Wisconsin, has been appointed a member of the committee which will arrange a proper representation at the Ninth International Veterinary Congress, which is to meet this year at The Hague.

Professor J. J. Green, formerly in charge of the electrical engineering department of Notre Dame University, has gone abroad to make a tour of the more notable electrical plants of Europe, and to attend the Marseilles International Electrical Exposition.

Alexander C. Lanier, assistant professor of electrical engineering in the University of Cincinnati, has resigned and will proceed with higher studies in the Harvard Graduate School of Applied Science.

Joseph W. Hayward, assistant professor of mechanical engineering at McGill University, has resigned in order to enter outside engineering work.

The Bakerian lecture of the Royal Society was delivered on March 26, by Professor C. H. Lees, F.R.S., his subject being "The Thermal Conductivities of Solids."

The Ohio State University chapter of Sigma Xi will conclude its annual lecture course on April 9 with a lecture by Professor Francis E. Nipher, of Washington University, St. Louis. Professor Nipher will speak on "The Limits of Scientific Thinking." On January 7 Professor Wallace C. Sabine addressed the society and its friends on "Optical Resolving Power in its Application to Biological Problems." Dr. H. G. Wells, of the University of Chicago, delivered a lecture on March 24. The title of his lecture was "The Present Status in the Search for the Cause of Tumor Formations."

The Syracuse chapter of Sigma Xi held an open meeting in the new Lyman Hall of Natural History on March 20, when Professor Clement D. Child, of Colgate University, gave a lecture on "Some Phenomena connected with the Electric Arc."

The Royal Society, the Royal Geographical Society and Trinity House have undertaken the expense of a memorial to the late Sir Leopold McClintock in Westminster Abbey, with the consent of the dean and chapter.

The memorial will consist of an alabaster slab, to be placed underneath the monument to Sir John Franklin, whose fate was definitely ascertained by Sir Leopold during his celebrated expedition on board the *Fox*. The inscription will be as follows: "Here also is commemorated Admiral Sir Leopold McClintock, 1819–1907. Discoverer of the Fate of Franklin in 1859."

Dr. Edouard Zeller, the eminent historian of philosophy, professor in the University of Berlin, from 1872 until his retirement from active service in 1895, died on March 19, at the age of ninety-four years.

Sir John Eliot, F.R.S., director general of Indian Observatories and meteorological reporter to the governor of India from 1886 to 1903, eminent for his services to meteorology, has died at the age of fifty-eight years.

The Prague journals announce the death in that city, on March 11, of Professor Josef Hlávka, a distinguished architect, patron of science and art, and president of the Bohemian Academy of Sciences and Art. The deceased, whose gifts for archeological and other research were very large, bequeathed the sum of 5,000,000 crowns, or about five sixths of his whole property, for the purposes of advancing Bohemian research and art, and for aiding talented but needy students of Bohemian nationality. The funds are to be expended under the auspices of the academy.

The U. S. Civil Service Commission announces an examination on April 29, 1908, to fill at least three vacancies in the position of magnetic observer (temporary) in the Coast and Geodetic Survey, and vacancies requiring similar qualifications as they may occur. The salaries will range from $60 to $75 a month, according to the character of the work and the qualifications of the applicant; and in exceptional cases where the person employed has had repeated experience in magnetic work the salary may reach $100 a month. Appointments to permanent positions are made from the examination for laboratory assistant in the Bureau of Standards.

The next meeting of the Astronomical and Astrophysical Society of America will be held at Put-in-Bay Island, Lake Erie, on August 25 and succeeding days.

The Smithsonian Institution has learned, through the Department of State, that the Second International Archeological Congress will hold its meeting at Cairo, Egypt, at the Latin Easter, in 1909. The congress will be opened under the presidency of the Khedive.

UNIVERSITY AND EDUCATIONAL NEWS

The Kentucky legislature, just adjourned, changed the name of the College of Agriculture and the Mechanic Arts to the State University and appropriated to it $200,000 in addition to what it has already been receiving; $30,000 of this amount is to be annual. At the same time it appropriated $150,000 each to the two new State Normal Schools. The legislature also changed the name of "Kentucky University," a denominational institution, back to Transylvania University.

Mrs. L. V. Morgan, of Harrison, Ohio, has donated to the State University of Iowa the extensive botanical collections of her husband, the late Professor A. P. Morgan. The donation includes the entire herbarium, together with accompanying books and pamphlets. These collections have been assigned a place in one of the new fire-proof buildings on the Iowa campus. The herbarium represents, better than any other in the country, the rich mycologic flora of the lower Ohio valley, and owing to the eminence of Professor Morgan as a student of mycology must ever remain of extreme historic importance.

During the present winter semester, there studied in the German medical schools 151 women, while in the Swiss medical schools the number was 1,129.

Dr. Johannes von Kries, professor of physiology at Freiburg, has been called to Munich as the successor of the late Professor Karl von Voit.

Dr. Fritz Rinne, professor of geology at the Hanover Technological School, has been called to a chair at Königsberg.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, APRIL 10, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION B—PHYSICS. I.

THE annual meeting of the American Association for the Advancement of Science, Section B, was held in the Ryerson Laboratory of the University of Chicago, December 30 and 31, 1907, January 1 and 2, 1908. This was a joint meeting with the American Physical Society. Each society held a short session for the transaction of routine business, but all of the meetings for the reading of papers were joint sessions of the two organizations.

The presiding officers were Professor Dayton C. Miller, of the Case School of Applied Science, vice-president and chairman of Section B, and Professor Edward L. Nichols, president of the American Physical Society. Other officers of Section B present at the meeting were the retiring vice-president, Wallace C. Sabine; the secretary, Alfred D. Cole; member of the council, Henry Crew; member of the general committee, H. S. Carhart; members of the sectional committee, W. C. Sabine, D. C. Miller, A. D. Cole, F. E. Nipher, E. L. Nichols and A. P. Carman (elected at this meeting to serve for five years).

For the next annual meeting, to be held at Baltimore in the convocation week of 1908–9, and for the summer meeting to be held at Hanover, N. H., during the week beginning June 29, 1907, the officers elected are:

Vice-president and Chairman of Section B—Karl E. Guthe.

Retiring Vice-president—Dayton C. Miller.

Members of the Sectional Committee—D. C. Miller, K. E. Guthe, A. D. Cole, F. E. Nipher, E. L. Nichols, A. Trowbridge, E. B. Rosa, A. P. Carman.

In the afternoon of December 31, the retiring vice-president, Professor Wallace C. Sabine, delivered a very interesting address on "The Origin of the Musical Scale." This was followed by an instructive and entertaining account of "Physical Research at a Mountain Observatory," by Professor Geo. E. Hale, of Mt. Wilson, California. Joint meetings of the two societies were held on Monday, Tuesday, Wednesday and Thursday. The attendance was uniformly large and fully one hundred and fifty were present to hear the vice-presidential address. Fifty-two papers were presented covering a wide variety of topics, and many of them of very great interest. There was a hotel headquarters for physicists, a feature which added much to the pleasure and profit of the meeting.

The abstracts and titles of the papers presented at the joint-sessions of the two societies are given below.

The Discharge of Electricity from Pointed Conductors: John Zeleny, University of Minnesota.

The way in which the discharge of electricity from steel sewing needles and from 12° cones, depends upon the sharpness or diameter of the points, has been studied. The potential required to start the positive discharge from these points can in each case be represented by a formula involving the diameter of the point. The relation between the potential of a point and the current flowing from it can be represented in each case by a formula involving the diameter of the point and the potential required to start a current. During the positive discharge from steel points masses of iron oxide form on the tips of the points. This also occurs to a much smaller extent during the negative discharge. The current, flowing to a spherical surface from a point placed at its center of curvature, distributes itself quite uniformly over the whole surface of the hemisphere opposite. With diminution of pressure the discharge between a point and a plane takes place at gradually lower and lower potentials, and the current increases more and more rapidly with change of voltage. Below a pressure of one centimeter the potential required for the discharge drops rapidly to about 400 volts as the pressure is reduced to a few hundredths of a centimeter, and then at about a hundredth of a centimeter it begins to increase again rapidly.

Notes on Spark Potentials: R. F. Earhart, Ohio State University.

Point and Plane.—Measurements were made on the P.D. required to cause a discharge between a needle point and a plane surface, for very small distances.

Potentials were secured from a bank of storage cells. Distances were measured by means of an interferometer.

Curves are shown representing the relation between distance and potential. One family of curves represents discharge from a positive point for pressures of 75 cm., 37 cm. and 25 cm. In a similar manner results obtained for point negative are shown.

The least potential required for ionization of air under these conditions is 338 volts, a value somewhat less than has been previously determined for plane electrodes.

Potentials less than 338 volts can produce a discharge, but of a different character. Such discharge is probably produced by the projection of corpuscles or metal atoms. The polarity of the point does not influence the discharge for the abnormally small distances. For greater distances discharge occurs more readily from a negative than for a positive point.

Discharge between Metal Electrodes for Potentials Less than Ionizing Potentials.—Hobbs has shown that discharge produced by potentials less than an ionizing potential depends on the character of the metal electrode. Such discharge can be secured through greater distances if Al electrodes are used than if Pt were employed.

Using electrodes of Pt, Al and Ag, in the various permutations and plotting P.D. and distance, I have found that discharge is not determined by the character of the negative electrode, but rather by the electrode having the lower potential gradient, irrespective of its polarity.

This indicates that the discharge under these conditions is not carried entirely by negative corpuscles.

The Influence of Humidity upon the Electrical Discharge from Points in Air: John Zeleny, University of Minnesota.

A study has been made of the discharge from a point in air of various degrees of humidity. A complete potential-current curve was attained for each case, and from the results curves were drawn showing how the potential required to produce a given current varies with the humidity of the air. The potential required to start the positive discharge was found to diminish slightly (about 3 per cent.) as the humidity increased from 0 to 100 per cent. The potential required to produce a positive current (25×10^{-7} amp. to 100×10^{-7}) increased about 6 per cent. for the same change in humidity. The potential required to produce a negative current also increased with the humidity of the air, the total increase being about 16 per cent. for the whole range.

Radioactivity of a Smoke-laden Atmosphere: S. J. Allen, University of Cincinnati.

This paper gives an account of a series of observations on the rate of decay of the radioactivity of the air at Cincinnati, during the last eight months. The atmosphere at Cincinnati is very smoky and it was therefore thought interesting to observe what effect the smoke particles might have on the rate of decay.

An endless copper wire running over two insulated wooden pulleys was suspended about 20 feet from the ground, and could be charged to a high potential by means of a large static machine. The length between the pulleys was about 180 feet, thus giving 360 feet of wire for the activity to be deposited on.

The active substance deposited on this wire was removed and tested for its activity in the usual manner. In some of the observations the rate of leak method was used and in others the activity was measured by means of the new null reading instrument devised by the author and described in an accompanying paper.

The active substance was collected on the wire under three different conditions: (1) The wire was charged negative, (2) the wire was charged positive, (3) the wire was uncharged.

About fifty decay curves in all were obtained.

The main facts brought out in this investigation may be summarized as follows:

1. When the wire was charged negatively a very large amount of activity could be obtained. When charged positively only a small amount. When uncharged the amount obtained was quite considerable.

2. The decay curves obtained differed widely, the period of decay (time taken to fall to half value) varying from 30 to 80 minutes.

3. Only two simple exponential curves could be obtained which extended over any appreciable length of time. One gave a period of about 38 minutes and the other a period of 30 minutes. About one third

of the curves were approximately exponential and had a period from 36 to 40 minutes. There thus seems to be a period of decay of about 38 minutes.

4. At least eight or ten of the curves showed a slow rate of leak remaining for many hours. In two or three cases this rate of decay was identified with that of thorium excited, having a period of decay of about 11 hours.

One may, I think, conclude from these results that there is a simple exponential decay with a period of 28 minutes, another one of 38 minutes, and some evidence of a much slower rate of decay with a period of over 50 minutes. If the period is over 60 minutes one can be certain that thorium excited is present. The period of 28 minutes agrees with that of radium. The results of this paper then show that in general the decay curves of the radioactivity of the atmosphere will be irregular and made up of several rates of leak due to radium-excited activity and in many cases also to thorium excited. The effect of smoke particles is undoubtedly the same as that of snow and rain, as observed by other experiments, though the rate of decay is in general different.

On the Charge carried by the Negative Ion of an Ionized Gas: R. A. Millikan and L. Begeman, University of Chicago.

The paper is a discussion of the sources of error in preceding determinations of e, and a description of attempts to eliminate some of these sources of error. In its essentials the method employed was that used by H. A. Wilson. The source of ionization was radium. The potential difference established between plates 5 mm. apart in the cloud chamber ranged from 1,600 to 3,000 volts. The expansion was of such value as to cause the fall in pressure to be between 22 and 24 cm. of mercury, its initial value being about 75 cm. The cloud was timed as it fell between the cross hairs of a short focus micrometer telescope, so set that the distance between these cross hairs corresponded to an actual fall of 2 mm. The degree of accuracy with which results could be duplicated was shown from a typical set of observations.

The results of ten different sets of observations made with fields of the indicated strengths were as follows:

Field Strength			
1,600 volts	10.67 E. S.		3.81×10^{-10}
2,100 "	14.00 "		3.89 "
2,400 "	16.00 "		4.10 "
2,950 "	19.67 "		4.25 "
1,600 "	10.67 "		4.34 "
1,600 "	10.67 "		3.66 "
2,100 "	14.00 "		4.10 "
2,250 "	15.00 "		3.94 "
2,350 "	15.67 "		4.37 "
2,750 "	18.30 "		3.84 "
	Mean	....	4.03×10^{-10}

Distribution of Ionizing Energy about X-Ray Tubes: Wm. R. Ham, University of Chicago.

The distribution of ionizing energy about X-ray tubes was examined by an electroscope method in order to determine whether the uniformity in distribution obtained by previous observers by photographic and fluoroscopic methods would be found to hold.

Working at one and one half meters distance from the center of the tube there was found to be a wide variation in ionizing energy in certain planes. Thus:

1. In the plane determined by the axis of the cathode and the normal to the target there are large variations, the energy along the normal being about one half as great at a point 60° from the normal, where it is a maximum.

2. In the plane at right angles to the preceding plane and containing the normal to the target there are also variations as shown by a large number of curves.

Velocity of the Negative Ions produced by the Ultra-violet Rays. Alois F. Kovářík, University of Minnesota.

Rutherford, adopting the alternation of the field method, found the velocity of the negative ion produced in air at atmospheric pressure by the ultra-violet rays to be 1.41 cm. per sec. for a potential gradient of 1 volt per cm. Lenard, adopting Zeleny's method of driving a current of air against the motion of the ions found the velocity to be 3.13 cm. per sec. In the present experiments the former method was used, making the alternations of the potential of the field by means of a sechommeter. With rates of alternations differing by more than 100 per cent. the values of the velocity of the negative ion in air at atmospheric pressure were found concordant within limits of experimental error and the average of the values obtained is 2.05 cm. per sec. for a potential gradient of 1 volt per cm. Reducing the pressure from 76 cm. to less than 2 mm., the velocities were measured. The products of the velocities by the ratio of their corresponding pressures to 76 gives uniform values whose average is 2.09 cm. per second. The velocity in moist air at atmospheric pressure is found 10 to 15 per cent. less than in dry air. Experiments will be carried on with different gases, pressures, and also temperatures.

Absorption Spectra of Röntgen Rays, measured by a Radiomicrometer: J. M. Adams, Harvard University.

It has previously been shown photographically that the Röntgen rays from an ordinary focus tube are heterogeneous, that metals show selective absorption toward the different kinds of rays, and that this selective absorption follows different laws with the various metals. The spectrum used in the present paper was obtained by the same method that was used in making the photographs above mentioned, and narrow slits taken from different parts of the spectrum were examined by the radiomicrometer. It was usually found that the beam proceeding from any one of these slits consisted chiefly of rays of one kind, upon which was superposed a small quantity of rays of other kinds. The latter rays were easily removed from the beam by transmission through a metallic sheet of proper thickness, and the beam thus purified satisfied a test for homogeneity, in that its quality, judged by its penetrating power for various substances, was not changed by further transmission through metallic sheets. A beam of rays direct from an ordinary focus tube, on the contrary, shows a decided change of quality after each transmission.

Absorption spectra for metallic sheets of different materials and thicknesses were obtained by placing the radiomicrometer in various regions of the spectrum, and plotting its deflections, reduced by the interposition of the metallic sheet, as ordinates against the distance from one end of the spectrum as abscissæ. The resulting curves in some cases were practically straight lines, indicating by their slope that the rays produced by the swiftest cathode particles had the greatest penetrating power; while in other cases there were well-marked maxima and minima of absorption in going along the spectrum.

A Mechanical Effect accompanying Magnetization: O. W. Richardson, Princeton University.

On the view that the magnetic properties of bodies are due to the motion of electrons in closed orbits, magnetization is accompanied by the acquirement by the revolving electrons of a resultant moment of momentum about the direction of magnetization. The magnitude of this moment of momentum is calculated, and it is shown that in the general case the moment of momentum per unit volume is proportional to the intensity of magnetization. In the case where all the revolving electrons are of the same sign, the coefficient of proportionality reduces to $2m/e$ where m is the mass and e the charge of an electron. If, as is generally assumed, the revolving electrons in all real bodies are alike as to mass and charge, this coefficient should be the same for all substances. Experiments are being made at Princeton University to detect the existence of this moment of momentum, which should give rise to effects within the reach of experimental measurement.

Ionization of Gases at High Pressures: Henry A. Erikson, University of Minnesota.

This paper gives the results of an experimental investigation of the ionization produced in gases at high pressures by the γ rays of radium.

The results show that the current obtained with a constant difference of potential between the electrodes becomes a maximum at a certain pressure and that a further increase in the pressure causes a decrease in the current.

The position of the maximum point depends upon the difference of potential. When the potential difference is 18 volts between concentric cylindrical electrodes separated by about 6 mm., the maximum is at a pressure of 70 atmospheres, and the current at 400 atmospheres is 60 per cent. of the maximum. With a difference of potential of 1,000 volts the maximum is at 150 atmospheres, the current at 400 atmospheres being about 78 per cent. of the maximum.

The results also show that some of the ions remain uncombined for some time after the rays have been discontinued. At the end of an interval of 20 seconds the number of ions obtained from air at 200 atmospheres, with a difference of potential of 1,000 volts, is about 8 per cent. of the number obtained at the end of an interval of 0.1 second, and at 400 atmospheres the number is about 13 per cent. for the same intervals.

The current-pressure curves for carbon dioxide are similar to those for air, up to the pressure at which the gas liquefies.

The Variation of Apparent Capacity of a Condenser with the Time of Discharge and the Variation of Capacity with Frequency in Alternating Current Measurements: Bruce V. Hill, Chicago.

It has been shown that the capacity of a condenser, as measured by the ballistic method, varies greatly with the time during which the condenser is connected with the galvanometer. The present study was designed to investigate this further and also to learn the behavior of capacities used in ordinary telephone circuits.

For measuring short time intervals a falling weight, operating make-and-break keys was used. Intervals as short as 1/6,000 of a second could thus be read. Discharge times varied from .0001 second to 11 seconds. A D'Arsonval ballistic galvanometer was used. With a mica condenser the apparent capacity was found independent of the time of discharge, but in four paper condensers the absorption was considerable.

A small inductor generator was used in testing the dependence of capacity upon frequency. The mica condenser fell 1 per cent. in capacity as the frequency varied from 60 cycles to 3,000. A paper condenser fell 2.5 per cent., which is too small to be taken account of in practical telephone work.

An Examination of Certain Alternating Current Circuits including those Con-

taining Distributed Capacity: Carl Kinsley, University of Chicago.

In alternating current circuits, particularly those approaching the condition of resonance, the self-induction, capacity and resistance as used are frequently far from correct.

(1) The *self-induction* must include that of the source. If a small transformer is used its self-induction may be a considerable part of that of the circuit. (2) The *capacity* must be measured with the same conditions under which it is employed in the circuit. (3) The resistance of the circuit is both the ohmic resistance and the apparent resistance introduced by hysteresis. The importance of each correction was discussed and illustrated.

The use of periodic and aperiodic current variations over artificial lines was studied by means of the Braun tube. The conditions which must be satisfied in working over long lines were discussed. The paper was illustrated with diagrams and lantern slides.

The Capacity of Paper Condensers and Telephone Cables: Anthony Zeleny and A. P. Andrews, University of Minnesota.

The free-charge capacities of various paper condensers and a telephone cable were compared with their capacities as obtained by the ordinary method where the galvanometer remains connected during the whole period of its throw (A. Zeleny, *Physical Review*, 1906, Vol. 22, p. 65).

The accuracy with which the free charge can be determined is shown by discharge curves which give the relation between the quantity and the time of discharge. In most cases, the free charge determinations can be made to within one tenth of one per cent., and the capacities as obtained by the ordinary method are shown to be from 2 to 300 per cent. greater than the free charge capacities, the amount of difference depending on the condenser.

Errors are shown to exist in the present methods of determining the specific capacities of dielectrics and in the resistance of dielectrics as obtained by the loss-of-charge method.

A Hydrogen Peroxide Cell: H. T. Barnes and G. W. Shearer, McGill University. (Read by title.)

Two papers have been presented before the American Electrochemical Society by one of the authors in conjunction with H. M. Tory and G. H. Cole, where the results of experiments on the effect of dissolved gases in water on metal surfaces have been given. In the second paper a cell was described which consisted of electrodes of aluminum and magnesium in a solution of aluminum sulphate, to which some hydrogen peroxide was added. Aluminum metal behaves in a peculiar manner in contact with dissolved air, or oxygen, and becomes electronegative to a similar aluminum electrode in water free from dissolved air. Magnesium does not show this effect: hence a cell with the two metals for electrodes has a comparatively large E.M.F. developed between them when dissolved air or oxygen is introduced. The effect is considerably increased by adding hydrogen peroxide. Acting on the suggestion of Professor Bancroft, tests were applied to the water in which clean aluminum had stood for a few hours, and a measurable quantity of hydrogen peroxide was detected. This was developed from the action of the dissolved oxygen on the aluminum, probably according to the following reaction, also suggested by Bancroft:

$$2Al + 6H_2O + 6O = Al_2(OH)_6 + 3H_2O_2.$$

The amount of yield of the peroxide was considerably increased in several ways. Without dissolved air no trace of peroxide was observed. The generation of the hydrogen peroxide completely explains the abnormally high E.M.F. developed between two metals so close together in the electrochemical series.

The Heat of Dilution of Aqueous Salt Solutions: F. L. Bishop.

At the meeting of the American Physical Society held in Chicago in 1906 the author read a paper describing a new form of calorimeter for certain thermochemical measurements and gave some preliminary results on the heat of dilution. The apparatus has since been perfected, tested and determinations made of the heat of dilution of sodium, barium, and potassium nitrates and potassium chloride when dissolved in water.

These results show that the heat of dilution is a linear function of the concentration when the concentration is expressed in weight normal solutions. If we represent by U the heat in calories per gram-molecular weight of the substance and by C the concentration, then dU/dC is a constant within the limits of concentration used. Now since $C = I/v$ where v represents the volume of water in which one mol of the substance is contained, we have that $dU/dv = a/v^2$ where a is some constant. This shows that as the concentration approaches zero the heat effect caused by the addition of a definite amount of solvent dv to the solution approaches zero. These results would seem to show that there is a similarity between the heat of dilution of a solution and the Joule-Thomson effect in gases for which, as is well known, the same expression holds true. They also indicate that the osmotic pressure P, like the gas pressure in van der Waals's equation, must be corrected by a term a/v^2 representing the attraction of the molecules.

Determination of the Fusion Points of Sodium Nitrate and Potassium Nitrate: Floyd R. Watson, University of Illinois.

The object of the investigation is to determine a series of definite melting points of salts from 300° to 1,400° centigrade that will be helpful in the calibration of thermo-elements and resistance thermometers.

The determination of the fusion points of the nitrates of sodium and potassium has developed a method that is sensitive, and has opened the way for the more difficult problem of determining fusion points of salts that melt at higher temperatures.

The salts were melted in a hard glass tube which was surrounded first by a small air space, then by a hot bath of mixed salts. The heating was effected by gas flame and electric current. Temperatures were found by means of a copper constantan thermo-element; the E.M.F. of the latter being determined by a potentiometer. Readings of E.M.F. were taken to microvolts by having the bridge wire of the potentiometer ten meters long, and by arranging the bridge resistance to be only a small part of that of the potentiometer circuit. A certificated cadmium cell was used as a standard E.M.F. The thermo-element was calibrated for ice, steam and boiling sulphur points.

Results of a number of preliminary observations give the temperature of fusion of sodium nitrate as 302° centigrade, and of potassium nitrate as 331°. Apparatus is now being constructed that will allow these results to be verified with a platinum platinum-rhodium thermo-element, and which will also furnish a means of determining fusion points of salts that melt at higher temperatures.

A New Apparatus for Measuring Electrolytic Resistance: Arthur Whitmore Smith, University of Michigan.

The principal object in the design of this cell is to present the concept of "molecular conductivity" of an electrolyte in such a clear and concise form that no one who is capable of making electrical measurements can misunderstand it. The apparatus consists of a strong glass tube provided with a small side tube for filling. Both ends are ground plane and closed by platinum-faced electrodes, the whole being firmly clamped together in a suitable framework. Good insulation between the electrodes is provided by making a portion of this frame of ebonite. Crushing strains due to the unequal contraction of glass and metal are avoided by the use of heavy rubber washers, one on each side, which take up the extra length without much increase in pressure. It has been found that a moderate pressure is sufficient to prevent leakage between the ends of the glass tube and the metal electrodes. The apparatus is supported by four short legs, one at each corner.

The resistance of the column of liquid contained in this tube is measured by the method of Wheatstone's bridge, using a telephone and alternating current, and the specific conductivity, c, or the conductivity of a centimeter cube of the solution from one face to the opposite one, is computed in the usual way.

The molecular conductivity, μ, of the electrolyte is then defined as the conductivity of a centimeter cube of the solution per gram molecule of salt within this cube. In symbols,

$$\mu = c/m,$$

where m denotes the concentration of the electrolyte expressed in gram molecules per c.c. of the solution.

Heat of Evaporation of Water: A. W. SMITH, University of Michigan.

The heat of evaporation of water is one of the important constants of nature. It has far-reaching practical applications, especially at high temperatures, while at low temperatures it enters into many problems of the physicist, the chemist and the meteorologist. Unfortunately, few determinations have been made at ordinary temperatures, and to fill this want my recent work was undertaken. The method employed was to draw a stream of dry air through the water and determine the amount of water evaporated by again drying the air and weighing the water thus collected. Heat to maintain a constant temperature was supplied by an electric current and the results are expressed in terms of international joules per gram of water evaporated.

The present pape: gives the final corrected results expressed in terms of "mean calories" as well as in joules. The true value of the E.M.F. of a Clark cell at 15° C. is probably much nearer 1.433 volts than the legally accepted value, 1.434 volts. It is further shown that for this purpose at least, the most probable value of J is 4.1836 joules per mean calorie. Using these factors brings my results and those of other investigators at both higher and lower temperatures into perfect agreement. It is, therefore, possible to give the values of the heat of evaporation of water for the entire range of temperature from 0° C. to 100° C. with a very high degree of certainty at the lower temperatures and probably not over 0.2 per cent. error at 100° C.

The values of the heat of evaporation determined by the various investigators are plotted on a sheet of accurately engraved cross-section paper, and the nearest smooth curve is drawn through the points thus located. From this curve are then obtained values corresponding to temperature intervals of 5° C. These values decrease from 596.3 calories at 0° to 538.0 at 100°.

A Galvanometer Scale for the Direct Reading of Temperatures with Thermo-electric Couples: Anthony Zeleny, University of Minnesota.

An accurate scale for use with thermo-electric couples for the direct reading of temperatures is obtained by making the magnitude of the individual scale divisions proportional to the first differential coefficient, de/dt, of the equation for the particular couple employed.

With the proper resistance in the circuit, and with a galvanometer in which the deflections are proportional to the current, any number of such consecutive divisions represents the deflection produced when the temperatures of the junctions are those indicated by the lines at the extreme ends of those divisions.

The movable scale is set, when the circuit is open, to indicate the temperature of the known temperature junction, and then when the circuit is closed, the reading obtained indicates the temperature of the other junction.

The Use of the Bunsen Ice Calorimeter for Accurate Heat Measurements: H. T. Barnes and Franklin H. Day, McGill University. (Read by title.)

In applying the Bunsen ice calorimeter for some measurements of the heating effects of some of the radioactive changes an effort was made to eliminate the uncertainty which always appears in the want of steadiness of the reading. It is a well-known fault with this type of instrument, that the readings are never steady, but have always to be corrected for a slow freezing or melting going on inside the instrument. The creep or "gang" may be reduced in several ways: Bunsen, 1871, used air-free water and applied a considerable hydrostatic pressure, and still obtained a constant increase in reading (freezing).

Schuller and Wartha, 1888, used the same apparatus with water not air-free and obtained a continuous decrease in reading (melting). Boys, Mond, Ramsay and Shields found a continuous increase in their instrument and compensated for it by surrounding the bulb with an air jacket, thus balancing the freezing by a continuous melting.

Dieterici used a modified form of the Dewar flask, surrounding the calorimeter with a vacuum jacket and thus considerably reduced the creep.

One of the authors, with Mr. Lucas, had previously made an effort to reduce the creep by surrounding the calorimeter with freezing-point mixtures of great purity, such as clean, freshly fallen snow and distilled water, but had not succeeded. It occurred to the authors, after trying tap water with and without air, and water from the clean blocks of melted river ice, all without success, that it was better to use distilled water, eliminate so uncertain a quantity as the dissolved air, and add a very small quantity of cane sugar to the water before filling the bulb of the instrument.

After several trials with various strengths, we found that a solution of cane sugar containing .18 gram to the liter practically did away with the creep when the instrument was immersed in clear, cracked river ice and tap water. The capillary tube of the instrument had a bore of .0006619 c.c. per millimeter, and the actual change in reading which we obtained was less than 5 mm. in 14 hours, and was constant for over two days. Changing the height of the capillary tube was found to have only a very small effect on the creep.

The authors strongly recommend to those desiring to use the Bunsen ice calorimeter that the bulb be filled with a solution containing from .15 to .18 gram per liter, and boiled free from air. The solution is so weak that the sugar added can not be detected by its taste, and the arrangement is the simplest way to avoid an otherwise uncertain and troublesome correction.

The Resistance Temperature Coefficient and the Coefficient of Expansion of Carbon: G. W. Stewart, University of North Dakota.

With the exception of the diamond and charcoal, carbon in its various forms conducts electricity metallically. Its resistance temperature coefficient is, however, negative. This paper accounts for the apparent negative coefficient by assuming the changes in resistance to be due to the expansion of the particles of carbon.

Assuming this explanation to be the correct one, experiments were performed to obtain the coefficient of expansion of carbon. The carbon used was in the form of films made of commercial lampblack and a lacquer called "zapon L." The apparent resistance temperature coefficient of the films and the effect of the expansion of the hard rubber base upon which the films were placed were measured, and the actual coefficient of expansion of the carbon particles was computed. The result obtained shows the coefficient to be about 0.0003, which is from ten to thirty times that of the pure metals.

The Temperature Coefficient of the Moving Coil Galvanometer: Anthony Zeleny and O. Hovda, University of Minnesota.

The temperature coefficient of a moving coil galvanometer having a cast-iron magnet, was determined in order that the change in the sensibility could be calculated when the instrument is used at different temperatures.

Since the temperature coefficient depends upon the magnet, the suspensions and the coil, and in different relations for different kinds of measurements, the coefficients of these different parts were determined separately. These are combined in their proper relation to determine the temperature coefficients for current, potential and ballistic measurements.

The Effect of Tension on Thermal and Electrical Conductivity: N. F. Smith, Olivet College.

Two metal bars called A and B of the same material, each 5/16 of an inch in diameter and about one meter long, are mounted horizontally about 10 cm. apart. One end of each bar is held in a clutch made from a heavy block of copper which is heated and maintained at a constant temperature. By means of thermo-electric couples sliding on the bars a point is determined on B which has the same temperature as a given point on A when the steady state is reached. B is then subjected to a stretching force while the condition of A remains unchanged. When the steady state is again reached the couple on B is shifted till it is again at a point where the temperature is the same as at the given point on A. The stretching force is increased, step by step, up to the maximum which the bar will withstand. It is assumed that the thermal conductivity is proportional to the square of the length to the position of the thermo-electric couple. At each step the electrical resistances of the two bars are compared by a modification of Kelvin's double bridge method.

Observations have been made on bars of several different metals and each shows an *increase* in the thermal conductivity with the stretching force. The maximum increase is about 1.7 per cent. At the same time the electrical conductivity *diminishes,* the variation being about the same as that found by other experimenters. The length of time that the stress is applied has a marked effect upon the thermal conductivity.

Some Cases of Excessive Damping of Torsional Vibrations: K. E. Guthe, Iowa State University.

The decrease of the logarithmic decrement with the amplitude, frequently observed in torsional vibrations, is usually extremely small. It is considered as closely connected with the elastic after-effect. Wires of platinum-iridium which are practically free from such after-effect have not alone a large logarithmic decrement, but show also a decided decrease of decrement as well as period with decreasing amplitude. This is especially pronounced in a 40 per cent. platinum-iridium wire whose logarithmic decrement decreased from 0.0137 to 0.0025, while the amplitudes decreased from 5.7 to 0.85 degrees. The corresponding change in the period was from 7.350 to 7.175 seconds. The decrease in amplitude is nearly proportional to the square of the amplitude. With different moments of inertia suspended from the wire the values of the decrement remained the same for the same amplitudes.

Similar effects, though less pronounced, were observed with wires containing a smaller percentage of iridium and in drawn wires of other materials. It was attempted to explain the phenomena by the assumption that the disappearance of the elastic after-effect is very rapid.

The increase of the logarithmic decrement upon drawing was explained by Beilby's theory of the effect of mechanical hardening. A carbon filament was shown to have a large decrement; the electrolytic deposition of hydrogen upon palladium increased the logarithmic decrement fivefold. In conclusion, it was pointed out that the conditions under which a wire is annealed by heating greatly influence its elastic properties.

F. N. Cole,
Secretary

(*To be concluded*)

THE CARNEGIE INSTITUTION OF WASHINGTON[1]

Referring to the individual reports of the heads of departments for a more adequate account of the year's work on the numerous and diverse fields of departmental activity, the following summary may suffice to show the trend of current progress.

DEPARTMENT OF BOTANICAL RESEARCH

This department is engaged on a series of problems whose elucidation can not fail to be of the greatest interest and value, whether applied to the restricted field of botany or to the broader domain of biology. By means of observation, experiment and measurement it is proposed to determine, as nearly as may be, the conditions of development, growth, distribution, migration and variation of desert plants. Thus, in addition to systematic studies of the forms and distribution of these plants, there must be carried on studies of the factors of temperature, rainfall, evaporation, soil moisture and anatomical and physiological adaptability. The location of the desert laboratory in a country affording a wide range of plant forms, as well as a wide range of conditions in altitude, temperature, soil moisture and soil composition, presents unequaled opportunities for such studies.

Along with these lines of work, the anatomical, physical and physiological researches of the department staff have already resulted in noteworthy contributions to biological science. Among these, reference may be made especially to publication No. 81, in which Director MacDougal gives an account of the production of a new species of plant by an application of chemical fluids to the parent plant seeds during the period of germination. This remarkable achievement must be regarded as one

[1] From the annual report of the president for 1907.

of the noteworthy advances in modern biology. Mention may be made here also of the important contribution of Professor Lloyd, formerly an associate of the department, on the "Physiology of Stomata," now in press as publication No. 82 of the institution. Scarcely less important and promising in their ultimate applications are the descriptive studies of the desert flora of Professor Spalding, the investigations of the physics of plant life by Dr. Livingston, and the histological researches on hybrids by Dr. Cannon. In the last-named work Dr. Cannon has derived valuable assistance from Mr. Burbank, whose unrivaled production of hybrid plants furnishes ample and varied material for the histologist as well as for the horticulturist.

DEPARTMENT OF ECONOMICS AND SOCIOLOGY

As may be inferred from its name, this department includes a wide range of work and requires a correspondingly large corps of collaborators. During the past year 185 individuals have participated in its work. Its investigations are under the following titles: Population and Immigration; Agriculture and Forestry; Mining; Manufactures; Transportation; Domestic and Foreign Commerce; Money and Banking; The Labor Movement; Industrial Organization; Social Legislation; Federal and State Finance, including Taxation; The Negro in Slavery and in Freedom.

The names of the experts in charge of these divisions and the abstracts of progress given in the report of the director afford a sufficient guaranty of an abundant harvest from these varied fields of research. Many preliminary results have already been published and many more are forthcoming.

One of the first necessities which confronted this department was that of a systematic search for early as well as recent economic material in the official documents of the several states of the United States. To meet this need the preparation of a classified index of economic material in the state documents has been undertaken for the department by Miss Adelaide Hasse, of the New York Public Library. Three volumes of this important work, namely, those for the states of Maine, New Hampshire and Vermont, have been issued by the institution during the past year, and volumes for New York and Rhode Island are now in press.

DEPARTMENT OF EXPERIMENTAL EVOLUTION

The work of this department is progressing favorably along lines explained in preceding reports, the principal problems under investigation being those of heredity in plants and animals. Old as these problems are, it is only recently that their study has risen to the level of the older physical sciences in which measurement and calculation are so advantageously applied. It is now clear, however, that these powerful adjuncts of research may be applied with equal advantage in biological investigations. Thus the more important work of our Departments of Experimental Evolution, Botanical Research and Marine Biology serves to mark the advance of biological science from the qualitative to the quantitative stage.

One of the most interesting and gratifying results flowing from the larger projects undertaken by the institution is the stimulus they are producing amongst individual investigators at home and abroad. This is especially the case with the Department of Experimental Evolution, whose location close to the main routes of travel makes inspection of its work somewhat more easy than in the case of other departments. The reciprocal advantages arising from visits to our departments of experts in similar lines of work are of the highest significance. Indeed, it appears not improbable that the indirect results arising from such conferences may prove to be in the aggregate of as great value in the advancement of knowledge as the direct results of departmental investigations.

THE GEOPHYSICAL LABORATORY

The completion and occupancy of the Geophysical Laboratory mark a noteworthy advance in the progress of the novel and difficult experimental work carried on in this department of research. This work was started in a tentative way by Dr. Day, now director of the laboratory, while he was a member of the staff of the U. S. Geological Survey. The results of his preliminary investigations and the limited quarters available in the survey building rendered the construction of a special laboratory essential to adequate development and prosecution of the work. Accordingly, as explained more fully in my last report, provision was made by the board of trustees at their meeting in December, 1905, for the purchase of a site and for the construction and equipment of such a laboratory. In compliance with the contract made in July, 1906, the laboratory was completed and ready for occupancy within a year, so that the director and his staff were in possession of their new quarters early in July of this year. At the present writing the equipment of the laboratory is also nearly secured and installed.

Attention is invited especially to a description, with appropriate illustrations, of this laboratory, to be found in the report of Dr. Day on pages 85–96 of this volume. It may suffice here, therefore, to remark that the building is in many respects no less novel than the work for which it is designed. Substantially, though economically, built, nearly fire-proof, admirably situated as regards isolation, elevation, light and ventilation, it is worthy of inspection by those interested in physical laboratories in general as well as by those interested in the special work to which this one is devoted.

Naturally the time and energies of the staff of the laboratory have been absorbed largely by the duties of construction, transfer and installation of equipment and by the attendant preparatory work. Several publications from members of the laboratory staff have been issued, however, as explained in the director's report and as recorded on pages 46–54.

DEPARTMENT OF HISTORICAL RESEARCH

With many departments devoted to as many different fields of research there must be of necessity a corresponding diversity of aims, methods and results. It is impossible, therefore, to measure adequately departmental activities by any common standard. This diversity and this lack of common terms of comparison are forcibly suggested in passing abruptly from the physical to the historical sciences. But the work which the Department of Historical Research has entered upon is not so remotely allied to the physical sciences as might at first appear. It is, for example, in one respect, strikingly similar to the work of the Department of Meridian Astrometry; for while the latter has for one of its main objects the construction of a catalogue of the positions of the stars for the use of astronomers and navigators, the former has for one of its main objects the construction of a comprehensive series of catalogues of historical documents for the use of historians and investigators in American history.

In addition to the line of work just named, the department serves also as a sort of American clearing-house for the dissemination of historical data and for the promotion of historical research. Thus the guides in preparation to materials of American history found in the archives of Canada, Cuba, Mexico, Spain, England and other foreign countries, as well as in the United States, seem destined to prove of great aid to a wide circle of contemporary and future investigators in this field of history. A guide to materials in Cuban archives, by Mr. Luis M. Pérez, has been published during the year; a similar guide to materials in Spanish archives, by Professor W. R. Shepherd, is now in press; while others are in a forward state of preparation. A revised and much enlarged edition of the "Guide to the Archives of the Government of the United States at Washington" is also now in type, and will soon be issued.

For an outline of prospective as well as current work under this department, attention may be called to the full report of Director Jameson, to be found on pages 97–105.

HORTICULTURAL WORK OF MR. LUTHER BURBANK

The experiments and investigations of Mr. Burbank and the work of preparing a scientific account of his methods and achievements are progressing as favorably as the available division of time and labor will permit. Being necessarily and properly very busy with his own affairs and overburdened by importunities of the public, the amount of time available for conferences concerning the origin and the history of his productions is limited.

Dr. Shull, of the staff of the Department of Experimental Evolution, who is collecting the data for the account just referred to, has been at Santa Rosa for two series of conferences during the year, and plans to spend a portion of each year there until this work is completed. Dr. Cannon, of the Department of Botanical Research, has also spent a portion of the year at Santa Rosa, studying especially the physiology of some of the numerous hybrids developed by Mr. Burbank.

One of the most important results which may be expected to arise from Mr. Burbank's work and from the interest in it taken by the institution is a general stimulus to scientific horticulture. That contemporary society is ready to appreciate and utilize such a stimulus is a noteworthy sign of the times. Thus, many individual and governmental enterprises are giving attention to the economic advantages to be gained from rationally conducted experiments in this field, while biologists in increasing numbers are devoting their studies to the more recondite laws which govern plant, fruit and flower developments.

DEPARTMENT OF MARINE BIOLOGY

As explained more fully in my preceding report, the unique conditions under which this department must carry on its work have led to a similarly unique development, the more essential features of which are the absence of a permanent scientific staff and the closing of the laboratory at Dry Tortugas during the autumnal and winter seasons of the year. But these features do not diminish the efficiency or limit the extent of the work peculiar to the department, since the pelagic life of the region can only be investigated advantageously during the spring and summer seasons.

During the past season, as hitherto, the department has extended its laboratory and collecting facilities to specialists in zoological research, eleven such guests having availed themselves of the opportunities afforded at Dry Tortugas and in the adjacent regions accessible by means of the vessels of the department. Signal aid is thus rendered to investigators in localities whose exploration is often attended by dangers as well as by difficulties.

Publication No. 47, on "Rhythmical Pulsation in Scyphomedusæ," by Director

Mayer, has been issued during the year, and he has submitted for publication a comprehensive monograph on the medusæ of the world. Manuscript for two volumes of researches by associates of the department is also now ready for the press.

DEPARTMENT OF MERIDIAN ASTROMETRY

The work of this department during the year was mainly devoted to preparations for its larger enterprise of a comprehensive catalogue giving accurate positions of all stars from the brightest to the seventh magnitude, inclusive. Amongst these preparations is a preliminary catalogue, embracing the precise positions for upwards of 6,000 stars, which has been brought to substantial completion during the year. This will not only be of great service to the department, but it will be of signal aid also to astronomical science in general.

Preparations for the establishment of a temporary observatory in the southern hemisphere are likewise approaching completion. An exhaustive study of the meridian instrument to be used at this observatory has been made, so that its constants and peculiarities may be well known before observations with it are begun.

The exquisite and penetrating precision of modern stellar research is not alone interesting and useful by reason of its applications to geography, geodesy and navigation. It is illuminating also many recondite questions concerning the constellations, the motions, the masses and the relative distances asunder of the universe of stars. Some of the possible investigations to which these questions may give rise are referred to in the report of Professor Boss, director of the department.

THE NUTRITION LABORATORY

In conformity with provision made by the board of trustees at their last meeting for the establishment of a laboratory to be devoted especially to an extension of the physical and chemical investigations in nutrition carried on hitherto under the direction of Professors Atwater and Benedict, steps were taken early in the year to select a suitable site and to prepare tentative plans for the building. Since experiments on men in an abnormal as well as in a normal condition of nutrition are contemplated, one of the first requirements of a site was proximity to hospitals whence pathological cases may be furnished. Among other requirements, those of moderate cost of land and the availability of water, gas and electric current had to be considered; while favorable climatic conditions and convenience and cost of living for the laboratory staff were important desiderata. After preliminary consideration of this project by the executive committee, the matter was referred to its subcommittee on nutrition, and the latter committee in turn requested the president and Professor Benedict to examine and to report upon the relative advantages of various available sites in the cities of Boston, New York, Philadelphia and Baltimore. A week's time was devoted to this task, and, after further consideration by the subcommittee, it was decided to locate the proposed laboratory in the city of Boston, on Vila Street, near the power house of the Harvard Medical School.

The site selected was purchased from the corporation of "The President and Fellows of Harvard College" on March 13, 1907. The area of this site is 14,312 square feet, and the price paid is $10,466.70.

On the date just mentioned Messrs. Shepley, Rutan and Coolidge, architects, of Boston, were engaged to prepare plans and specifications and to superintend the construction. Preliminary plans were presented by them to the executive committee at its meeting of April 8, 1907, and were approved and the president was authorized to make the contracts and attend to other necessary details. Bids from four independent firms of contractors were submitted early in May, and on May 14, 1907, a contract was entered into with Messrs. Horton and Hemenway to do the work of construction for $68,334, and a similar contract was made with Messrs. Buerkel and Company, of Boston, to supply the heating and ventilating apparatus at a cost of $14,825. These contracts required that the building be completed by February 1, 1908. The construction was begun early in July and the building is now rapidly approaching completion.

Through the courtesy of the authorities of the Harvard Corporation, the laboratory will be able to secure heat, light, power and refrigeration, at the cost of production, from the near-by power house of the Harvard Medical School. The site of the laboratory is also near to existing and contemplated hospitals, and the location appears to be in every way extremely favorable for the prosecution of the arduous researches required to improve our knowledge of the physics, chemistry and pathology of nutrition.

THE SOLAR OBSERVATORY

The work of this department is still largely in the preparatory stage, and is thus as much a work of engineering as of astronomy. The novelties of construction, equipment and program of research for the observatory, along with the initial difficulties presented by a mountain site, conspire to make the undertaking a formidable one. In spite of many obstacles, due chiefly to unprecedented precipitation during the past winter and to labor troubles on the Pacific coast, the work of construction has gone rapidly forward.

The optical parts of the 60-inch reflecting telescope have been made ready for mounting, but owing to the labor strikes at San Francisco the completion of the dome for the telescope may delay its erection until the spring of 1908.

The novel tower telescopic apparatus, part of which is above and part of which is below the ground level, has been substantially completed. This consists essentially of a vertical telescope with a 12-inch objective and 60 feet focal length in combination with a Littrow grating spectrograph of 30 feet focal length, thus furnishing a powerful component in the battery of instruments for direct observations of the sun.

Preparations for grinding, figuring and testing the 100-inch reflector, whose construction, as explained in my preceding report, was rendered possible by the gift of Mr. J. D. Hooker, have likewise gone forward. A fire-proof building for this work has been constructed and the necessary grinding-machine is nearing completion. In the meantime it is expected that the Plate Glass Company of St. Gobain, France, will soon have the large disk for this reflector ready for shipment, since it was successfully cast on August 28 last. In the rough this disk will weigh about 4.5 tons.

Simultaneously with these varied works of construction, daily photoheliographic and spectroheliographic observations have been made by aid of the Snow telescope. Daily studies of the sun and sun-spot spectra have supplemented these observations, and to them have been added pyrheliometric and solar magnetic measurements, along with numerous laboratory investigations bearing directly on the physical properties of the sun.

DEPARTMENT OF TERRESTRIAL MAGNETISM

The year for this department has been one of varied activities and one specially fruitful in the quantity and quality of the results attained. The operations have embraced magnetic surveys of the North Pacific Ocean; surveys on land in Alaska, Bermuda Islands, Canada, Central America, China, Mexico and South Pacific Islands; and office work combined with special observational studies at Washington, D. C.

The ship *Galilee*, used in the magnetic survey of the Pacific, started from San Diego, California, on her third cruise on December 22, 1906. Sailing by way of the Marquesas Islands, Samoan Islands and Yap Island, she arrived at Shanghai, May 8, 1907. From this point she sailed east to Midway Islands, and thence to Sitka, where she arrived July 14, 1907. Leaving Sitka, August 10, she started on a cruise to the South Pacific by way of Honolulu, Jaluit, Marshall Islands and New Zealand; returning thence by way of Callao to San Francisco. It is expected that she will complete this cruise about May 1, 1908, when she will be returned to her owners.

Up to September 1, 1907, the *Galilee* had traversed nearly 50,000 miles in the Pacific Ocean along courses where few magnetic observations have been made hitherto. Complete measurements of magnetic declination, dip and intensity were secured at intervals of 200 to 250 miles along these courses, as well as at numerous points on islands and at prominent ports. All of the results of this extensive survey available in March of the present year were furnished to the U. S. Navy Department and incorporated in a magnetic chart issued in May last by that department for the benefit of mariners. Important errors in previous charts, amounting in cases to as much as 5° in magnetic declination along some main routes of transportation, were thus corrected.

For an account of the work done at the numerous and widely separated land stations during the year, reference must be made to the director's report to be found on pp. 154–166 of this volume. Similar reference must be made also for an account of the computations and special investigations carried on at the office by Dr. Bauer and his staff. Attention is invited likewise to the annual bibliography for a list of the departmental publications. One of the latter, however, is worthy of special mention and commendation here, namely, a quarto volume of 629 pages, giving the detailed results of the magnetic, tidal, astronomical, and meteorological observations made by Mr. W. J. Peters while serving as a member of the Ziegler Polar Expedition of 1903–5. Mr. Peters has been in charge of the *Galilee* since January, 1906, and as his duties at sea have prevented him from attending to the publication of his work, the task of editor has been assumed by his colleague, Mr. John A. Fleming. The handsome volume issued under Mr. Fleming's editorship has been published under the auspices of the National Geographic Society by the estate of William Ziegler.

RESEARCHES UNDER MINOR GRANTS

Many researches begun by aid of minor grants made during the past six years have been carried forward during the current year. Twenty-one volumes giving the results of these researches have been published during the year, and several more are in press. In addition, as may be seen by reference to the bibliography on pages 46–54, many briefer or preliminary papers have been published in journals.

A list of the volumes issued during the year will be found in the next section of this report. Of the works in press, attention may be called here to a second volume giving the archeological and physiographical results of explorations in Turkestan under the direction of Professor Raphael Pumpelly; to two works on engineering, on high steam pressures in locomotive service and on the performance of screw propellers, by Professor W. F. M. Goss and Professor W. F. Durand, respectively; to the Vulgate Version of the Arthurian Romances, by Dr. H. Oskar Sommer; to a reproduction, with translation and annotations, of "The Old Yellow Book," the source of Browning's "The Ring and the Book," by Professor Charles W. Hodell; to a monograph on The Fossil Turtles of North America, by Dr. O. P. Hay; to a treatise on dynamic meteorology and hydrology, by Professor V. Bjerknes and Mr. J. W. Sandström, of the University of Christiania; and the report of the California State Earthquake Commission.

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GRATUITOUS DISTRIBUTION OF PUBLICATIONS

In his report for the year 1905 the president indicated that the distribution of the publications of the institution was likely to present some difficulties. Under provisional rules approved by the executive committee in January, 1905, and published in the annual report for that year all publications of the institution except the "Index Medicus" are sent free of charge to a list of about three hundred leading libraries of the world. This list was compiled with great care from a much larger list selected by a competent librarian, with a view to include every important library of educational and learned institutions of the world. Pains were taken also to secure as effective geographical distribution as practicable.

In accordance with the same rules, authors, in addition to receiving 25 copies of their works, were authorized to designate 100 addresses to which complimentary copies might be sent by the institution. The president was also given discretionary authority to distribute gratis 100 copies of any work. The possible maximum free list for any work was thus about 525 copies.

The standard edition of our publications approved by the executive committee at the same time is 1,000 copies; and copies not disposed of in the ways just mentioned were offered for sale at a cost only sufficient to cover the expense of publication and transportation to purchasers.

While the rules referred to have been justified by the necessity which confronted the institution at the time of announcing some mode of distribution, many difficulties have been met in their application. The most serious of these arise from the importunities of institutions and individuals claiming rights to the free receipt of all our publications or to the free receipt of certain of them. No amount of courteous endeavor or painstaking research into the relative merits of applicants for such favors can overcome these difficulties. The simple fact is that the demand for a gratuitous distribution of the publications of the institution is much larger than its income can bear. An attempt to meet this demand in a limited way by means of editions of 5,000 to 10,000 copies of our works would require, at the present rate of issue of 25 to 30 volumes per year, a quarter to a half of our income.

Some serious objections have developed also against the liberal terms accorded to authors in the distribution of complimentary copies of their works. One of these objections rests on the charge of favoritism brought against the institution by many who have not been thus complimented; a second rests on the complaint of book-dealers who, having filed orders for books published by the institution, find their clients disposed to cancel such orders by reason of the receipt of presentation copies; while a third rests on the fact that complimentary copies and copies for review are finding their way unduly early to the shops of second-hand dealers.

There appears to be but one way, alike equitable and effective, to check the increasing importunities of individuals and institutions for the free receipt of sets of our publications and to avoid the abuses which have arisen from an attempt to deal generously with authors in the distribution of complimentary copies. This way is to limit the omnia list to its present dimensions and to cut down the authors' list to a minimum which will prevent those abuses. The executive committee at its meeting of October 23, 1907, authorized such a restriction of the omnia list and the president desires to recommend in the near future a similar restriction of the presentation lists.

STORAGE AND SALE OF PUBLICATIONS

As shown in the earlier parts of this report, the publications of the institution have accumulated at a rapid rate. Assuming that something like a stable state of affairs is now attained, it would appear that with an appropriation of one tenth of the annual income for publications an average of 25 volumes per year may be advantageously published. If these are issued in editions of 1,000 copies each, books must be expected to accumulate at the rate of 10,000 to 15,000 volumes per year for some years, unless sales increase more rapidly than during the past three years.

Provision must be made, therefore, for more adequate storage room in the near future. Such room is provided for by the plans for the proposed Administration Building, which it is hoped may be erected within two years. In the meantime use is being made of the available storage room in the attic of the Geophysical Laboratory, where the risk of loss from fire is much less than in the present office quarters of the institution.

As to the possibilities of sales of publications, it appears plain from a study of existing trade conditions, as well as from the accumulating experience of the institution itself, that 500 to 700 copies of each volume of our published works will be needed to meet a normal commercial demand; so that to supply the omnia list and the trade our standard edition of 1,000 copies is essential. But to secure this normal commercial demand the institution must strictly limit the gratuitous distribution of its books and let them pass on their merits through the legitimate channels of trade. Believing this method of distribution to be the best one in the interests of society as well as in the interests of the institution, it is hereby recommended for early adoption.

SCIENTIFIC BOOKS

The World Machine. By Carl Snyder. New York, Longmans, Green & Co. 1907. Pp. xvi + 488.

The perusal of this volume calls to mind the clean-cut dilemma in which a recent writer[1] shows we are placed when we examine the question of man's relation to his environment in a way sufficiently comprehensive to include the problem of his consciousness and his knowing as well as that of the physical objects of which he has knowledge. Either knowledge itself and all mind and consciousness are in some sense a product of inorganic and organic evolution, or, conversely, this physical evolutionary process is in some way conditioned by that very act of knowing or existence of mind. Either "matter" or consciousness must be chosen as the "end-term." The former position seems to appeal most to the "scientists," although it is found by the far-thinking among these to meet with certain serious difficulties in its completion. On

[1] Professor F. J. E. Woodbridge in Studies in Philosophy and Psychology, "The Problem of Consciousness," Houghton, Mifflin & Co., 1906.

the other hand, the second is the conclusion accepted by the idealist and phenomenalist in philosophy and even by some of the scientists.

The present volume proves to be really an endeavor to make a contribution in support of the first position. However, the argument by which the author supports this view consists only in an account of the grosser structure of the cosmical universe which he presents by relating the more important historical discoveries in astronomy and physics. The major portion of the book is, then, only a rewritten history of astronomy; a few other chapters are added treating of speculative, yet germane subjects, such as the origin of life, etc. In its production, too, it is evident that little if any recourse has been had to original sources; indeed, it is not a scholarly work in an academic sense, nor is it a scientific contribution. Nevertheless, it is an example of a kind of work that deserves a welcome, and not discouragement, from academic circles. For, although Mr. Snyder is not of these, he is "with them"; he is the layman who is manifesting a keen interest in things scientific, who has acquired a large fund of general information, and who can write a style at once attractive and clear to the general reader. In these and in many other ways, perhaps, he would seem to have certain advantages over the average academic writer in the dissemination of that which to his reader will be only "knowledge for knowledge sake." Much too infrequently, indeed, do such men venture into scientific and philosophic fields, so that, when we find a work which on the whole is done as well as is this, it certainly merits welcome.

In criticism of the book it remains to be said that it reveals those deficiencies which the possession of general information, when not supplemented by accurate and detailed knowledge, usually manifests. Indeed the book is in some respects distinctly misleading, aside from the fact that many inconsistencies and contradictions are to be found, especially when the author ventures the expression of his own opinions and conclusions. And although these are perhaps to be expected in the work of a man who is more narrator than authority, nevertheless it is probable that the lay-reader will not only overlook these, but will be gradually influenced by the announced purpose of the author to give not only history, but "the philosophy of history." For this reason, and because, too, of a number of statements distinctly idealistic in trend, the occasional decidedly flippant and scornful flings at philosophy and philosophers appear most amusingly inconsistent.

It is, then, with only a modicum of insight into philosophical evidence and the detailed technique of science, and with a total neglect of all other data bearing on the problem, that our author endeavors, by telling the story of discovery in astronomical physics, to show that the "mechanical conception of phenomena must one day end in a mechanical conception of the whole." Even the meaning of this, by itself, is doubtless obscure enough; but, as made clearer and more definite by the purpose revealed on page after page and in chapter after chapter, and notwithstanding a few explicit, yet inconsistent denials of this, the real conclusion, to which the author wishes to lead and probably will succeed in leading some of his unsuspecting lay-readers (and dogmatic scientists) is that of a thorough-going mechanistic materialism. This is the position which results, he thinks, from regarding intelligence as simply a function of a definite physical organization. Whether he is correct in this or not is not here the question. But to try to lead a reader to such a conclusion without considering any evidence at all on the other side, and to make no attempt to determine the character of such a *functional* relation, is manifestly both unfair and unscientific. Indeed, it must be said of the evidence that is presented, that much of it consists of a very crude and gross interpretation of the "mechanical conception." Of such critical analyses as those of Mach, Ward, Duhem, Poincaré and others the author appears to be wholly oblivious. Only the briefest mention, too, is made of radioactivity and its allied phenomena, notwithstanding their paramount bearing on the cosmical questions discussed.

So far, then, as the author sets up pretensions to give us a philosophy of any kind, his volume deserves only adverse criticism; in fact, it would be beneath criticism in this respect did it not exemplify a frequently recurring tendency on the part of many scientists to construct their philosophy by generalizing from what is really evidence on only one side. However, if we disregard the author's philosophical pretensions, and consider his volume as what it for the most part really is, viz., a history of astronomical discovery, written in a style unusually clear and interesting and portraying facts which will set the lay-reader to thinking, then only praise is due him for his endeavor, and may his reappearance in the two volumes on The Mechanism of Life and The Social Mechanism, which he announces, be an early one.

E. G. Spaulding

The Sense of Touch in Mammals and Birds, with Especial Reference to Papillary Ridges. By Walter Kidd, M.D., F.Z.S. London, Adam and Charles Black. 8vo, pp. 176; 164 illustrations.

This work, although hardly of sufficiently broad scope to justify its main title, since it treats of only a very limited region, still contributes much to our general knowlege of the character of the skin which covers the ventral chiridial surface.

After a brief introductory chapter, in which the author explains the general plan of the work, and reviews the scientific literature already published upon this subject, Dr. Kidd proceeds to the discussion, which he divides into three parts, (I.) the macroscopical, (II.) the microscopical and (III.) the physiological study of the volar and plantar skin. This work comprises a study of 86 species of mammals representing 59 genera and 9 orders; also one species each of 11 genera of birds.

The varieties of skin are classified somewhat arbitrarily as follows: *leading types,* (1) smooth epidermis, (2) corrugated epidermis, (3) scales, (4) nodules, (5) hair, (6) rods, (7) papillary ridges; *mixed types,* (*A*) epidermis more or less corrugated, with coarse transverse ridges on he digits, (*B*) corrugated epidermis with papillary ridges, (*C*) nodules with papillary ridges, (*D*) hair with coarse transverse ridges and smooth pads. Practically no attempt is made, however, to show any morphological relationship between these various types, a phase of the investigation which would be of the greatest interest and value.

Careful descriptions are given of each species studied, and the descriptions are accompanied by many diagrams. Especial attention is given to the occurrence of the papillary ridged type of skin. This type the author finds, as have other investigators, partly covering the volar and plantar surfaces of a few of the marsupials, rodents and carnivores and of all of the prosimians; but it is in the primates that the development of this form of skin becomes so complete and universal that it is justly designated "a character of ordinal rank." However, Dr. Kidd's statement that "of course, its highest development is found in the hand and foot of man," is plainly refuted by his own excellent diagrams showing the far more highly developed patterns upon both the volar and plantar areas of monkeys, particularly below the anthropoids. Indeed, one can but see in this statement the effect of a strongly preconceived idea that the ridges and the patterns which they form are, as the author attempts later to prove, purely tactile in function, and that he assumes that they must, therefore, reach their highest development in man. As a matter of fact, in the case of the hand of man, where certainly the tactile function is most highly developed, patterns are so seldom found, except upon the apical pads, as to argue conclusively that the patterns which appear in the lower monkeys and to a certain extent in other mammals are directly associated with and determined by external pressure upon the walking pads or elevated areas, upon the surface of which they are developed.

Part II. furnishes descriptions, with illustrations from photographs and drawings, of sections through many varieties of volar and plantar skin. If these illustrations were accompanied by interpretations pointing out clearly the various features shown, they would be a most valuable addition to our knowledge. Unfortunately, we are left in doubt as to these points.

Further, in view of the fact that the whole treatise is upon the subject of the sense of touch, there is a singular lack of all study or delineation of the nerve supply to the skin and the nature and distribution of nerve endings. This study the author says is not necessary to the present treatment of the subject; and yet later he bases his argument that the ridges are tactile organs upon the arrangement of the papillæ of the corium, which he at the same time admits are, many of them, merely vascular networks. It would seem that the elaborate and careful work already done by Dogiel and others upon the nerve structures of the skin of mammals might at least have been allowed to shed some light upon this subject.

Dr. Kidd finds an interesting imbricated form of ridge structure occurring somewhat sporadically not only in man, but in occasional cases of the lower primates. Also in the case of the lower mammals a few individuals were found in which occurred similar imbrication of the papillæ of the corium. This imbrication is in no case a specific character; it is in some cases proximal, in others distal even upon the same region, though there seems to be a certain degree of constancy in direction in man, at least, the imbrication on the finger tips, when it occurs, being more often distal, and on the hallucal region of the foot, proximal.

In part III. the author strongly adheres to the view of Schlaginhaufen that the ridged form of epidermis has essentially and primarily a tactile function instead of the mechanical one first suggested by Hepburn, and later elaborated by Miss Whipple. This latter writer, whose views Dr. Kidd strenuously attempts to refute, believes that the ridges are formed by the coalescence of epidermic units (modified scales) in response to external pressure conditions, and that they perform the function of presenting a roughened surface to increase friction and thus prevent slipping either in walking or prehension, hence the term "friction skin." According to this interpretation there is no attempt to minimize the importance of the general tactile function of the regions in question, since in the very nature of the case they are especially exposed to contact with external objects. The arrangement of the papillæ of the corium in double rows underlying the ridges is, however, regarded as merely incident to the fact that, in the primate type at least, enormously large sweat glands are arranged in a row underlying each ridge and opening upon its surface, thus by their secretion adding greatly to the efficiency of the friction skin in prehension. Of necessity, then, the papillæ must occupy the only remaining space, which is upon either side of the line of sweat glands and hence follows also the course of the ridges.

After this brief exposition of the view which Dr. Kidd would refute, let us return to his arguments. He makes no attempt whatever to account for the large number and great size of the sweat glands associated with the ridges; but from the fact that the papillæ, many of which are indeed merely vascular, are arranged in rows underlying the ridges, he argues that the ridges themselves must be tactile organs. Neither does he seem to see that the great thickness of the epidermis over ridged areas (which certainly can not be for the purpose of increasing the sensitiveness of the skin) must in part account for the necessity for more numerous and taller papillæ than in more thinly covered regions of equal sensitiveness. It is just at this point that we feel the author's mistake in not including in his work a careful study of the nerve structures of the skin.

Neither is there any satisfactory experimental basis presented to show that the external epidermic ridged structure actually does add to the tactile function. This is, indeed, a point upon which such trustworthy experimental psychologists as Stern and Féré absolutely disagree. The only possible relationship which any one has attempted to establish between the direction of the ridges and the sensitiveness of the surface is that referred to by Dr. Kidd, which lies in the fact that two points seem to be more readily distinguished when so placed that a line joining them is at right angles to the general course of the ridges. The author apparently does not see, however, that such a result is quite in accord with the very ideas which he is trying to refute. Miss Whipple has shown that the friction ridges are so arranged as to be at right angles to the usual direction of pressure, and naturally the correlated tactile function would tend to be most highly developed along these same lines of pressure. This, indeed, is very probably purely the result of practise; for the experiments of Volkmann and Dresslar have shown that a given region of the skin has power to increase in sensitiveness by practise to an extent far exceeding the slight differences in sensitiveness which seem to be associated with the direction of the ridges. The fact that many ridged areas, such as, for example, the ball of the foot, where the ridges are markedly high and distinct and the patterns which they form are very complex and varied, are found to be low in the scale of relative sensitiveness should in itself show that the ridges serve primarily a mechanical and not a tactile function.

Dr. Kidd brings forward a list of instances in which ridges are formed upon unaccustomed places, where, he says, they can have no prehensile function. However, as he himself is forced to intimate, these instances of ridge formation can certainly be attributed to the influence of external pressure, and there is no doubt that many of them are valuable observations showing that ridges do form in response to such pressure. Certainly some of the regions mentioned do not possess a degree of sensitiveness which would justify the creation of highly specialized sense organs.

Others of Dr. Kidd's arguments are so plainly fallacious that they need only be mentioned. For instance, he says, "arches, loops, and whorls represent degrees of departure from the primitive arrangement, and enable a larger area of ridge-covered surface to be exposed to contact relatively to the size of the part." One can hardly see how the form of pattern can increase the area of the surface, provided that in each case the surface is covered with ridges.

Again he argues: "The pulps of man's fingers have highly developed patterns, and these are more variable and complex than those of any other part of any of the primates, and these are the most sensitive areas in any hand or foot. In this instance the connection between sensibility and complexity of pattern of ridges is intimate. The pulps of the toes in man are less sensitive than those of the fingers, and the patterns of the second, third, fourth and fifth digits simple, and these digits are relatively weak in function compared with the hallux." One has only to turn over the pages of Dr. Kidd's own book to see many illustrations of patterns on the interdigital and proximal pads of monkeys which represent not only perfect whorls, but many other very intricate and complicated patterns. Furthermore, in the study of many hundreds of human hands and feet, the most complicated patterns which the reviewer has found have been upon the apical pads of all five of the toes; these patterns are, however, very large and one must study the lateral sides of the digit as well as the mere contact surface, in order to appreciate them.

The author presents, also, as an argument in favor of the tactile function of the ridges, the fact of their imbrication above referred to. This, he avers, must have some important significance in relation to the sense of touch, though he is unable to show how. It is a little surprising that so strong a Lamarckian as he has shown himself to be by his previous writings should fail to see, in this imbrication, a Lamarckian character due to external pressure, a pressure which would be the resultant of the shape of the surface and the amount and kind of use of the region involved. Two cases cited in which the imbrication has a definite relationship to the center of the core of the pattern, being toward the center in one case and away from it in the other, would thus find a possibility of explanation; while on the basis of some important tactile function the two cases absolutely defeat each other.

As a whole the book is a timely contribution to a subject which has recently come into renewed prominence, and with its excellent illustrations and extensive bibliography, is valuable as a source of general information on the subject.

Inez Whipple Wilder
Smith College,
Northampton, Mass.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 201st meeting of the society, held in the Cosmos Club, on Wednesday evening, February 26, the following papers were presented:

Regular Program

Evidences of Recent Volcanic Activity and the Glaciers of Mt. Hood, Oregon: A. H. Sylvester.

Mt. Hood, the highest mountain in Oregon and one of the most beautiful of the ice-covered extinct volcanoes of the Cascade Range, lies on the crest of that range about 20 miles south of the Columbia River. Its elevation is 11,225 feet. About two thirds of its crater remains, the southwest side being broken away.

The evidence of field observations and the new topographic map made by the writer last summer point to a very extensive glaciation at some former period, and to another less extensive advance in comparatively recent times.

An enormous mass of morainal material covers the southwest flanks of the mountain and nearly fills three of its large canyons. This was probably derived from the cutting away of the crater by the early glaciation. The Zigzag and White River glaciers now head against the inside of the north wall. They have cut away the old crater floor and exposed the volcanic neck or plug which now stands a prominent feature in the center of the ruined crater and is known as Crater Rock.

A section exposed in White River Canyon by the cutting of the present streams through the morainal filling shows two layers of drift separated by a layer of soil and logs in place, and ten or twenty feet of fossil ice underlying all. There are eight glaciers of fair size on the mountain. On the whole, they are probably receding, but owing to several recent heavy winters there now appears to be an advance.

The Zigzag and White River glaciers are exceptions to this rule, because of volcanic heat. Their lower ends are disintegrating and opposite Crater Rock, the point of greatest volcanic activity, the Zigzag is partially and the White River wholly cut in two.

On August 28, 1907, in addition to the usual steam, smoke was seen issuing from Crater Rock and at night a glow was observed. The next day the White River was trebled in volume without other warrant than the mountain's internal heat.

No alarming symptoms have been observed since.

Physical Features of Peru: Geo. I. Adams.

Peru is generally considered as containing three regions: the coast, the sierra and the montaña or forest. These regions differ climatically, the coast is arid and agriculture is carried on by means of irrigation. The sierra has a moderate rainfall and being an elevated region evaporation is great, so that the climate is semi-arid. The forest region has a heavy rainfall and is covered with a tropical forest.

The coast region is a narrow belt. In the northern, south-central and southern portions there are coastal plains. The extent of these plains was shown for the first time on the maps accompanying Mr. Adams's reports of his reconnaissance of the coast, published as bulletins of the Corps of Engineers of Mines of Peru. Between the northern and south-central plains and likewise between the south-central and southern plains the mountains descend to the sea. Between the southern plains and the sea there is a range of coast hills. The coastal plains are occupied by Tertiary formations.

The division between coast and sierra is dependent upon elevation, not upon topography, and corresponds with the limit of general annual rainfall excepting to the northward, where the rainfall extends over a portion of the coastal plains in the region of the Gulf of Guayaquil. The approximate limit of the annual rainfall is shown on Mr. Adams's maps.

The sierra consists of Cordilleras and inter-Andean valleys. The higher regions are spoken of as *punas*. Agricultural products of the sierra which are grown at moderate elevation and for the most part independent of irrigation are corn, barley and potatoes and similar crops. Descending the rivers toward the Amazon the valleys are fertile and productive, but upon entering the forest agriculture is meager because of the dense growth of vegetation which has not yet been dominated.

Ralph Arnold,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The forty-seventh regular meeting was held in the seminar room of the Bureau of Plant Industry on Saturday evening, February 29, at 8:30 o'clock. Dr. George G. Hedgcock presented a paper entitled "Crown-gall of the Apple."

A summary was given of observations and studies on the apple crown-gall conducted during the past five years with large experiments in nursery plots and orchards containing nearly 100,000 trees; a part of this work was carried on under Dr. Hermann von Schrenk, at the Mississippi Valley Laboratory, St. Louis, Missouri.

The term "crown-gall" as applied to the abnormal growths on the apple tree, includes a number of forms. The two forms known as the "hard" and "soft" crown-gall are fairly distinct from the hairy-root forms. The latter may be considered for the present as a separate disease.

The crown-gall of the apple occurs in both the hard and soft forms in this country wherever apple trees are grown to a large extent; it is present on seedlings, grafted and budded trees; both forms are closely related to wounds and the formation of callus. Only wounded trees become affected with the disease, indicating that it may enter through the resulting callus, possibly through stimulation by a parasitic organism. The soft form of apple crown-gall is contagious to some extent, and is identical with the disease on the stone fruits, raspberry, blackberry, dewberry, rose, pear and possibly chestnut and walnut. The hard form differs in texture and appearance from the soft, and is either not at all, or only slightly, contagious. It may yet be proved that in case of the hard form, the apple tree has been able to resist and largely overcome the disease by healing processes which lower the vitality of the parasitic organism causing it, and that the two forms have one and the same cause.

The disease is always injurious to the apple tree in case of the soft form, but the effect in case of the hard form may not always be injurious except where the disease encircles the tree, interfering with the circulation. In milder forms the tree may overcome the disease.

Certain varieties, as Wealthy, Wolf River, Yellow Transparent and others, are subject to the hard form of the disease. On the other hand, certain varieties, as Maiden Blush, Rambo, Red June, Minkler and others, are more subject to the soft form of the disease. The results *from experiments* indicate the value of selecting scions from healthy trees. Preventive and curative measures were suggested for the control of the disease.

This paper was illustrated with lantern slides.

Mr. W. F. Wight presented a paper entitled "Some European Botanic Gardens." The paper consisted of a series of illustrations taken by the speaker, showing scenes in nearly all of the leading botanical and public gardens of Europe, and were explained in detail by him. An account was also given of the work and administration of the Kew gardens.

Haven Metcalf,
Corresponding Secretary pro tem.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 647th meeting was held March 14, 1908, Vice-president Day in the chair.

Professor Frank H. Bigelow, of the U. S. Weather Bureau, read a paper entitled "Evaporation Studies at Reno, Nevada, and at the Salton Sea, Southern California."

In the preparation for an extensive campaign on the evaporation of water over large lakes and reservoirs, in an effort to supply data requested by the constructing engineers of reservoirs and irrigation projects, it has been decided to use the Salton Sea, southern California, on account of the intense evaporation there prevailing under conditions which are favorable because of the small amount of precipitation and inflow from the rivers in that region. A comparison of several careful studies on evaporation in different parts of the world shows that the formulas result in very different constants, depending apparently upon the local conditions. It seemed proper to attempt to discover the cause of this discrepancy in order to plan the Salton Sea work more carefully. We set up a temporary station at Reno, Nevada, at the double city reservoir, the two reservoirs being 400 by 800 and 300 by 500 feet, approximately, having a large irrigated alfalfa field to the west, in the direction of the Truckee Valley, and a dry field to the east in the direction of Sparks. The meteorological conditions were very favorable, and observations continued from August 1 till September 14, 1907. Five towers, 40 feet high, were erected: No. 1 (east) in the dry field, No. 2, No. 3 (center), No. 4, in order, on the bank of the reservoir, No. 5 (west) in the alfalfa field. Twenty-nine pans were set up, five six-foot pans on the ground or in the water, and twenty-four two-foot pans on the stages of the towers, ten feet apart, or on the platforms leading to the pans in the water. The observations were made regularly at the hours, 1 A.M., 5 A.M., 8 A.M., 11 A.M., 2 P.M., 5 P.M., 8 P.M., and consisted of dry and wet bulb temperatures in the air near the pans, also one half an inch above the water in the pans, the surface water temperature by means of a floating raft, the depth of the water in the pans at each hour, the anemometer at tower No. 2 (east bank), and comparative Piche evaporimeter readings at tower No. 2 on six stages. The results may be briefly summarized as follows: (1) No difference appeared in the evaporation on account of the size of the pans. (2) The wind effect is given by the formula

$$E_2 = E_1(1 + Aw) = E_1(1 + 0.0175\ w)$$

where E_1 is the evaporation without wind and w is the velocity in kilometers per hour, E_1 being the evaporation in centimeters. (3) The evaporation diminshed from a maximum down the center tower to the water surfaces, something like the amounts indicated by the coefficients following:

Towers.	(5)	(4)	(3)	(2)	(1)	Height.	
						Meters.	Feet.
Maximum	.043	.043	.043	.043	.043	∞	∞
Pan (7)	.039	.038	.036	.037	.039	12	40
Pan (5)	.037	.035	.032	.035	.037	6	20
Pan (3)	.035	.031	.026	.030	.034	3	10
Pan (1)	.025	.024	.017	.023	.029	0	0

The adopted formula is:

$$E = Cf(h)e\frac{de}{ds}(1 + Aw),$$

where e is the vapor pressure of the air at the dew-point temperature, de/ds the rate of change of the vapor pressure per degree temperature centigrade. $Cf(h)$ the variable function. As in the table, the lines for $Cf(h)$ at each pan become asymptotes to the maximum coefficient (the extreme desert station) and they express a complex function of the diffusion and mechanical mixture of fresh streams or evaporating vapor. The vapor blanket lying over a lake retards evaporation in this manner, and the location of a pan in the blanket is of prime importance. Note the effect of the alfalfa field on pan (1), tower No. 5 (0.025 which is depressed). We propose to erect towers in the Salton Sea, and shall endeavor to discover the function $Cf(h)e$, which undoubtedly has a small diurnal period and probably an annual period. To integrate this function over a lake surface is very difficult, and to pass abruptly from an isolated pan to a lake is not permissible.

The papers on the Reno work will appear in the *Monthly Weather Review*.

The second paper of the evening was presented by Dr. J. W. Spencer, under the title "Soundings under Niagara Falls and in the Gorge."

This very interesting paper gave a description of the application of sounding methods to an unusual subject, by which the physical features of the gorge were brought to light, thus determining what work the Falls of Niagara had accomplished at each point in their recession. Apart from the soundings in the vicinity of the crossing of the little steamer *Maid of the Mist,* and at the cantilever bridge, none had been previously undertaken, so that even the depth of the river and its characteristics in front of the American Falls, and nearer the Canadian Falls, as well as in the gorge generally, were not known. The whirlpool was a mystery, and it was thought impossible to sound under the falls themselves.

For a mile and a half below the falls, the soundings in the navigable basin were made from the steamer *Maid of the Mist,* and from the bridges. At the whirlpool and below, a cable was extended across the gorge, and soundings were made from it. Inside and beyond the end of the gorge the soundings were made from a small boat, as also in a most dangerous section below the whirlpool. As the currents were violent, resort was made to self-registering hydrostatic tubes (the Tanner-Blisch), so that the depths were obtained. At the falls a suitably designed buoy was used, in which were placed two separate self-registering tubes. This was repeatedly sent over the falls and recovered, so that results were obtained which were surprising. In one instance the buoy struck the fallen rock in the falls (as shown by the marks on the lead shoe) at a depth of only 72 feet. In the center of the river, farther down, the depth was from 84 to 100 feet, but a lateral channel reached 192 feet in depth. The effective excavating power is thus found to be about 100 feet below the surface of the river. The greater depth resulted from the previous lower river surface. The line of deepest soundings repeatedly showed 186 feet to near the cantilever bridge, about two miles below the falls. Under the bridge the maximum depth is 85 feet (found by engineers for the railway company). Here also borings had been made beneath one of the piers, showing a refilled channel to a depth of 185 feet. The descent of the whirlpool rapids is 51.5 feet. A section across it shows a maximum depth of 102 feet, but in the river course itself a depth of 126 feet was obtained, but it is possible that one from 8 to 14 feet more may occur just beyond. Thus, from near the falls to the whirlpool, the floor of the cañon is found to reach 87–90 feet below the level of Lake Ontario.

Just below the whirlpool great changes occur in the gorge, and at a quarter of a mile farther the maximum depth was found to be 99 feet, or to a plane 59 feet below the level of Lake Ontario. As the Whirlpool Rapids are produced by the fallen rocks refilling the original channel, so also Foster Rapids are due to the same cause. Other measurements were made. Those a short distance within the gorge were found to reach 150 feet, and others some distance beyond its termination showed a narrow inner channel to a depth of 183 feet, or 181 feet below the level of Lake Ontario. These discoveries were hitherto absolutely unsuspected.

These results show that the narrow channel was formed when the level of Lake Ontario was about 180 feet lower than now, at the time when the Niagara was draining only the Erie basin and not the four Upper Great Lakes. They show that the falls were once very much higher than now, and that the last cataract, of the three which composed them, was alone over 300 feet high, and the whole aggregated over 500 feet.

The soundings also complete the proof that the falls were located just above Foster Flats, or about three miles within the end of the gorge, when the volume of the Niagara was vastly augmented, owing to the addition of the waters from the three highest lakes, which now took place. Again, the soundings at the falls bring to light the fact that the modern cataract is not so high as it was a few hundred years ago, before the completion of the Whirlpool Rapids.

These investigations were made under commission of Dr. Robert Bell, the head of the Geological Survey of Canada.

A full discussion of the important significance of these results is soon to be published by the speaker under the title "Evolution of the Falls of Niagara." R. L. Faris, *Secretary*

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

The 176th meeting was held in the main lecture room of the chemical laboratory, Wednesday, February 12, 1908, at 7:30 P.M. Professor Collier Cobb addressed the society on "The Cause of Earthquakes in the Light of Recent Earthquake Action." The lecture was fully illustrated with lantern slides.

A. S. Wheeler, *Recording Secretary*

DISCUSSION AND CORRESPONDENCE

SCHAEBERLE, BECKER AND THE COOLING EARTH

To the Editor of Science: Professor Schaeberle is certainly a bold man when, in your current number (March 6, 1908, p. 392), basing himself on his method of observing stellar temperatures, he would upset modern astronomy with one hand, and make the sun the center of the sidereal cosmos, and with the other would upset most modern theories of geological climate! I hardly think that Borrell, in the current number of the *Journal of Geology,* Huntington, in the current volume of the Geological Society of America, or most of the speakers at the Geological Congress in Mexico, will at all agree that Manson's hypothesis is "demonstrated as a true theory"! They will agree with Chamberlin's strictures. But one can not yet go into further criticism, save to urge those of your readers who are neither geologists nor astronomers not to accept Professor Schaeberle's *ipse dixit,* but rather await the demonstration which he promises "later on."

The object of this letter is rather to call attention to the bearing which his work has on that of Becker[1] on the cooling earth. Since Becker has kindly undertaken what I had thought to do myself, when I had just a few more facts, a few comments as to the applicability of his conclusions may be ventured.

[1] Science, February 7 and March 8, Vol. 27, pp. 231, 232, 392.

Though Becker's concise method of deriving his formulæ (2) is not beyond criticism mathematically, the same may be derived from Riemann's and Byerly's[2] more general and rigid treatment. But Becker's discussion of his formula obscures a most important limit to its application, to wit, the *temperature must remain constant at the surface of the cooling body, which he assumes to be the rock surface.* Otherwise the solution applicable is that given by Byerly (*loc. cit.*) on page 88, following Riemann.

If we assume the temperature of the atmosphere at the surface to have varied appreciably, and especially if we assume that its temperature depends on that of the earth, as Schaeberle says is largely the case (that two thirds of its temperature is due to interior heat), Becker's solution is inapplicable in the form he gives it. In fact, if two thirds of its heat comes from the ground *now,* originally, at the time "hell froze over" and the waters above the earth were separated from those under, must not the temperature of the atmosphere near the earth have been much hotter and much nearer that of the freshly consolidated rock than Becker assumes? Must not the waters of the ocean have been then largely up in the air and so the blanketing effect and the atmospheric pressure much greater? If so, Becker's conclusions are utterly useless. For his fundamental formula may be thus worded:

$$\left(\frac{V = \text{original excess of surface rock temperature over atmospheric}}{\text{present geothermal gradient} - \text{original gradient}}\right)^2 = 22/7 \times \text{diffusivity} \times \text{time elapsed.}$$

Now, Becker estimates the numerator as something like 1,300° C., apparently assuming this as the fusion point of a fairly silicious rock, and the atmospheric temperature at 0° C.? But all my work with grain indicates lower consolidation temperatures for the acid than the basic rocks, the former being in the state of aqueo-igneous fusion of a sugar syrup at 150° C. Moreover, as Day and Co. have shown, quartz will not crystallize above

[2] "Fourier's Series and Spherical Harmonics," p. 84.

800° C. A fundamental crust of the earth without any original quartz would be a geologically novel conception. The atmosphere above, being vastly heavier perhaps than at present, should certainly be at over 0° C. I should guess very much over 100° C., and it would seem that Becker's 1,300° might well be cut in two, if, indeed, there were any sudden jump between the atmospheric temperature and the rock surface temperature.

Now, when we come to the denominator, he fixes the original gradient, which will still persist below the relatively thin rim of the earth that has cooled appreciably, so that the earth may remain rigid. That seems reasonable, and is practically the hypothesis of Chamberlin and Lunn. But with regard to the present geothermal gradient, Becker's work seems defective in that he has made no attempt to get his geothermal gradient and diffusivity for the same rocks, though they depend on each other. The diffusivity in dry sand and peat is very low and the gradient proportionally high. Moreover, most determined values of the geothermal gradient are in that "ragged pellicle" of detrital matter which he would leave out of consideration. On this account alone, as well as the fact that they may occupy several thousand meters, out of some 114,000 meters discussed, the omission is a serious one. Thus to "abnormally high diffusivity" as a possible cause of deceptively low gradient we may add depression under a load of sediment, downward water circulation, endothermic reactions.

It so happens that in our Michigan copper mines we have an unusually good chance to coordinate gradient and diffusivity, for:

1. There has been but little net erosion or deposition since a very early date.

2. The rocks are very uniform in character. The average of thousands of feet of diamond drilling shows only about 7 per cent. of sediments in the main range. The traps are quite uniform in character, mainly ophitic auverg-noses.

3. Sulphides are rare and reactions that generate much heat are not present.

4. The gradient is known for an unusual depth.

5. The conductivity of the three main types of rock has been determined by Professor B. O. Peirce, of Harvard.[3] The mean conductivity of the formation is about .0035, the diffusivity .0064 in c.g.s. units, or in Becker's units the meter and year about 20.

The rate of increase of temperature throwing out the first 100′ of drift[4] is 1° F. in not over 110′; 107′ seems better, *i. e.*, 1° C. in 59 to 60 meters.

Varying diffusivity, if the same depends merely on the depth, will be no great hindrance. We need merely to peel the earth up into layers like an onion, each of which shall offer the same resistance to the transmission of heat. They will be of unequal thickness really, but we shall have to call it for each of them an equal increment of z, z being a new variable in terms of which to express the flow of heat. Then we shall have to express x also in terms of z, x being the real distance from the surface or some other place of reference. We can then use all the old diagrams of Kelvin, King and Becker, but have to change the divisions on the scale corresponding to the earth's radius and make them unequal.

Becker is also quite safe in neglecting the curvature of the earth. The cooling of a sphere has been treated by Woodward,[5] and, as I have elsewhere remarked,[6] if we represent by V_m and u_m the temperatures, respectively, in an infinite slab with plane sides at a distance (c) apart and in a sphere (radius c) cooling under certain similar conditions, at points, in the one case at a distance x from the plane face such that $x/c = m$, and in the other case at a distance from the center such that $u/c = m$, then

$$V_m = mu_m + 1 - mu_{1-m}.$$

Now, for points near the surface $m = u/c$ is

[3] *Proc. Am. Acad. Sci.*, May, 1903, XXXVIII., No. 23, p. 658.

[4] See discussions in my reports, Board of Geol. Surv. of Mich., 1901, pp. 244 ff., 1903, pp. 195 ff.

[5] R. S. Woodward, *Annals of Mathematics*, Vol. III., 1887, Eq. 10.

[6] Geological Survey of Michigan, Vol. VI., Part I., p. 121.

near 1, while $1 - m$ is near 0. Also, u_{1-m} is for a point near the center, which will not have cooled appreciably and its rate of change $D_t u_{1-m}$ will be 0. Thus V_m approaches u_m as $m = 1$.

It would be quite a help if Becker would compute the general solution of the problem as given by Riemann and by Byerly[7] for a select lot of plausible hypotheses, including one which shall include the surface temperature, becoming from time to time 0°, when there are glacial periods.

The only way that I can at all see of using Kelvin's method which considers the surface kept at a constant temperature, is to include the atmosphere, and let the temperature be that of space, which is $-270°$ C. *If,* then, we can assume that the effect of atmosphere, ocean and pellicle of sediments amounts to that of a very narrow contact zone, a questionable yet plausible assumption, *if* we may consider the present surface gradient as uniform for an equivalent distance beneath the surface, after a short time rock and contact zone cool together as one mass and we may apply the treatment I applied to that case,[8] and we may find what kind of a jump in temperature at the surface would have produced the gradient that we have in a given number of years. But that temperature must be reckoned *from the temperature of space.* Using 100,000,000 years as the age of the earth and the Calumet gradient and diffusivity, we have

$$\frac{V^2}{(.0168 + - .00675 -)^2} = \tfrac{22}{7} \cdot 20 \cdot 100,000,000$$
$$= (79500)^2.$$

$V = 1,320°$ above the temperature of space $= 1,150°$ C.

We may, therefore, if we like, assume that one hundred million years ago the earth was shrouded in an atmosphere whose temperature rather suddenly increased from that of space to a little above the critical point of water near the rock surface, and that the rock surface or a few feet below was just below the melting point of diabase. This looks quite reasonable to me.

But if we want the earth only 60 million years old we can get it if we are willing to assume a granitic crust solidifying under an atmosphere with an enormous water pressure at the modest temperature of 345° C. This also looks good.

After all, however, what reason have we to believe there was ever any such sudden jump in temperature at the bottom of the atmosphere as any application of Kelvin's method of finding the age of the earth must assume? There would be none on the planetesimal hypothesis nor on the crenitic hypothesis, nor others we might frame. Yet unless there was some such jump the gradient so far as the mere cooling of the earth is concerned *is just what it was in the beginning,*[9] subject, of course, to accidents of water circulation, volcanic activity, etc. That, in fact, the gradient was not greater than at present in very early times might be inferred from the fact that rocks seem to have been buried to as great depths without metamorphism then as now. As soon as a layer largely iron was reached the diffusivity would increase and the rate of increase of temperature decrease. If that iron layer was at different distances from the surface in different parts of the world, but everywhere at about the same temperature, the rate of increase of temperature from the surface to it would, of course, vary.

The geothermal gradient would then depend upon the diffusivity and the thickness of the crust. Rocks would, with the copper country gradient of 1° C. in 60 meters, attain a temperature of 2,000°, that of some gabbros, in 120,000 meters, which is about the thickness of the crust Becker assumes, if the rocks remained of uniform diffusivity.

Until then we can throw out these latter suppositions by showing some geological signs of a higher rate of increase of temperature in early geological times, such as that rock of the same kind was hotter, or the crust subject to folding and fracture thinner, speculations on the age of the earth based on the

[7] Fourier's Series, last equation on p. 88.

[8] Annual for 1903, equations 15 and 20, pp. 213 and 214.

[9] If the numerator $V = 0$ in the equation above, the denominator must be so also, unless $\tau = 0$.

geothermal gradient will be mere speculative hypotheses.

Alfred C. Lane
Lansing, Mich.

SPECIAL ARTICLES

THE REDISCOVERY OF A LOST ART AND A FEW NOTES ON THE THEORY OF THE VIOLIN

Shortly before the discovery of America they were using, on the gondolas in Venice, a perfectly transparent, lustrous, orange-red varnish. It is reasonable to assume that the great beauty of this flame-colored material, on the handsome figured wood used, prompted the subsequent lavish extravagance in their decorations, that almost ruined the owners and was so universal, that in the sixteenth century a sumptuary edict was passed by the grand council compelling the use of black only on all gondolas. The principal use, then, for this lustrous varnish having been done away with, the price fell to a point where the cabinet-makers and others could use it for certain purposes.

The historical ceremony, "The Wedding of Venice to the Adriatic," has been preserved to us on canvas by a painting of this gorgeous scene made at the time, in which can be seen the color of this varnish on the hull of the royal gondola. The varnish itself can be seen on the wood of an old figure-head of one of these boats (preserved in the museum) where the black paint has been chipped off. The cast-off varnish had not long to wait for a market, as the violin came into existence at this time, and the now cheap varnish found immediate favor with the violin makers of Italy, and was used exclusively by them until the supply at Venice was exhausted, about the year 1730.

Tradition has it that a Venetian varnish dealer, in reply to solicitations from Cremona on the subject, said: "My supply is exhausted, I know not what it is, nor where it came from."

It is possible that this inquiry came from Stradivarius himself. If so it might account for the much more sparing coats of varnish he put on his violins at this time, than earlier —he may have already begun to husband his supply.

Italian furniture of the seventeenth century, still extant, has varnish of this character upon it, but since about the time when the old Cremona violin varnish was last used, diligent investigation fails to find any article whatever with this material upon it.

By carefully comparing the physical properties of the varnish on any of these older articles, with that on a Cremona violin, a striking similarity is at once seen, and no effort is necessary to conclude that the two are identical. The materials, then, must have been imported into Venice, as no colored gums or resins of this texture are produced in Italy, they being certainly of tropical origin. The proximity of Africa to Italy naturally suggests the source of supply of these gums. (Subsequent experiments, with African gums, produced a red varnish not to be distinguished from that on a 1715 Stradivarius.)

Certain characteristics of this varnish are known, and how these affect tone has been carefully tested, and the most distinguishing feature seems to be that it damps out the upper harmonics, leaving the pure fundamental tone to be heard.

In drawing the bow across the strings of any violin, a certain fairly constant fraction of the energy is transformed into sound—a portion of this is carried by the fundamental tone, while the rest goes into the upper harmonics. Now, the preponderance of these upper harmonics gives to a violin its harshness. If a large proportion of the total energy is dissipated in these higher harmonics, the amount of fundamental tone reaching the hearer will be small; if, on the other hand, the large proportion of the total energy is forced into the fundamental, the instrument will have great carrying power.

Had it not been for this compound, known as the old Italian varnish, the world would not have heard of the town of Cremona, nor of her sons Amati, Guarnerius and Stradivarius, and in all probability the violin itself would have passed out of existence, after a very brief experimental stage, like most other musical instruments of these early times, such as lutes, lyres, gigues, crwths, etc.

The writer, after a great deal of experimenting along the lines indicated above, has found a gum varnish which he believes is identical with that used by the Cremona makers.

The general appearance of this new varnish is so characteristic that the eye can not discriminate when placed side by side with the original. The chief reason for this is that the color is natural to the gum, and is not added to it, consequently we get no stain effect on the wood, such as we always do when artificially colored varnish is used. Secondly, the transparency is so perfect that we get two reflections, one from the upper and one from the under surface of the varnish. Thirdly, the color bleaches in the sun, to "Amati" yellow, it being known that this great maker dried his violins in the sun, whereas Stradivarius dried his to red in the shade of an attic, which he built on the roof of his home, open on two sides to the atmosphere. The new varnish chips off the wood, on rough usage, as does the old, and in texture and hardness they are identical. The effect on the tone of an instrument is very marked. When covered by this material all harshness disappears, being replaced by what is known among musicians as the "Italian tone."

The supposition for the explanation of this last effect is that the varnish is so similar in elasticity and other properties to the wood of the instrument, that it exerts no influence thereon whatever, leaving the violin to expand or contract, under differences of atmospheric temperature and moisture, just as though it were not varnished at all, thus differing from all other varnish, whether of spirit or of oil.

In order to give this varnish a thorough practical test twelve common trade violins "in the white," of standard models, were procured from four different makers (three from each), and varnished and strung up. Many times were duplicate pairs of these violins put in a double case and submitted to prominent professional violinists in order that they might select the better of the two, if possible. In no case has a definite decision yet been reached. This is taken to mean that the tone is so pure that the musical ear can find no point on which to offer any adverse criticism. Comparisons actually made with some of the old Cremona violins prove very flattering to the new varnish, the tone being not so "stale" as in the old instruments.

FRANK DELLA TORRE

BALTIMORE, MD.,
February, 1908

QUOTATIONS

MERCY TO MANKIND

SURGERY in England was set back so far by the successful crusade against vivisection that probably many thousands of men, women and children have suffered days of agony for every minute of discomfort saved to any animal. The merits of the discussion are almost pitifully clear. The proposed laws will never reach the irresponsible experimenter, even if he is not entirely mythical. All they can do is to handicap the hospitals and the expert work. The present agitators are of a kind with them who sneered at Pasteur as "an obscure druggist"; opposed Harvey's experiments about the circulation of the blood, those of Galen fifteen centuries earlier, and those of Lister in our day. To show where real science stands, we may observe that the men who have protested against the present outbreak of ignorant sympathy include, among many others, Dr. Weir Mitchell, Dr. Janeway, Dr. W. W. Keen, Dr. Osler, and leading professors of anatomy, physiology, surgery, physiological chemistry, biology, bacteriology, zoology and medicine, in Harvard, Columbia, Johns Hopkins, Yale, the University of Michigan, the University of Pennsylvania, Rush Medical College, Dartmouth, the Massachusetts Institute of Technology, Georgetown University and the University of Chicago. Already there is punishment provided for experiments improperly performed. The new laws are an attempt to give ignorance a whip to hold over science. The view which would be taken of humane research by these animal-defenders is shown clearly enough by their special attack on the experiments on cats now being made in the Rockefeller Institute, designed to lead to the mastery of many serious kidney troubles. One of their gruesome pictures is called "The Dog has no Chance."

Apparently these excited individuals wish a fair combat between the operator and the dog.

Regarding the present agitation in the United States, some of our readers object to our speaking of the factitious side. As far as we are able, however, we print the most important news in whatever direction it may strike. Many people genuinely oppose vivisection, but few, if any, of them have the least standing in the scientific world. The New York County Medical Society was instrumental in having the *Herald* legally prevented from carrying certain medical advertising, and that paper seldom forgets a grudge. Moreover, this agitation happens to be extremely good business. The most profitable part of a daily paper is the drygoods advertising; women are the buyers; and in this howl about our dumb friends there is a mighty feminine appeal, especially to those women who are unfortunate enough to have no children. It is more vivid to proclaim in a half-inch headline, "See the bloody knife. It cuts. It cuts," than it is to talk about a reduced death-rate. Only two qualities are needed to conduct a first-class crusade, like the *Herald's* present picturesque effort—a slight knowledge of mob psychology and a short memory. The *Herald* may have forgotten that in 1895 it espoused the cause of antitoxin, started a fund for its popularization with a gift of $1,000, and, with its brass band of publicity, induced the community to give $7,000 more. To be sure, the generosity of the *Herald* flagged at this point, and a representative of the warm-hearted newspaper asked if the original $1,000 could not be returned!—*Collier's Weekly.*

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

MONTHLY WEATHER REVIEW

Recent issues of the *Monthly Weather Review* (U. S. Weather Bureau, Washington, D. C.) have contained many contributions of general scientific interest. Among these, the following are selected for special mention. In the September number (dated December 16) we find, under the title "On Atmospheric Currents at Very Great Altitudes," a discussion, by Professor C. C. Trowbridge, of the atmospheric currents which are shown to exist in the extreme upper regions of the atmosphere by the observed drifting of the luminous trains formed by meteors. One method for determining the height of the atmosphere is by means of meteors. This paper gives many facts of interest, and is illustrated. "Studies of Frost and Ice Crystals," by W. A. Bentley. A continuation of a paper in the August *Review*. Mr. Bentley has made a life-long study of snow crystals, and presents details of extraordinary accuracy. "Colliery Explosions and Barometric Pressure." Note on the fact, many years ago pointed out by the English Commission on Prevention of Explosions in Collieries, that the combustible gases escape most freely into mines when the external pressure is falling and lowest.

The *Monthly Weather Review* for October, 1907 (dated January 21, 1908), contains the following contributions: "Highest Kite Flight at Mount Weather, Va." On October 3, 1907, the altitude above sea level reached by the leading kite and the meteorograph is believed to be the greatest yet attained in any kite ascension, viz., 23,110 feet. "Interconversion of Centigrade and Fahrenheit Scales"; formulæ suggested by F. K. Ferguson, superintendent of schools, Paola, Kansas, as follows:

$$C = 5/9\ (F + 40) - 40,$$

$$F = 9/5\ (C + 40) - 40.$$

"Studies of Frost and Ice Crystals," by Wilson A. Bentley. "Meteorological Stations in Southern Nigeria," by C. F. Talman. Mr. Talman has, for some time past, performed a very useful service to climatologists in pubtions of the meteorological stations in various countries concerning whose climates we as yet know but little. In the present article he gives an account of the development of meteorological observations in southern Nigeria, with a map showing the location of the stations. "The Lagging of Temperature Changes at Great Heights behind those at the Earth's Surface, and Types of Pressure Changes at Different Levels," by H. H. Clayton. This is a preliminary report upon some results derived from a study of the records obtained with sounding balloons launched from St. Louis. The detailed discussion will appear in the *Annals* of the Harvard College Observatory. "Our Present Knowledge regarding the Heat of Evaporation of Water," by Professor A. W. Smith. "Studies on the Vortices in the Atmosphere of the Earth," by Professor F. H. Bigelow. This paper deals with the application of the theory of vortex motion to the funnel-shaped waterspout at Cottage City, Mass., August 19, 1896.

The November, 1907, number (dated February 10, 1908) contains the following contributions: "Phenomena connected with the San Francisco Earthquake," by Dr. C. M. Richter and Professor A. G. McAdie. Reference is made to the fact that the writers "have no record of any detonation coming from the ground"; that they "have no proof whatever that any particular optical or electrical phenomenon occurred preceding, during or following the earthquake." At the time of the San Francisco earthquake there was a well-defined high over practically the entire area of the United States. There were no unusual features connected with the wind, or with other meteorological elements. "It was a pleasant spring day." Dr. Richter and Professor McAdie believe that the clouds which have been reported over the San Francisco fire (see SCIENCE, November 14, 1906, and April 5, 1907) showed no features that can not be explained as smoke effects. "Well-marked Foehn Effects with Great Diurnal Ranges of Temperature in Southern California," by Professor A. G. McAdie. A foehn effect on November 29 and 30, and on December 1 gave maximum temperatures between 80° and 86°, while the morning temperatures were so low that frost was reported in many places. This range, of about 50°, is a very unusual one in southern California. "The Relation of the Movements of the High Clouds to Cyclones in the West Indies," by John T. Quin. This is the continuation of a previous discussion in the *Monthly Weather Review* for May, 1907. "Studies of Frost and Ice Crystals," by W. A. Bentley. "The Winds of the Lake Region," by Professor A. J. Henry. This is an important paper, on a subject which has received little attention. It deals with the seasonal wind directions (with charts); the average velocities, and with high winds. "Influence of Vegetation in Causing Rain." A brief discussion, by the editor, as to the possible effects of soils, bare and covered with vegetation, upon rainfall.

R. DEC. WARD

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

MR. ANDREW CARNEGIE has added $5,000,000 to the endowment of the Carnegie Foundation in order that retiring allowances may be provided for professors in state universities.

UNIVERSITY	Date of Founding	No. in Faculty	Student Registration	Receipts, 1906	Entrance Requirements
Georgia	1785	23	408	82,642	11
N. Carolina	1789	36	870	235,603	11.6
Tennessee	1794	27	695	88,390	10
S. Carolina	1801	19	296	41,730	5.2
Ohio (Athens)	1804	22	1272	135,198	12
Indiana	1820	49	1684	152,138	15
Miami	1824	36	991	97,472	14
Virginia	1825	35	706	111,094	8.4
Alabama	1831	17	491	56,053	10
Michigan	1837	113	4136	451,697	14
Missouri	1840	85	2072	366,111	15
Iowa	1847	53	1815	432,304	15
Mississippi	1848	17	571	144,704	11
Wisconsin	1848	119	3571	804,521	14
Utah	1850	30	1063	159,007	10.7
Louisiana	1860	27	458	65,214	9.5
Washington	1861	43	925	149,345	15
Kansas	1864	88	1706	391,778	15
Maine	1867	28	687	41,900	13.5
W. Virginia	1867	36	1422	138,660	12.5
California	1868	116	4173	727,536	15
Illinois	1868	156	4074	825,107	14
Minnesota	1868	90	3955	345,261	15
Nebraska	1869	84	2914	357,060	14
Ohio State	1870	92	2157	628,000	14
Arkansas	1872	36	1528	143,900	10
Oregon	1876	19	506	117,200	15
Colorado	1877	31	1327	140,000	15
South Dakota	1882	24	381	68,750	15
North Dakota	1883	18	733	177,250	13
Texas	1883	43	1991	289,193	11.4
Nevada	1886	23	254	130,000	12
Wyoming	1886	18	241	26,081	14
Idaho	1889	16	363	96,537	15
Arizona	1891	13	226	32,200	15
New Mexico	1891	8	89	29,615	15
Oklahoma	1892	19	475	85,000	15
Montana	1895	15	289	57,000	14
Florida	1904	14	136	57,710	9.9

The institutions that may be eligible with certain data in regard to them as compiled by Dr. Henry S. Pritchett, president of the foundation, are given above. These institutions will only be eligible if their entrance requirements are based on a high school preparation counted at 14 points on the table.

SCIENTIFIC NOTES AND NEWS

At the recent Founder's Day celebration at the University of Pennsylvania, Dr. S. Weir Mitchell presented to the university a portrait of the late Fairman Rogers, first professor of engineering and for many years a trustee of the university, given by Mrs. Rogers.

Dr. Charles E. St. John has resigned the chair of physics and astronomy in Oberlin College and the deanship of the College of Arts and Sciences to accept the position of research associate in the Mount Wilson Solar Observatory of the Carnegie Institution of Washington.

Dr. T. H. Krumbach, assistant in the zoological laboratory at Breslau, has been appointed director of the Zoological Station at Rovigno.

Herr Emil Ehrensberger, technical director of the Krupp works, at Essen, has been given the honorary degree of doctor of philosophy by the University of Göttingen.

On the occasion of its commencement in June, Hobart College will confer the honorary degree of doctor of letters upon Professor R. M. Wenley, of the University of Michigan.

Professor W. B. Scott, of Princeton University, in presenting Grove Karl Gilbert, for the honorary degree of doctor of laws at the University of Pennsylvania last month, said: "For nearly forty years one of the most distinguished of those brilliant investigators who have adorned the successive organizations culminating in the present U. S. Geological Survey, you have enriched geology by a series of studies and contributions of striking originality and importance, which have led to new conceptions of the earth's history and opened new fields of investigation. As a pioneer in what may almost be called the American science of physiography, your work is recognized and valued the world over as being of the highest significance. Therefore, at the request of the trustees of the University of Pennsylvania, I ask the provost to confer upon you, Grove Karl Gilbert, the degree of doctor of laws."

President Roosevelt has appointed President Van Hise, of the University of Wisconsin, to represent the National Association of State Universities at the conference on the conservation of natural resources, to be held at the White House on May 13–15.

Dr. Heinrich Rosenbusch, professor of mineralogy and geology at Heidelberg, will retire from active service on October 1.

The officers of the Southern Society for Philosophy and Psychology, elected at the recent meeting of the Society at Washington, D. C., are : *President,* Professor J. MacBride Sterrett, George Washington University; *Vice-president,* Professor Albert Lefevre, University of Virginia; *Secretary-Treasurer,* Professor Edward Franklin Buchner, University of Alabama.

Dr. Michael F. Guyer, professor of zoology in the University of Cincinnati, has been granted one year's leave of absence, beginning on June 1, 1908, for study in Europe. The same privilege has been granted to Associate Professor George Morey Miller, English. Professor Marco F. Liberma, romance languages, will spend the summer only in France.

Professor W. H. Hobbs, of the University of Michigan, accompanied by two assistants, will make a special study of the glacial formation of the Alps during the summer.

The board of managers of the Museum of Science and Art at the University of Pennsylvania, announces that D. Randall MacIver, curator of the Egyptian sections of the museum, will return to this country with a valuable collection of Nubian statues, tablets, vases, bronzes and other curios, dug from Egyptian ruins.

Professor J. B. Woodworth, of Harvard University, will take charge of the Shaler Memorial Expedition to South America. The expedition will leave in June, going from New York to Rio Janeiro, and remaining in Brazil until the rainy season in October. The Brazilian government has offered facilities to the expedition. Upon leaving Brazil, Professor Woodworth will go to Chili for the purpose of investigating shore-line changes.

On April 2, Dr. A. Hrdlička, of the U. S. National Museum, delivered a lecture on "The physical type of Indian men and women" before the Pittsburg Academy of Sciences.

Dr. Anton von Braunmühl, professor of mathematics in the Technical Institute at Munich, has died at the age of fifty-five years.

A forest survey of Illinois is to be carried on jointly by the State Laboratory of Natural History at the University of Illinois and the U. S. Forest Survey, the two contributing equally to the expense of the work.

The Imperial Meteorological Congress planned to be held in Ottawa in May has been postponed to the last week in July and will take place in Quebec immediately after the close of the ter-centenary celebration of Champlain's landing.

The third International Congress for Philosophy will be held at Heidelberg from August 31 to September 5, under the presidency of Professor Windelband.

The Fourth International Congress of Electrotherapy and Radiology will be held in Amsterdam from September 1 to 5, 1908.

The commissioner of education has received from the organizing committee of the first Pan-American Congress at Santiago, Chile, the following announcement, with the request that measures be taken to give it due publicity: "The organizing committee of the fourth scientific (first Pan-American) congress took into consideration in one of its last sessions the requests which various distinguished Americans have made that the date of opening the congress might be postponed to a later date than December 1, 1908, which was announced as the time of opening in the official communication previously sent. The objection to opening the congress on December 1 came principally from teachers in the different American countries who are attending to their scholastic duties at that time. Under the circumstances, and in order that the attendance of foreign delegates and members may be as large as possible, the organizing committee has decided to postpone the date of opening of the congress to December 25, 1908, and the closing exercises will take place January 5, 1909."

The fourth annual dinner of the graduates and former students of the School of Civil Engineering of Columbia University will be held in the college room of the Hotel Astor on Thursday evening, April 23, 1908, at seven o'clock. The toastmaster of the evening will be Mr. Allen N. Spooner, C.E., '86, commissioner of docks and ferries. Other speakers of the evening will include President Nicholas Murray Butler; Mr. C. M. Jacobs, chief engineer in charge of the construction of the Pennsylvania Railroad and McAdoo tunnels; Mr. William G. McAdoo; Rev. Hugh Birkhead, '99, of St. George's Church; Mr. John A. Bensel, chairman of the board of additional water supply; Mr. William Barclay Parsons, '82, and Dean Frederick A. Goetze.

The Naples Table Association for Promoting Laboratory Research by Women announces the offer of a fourth prize of one thousand dollars for the best thesis written by a woman, on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical or physical science. The theses offered in competition are to be presented to the executive committee of the association and must be in the hands of the chairman of the committee on the prize, Mrs. Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass., before February 25, 1909. The prize will be awarded at the annual meeting in April, 1909. Each thesis must be submitted under a pseudonym and must be accompanied by a sealed envelope, enclosing the author's name and address, and superscribed with a title corresponding to one borne by the manuscript. The papers presented will be judged by a regularly appointed board of examiners, or by such specialists as they may choose. The association reserves the right to withhold the award of the prize, if the theses presented are not, in the judgment of this board, of adequate merit to deserve the award. The board of examiners are: Dr. William H. Howell, Johns Hopkins Medical School; Dr. Theodore W. Richards, Harvard University, and Dr. Albert A. Michelson, University of Chicago. The first prize was awarded to Florence Sabin, B.S. Smith, '93, M.D. Johns Hopkins University, '00, for a thesis on "The Origin of the Lymphatic System." The second prize was awarded to Nettie M. Stevens, B.A., M.A., Leland Stanford University, '99, '00, Ph.D. Bryn Mawr, '03, for a thesis on "A Study of the Germ Cells of *Aphis rosea* and of *Aphis œnotheræ*." The third prize offered was not awarded.

The German Kant Society offers prizes of 1,000 and 600 Marks for essays on "What are the Real Advances made by Metaphysics in Germany since the Time of Hegel and Herbart."

The president of the German Colonial Society, Duke Johann Albrecht zu Mecklenburg, announces that a prize of 6,000 Marks will be awarded for a means by which cattle can be protected against the bites of the tsetse flies while they are being taken through infected regions.

The president of the British Local Government Board has authorized for the current year the following researches, in addition to those already announced, under the grant voted by parliament in aid of scientific investigations concerning the causes and processes of disease: (1) Further studies by Drs. Andrewes and Horder as to methods of inhibiting in the animal body the activities of infection by certain cocci; (2) a study of the various forms of pneumonia, especially in children, by Mr. Foulerton; (3) a study of acid-fast bacilli in butter by Dr. Nabarro; (4) an investigation of the injurious gases evolved during artificial illumination by Dr. J. Wade.

On the occasion of the meeting of the general board of the National Physical Laboratory, on March 20, a number of gentlemen traveled to Bushy-house, at the invitation of Lord Rayleigh, the chairman, to view the laboratories. The whole of the premises were thrown open to their inspection, and the various appliances and the uses to which they are being put were explained to them by Dr. Glazebrook, the director, and other members of the staff.

Reuter's Agency states that the second International Sleeping Sickness Conference has terminated without being able to agree on the draft convention before it. The French and Italian plenipotentiaries declared themselves unable to accept a proposal, made at the last conference in June and then unanimously recommended, for the establishment of a central bureau in London, and they proposed that the work connected with sleeping sickness should be taken over by the hygienic bureau, which a conference held in Rome in November last as a sequel to the Paris conference of 1903 has proposed should be established in Paris. This proposal the German plenipotentiaries declined to accept, and they strongly support the British plan for the establishment of a bureau in London. The French plenipotentiaries were also unable to agree to other parts of the draft convention, and, although the majority of the powers represented supported these proposals, it was found useless to proceed further in the absence of unanimity.

According to an article in the London *Times*, arrangements are now well advanced for the Ninth International Geographical Congress, which is to be held at Geneva during the coming summer, from July 27 to August 6. The congress meets only at intervals of four or five years, and, as the last place of assembly was in the United States, it is nine years since the geographers of the world came together in Europe—at Berlin in 1899. The last occasion on which the congress met in Switzerland was at Berne in 1891. That Geneva should this year be the place of meeting is peculiarly fitting, the Geneva Geographical Society having been founded just half a century ago. The representative character of the congress is already assured. Dr. Arthur de Claparède, as president of the Geneva Geographical Society, will be the president of the congress. Among the honorary presidents is the president of the Swiss Confederation, while those who have accepted office as honorary vice-presidents comprise the presidents of former congresses, including Sir Clements Markham and Commander Robert Peary; the presidents of over a score of the leading geographical societies of the world, and a long list of distinguished explorers and scientific geographers. The governments of eleven counties (France, Austria, Hungary, Spain, Portugal, Belgium, Switzerland, Rumania, Turkey, the United States and Brazil) have intimated their intention of being officially represented at the congress, and delegates are also expected from between eighty and ninety universities and geographical and other learned societies. For the purposes of the meetings, the field of geography has been divided into fourteen sections, each of which covers some particular aspect of the science, ranging from mathematical geography and cartography through seismology, oceanography, anthropology and economic geography to geographical education and questions of nomenclature. In any of these sections approved contributions may be submitted in one of the four official languages of the congress—English, French, German and Italian.

The nineteenth annual session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences will be held at Cold Spring Harbor during six weeks, beginning Wednesday, July 1. The laboratory will be open for investigators during the entire summer. The courses of instruction offered are: (1) Field Zoology, by Drs. Davenport, of the Carnegie Institution of Washington; H. E. Walter, of Brown University, and W. M. Wheeler, of the American Museum of Natural History, together with others. (2) Bird Study, including both field and laboratory work and a set of lectures by Mrs. H. E. Walter, joint author of "Wild Birds in City Parks." (3) Comparative Anatomy, by Professors H. S. Pratt, of Haverford College, and D. S. Hartline, of Pennsylvania State Normal School. (4) Beginning Zoological Investigation, with lectures on Animal Bionomics and evolution, by Dr. Davenport. (5) Cryptogamic Botany, by Professor D. S. Johnson, of Johns Hopkins University, and H. H. York, of the University of Texas. (6) Plant Ecology, by Mr. George D. Fuller, of the University of Chicago. (7) Beginning Research in Botany, by Messrs Johnson and Fuller. No formal course in embryology and microscopic technique is given this year, but Mrs. Davenport and Miss Mabel Bishop, of Smith College, will give the necessary practical instruction to those desiring assistance in these subjects. The Biological Laboratory undertakes to provide dormitory rooms and boarding arrangements for all students and its equipment in this respect has been greatly increased by the gift from Mrs. Blackford of a new fire-proof building as a memorial to Mr. Eugene G. Blackford. Tuition for those taking courses of instruction is $30. Further details are given in the announcement just issued, which may be obtained from the director of the laboratory, C. B. Davenport, Cold Spring Harbor, Long Island, N. Y.

The Russian government is despatching a research commission to investigate one of the latest discoveries of mammoth remains in the Yakutsk Province of Northeast Siberia. The commission consists of a doctor of zoology of the Academy of Science; the senior curator of the zoological department of the academy, and six junior laboratory students. One of the most remarkable features of the discovery is the existence in the intestines of this extinct animal of perfectly conserved food, relics of a vegetation until now unknown to science. The expedition, which is expected to be absent for a year or more, is supplied with a grant of 16,000 roubles. The framework of this mammoth is to be deposited in the St. Petersburg Museum of the Academy of Arts, where there is already one other specimen.

The State University of Idaho, located at Moscow, has just entered into a cooperative agreement with the United States Forest Service to carry on a series of tests to determine the relative value of the commercial timbers of the state. All the tests will be made at the university in accordance with the methods used by the government, and at least once a year a testing engineer of the Forest Service will make a careful inspection and report upon the progress of the work. These tests will be of considerable value in ascertaining for what purposes and uses the timbers of Idaho are best adapted. Bridge stringers will be tested to determine the fitness of different species for the construction of trestles and bridges; the spike-holding power will also be investigated to determine just what species can be advantageously used for railroad ties and tests will be made to determine the relative hardness, which property is very important in material used for paving blocks. The Forest Service at other laboratories in various parts of the country is making tests on important timbers from other sections, and by cooperating with the service the university will secure results which will furnish an accurate basis for comparing Idaho timber with timber from other states.

UNIVERSITY AND EDUCATIONAL NEWS

The regents of the University of Nebraska have established a College of Education for the preparation of teachers, and have tendered the deanship to Dr. Fordyce, professor of zoology in Wesleyan University.

The University of Cincinnati and the Cincinnati General Hospital will soon employ jointly a pathologist, with the title of professor of pathology in the former institution, and head pathologist in the latter, who will give his whole time to research and instruction in his science. The determination is the result of several years' effort. Plans for the new hospital, now being erected, include an elaborate equipment for the study of pathology.

President Frederick M. Tisdel has been deposed by the trustees of the University of Wyoming, the board adopting resolutions which, after charging that he had been guilty of maladministration, insubordination and untruthfulness in university affairs, adds: *Resolved,* That Frederick M. Tisdel be and is hereby removed from the office of the president of the University of Wyoming; that he be informed at once of his removal, and that all salary and rights appurtenant to such office shall upon such notification immediately cease." President Tisdel has charged the trustees with destroying the usefulness of the university by political machinations.

In reorganizing the work of some of its departments the Northwestern University Medical School has made these important additions to its faculty: Dr. Arthur W. Meyer, of the University of Minnesota, has been called to the chair of anatomy, including histology and embryology in the department, and Dr. Albert N. Richards, of Columbia University, has been called to the chair of pharmacology. Dr. Meyer was graduated from Wisconsin, and took his doctor's degree at Johns Hopkins, where he afterwards gave instruction in anatomy. During the past year he has been the head of that department in the University of Minnesota. Dr. Richards is an alumnus of Yale, and took later the doctor's degree at Columbia. After spending three years at research work in the Rockefeller Institute he became instructor in pharmacology in Columbia, which position he holds at the present time.

The Harvard Corporation has confirmed the appointment of the following as Austin teaching fellows for the ensuing year: William Robert Davey, Semitic languages; John William Hotson, botany; Arthur Merle Hurlin, music; Paul Weidemeyer Graff, botany; Herbert Hugene Merwin, mineralogy and petrography; Horace Upham Ransom, applied mechanics; Mason Thacher Rogers, civil engineering; Herbert Joseph Spinden, anthropology.

Dr. Anathon Aal, docent for philosophy at Halle, has accepted a call to a professorship in the University of Christiania.

M. Camille Matignon has been appointed professor of inorganic chemistry in the Collège de France as successor of H. Le Chatellier.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, APRIL 17, 1908

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MEDICAL LABORATORIES: THEIR RELATIONS TO MEDICAL PRACTISE AND TO MEDICAL DISCOVERY[1]

To be asked to give an address on an occasion so worthy of joyful and honorable celebration as that which has brought us together to-day is an honor of which I am far from being insensible. When the invitation to the formal opening of your new building came in letters from my former schoolmate, Dr. Third, and the dean of your medical faculty, Dr. Connell, I was much pleased; though I knew that it came to me mainly on account of the fact that I happen to occupy a chair in an institution especially identified with medical laboratories, medical instruction and medical research, I could not help but feel grateful to fortuity for the favor she brought. Born in Canada, educated in Canadian schools, a graduate of a medical college in this province and at one time licensed to practise among the people of Ontario, I have every reason for filial affection to this great country and rejoice in my right to share your pride in its phenomenal advance. And no advance seems to me greater than that which you have been making in the betterment of medical education and in the promotion of medical knowledge; one striking evidence of it is before us in the new building which you have just now met to dedicate.

The subject which I have chosen for my remarks, namely, "Medical Laboratories:

[1] An address delivered at the formal opening of the Medical Laboratories Building, Queen's University, Kingston, Canada, January 14, 1908.

their Relations to Medical Practise and to Medical Discovery," is of such great importance that I wish I felt myself more competent adequately to discuss it. The topic has the advantage, however, that no skill on my part is necessary to excite your interest in it, for the current of your thought is, by the occasion, set in its direction. The completion of this building indicates the lively sympathy of members of your university with laboratory medicine; the substantial aid which an enlightened legislature has given you is proof that there is already some appreciation of the fact that the benefit of such laboratories is not to individuals alone, but also to the people at large and that the appropriation of public funds for their construction and maintenance is justifiable. Without occupying a great deal of your time or dissipating too much of your energy I shall try to make plain to the less medical portion of this audience how it is that medical laboratories such as have been built here have become a necessity, how indispensable they are for the training of doctors who are to care for the sick, of what use they may be in helping physicians actually to utilize, in cases of serious illness, the fruits of the more recent medical discoveries, and finally how, if provision be made in them, as should be and doubtless will be, for the undertaking of original investigations directed toward the solution of some of the medical problems now pressing, we may hope that here in Kingston new knowledge may be acquired which will make medical men able, better than now, accurately to predict, and give them greater power than they yet possess to cure and to control. And while I congratulate you heartily on the position to which you have now attained in the matter of laboratories, I intend to point out (what those among you best informed as to medical progress fully realize) that the policy of laboratory expansion upon which you have entered is in reality but a beginning and will lead irresistibly later on to still further, and perhaps fully as important, developments in your medical school.

THE DEVELOPMENT OF SCIENTIFIC MEDICINE AND OF MEDICAL LABORATORIES

Every one knows nowadays what is meant by the scientific method. It consists in gathering facts carefully, arranging them according to their similarities and sequences and finally epitomizing them in the form of brief formulas or so-called general laws. As a result thought is economized and suitable action follows most surely and quickly upon impressions of sense.

Medical science, like all natural science, began with simple observation. The physician first by means of his unaided sense organs collected sense impressions. This simple observation could not, however, take him very far, for it was too inexact. It became necessary to invent artificial aids for extending the powers of the sense organs and for rendering their measurements more precise. Medical men learned how to experiment so that their observations could be made under peculiarly favorable circumstances. They have found out how to interrogate nature and to compel her to answer; on inquiry they see to it that their attention is specially prepared; their interest in observation is sharpened by the particular question asked.

Hippocrates, the most accurate of ancient medical observers, realized the importance of contact with natural objects; it was his opinion that this must be the basis of all medical knowledge. "The student must rub and grind at nature, using his reason at the same time; but his reason must be a perceptive and interpretative, not a productive, faculty, for he who lends himself to plausible ratiocination will find himself ere long in a blind alley; and those who have pursued this course have done no enduring service to medicine." It was the accessibility of external medicine or surgery to direct observation that accounts for the more solid foundation early laid in that branch of medicine; inner medicine, in which there was but relatively little opportunity for direct observation, was the field for rank speculation for centuries, and it was not until experimental researches began to be undertaken systematically that inner, as contrasted with outer, medicine began to make significant progress.[2]

The history of the development of experimental work is very closely connected with the history of scientific laboratories. The bibliography of this subject is surprisingly small; an unusual opportunity for an interesting and instructive historical contribution lies open to him who will trace carefully the origins of laboratory work and their relation to the development of natural science in general.[3] In the third century before Christ several natural sciences, including anatomy, physiology and pathology, were cultivated in state-supported institutes in Alexandria. Though the apparatus was probably crude, there is evidence that students in these institutes studied nature by coming into direct personal contact with the objects of study. With the decline of the Alexandrian school, however, this method of practical study fell into desuetude, and, except for the experimental physiological methods of Galen (second century A.D.), and perhaps a little anatomical work at Salernum (thirteenth century), it was chiefly the surgeons —men like Hugh of Lucca, Theodoric of Cervia, Guy of Chauliac—who, keeping their hands at work, managed to cultivate medical studies more or less objectively. Benivieni (1448–1502), the founder of the craft of pathological anatomy and forerunner of Morgagni, seems to have been "the first to make the custom, and to declare the need of necropsy to reveal what he called . . . the hidden causes of diseases." In the fifteenth and sixteenth centuries came the great development of human anatomy. Vesalius published his wonderful volume in 1543, and anatomy has ever since his time been studied by dissection of the human body. Anatomical laboratories for teaching and investigation have been in existence for more than three hundred years; indeed, the anatomical laboratory has priority in foundation over all other scientific laboratories.

It was not, however, until the nineteenth century that the scientific spirit and scientific work became the main characteristic of the age. The nineteenth century has been designated therefore the scientific century, just as the eighteenth was called the philosophical century, the sixteenth the century of the Reformation and the fifteenth the century of the Renaissance.[4] The great inventions before the nineteenth century were made without special scientific knowledge and were brought about "more by accident or by the practical requirements of the age than by the power of an unusual insight acquired by study." During the last fifty years the great discoveries have been made in scientific laboratories. Whereas, formerly, necessity was the mother of invention, latterly the tables

[2] Cf. Allbutt, T. C., "The Historical Relations of Medicine and Surgery." Reports of the Congress of Arts and Science, Universal Exposition, St. Louis, 1904, Vol. VI.; Boston and New York, 1906, 189–209.

[3] An excellent résumé of the subject as far as medical laboratories are concerned is to be found in an address by Professor W. H. Welch entitled "The Evolution of Modern Scientific Laboratories," delivered at the opening of the William Pepper Laboratory of Clinical Medicine. *Johns Hopkins Hosp. Bull.*, Baltimore, 1896, VII., 19–24.

[4] Cf. Merz, J. T., "A History of European Thought in the Nineteenth Century," Edinburgh and London, 1904, p. 89.

have been turned and scientific discoveries have produced new practical needs and created new spheres of labor, industry and commerce.

Though physical researches were carried on from the time of Galileo downward and chemical work goes back to the age of the alchemists who sought for the philosopher's stone, the first distinctly modern scientific laboratories appeared in Europe in 1824 and 1825. In the former year Purkinje established a physiological laboratory in Breslau, and the year after Liebig, in Giessen, opened a chemical laboratory for the use of students and investigators; the latter laboratory, stimulated from two independent centers—Berzelius's laboratory in Sweden and Gay-Lussac's in Paris—developing in the atmosphere of the German ideal of *Wissenschaft,* was destined to exert the greatest influence upon the development and organization of other laboratories for scientific work. In 1856 Virchow established the first pathological laboratory in Berlin. Dorpat was the home of the earliest independent pharmacological laboratory, established there by Buchheim in 1849. Physiological chemistry was housed in a laboratory of its own in Strassburg in 1872 (Hoppe-Seyler), and hygiene at the instance of Pettenkoffer was given a special institute by the Bavarian government in 1872. The first clinical laboratory proper was started in the Munich Hospital by von Ziemmsen about 1886. Still later came special laboratories for psychopathic studies. Now every university in Germany has a complete set of these laboratories and there are in that country, all told, more than two hundred such medical institutes.

From Germany the exact spirit of research by means of organized laboratories spread rapidly to other countries—to England, Scotland and America, but Germany has the credit of the first and most extensive laboratory development; it is to this development that she owes her leadership in medicine and the biological sciences during the last eighty years.

Liebig's chemical laboratory was opened in a small town, not in a great city, and in this there were certain advantages. In an autobiographical memoir Liebig has said: "I always remember with pleasure the twenty-eight years which I passed at Giessen; it was, as it were, a higher providence which led me to the small university. At a large university, or in a larger town, my powers would have been broken up and frittered away, and the attainment of the aim which I had in view would have been much more difficult, if not impossible; but at Giessen all were concentrated in the work, and this was a passionate enjoyment." "A kindly fate had brought together in Giessen the most talented youths from all countries of Europe. . . . Every one was obliged to find his own way for himself. . . . We worked from dawn to the fall of night: there were no recreations and pleasures at Giessen. The only complaints were those of the attendant, who in the evenings, when he had to clean, could not get the workers to leave the laboratory.[5]

The peculiar advance made by Liebig's laboratory was the introduction of systematic and methodical training on an especially devised plan by which young men were introduced to a thorough practical knowledge of chemical properties and manipulations. The laboratory became the training school for the majority of chemists outside of Paris, and was used as a model for similar establishments in other cities in Germany as well as in other countries. This laboratory convinced the world of what could be done in an institution containing suitable workrooms and adequate equipment in apparatus, with proper materials for study, including ready access

[5] Cf. *Deutsche Rundschau,* Vol. LXVI., 30–39. Cited by Merz.

to books and scientific journals, especially when a director, who can give his whole time to teaching and research and is filled with the enthusiasm of his subject, leads the way. Later on, in Berlin, Johannes Müller did for physiology what Liebig had done for chemistry, and many of the physiological chairs in European universities were filled subsequently by men who had worked under Müller.

It goes without saying that laboratory buildings alone, even when adequately equipped and with a liberal maintenance budget, are far less important than the men who work in them. Nevertheless, experience teaches that in cities and countries where the laboratory facilities are most ample there, on the whole, more and better men apply for training, and a greater number of important discoveries are made.

An obstacle in the way of laboratory expansion has been the great cost of such institutions. While the buildings themselves are not necessarily very expensive, still the outfit needed often entails a large outlay, and unless the director and his assistants are paid sufficient salaries to permit them to devote all or almost all their time and energies to the work but little progress is likely to be made. Moreover, the expense of supplies for the experimental work in such laboratories is great and a liberal annual budget is therefore an essential. The scientific workers, too, should be provided with a certain number of paid mechanical helpers, for where the best brains in the laboratory are hampered by the necessity of doing the work which could just as well be done by laboratory servants a serious economic mistake is made.

The endowment necessary for modern laboratories has been one of the main factors in leading to the disappearance of proprietary medical schools, since a medical school conducted by modern methods can no longer be run for profit. Indeed, large sums of money are absolutely necessary for the conduct of modern medical education, and unless these endowments are available through private benefaction, they should be provided by the state. It may be asserted safely that at the present time money can not be invested to better purpose than in judicious support of medical laboratory work. A survey of the results of such work shows a greater return in practical benefits to mankind than can be claimed perhaps by any other mode of utilizing the money. The medical discoveries of the last twenty-five years demonstrate conclusively that the endowment of medical science yields an enormous reward, and nothing seems more likely than the probability that those medical schools and those countries which fall behind in the maintenance of medical laboratories and of scientific workers in medicine are destined to occupy an inferior place in medical education and to remain behind in social and economic importance.

MEDICAL LABORATORIES AS A TRAINING PLACE FOR PHYSICIANS

A large part of the education which medical students receive nowadays is given to them in laboratories. Instead of the didactic lecture of former periods the student in a medical school of our time does practical work in nearly all the subjects of the medical course. In the anatomical laboratory he dissects the human body and examines its constituent organs, tissues and cells under the microscope, making many of the preparations for himself. In the physiological laboratory he studies the functions of the animal body less from books and from lectures than from actual observation, as he repeats the experiments of the great masters who have made fundamental physiological discoveries. In the pathological laboratory he assists in the making of post-mortem examinations, studies the changes in form, consistence and color of organs in disease, and under the microscope investigates the finer changes in the cells and intercellular substances in pathological states. In the better laboratories of this sort, too, he has the opportunity of witnessing the phenomena of life as manifested under abnormal conditions, and though pathological physiology as such has not yet reached the place in our medical schools which it seems destined to occupy, it is rapidly being developed and promises to become in the near future one of the most important features of undergraduate medical instruction. In the bacteriological laboratory the student not only hears of bacteria and of their relations to fermentation and to disease, but he handles these bacteria himself, studies them, alive and dead, under an oil immersion lens, grows them artificially upon media prepared by himself, produces certain of the infectious diseases experimentally by inoculation of animals, and recovers from the bodies of the diseased the same microorganisms which he has inoculated. He is given, too, a practical acquaintance with the simpler methods of studying the phenomena of immunity, and gains in this way a unique conception of the nature of infection and the tendency of self-limitation of the infectious diseases; he becomes familiar with the fundamental principles of contagion on the one hand and of prevention on the other. These studies, together with those which he makes in the laboratory of hygiene, prepare him, in a way unequaled by any other form of preparation, for meeting those problems of personal hygiene and public safety which confront the medical man in private practise and in the protection of the public health. In the laboratory of physiological chemistry the medical student perfects his methods of chemical manipulation and examines for himself the various chemical constituents of the human body and its secretions and excretions. One needs no special prophetic instinct to recognize how important a training of this kind is for the prospective physician who will wish to keep abreast of medical advance during the next two decades, for there seems to be but little doubt in the minds of those best informed that the laboratories of physiology and physiological chemistry are to stand in much the same important relation to medicine during the next twenty years as that occupied by the laboratories of pathology and bacteriology since 1880. Furthermore, practical pharmacological studies are now essential for the medical student. The undergraduate who in the pharmacological laboratory studies the physiological effects of drugs by actual observation of the effects produced after administration to animals, making accurate measurements by the precise methods of physics and chemistry, will acquire an insight into the possibilities and limitations of treatment by drugs which will protect him from a pessimistic nihilism on the one hand, and, even more important, from uncritical enthusiasm on the other. The student thus trained will be less likely to fall a prey to the proprietary medicine manufacturer and the nostrum monger than the physician who has obtained all his knowledge concerning the action of drugs from books, lectures or the circulars of manufacturers.

In the clinical laboratories associated with the wards of the hospital the student will be taught how to apply the knowledge gained in all the laboratories just mentioned to the problems of diagnosis and treatment as he actually meets them in his study of patients in the hospital wards and dispensaries. These hospital clinical laboratories have only just begun their development, and there are but few medical schools which have made adequate provision for them. I have in another place[6] called attention to the great importance of these laboratories for the training of medical students as well as for the advance of practical medicine, and have tried to show that it is just as necessary for physicians and surgeons to have their own special laboratories attached to their wards, in which chemical, physical, bacteriological and psychic investigations can be made as it is for aniline dye manufacturers to have chemical laboratories attached to their plants for solving their special problems, or for brewers to have bacteriological laboratories and skilled bacteriologists constantly at work to maintain and improve the standard of their products. It will not do for the sciences of diagnosis and therapy to rely upon the laboratories of chemistry, physiology and pathology in the medical school to solve their particular problems for them. The more fundamental sciences have their own problems of a more abstract nature which it is their duty to investigate, and the time has certainly come for diagnosis and therapy to develop the laboratory sides of these sciences for themselves.

By far the greatest advantage of instruction of the medical student by the laboratory method is, however, his training in the scientific habit of thought. What helps him is less the facts which he learns, or the memory of the experiments he makes, than the establishment in him of the conception that in order really to understand it is necessary to come into direct personal contact with the object to be understood. If some of his teachers are, and certainly some of them should be, productive investigators, he is likely to be impressed with the necessity of accuracy in work, of patience in it, if things are to be accomplished, of steady industry and persevering effort. He learns also to have a love for detail and a desire for complete and exhaustive knowledge; he comes to appreciate skill in invention and in the application of new and precise methods, and there grows in him a desire for full appreciation of the value of all existing methods or principles which will prevent him from falling a prey to sectionalism in medicine or to any single idea or principle which is limited in its nature. In other words, he develops in those three directions of thought which characterize three more or less distinct and important attitudes of the human mind; namely, the exact habit or attitude of thought, the historical and the critical.

[6] Barker, L. F., "The Organization of the Laboratories in the Medical Clinic of the Johns Hopkins Hospital," *Johns Hopkins Hosp. Bull.*, June–July, 1907.

THE UTILIZATION OF LABORATORIES BY PRACTITIONERS AND HEALTH OFFICERS FOR THE DIAGNOSIS, CURE AND PREVENTION OF DISEASE

I have referred incidentally to the use of hospital laboratories by hospital physicians and surgeons as direct aids in the diagnosis and treatment of their cases. The chemical, physical, microscopical and bacteriological studies now made in hospital wards form a large part of the occupation of resident and attending physicians in those institutions; indeed, the examinations of the blood, of the urine, of the stomach juice, of the sputum, of the fæces, of the cerebro-spinal fluid, of the contents of abscesses and cysts, of portions of tissue removed at operation and X-ray and electrical examinations have become so potent a factor in medical diagnosis that many have begun to fear that physicians and medical students in their enthusiasm for the clean-cut results which they yield may come too much to neglect the older fundamental methods of inspection, palpation, percussion, auscultation and mensuration. And it is certainly wise that a note of warning should in this connection be sounded, for it would be a grave error to deprive ourselves of what is good in the old because of the helpfulness of the new. That such a fear should be expressed, however, shows how tremendous a hold laboratory methods are taking of the minds of developing clinicians.

Aside, however, from the laboratories connected with hospital wards there has been in recent years a phenomenal growth of private and public laboratories in our towns and cities for the use of private practitioners of medicine and officers of public health. I am sure that the laity scarcely realizes how much such laboratories promote the early diagnosis and facilitate the treatment of disease, and especially to how great an extent through them infectious and contagious diseases in the community are prevented and controlled. Time will not permit me to enter upon an enumeration of these particular benefits. I desire, however, to express my gratification at learning that at least some portion of these new laboratories which you have built in Kingston is to be devoted to the service of the public health, and I predict that no small part of their usefulness to this community and to the people of this province will result from the activities of the public health division of your laboratories.

MEDICAL LABORATORIES AS CENTERS OF RESEARCH

In addition to being necessary and desirable places of instruction for medical students and also institutions for practical use in the prevention and cure of disease by physicians and officers of the public health, medical laboratories subserve a still higher purpose, to which we should for a few moments advert,—I mean the function of medical research. In university circles no special plea for original research is necessary I know, for in those circles the advantages of creative inquiry, both from the economic side and from the standpoint of the highest human ideals, are well understood. It is to be feared, however, that the general public, sympathetic as it is with scientific advance in general and with the efforts made by scientific investigators in the struggle for enlightenment, has no adequate realization of the results which have already attended the studies of medical scientists or of the urgency for the promotion of original studies in strictly medical domains. The public has always been willing to pay for hospitals to care for the sick, but it is only in recent years that it has begun to awaken to the possibilities of preventing disease by the endowment of research specifically directed thereto.

The advances which have been made in our own time by investigative medicine are truly phenomenal, and no layman, unless he has made a special point of looking into the matter, has any conception of the increased power medical men now possess to lessen physical suffering from disease and accident, or the means at their command for controlling the spread of infectious and contagious disease. Not only has the prospect of life for each human individual been markedly lengthened, but immeasurable advantages have accrued to the race as a whole, no small part of our industrial development at home and the opening up of countries abroad hitherto inaccessible to civilized whites having been due to the protective discoveries of modern medical science. It is not my purpose at this time to review even briefly the triumphs of modern preventive medicine, interesting as it would be to outline to you what has been done regarding the cause and the prevention of diseases like typhoid fever, Asiatic cholera, bubonic plague, yellow fever and malaria. The advances made in the prevention and cure of diphtheria and in the lessening of infant mortality are familiar even to the layman, and in the great crusade against tuberculosis now in progress all over the world we have a demonstration of the growing consciousness of the public that it is necessary for it to combine with physicians in applying scientific methods to the extermination of that dreadful malady which is the cause of death of one out of every eight of our people. Since scientific methods when applied to the solution of medical problems have so soon been able to yield the striking results at which I have hinted, what may not be done if more men and more money can be made available for the study of the diseases which as yet can not be controlled. Think of the benefits to the human race which would follow the discovery of a means for preventing or curing pneumonia, an infection which in spite of all the work yet done upon it kills as many people to-day as it did one hundred years ago; or what a boon it would be to human society if the secret of cancer and sarcoma and other malignant tumors could be unraveled and these dire diseases become as controllable as have diphtheria and wound infection. Another most important field for investigation is that which deals with the disorders which affect human beings after middle life is past and account for much of the misery which leadens the sky of so many men and women in their advancing years; I mean those degenerations of the blood vessels, kidneys, liver and brain, the origins of which are as yet obscure and the prevention of which we have yet to learn.

Germany took the lead in the recognition of this special research-function of the medical laboratory and of its significance for social progress. In 1880 the German government endowed a special laboratory—that of the Imperial Health Office—for the investigation of the infectious diseases, and put Koch at its head. France followed quickly with that great institution of international reputation founded for Pasteur after his epoch-making discovery of a method for preventing the development of hydrophobia after mad-dog bites. Since then special institutes for purely investigative purposes have been springing up like mushrooms, part of them supported by national governments, others endowed by private individuals of wealth and insight. I need only mention the Imperial Institute for Experimental Medicine in St. Petersburg (1890), the Institute for Infectious Diseases in Berlin (1891), the laboratory now known as the Lister Institute in London (1891), the Institute for Experimental Therapeutics in Frankfurt (1896), the State Laboratory for the Investigation of Cancer in Buffalo (1899), the Rockefeller Institute for Medical Research in New York (1901), the Institute for Infectious Diseases in Chicago (1902) and the Phipps Institute for the Study of Tuberculosis in Philadelphia (1903)—all establishments dedicated to original medical inquiry—to show you how rapid has been the expansion in this direction. Nor does such an enumeration exhaust by any means the list of medical laboratories engaged in special research. The better university laboratories combine research work with the work of instruction, and much excellent scientific labor is also performed in the laboratories of boards of health in our larger towns and cities.[7]

The people of Canada and the United States are to be congratulated upon the increase in public interest in medical research on this side the Atlantic during the last few years; nevertheless, there is still

[7] Cf. Welch, W. H., "The Benefits of the Endowment of Medical Research," an address delivered at the opening of the laboratories of the Rockefeller Institute for Medical Research, New York, 1906.

a great shortage of men here as compared with the number available for such work in European countries. It must be confessed, too, that the scientific output of individual workers in this country is smaller than it should be and could be were the conditions for work made more favorable. As yet we have only a handful of men who devote their whole time and energies to this kind of study and these are hampered in their work by serious defects in the conditions which surround medical research in America. In our medical schools the professors who are able to do investigative work and have the desire therefor, are often so overloaded with the routine work of lecturing, laboratory instruction and administration, that they really have not the time for the intense and absolutely undisturbed work necessary for the creative mind. Further, it is rare in this country to find an investigating professor supplied with research assistants to help him practically to carry out his ideas, whereas in Germany, by means of a graded staff and a department budget which permits the employment of several research assistants, the hands of the man with original notions are multiplied several fold and there is a much more rapid conversion of new ideas into new results.[8] Another hindrance to research lies in the insufficient financial rewards of academic work. We are undoubtedly holding back our people and the prestige of the country in which we live by the inadequate provision we are now making for the material side of the lives of professors in our universities and medical schools. This is false economy; commercially speaking, it is bad business. Until university trustees and the public generally recognize the necessity of retaining the best brains which develop among us in the service of instruction and research the activities of those brains will inevitably, in many instances, be diverted to other fields. The man with investigative ability, with the power of observing closely, of reasoning accurately, of thinking originally and of experimenting rigorously, is rare. The critical attitude of mind, the inspiration to originate, the training which makes men able to extend the boundaries of knowledge and to win new power from nature, is not common. Only a few men have the faculty of determining and grasping facts, and of verifying and digesting them; and still fewer have the ability to conceive fruitful hypotheses connecting these facts or explanations, united with the initiative necessary to test the validity of the hypotheses by experiment. Research work requires a patience and an enthusiasm, a self-denial and a perspicacity unknown to the average man. When we discover a worker who can find his way in medical regions as yet untrodden, who can discern new relationships among facts, who can elucidate some of the mysteries which for centuries have puzzled us, we should cherish him. He needs all our sympathy and support, for the conditions under which he works are lonely and difficult. He has, as a rule, but few companions, and his work is not in the public eye. He has to set his own tasks and to establish his own standards of excellence. Fortunately, he is a man of high ideals and his reward comes chiefly from his work, from the actual joy of the labor. But, since the results not only increase knowledge but promote the safety and happiness of the people, it is the duty of society to provide the facilities and conditions for his work, to elevate his position in life and to give him the honor and appreciation consonant with his high calling.[9]

[8] Cf. Stieglitz, J., "Chemical Research in American Universities," SCIENCE, N. S., 7, 1907.

[9] Cf. Eliot, C. W., "The Qualities of the Scientific Investigator," address at the opening of the laboratories of the Rockefeller Institute, New York, May 11, 1906.

In bringing my remarks to a close I hope that their main intent, despite their rambling and somewhat desultory character, may have become plain to you. I have tried to show you that medical laboratories such as these are indispensable in medical schools which are at all worthy of being known as the medical departments of true universities, and I have maintained that only in such laboratories can students be properly taught, for they come there into direct personal contact with the objects of study, a requisite if the scientific habit of thought is to be engendered. To them, too, your physicians and your guardians of the community's health may resort for making the special laboratory examinations now necessary for the diagnosis, the cure and the prevention of the ills by which your people are afflicted. And, above all, opening off these halls there are some rooms which will, I trust, become the workshops of mature original investigators and others which will serve as nurseries in which will be cultivated those qualities of mind, heart and hand which make men dissatisfied with knowledge as it is and compel them to try to extend it.

Untrammeled by the traditions and ultra-conservatism which are holding medicine back in the mother country, yet protected by intimate connection with her from the whimsical vagaries, the wildness and the freakishness which might otherwise tend to bring medical science here into disrepute, Canadians have an opportunity and a privilege in medicine they will not be slow to take advantage of, a duty they are sure manfully to assume. There are many young men and women in this country and this province capable of devotion to an ideal cause, independent of personal gain and glory. It is to the credit of Canadian parents that they instil into their children high and noble aspirations, that they teach them to endure privations cheerfully for the sake of things greater than mere physical comforts, and that they cultivate that generosity and elevation of spirit which make unselfish human effort not only possible, but really desirable. The fruits of this training will, I dare prophesy, become evident sooner or later in the activities of these laboratories. In them there will be professors and students who will choose as their life work the pursuit of medical truth and the acquisition of medical knowledge for its own sake; as a result of this ennobling and worthy occupation human suffering will be ameliorated, and, perhaps, some patients suffering from maladies now incurable may be healed. May the high aims and purposes of those who have planned these buildings and made their erection possible be realized! May the good that you hope for be the outcome of work in the laboratories which with suitable solemnity and earnest purpose you have set apart and consecrated to a special service to-day!

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION B—PHYSICS

II

A Relation of Mass to Energy: DANIEL F. COMSTOCK, Ph.D. (Read by title.)

In the paper of which this is an abstract it is shown that the momentum of any purely electric system having any internal motions and constraints, but possessing on the whole a kind of average symmetry, is given by the expression

$$M = \frac{2W^T v}{V^2[1 + (v/V)^2]}.$$

Here M is the momentum of the system, (v) its velocity as a whole, V the velocity of light and W^T the part of the total electromagnetic energy which is represented by the components of the electric and magnetic forces which lie perpendicular to the direction of motion of the system. This is a highly general result and is obtained by a method involving the generalized constraints of the system.

When the second order of the ratio v/V may be neglected, W_T is equal to two thirds the total electromagnetic energy (W) of the system (because of the average symmetry before mentioned), and hence we have

$$\text{Mass} = 4/3 \ 1/V^2 \ W.$$

This gives the electromagnetic mass of the system in terms of its total energy content.

If the electrical theory of matter be accepted this result applies to the mass of any piece of matter and we have the mass proportional to the total contained energy.

It is shown that if this hypothesis is accepted the irregularities which exist in the table of atomic weights are in harmony with the evolutionary theory of the elements.

Also on this basis gravitation must be considered as acting between quantities of confined energy and not between masses in any other sense.

Method of Determining the Modulus of Bending of a Flat Spring: R. S. Woodward, Carnegie Institution of Washington. (Read by title.)

The method applies especially to a uniform flat spring held rigidly and horizontally at one end but otherwise free to assume the shape due to its weight. The exact theory of this shape shows that measurements (1) of the vertical sag of the spring at any point of its length, (2) of its weight per unit length, and (3) the total length of its free part will give the modulus of bending.

An Investigation of the Optical Properties of Films of Magnetic Metals: C. A. Skinner and A. Q. Tool, University of Nebraska.

This paper deals with the magnetic rotation and ellipticity produced by films of iron, cobalt and nickel of definite thicknesses together with the refractive indices, reflection and transmission of the same.

It appears that two distinct types of films may be produced by cathode deposit *in vacuo,* one a *metallic* the other a *dark* film. The difference does not arise from the gas in which the films are produced, for they are alike, whether hydrogen, nitrogen or helium be used as gas filling.

The optical properties of these different types are quite different, and they also differ from those obtained by electrolytic deposition. Both iron and cobalt in the *metallic* type possess magnetic rotary power four times as large as the electrolytic films, while the *dark* types exhibit a rotary power remarkably smaller than the electrolytic. The ellipticity imparted to the transmitted ray is affected to an equal degree.

Dark films of iron have an absorption region in the blue and in this region the magnetic rotation and ellipticity reverse their directions, as might be predicted from the characteristics exhibited by other substances possessing an absorption region in the visible spectrum. *Dark* films of cobalt show also interesting results in the visible spectrum, which duplicate in a sense the results from the iron.

Only *metallic* films of nickel could be obtained and these exhibited effects almost too small to measure.

The Electric Double Refraction of Carbon Bisulphide: Charles F. Hagenow, Armour Institute.

In insulating media subjected to an electric field, light waves vibrating in the direction of the field are propagated at a velocity different from those vibrating perpendicular to it. Kerr's law for the relative retardation of two such vibrations is given by the formula

$$\delta = B\ V^2 l/d^2$$

where V is the difference of potential between the two parallel plates of a plane condenser producing the field, d their distance apart, and l the length of path of the ray in the field. B is thus the constant of the dielectric used.

For different reasons it is important to determine this constant for carbon bisulphide. Previous investigators have found it to fluctuate over a range as high as twenty per cent. This paper deals with the treatment of the liquid necessary to reproduce results, and finally gives a series of careful determinations of B for various wave-lengths. Incidentally the results of Blackwell, showing that Kerr's law for the variation of the retardation with the wave-length is in error, are supported.

The Spectrum of Calcium: James Barnes, Bryn Mawr College. (Read by title.)

The paper considers the changes produced in the intensity and distribution of light in the lines of the calcium spectrum obtained from an arc between metallic electrodes in air at atmospheric pressure and at lower pressures with varying current-strength. The results can be explained as a density effect rather than a temperature one.

The new triplets found by Saunders in a copper arc moistened with $CaCl_2$ appear very clearly and sharp when the arc is produced in a vacuum with a current of 12 amperes.

Many attempts were made to obtain true double reversals of the H and K lines with a steady arc, but without success. False multiple and double reversals appear in some of the other lines.

Upon the Magnetic Separation of the Spectral Lines of Barium, Yttrium, Zirconium and Osmium: B. E. Moore, University of Nebraska.

Preston observed a similarity in the magnetic separation for spectral lines which formed similar series. Runge and Paschen confirmed this observation for a number of substances.

This research uses the magnetic separation of spectrum lines to search for series in cases where they have not been before observed. Runge used this method with barium.

The substances were volatilized by means of a spark in a strong magnetic field (24,400 c.g.s. units per sq. cm.) and photographed by means of a 21-foot grating. The components were separated by a calcite prism. Observations were made upon barium, yttrium, zirconium and osmium. A table was presented, showing an extended comparison between the author's results and some recently published by Runge.

The most prominent feature of the table is the fact that most of the lines of the substances here studied do not belong to the types which are represented in the well-known series groups. The next prominent feature is that the types are seldom duplicated. Thirdly, a great many types have common intervals, whose difference consists in a variety of the factors by which the interval must be multiplied to produce the actual separation. Fourthly, whether or not the intervals are aliquot parts of a normal interval a is not so decisive. It can easily be contended that the intervals are irrational fractions.

Fifthly, the Zeemann triplets offer no great advantages for the study of series unless the magnitudes of the separations separate into well-defined groups, as they do not in zirconium, osmium and yttrium.

Sixthly, series are eliminated from the

lines having several components except under quadruplets of zircon designated by interval $3a/8$. No series was found here.

An extended abstract of this investigation may be found in the *Physical Review*.

On the Absorption of Short Electric Waves by Air at Different Pressures: James E. Ives and R. E. Clyde Gowdy.

It has been known for some time that wireless telegraph messages can be sent farther at night than in the day. One explanation is that sunlight ionizes the air and this increases absorption.

To investigate this in the laboratory short electric waves were used, and were sent through a glass chamber in which the pressure could be varied. The waves were excited by a Righi oscillator 5 cm. long and received upon a thermo-junction made of fine iron and constantan wires. The intervening chamber was 44.5 cm. long, with plate-glass ends. Pressures were used ranging from .5 mm. of mercury up to 1 atmosphere. Two maxima of absorption and one minimum were found. One of the maxima is near zero pressure, the other between 40 and 60 cm. of mercury. The minimum lies between 25 and 35 cm. of mercury. The percentage absorption is not large, varying between + 7 per cent. and — 7 per cent. for the whole tube, or between + .15 per cent. and —.15 per cent. for each centimeter of its length.

The Magnetic Properties of Antimony: Arthur L. Foley, Indiana University.

Antimony can be made to exhibit either paramagnetic or diamagnetic properties by changing the temperature conditions under which it solidifies and crystallizes.

A Repetition of Wheatstone's Experiment of 1834: Francis E. Nipher, Washington University, St. Louis.

The paper gave reproductions of Wheatstone's figures in *Phil. Trans.*, 1834. It was pointed out that it seemed somewhat improbable that his mirror could have been given a velocity of 800 revolutions per second. The three sparks in a line half a mile in length were photographed. When Wheatstone's connections were used his result was not obtained. When one end of the line was grounded, the sparks always began at the gap nearest to the terminal of the machine and the others followed in consecutive order in time. The result was the same for the positive as for the negative discharge. With Wheatstone's connection the middle spark should appear last, but the result was so affected by distributed capacity that his result was not attained.

Determination of the Susceptibility of Copper and Tin and their Alloys: O. C. Clifford, University of Chicago.

By means of a torsion balance, hung symmetrically with respect to two magnetic poles and made diamagnetic by superposition of bismuth pieces, the variation of the force of repulsion upon the test pieces examined was measured. From the mechanical force thus determined and the constants of the magnetic field found with an exploration coil, the susceptibility of the specimens was obtained. Within a range of field strengths of from 200 to 600 lines, the bismuth gave the same susceptibility as had been found by other observers with much larger fields. By careful preparation tin was obtained which had a susceptibility of $+ .31 \times 10^{-6}$. A very pure specimen of native copper was found to have a susceptibility of -1.22×10^{-6}. Alloys made from this tin and copper had susceptibilities which were in some cases of higher negative value than that of the copper, thus showing in diamagnetism a phenomenon altogether analogous to the Heusler phenomenon in paramagnetism. As the per cent. of tin increased from zero to about that used in speculum metal, the diamagnetism increased to a maximum and then decreased, making the susceptibility of the alloy a complex function of the per cent. of tin and copper present. The maximum diamagnetic susceptibility of the alloys was about -2.1×10^{-6}.

A Satisfactory Form of High Resistance: G. W. Stewart, University of North Dakota.

There is an increasing demand for a satisfactory form of very high resistance. This paper makes record of a very convenient and satisfactory form of high resistance in which carbon is utilized, and also furnishes data concerning its constancy. Commercial lampblack mixed with a lacquer, "zapon L," is spread into films upon an insulating base. These films are permanent, are not subject to ordinary changes in temperature, do not evaporate, and do not crack. Such films are very easy to make, and can be given practically any range. The resistance temperature coefficient of such films when hard rubber is used as a base, is from 0.1 to 0.2 per cent.

Phonographic Record of the Doppler Effect: Chas. T. Knipp, University of Illinois.

In this paper an attempt was made to obtain a phonographic record of the Doppler effect. The phonograph was placed at the side of the track, and distant about thirty feet. The horn was directed toward the moving source of sound. A record was taken of a continuous blast of the locomotive whistle sounded over a distance of about 1,000 feet—500 feet on either side of the position of the observer. By simple calculation it can be shown that the pitch will be lowered one tone when the train velocity is 44 miles per hour or 64 feet per second. The train in question was moving at a velocity of 57 miles per hour or 84 feet per second. The pitch accordingly should be lowered 9.3/8 tones. The phonographic record when reproduced showed a distinct lowering of the pitch—fully a tone as far as it was possible to judge by the ear.

How does the Violinist control the Loudness of his Tone: Harvey N. Davis, Harvard University.

One conclusion of the Helmholtz theory of the motion of a violin string does not seem to agree with experience, viz., that if the bowing point is fixed, the loudness of the tone depends wholly upon the speed of the bow and not at all upon its pressure. In explanation of this discrepancy, it is found that a certain pressure corresponds to each bowing speed, and that below this pressure the Helmholtz form of vibration can not be maintained.

The author is led to believe that the actual motion of a violin string is not usually of the normal Helmholtz type, but of the sort described in his paper a year ago as corresponding to light bowing. With the special apparatus devised it is possible to reduce the energy of the vibration to barely half its normal value, and the author hopes to be able to determine the limits of the sub-critical region for an actual violin and compare with them observations already obtained of the pressures ordinarily used.

A Wave Machine showing Damped or Undamped Compound Waves: Albert B. Porter. (Read by title.)

This machine compounds two harmonic waves either or both of which may be of constant amplitude, may have any desired damping coefficient, or may increase in amplitude at any desired rate. It thus serves not only to illustrate the ordinary problems in simple harmonic motion, but also the effects of damping by frictional or other resistance, and the phenomena of resonance.

The machine offers nine choices of ratio of periods between the two simple waves, and each of these ratios may be thrown slightly "out of tune" for the purpose of showing beats, or the changes in the compound wave and the evolutions of the Lissajous figure as the phase progressively changes. There are three choices of wave-length of the fundamental wave. The amplitude of either wave may be given any value between zero and the maximum permitted by the size of the machine; the phase difference can be varied between 0° and 360°; and either wave may be given any desired positive or negative damping coefficient.

Notes on Harmonic Analysis: Albert B. Porter. (Read by title.)

This paper describes: (1) A geometrical representation of the Fourier coefficients of a periodic function as a series of solids; (2) the essential mechanism of an integrating harmonic analyzer which is based on this representation; (3) a new method of harmonic analysis by use of specially ruled sine-coordinate paper, on which the given function is plotted, and the Fourier coefficients are determined by measurement with an ordinary planimeter, and (4) a modified form of the Yule analyzer.

Some Experiments on the Radioactivity of Potassium Salts: J. C. McLennan, University of Toronto.

In this paper an account is given of some experiments which confirm the discovery by Campbell and Wood that potassium salts emit a radiation of high penetrating power.

In the first series of measurements some chemically pure potassium sulphate was spread into a thin layer and placed close to and beneath an ionizing chamber 40 cm. long, 26 cm. wide and 28 cm. high. The bottom of this vessel was closed with a fine-meshed gauze which permitted the radiation to pass through. The saturation currents were measured with a quadrant electrometer.

In the first set of measurements different areas of the salt were exposed, and it was found that the radiation emitted was directly proportional to the free surface of the salt.

In a second series of measurements a layer of the salt 35 cm. by 18 cm. was placed under the ionizing chamber, and then gradually lowered, thus altering the air column traversed by the radiation before it entered the chamber. The results of this experiment show that it was necessary to lower the layer of salt some 17.5 cm. before the saturation current was reduced one half. With the salt at a distance of 42 cm. from the chamber, the ionization current was still approximately considerable, being one tenth of its highest value. In a third series of measurements a layer of the salt was again placed beneath the ionization chamber, and the absorption of its radiation studied by covering it successively with an increasing number of sheets of tin-foil, and at the same time measuring the corresponding saturation currents. The tin-foil used in these measurements was .0089 mm. in thickness. It was found that the saturation current diminished from 188 to 10 units as the number of sheets of tin-foil were increased from 0 to 32. Seven sheets reduced it to one half its value.

The fourth series of measurements was made with the object of ascertaining whether this radiation from potassium salts, which from its characteristics evidently consisted of β or γ rays, was due to some property possessed by the salt intrinsically, or whether it was due to a secondary radiation excited in the salt by the penetrating rays from the earth.

From the experiments described it is clear that the effects produced were due to a primary activity possessed by the salt and not due to a secondary activity imparted to it.

On Variations in the Penetrating Radiation from the Earth: C. S. Wright, University of Toronto. (Communicated by Professor J. C. McLennan.)

In this paper the author gives an account of some measurements made on the penetrating radiation from the earth in different localities on the north and south shores of Lake Ontario, and also at different points on the surface of the lake during the passage over it by steamer.

In making these measurements observations were taken by means of an electroscope of the improved Wilson type on the saturation current through the air in a closed lead cylinder.

The following statement contains a summary of the results. In this table the conductivities are corrected for variations in temperature and pressure, and are expressed for purposes of comparison by the number of ions generated per c.c. per second within the cylinder at the different points of observation.

TABLE OF CONDUCTIVITIES

Observation Stations	No. of ions generated per c.c. per second within the lead cylinder
First Set of Observations	
Physical Laboratory, University of Toronto	22.5
At edge of harbor waters (30 meters from shore) (filled-in ground)	19.3
South end of breakwater at Eastern Gap (water 4 meters deep)	14.1
On sand spit between lake and harbor (110 meters from shore)	14.26
On ground floor Canoe Club, at end of pier in harbor (water under floor 6.5 meters deep)	13.5
Second Set of Observations	
Old Physics Building, University of Toronto	23
New Physics Building	22
On board steamer *Corona* at dock	18
At different points between Toronto Harbor and Niagara River bell buoy av. 18.8	18.9 18.8 19.1 18.3
At Niagara dock	20
Niagara River, Paradise Grove	18.2
Queenston Heights	23.3
Niagara Falls Park	22.9
Elevator Shaft, Ontario Power Co., Niagara Falls (40 meters under ground)	22.6
At foot of Niagara Falls	20.3

A Null-reading Instrument for the Measurement of Ionization: S. J. Allen, University of Cincinnati.

A Comparison of the Formulas of Helmholtz and of Nernst for the E.M.F. of Concentration Cells: H. S. Carhart, University of Michigan.

The Stability of Cadmium Cells: H. S. Carhart, University of Michigan.

On the Separation of Echelon Spectra by Gratings: A. A. Michelson, University of Chicago.

Selective Reflection as a Function of the Atomic Weight of the Base: W. W. Coblentz, Bureau of Standards, Washington. (Read by title.)

The Infra-red Absorption of Certain Biaxial Crystals for the Three Principal Directions of Vibration: R. E. Nyswander, Cornell University.

New Physical Aids to Navigation: H. E. Wetherill, Philadelphia. (Read by title.)

The Distribution of Energy in the Spectrum of the Tungsten Filament: R. E. Nyswander, Cornell University. (Read by title.)

The Use of Complex Quantities in Alternating Currents: G. W. Patterson, University of Michigan.

Physical Research at a Mountain Observatory: G. E. Hale, Mt. Wilson Observatory.

Some Curious High-temperature Phenomena: C. E. Mendenhall, University of Wisconsin.

Alfred D. Cole,
Secretary

Vassar College

SCIENTIFIC BOOKS

The Origin of a Land Flora: A Theory based upon the Facts of Alternation. By F. O. Bower, Sc.D., F.R.S., Regius Professor of Botany in the University of Glasgow. With numerous illustrations. 8vo, pp. xii + 727. Macmillan and Company, Limited. St. Martin's Street, London, 1908.

The author of this book is well known to American botanists as the writer of many lucid articles, and especially as the propounder of a very helpful theory as to the nature of the flower and its relation to the remainder of the sporophyte. When Professor Bower published his "theory of the strobilus" (*Annals of Botany,* Vol. VIII., 1894, p. 343) he made a contribution to morphology which at once marshaled the floral and foliage structures of higher plants in accordance with the doctrine of evolution, and destroyed the time-honored theory of the metamorphosis of foliage leaves into the perianth and essential organs of the flower. In the light of this theory the origin of the flower is no longer the hazy, although plausible impossibility of the older text-books. That he swept away along with much accompanying rubbish, and in its place gave us an explanation which has the double merit of agreeing with observed facts, as well as being biologically possible. Now the author who gave us a rational theory of the origin of the flower appears with a volume devoted to the origin of the terrestrial habit in plants, or as he puts it in the title of his book—the origin of a land flora—and we may predict for this later theory a history equally successful with the former.

The volume consists of forty-seven chapters, divided into three parts, the first (of twenty chapters) being devoted to a "statement of the working hypothesis," the second (of twenty chapters, also) including a "detailed statement of facts," and the third (of seven chapters) devoted to "conclusions." Starting with the accepted doctrine of biologists that animal and plant life originated in the water, he shows that it is the sporophyte generation which becomes terrestrial, while the gametophyte is wholly aquatic, or at best still greatly dependent upon an abundant supply of water. His statement (p. 244) is so clear that we quote it here verbatim: "In respect to their whole life-cycle the *Archegoniatae* may be said to show an amphibial existence, the aquatic and the terrestrial characters being reflected in its two alternating phases. The gametophyte is as a rule delicate in texture, without intercellular spaces in its tissues, or a fully developed water-conducting system, while its sexual organs only become functional on their rupture in water outside the plant-body: the gametophyte thus proclaims its ultimate dependence on external fluid water as thoroughly as an alga. The sporophyte, on the other hand, is a characteristically sub-aerial body; this is shown by its more robust habit, its effective ventilating system, and its vascular strands for the conducting function seen in the higher forms: its final result, the maturing and dissemination of spores, is normally carried out under circumstances of dryness. All these features mark it as an essentially terrestrial phase."

In Chapter V. the author discusses the cytological differences between the gametophyte and sporophyte first distinctly pointed out by Strasburger in 1894, accepting chromosome-reduction as marking the end of the sporophyte generation and the beginning of the gametophyte, and chromosome-doubling as the end of the gametophyte generation and beginning of the sporophyte. By applying this test the beginnings of an alternation of generations may be recognized cytologically in the vegetable kingdom long before it becomes obvious morphologically.

In the final chapter, which is entitled "Results, Phyletic and Morphological," some of the conclusions may be quoted, as "Both Mosses and Liverworts may with probability be held to be blind branches of descent, which illustrate nevertheless phyletic progressions that illuminate the origin of sterile tissues from those potentially fertile, and the establishment of a self-nourishing system in the sporophyte." "The phyletic relationship of the *Sphenophyllales* and *Equisetales* has undoubtedly been a very close one; the distinguishing features are not to be found in the primary plan or construction of the shoot, so much as in the secondary modifications of number and relation of the appendages, and of their branching, together with changes in the originally protostelic structure of the axis. Such considerations support the conclusion that the Sporangiophoric Pteridophytes constitute a brush of naturally related phyletic lines." "The Filicales appear as the most divergent phylum of homosporous Pteridophytes." Speaking of the vegetative system of the sporophyte in higher plants the author says: "Taking an evolutionary course of its own it diverged more and more in character from the propagative system. The final result is seen in the Angiosperms which are now dominant: here the flowers differ widely from the vegetative shoots, though the plan of each resembles that of the primitive shoot from which both sprang. But whatever the modern complications may be, comparison along lines which have been pursued in this volume indicates that the sporophyte, which is the essential feature in the flora of the land, is referable back in its origin to post-sexual complications: it appears to have originated as a phase interpolated between the events of chromosome-doubling and chromosome-reduction in the primitive life-cycle of plants of aquatic habit."

It merely remains to say that the publishers have brought out the book in a style befitting its importance—paper, type, presswork and illustrations, all being good and pleasing to the eye. The illustrations, of which there are 361, are plain, and while no attempt has been made to secure artistic effect, they do what they were intended to accomplish—namely, they help to explain the subject-matter. It is in all ways a thoroughly satisfactory book.

Charles E. Bessey
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Monographie des Onychophores. By E. L. Bouvier. Extracted from *Annales de Sciences Naturelles, Zoologie* (1907), pp. 383 + 318, Pls. XIII.

The splendid monograph of the Prototracheata recently published by Professor Bouvier of the Paris Museum deserves a rather extended notice, because of the great interest attaching to the group of which it treats, and the fact that the work, owing to its place of publication, is very little known to American naturalists. A most interesting preface is headed by an appropriate motto, taken from Albert Gaudry: "Vieux habitants de la terre, apprenez-nous d' où vous êtes venus." A section follows, containing a general account of the morphology of the animals, with no less than 44 new and admirable text-figures. The bulk of the book is, of course, occupied with the detailed descriptions of the genera and species, while at the end are a complete bibliography and a check list. Everything is worked out in the most complete manner possible, and the history of each species is fully narrated; in its careful attention to detail and arrangement, the monograph may be classed with Scudder's great work on the butterflies of New England and Taylor's "Monograph of the British Land and Freshwater Mollusca."

The history of the classification of the Prototracheata is interesting. Up to 1894, all the known species were referred to the genus *Peripatus,* but in that year Pocock, in spite of opposition, recognized three genera, two proposed by him as new. This was thought revolutionary at the time; but to-day Professor Bouvier describes two families and seven genera, with excellent characters! The number of species has been increased from a mere handful to fifty, nineteen of them described by Professor Bouvier. The group remains as isolated as ever, and its distribution is still disconnected, indicating great antiquity and partial extinction. The Peripatidæ include two genera, *Peripatus* and *Eoperipatus*. The former is neotropical, with the exception of a single species (*P. tholloni*) found in the French Congo. The latter consists of three species, two from Malacca, the other Sumatran. Thus the distribution is not unlike that of the tapirs, and we should look for fossil remains in the Tertiary beds of the Palæarctic and Nearctic regions, were not the preservation of *Peripatus* in this manner so unlikely. The African species may possibly be explained by an accidental passage (*e. g.*, on a floating tree) across the Atlantic, rather than as indicating an ancient land-bridge, or a long migration via Asia or Europe. It is noteworthy, however, that in certain respects it approaches the Malayan *Eoperipatus*, so that it would be possible to regard the latter as having reached Asia by way of Africa, the *Peripatus* of the latter continent remaining as a relic of a very ancient route of migration.

The genus *Peripatus*, as now understood, is divided into three groups or subgenera, as follows:

(1) *Oroperipatus* n.n.; "Péripates andicoles." 12 species. Type *P. lankesteri* Bouvier.

(2) *Peripatus* s.str.; "Péripates caraïbes." 17 species. Type *P. juliformis* Guilding.

(3) *Mesoperipatus* Evans; "Péripates africains." 1 species. Type *P. tholloni* Bouvier.

Professor Bouvier does not use any subgeneric names; I have ventured to supply one for the Andicolous group. This appears to be the most primitive of the three, and might better be considered typical *Peripatus*, had not the name been first applied to a Caribbean species.

The distribution of the two neotropical groups is exceedingly interesting, one being characteristic of the Andean chain, the other of the more eastern regions and the West Indies. *Oroperipatus* has three species in Bolivia, six in Ecuador, one in Colombia, and finally enters Mexico on the *west* side, getting as far north as Tepic (*P. eiseni* Wheeler). The subgenus *Peripatus* has nine species and subspecies in the West Indies, two in the coast region of Brazil, five in the Guianas, three in Venezuela, one each in Costa Rica and Nicaragua, and reaches Mexico on the *east* coast, extending to Vera Cruz. If we think of the two subgenera as reaching Central America by way of the isthmus of Panama, it is not at first apparent why they should have carefully kept to the same two sides of the country they occupied in the southern hemisphere. It is to be remarked, however, that *P. eiseni* is a mountain species, occurring at an altitude of 4,000 feet, and so its ancestors doubtless followed the Andean chain; whereas the Caribbean types probably clung to the coast line, and consequently to the east. Whether through Tertiary time these animals were widely distributed over North America, or whether they reached that continent only at the time when the isthmus rose above the sea and permitted the ingress of various well-known neotropical genera, must for the present remain uncertain.

The details of the distribution of the West Indian species are worth investigating. There are apparently no species in Cuba and the Bahamas, and none have been described from Hayti, though they may be expected there. The lesser islands are populated by various forms of the *P. juliformis* type, and Professor Bouvier has shown that the Jamaican forms, which I formerly regarded as variations of a single species, really represent two, the so-called *P. jamaicensis swainsonæ* Ckll. being in fact a member of the *juliformis* series. It is indeed so close to *juliformis* that Bouvier makes it a variety of that species, though in view of its isolation I should prefer to treat it as a species, *P. swainsonæ*. It is practically certain, no doubt, that *P. swainsonæ* reached Jamaica from the east, along the chain of islands; but it seems probable that the other species, *P. jamaicensis*, reached the island (along with *Capromys* and other animals) from Central America, by way of a land bridge or chain of islands now represented by large areas of shallow water. Professor Bouvier, to whom I communicated this suggestion, agrees with me that it is probably correct; it has the advantage of accounting for the absence of any close relatives of the very distinct *P. jamaicensis* in the other West Indian islands.

The Peripatopsidæ, with five genera, are no less interesting. They are confined to the southern hemisphere, with the following distribution:

Paraperipatus Willey. 1 species. New Britain.

Peripatopsis Pocock. 6 species. S. Africa.

Opisthopatus Purcell. 2 species; one Natal, the other Chili!

Peripatoides Pocock. 4 species; two in New Zealand, two in Australia.

Ooperipatus Dendy. 4 species; one in New Zealand, one in Tasmania, two in Australia.

The case of *Opisthopatus* is most remarkable, though similar instances are known among insects. The Chilian *O. blainvillei* may be imagined to represent the last relic in America of the Peripatoid fauna of von Ihering's Archhelenis, a continent supposed to have once connected Africa with South America. This would mean that the genus *Opisthopatus,* though severed into two widely-separated parts, has retained its essential characters throughout Tertiary time.

The classification of the Australian and New Zealand species is not quite satisfactory. Professor Bouvier shows, or at least gives very good reasons for believing, that *Ooperipatus oviparus* is not genetically related to the other three species of the genus, but represents an independent development of oviparity from *Peripatoides* stock. Hence it would appear necessary to make *O. oviparus* the type of a new genus, to follow *Peripatoides* in the list. The Tasmanian species is called by Professor Bouvier *Ooperipatus insignis* Spencer and Dendy; but since it is not the earlier *P. insignis* Dendy, it must have a new name.

T. D. A. C.

SCIENTIFIC JOURNALS AND ARTICLES

In *The American Naturalist* for January T. H. Morgan describes some "Experiments in Grafting" undertaken primarily with a view to finding out whether or not it is possible by artificial means to induce regeneration in a part that does not ordinarily regenerate. For example, a part of a lizard's tail was grafted on the stump of a leg, the idea being that the stimulation of the tail portion, which does regenerate, might induce regeneration in the limb. The results, however, are so far negative. Charles A. White discusses "The Phenogamous Parasites" and C. William Beebe gives a "Preliminary Report on the Investigation of the Seasonal Changes of Color in Birds," noting the influence of warmth and moisture. A. H. Wright and A. A. Allen have "Notes on the Breeding Habits of the Swamp Cricket Frog, *Corophilus triseriatus* Wied," and Adam Hermann describes "Modern Methods of Excavating, Preparing and Mounting Fossil Skeletons," methods which have probably reached a higher degree of perfection in this country than in any other and which Mr. Hermann himself has done so much to develop. John T. Gulick considers "Isolation and Selection in the Evolution of Species: The Need of Clear Definitions," pointing out that the above terms, as well as environment and even evolution, are used by different writers in a varying sense.

The Museums Journal of Great Britain for February opens with an article by James Duncan, on "Experience of Sunday Opening at Dundee," the matter being deemed of special importance because it is the most northern museum in "Sabbath-keeping" Scotland to open its doors on a Sunday. The results have been eminently satisfactory. There is a brief description of "The Royal United Service Museum" and, under "Museum Notes," F. W. Fitz Simons suggests that the round, perforated stones from Africa, known as Bushmen's stones, may have originally been symbols of Phallic worship.

The American Museum Journal for March has as frontispiece a reproduction of Eastman Johnson's portrait of the late Morris K. Jesup, taken in 1892. It is noted that a special publication will give an account of Mr. Jesup's life and service to the museum. There are articles descriptive of the "Bismarck Archipelago Collection," the "South American Blow-gun" and the "Exhibition showing the Congestion of Population in New York City."

This exhibit is shortly to be transferred to Brooklyn.

The Bulletin of the Boston Society of Natural History for March gives notice of the coming meeting of the geologists and mineralogists of the northeastern section of the United States, to be held in New York, April 6. It also gives a description of the botanical collection of the society and the work in its development.

Leaflets Listing and Describing Birds of Oregon may be added to the ever-increasing number of publications whose intent is to furnish information as to the habits and value of birds and the desirability of protecting them. These just mentioned are intended largely for use in the public schools. No. 1, by William L. Finley, treats of the "Study of Birds and Their Economic Value"; No. 2, by the same writer, tells of "Some Common Birds of Oregon with Notes on their Economic Value."

SOCIETIES AND ACADEMIES

THE SECTION OF GEOLOGY AND MINERALOGY OF THE NEW YORK ACADEMY OF SCIENCES

The regular monthly meeting of the Section of Geology and Mineralogy of the New York Academy of Sciences was held on Monday evening, January 6, 1908, at the academy rooms in the American Museum of Natural History, New York City.

The section authorized the officers to arrange for a joint meeting of sections and departments of geology and mineralogy from neighboring academies, museums, surveys and colleges to be held in April. Invitations are being prepared and will be distributed through New England and the Middle Atlantic States.

Two papers were presented, the titles and abstracts of which follow.

A Revised Classification of the North American Siluric System: Amadeus W. Grabau.

A review of the successive modifications of the classification of the Siluric system in North America brings out the fact that the process of refining has been largely by separation off from this system of those divisions not properly belonging to it. Thus Dana in 1863 (first edition of the "Manual") included the Ordovicic and Cambric as Lower Silurian, dividing it into Potsdam, Trenton and Hudson, and dividing the Upper Silurian into Niagara, Salina and Lower Helderberg. In the fourth edition of the "Manual" (1895) the Cambric, Ordovicic and Siluric systems are recognized as distinct, though the name Lower Silurian is still preferred for the Ordovicic. The three-fold division of the Siluric is into (1) Niagara, (2) Onondaga (Salina), and (3) Lower Helderberg. In 1899 Clarke and Schuchert published their revised classification of the New York series, which has been pretty generally adopted. In this the Helderbergian exclusive of the Manlius was separated as Lower Devonic, while the remainder of the Siluric (Niagara and Onondaga (Salina), of Dana, 1895) was divided into the Oswegan (Oneida Conglomerate-Shawangunk grit and Medina sandstone), Niagaran (Clinton, Rochester, Lockport and Guelph), and Cayugan (Salina, Rondout and Manlius). Since then Grabau and Hartnagel have independently demonstrated that the Oneida is the equivalent of late Medina, and the Shawangunk, Salina. In 1905 Grabau suggested the Richmond age of the lower 1,100 feet of the Medina of Western New York,[1] uniting the upper with the Clinton. These relations were more fully discussed in 1906[2] and again in 1907 before the Geological Society of America, New York meeting, after a prolonged investigation of the Appalachian deposits. This relationship is now fully established and the dividing line between Ordovicic and Siluric is drawn at the base of the Upper Medina or the Medina proper. For the red Medina shales now recognized as of Ordovicic age the name Queenston beds is proposed, from the town of that name on the Niagara River opposite Lewiston, where these beds are partly exposed.

Recent studies by Grabau and Sherzer in southern Michigan and adjoining regions in Canada and Ohio have demonstrated the existence of about 900 feet of fossiliferous strata above the Salina, to which it is proposed to restrict the name Monroe. These will be fully

[1] Science, XXII., p. 529, October 27, 1905.

[2] Bull. 92 N. Y. State Museum.

discussed in a forthcoming memoir, where the correlation of the eastern attenuated Upper Siluric beds will be given. The fauna of the Upper Monroe above the Sylvania sandstone is a remarkable mixture of Siluric and Devonic types as recently demonstrated before the Michigan Academy of Sciences, the Chicago meeting of Section E, American Association for the Advancement of Science and the Albuquerque meeting of the Geological Society of America.

The following classification of the Siluric System of North America is proposed as most expressive of the relationships indicated by the facts now known.

Upper Siluric or Monroan (900 ft.)	Upper Monroe.	
	Middle Monroe (Sylvania sandstone the only known representative).	
	Lower Monroe.	
Middle Siluric or Salinan (1,000 ft.)	Represented so far as known only by non-marine sediments.	
Lower Siluric or Niagaran (500–1000 ft.)	Guelph (possibly to be placed with Middle Siluric).	
	Lockport dolomite.	
	Rochester shales.	
	Clinton	Clinton shales and limestones.
		Medina sandstone including Oneida conglomerate.

Ordovicic—Queenston shales.

A Study of the Mineral Constitution of the Chloritic Group Termed Delessite: ALEXIS A. JULIEN.

In regard to the constitution of minerals and mineral micro-aggregates, as in rocks, it is entirely insufficient and often misleading to depend upon chemical analyses alone, or upon formulæ deduced therefrom, although commonly this is all that is supplied in the treatises. In place of these, a calculation of the actual mineral constitution of the aggregate through a recasting of the analyses is required for the needs of the mineralogist or petrographer. All are mixtures. Even the best crystallized mineral has definite mineral impurities. From the well-crystallized form to the amorphous compact mass, in which only the microscope can perhaps barely detect the structures and optical behavior of obscure crystalline conditions—all are mineral mixtures. For each group of minerals under such investigations it is found advisable to prepare a tabulated scheme comprising all possible mineral constituents, together with their percentage composition. Using this, on the assumption of absolute accuracy of the certainly determined mineral formulæ, allowing for the limitations of replacement inherent in each mineral as far as known, and making careful correlation with the ascertained physical and optical characteristics of the identical mineral or micro-aggregate, its mineral constitution can be deduced with satisfactory accuracy.

In illustration, this simple method has been applied to a most complex group of micro-aggregates, many of which now pass as definite mineral species—the delessite group. It will suffice here to give one example covering the hitherto accepted mineral "delessite" itself. The analysis is of material from Zwickau by Delesse.

	Per Cent.
Silica, SiO_2	29.45
Alumina, Al_2O_3	18.25
Ferric oxide, Fe_2O_3	8.17
Ferrous oxide, FeO	15.12
Lime, CaO	0.45
Magnesia, MgO	15.32
Water, H_2O	12.57
Total	99.33

In explanation we are informed by Dana: "Comp.—Perhaps (Groth) $H_{10}(Mg, Fe)_4$-$(Al, Fe)_4Si_4O_{25}$." By using, however, the theoretical percentage composition of each of the minerals stated below, in harmony with the description of "delessite," the figures of this analysis will be found to correspond to a mere mixture with the following mineral constitution:

	Per Cent.
Prochlorite	72.13
Halloysite	10.34
Limonite	9.54
Colloid silica with water	7.32

By similar calculations the constitution of the whole delessite series has been approximately brought to light. The paper will be published in full in the *Annals* of the academy.

Charles P. Berkey,
Secretary of Section

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 441st meeting was held on March 7, 1908, President Stejneger in the chair.

Mr. H. W. Clark noted a case of fasciation in two specimens of hyacinth seen in a Washington market. The flattening of the flower stalk gave a larger floral surface and made it conspicuously showy. The bulbs of these flowers were said to be imported from Holland and new stock was asexually propagated from lateral tubers. This is the beginning of a new and very showy stock of cultivated plants probably worth developing. Fasciation is a unique and remarkable phenomenon in the history of cultivated plants, and occurs frequently in such plants as the sweet potato and yam which are cultivated asexually. In the cultivated cockscomb (*Celosia*) it is propagated by seed. Among our native plants it is common in *Œnothera,* and occasional in *Leptilon* and the sumacs. It is also common in the imported *Ailanthus.*

Professor W. P. Hay by request demonstrated "Some Additional Colored Lantern Slides by the Autochrome Process." He showed on the screen many colored pictures, illustrating the possibilties, difficulties and defects of the autochrome process. He explained the technique of the process, calling attention to the difficulties in handling the plates and the differences between autochrome and ordinary photography.

Mr. Vernon Bailey gave a lantern-slide lecture on "Home Life of the Lobo or Buffalo Wolf of the Great Plains." This was an account of the observations of the speaker on the large or timber wolf of the western plains, undertaken partly to learn to what extent the forests harbored these wolves. Forest reserves have been opposed with the argument that the wolves breed in them. Mr. Bailey found wolf dens in the open and on the edge of the forest reserve, but none in the timber. He described the habits of the wolves and their wary avoidance of attempts to trap them and showed many photographic lantern slides of the dens, the young, and of the wolf country.

Dr. Marcus W. Lyon, Jr., read a paper, describing and illustrating "A Simple Method to Represent Graphically the Trend of Variation in a small number of Specimens of Related Species." Where there is but a small number of individuals in a group of related organisms, A_1, A_2, etc., to be examined, the usual curves representing the extremes of variation with the average at the highest part of the curve, do not give satisfactory results as the curve will present too many irregularities and sometimes show no distinct maximum for the average. A modification of the regular coordinate system may be used, however, to represent graphically the extent and trend of variations, V_1, V_2, etc., by running a series of parallel lines at right angles to the vertical axis, the space between the lines corresponding to the variable character, with its least development at the level of the horizontal axis and its increasing development at regular intervals above it. The horizontal axis is similarly divided by a series of parallel lines, the space between any two lines corresponding to the groups of the organisms under consideration. To allocate the individuals with respect to the variations it is only necessary

to examine each specimen in turn and place a dot in one of the small squares made by the intersections of the parallel lines, which corresponds to its proper group and the extent of its variation. The resulting system of dots shows at a glance the extent and trend of the variations in any of the groups, and in a much more graphic manner than an examination of the specimens, or tables of measurements, or descriptions.

In the diagram, groups A_1 and A_4 show the possession of similar characters, groups A_2, A_3, A_5 and A_6 possess another set of characters. Some specimens in each group show an overlapping of characters or intergradation. The two major groups thus show a subspecific relation to each other.

M. C. Marsh,
Recording Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 648th meeting was held March 28, 1908, President Bauer in the chair.

Dr. C. G. Abbot presented a paper entitled "Total Eclipse Observations of January 3, 1908," giving an illustrated account of his trip to Flint Island in the south Pacific Ocean, via California and Tahiti, for the purpose of observing the recent solar eclipse. His principal object was to ascertain the comparative brightness of the solar corona and the sun, and to compare the quality of the radiation of the corona with that of the sun, the moon and the sky. He was successful in measuring the brightness of the corona at five points with the bolometer, and by interposing a screen of asphaltum varnish determined roughly the proportion of its radiation which falls in the visible spectrum. At brightest the corona was little more than 1/1,000,000 as bright as the sun, but the quality of its radiation as tested by the asphaltum screen differed little from that of the sun. The results are perhaps best explained by considering the corona to shine mainly by reflected sun rays.

Informal Communications

Professor C. F. Marvin spoke of the seismograph records of the recent Mexican earthquake (March 26, 1908) which had been obtained from the Omori and Marvin types of seismographs at the U. S. Weather Bureau, and pointed out significant differences in the amplitudes and the character of the wave motion as recorded by the two forms of instrument which were installed under exactly similar conditions.

The secretary read a communication prepared by Professor Cleveland Abbe, giving the following abstract of the results of a computation, by Professor H. A. Peck, of Syracuse University, of the orbit of the meteor of Christmas eve, 1873, based on the data in the report of the meteor committee.[1]

First, the point of *disappearance* was determined from records at four of the best observing stations, following the method given by Bauschinger. The resulting location is:

Longitude, 0° 57.8′ west of the dome of the capitol.
Latitude, + 38° 42′.
Altitude, between 5 and 9 miles—the mean of which, 7 miles, is adopted.

With this determination as a foundation the position of the radiant point was determined by the method of least squares from the observations at twelve good stations. The result is:

A (right ascension of radiant)	66° 55′
D (declination of radiant)	+ 29° 51′

This last result may be otherwise expressed thus: The bearing and apparent angular altitude of the radiant point, as seen by an observer *at* the point and moment of disappearance, would be

Azimuth	S. 86° 55′ E.
Altitude	56° 27′

The first appearance of the meteor, or the beginning of its visible path, may plausibly have been at about 130 miles above a point in latitude 38.6°, longitude 76.3°, or above the mouth of the Choptank River, Maryland. The corresponding length of the visible path would be 154 miles and the velocity relative to the earth's center 38.5 miles per second.

The computation of the path relative to the sun and the ecliptic gives the true radiant point:

Longitude	(λ) 50° 47′
Latitude	(β) + 6° 26′
Velocity	50 miles per second.

[1] *Bull. Phil. Soc.*, 1877, Vol. II., pp. 139–161.

The meteor was following and overtook the earth, the angle between its path and the direction toward the apex of the earth's motion being 132°. The elements of the orbit with reference to the sun are:

Ω	273° 22′	longitude of ascending node.
i	9° 28′	inclination to the ecliptic.
π	150° 12′	longitude of the perihelion.
$\log q$	9.7937	logarithm of the perihelion distance.
$\log e$	0.6329	logarithm of the eccentricity.

Professor Peck's paper will be printed in full in the *Monthly Weather Review*.

R. L. Faris,
Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the meeting of February 18, Miss Frances Densmore read a paper entitled "Music of the Chippewa," and used as illustrations many phonographic records secured by her during a season's work for the Bureau of American Ethnology among the Chippewa of Minnesota. Miss Densmore said that the music of the Chippewa is an echo from the land of the pine trees, the lakes and the little hills. All their life is intertwined with music; from babyhood to death the songs of the people express the joys and sorrows of life, the exultation of war, the solemnities of their religion, the tenderness of love and the cradle songs, farewells to the warrior and dirges for the departed. Miss Densmore gave a cradle song, the invitation to a ceremony, a plaintive love song, the requiem of Chief Flatmouth, the song of Wain-ah-bo-zho (who wrung the ducks' necks), and a series of songs of initiation into the Grand Medicine Society, which latter ceremony was described in some detail. At the close of Miss Densmore's paper three Chippewa Indians visiting Washington gave a representation in costume of the initiation of a candidate for membership in the medicine lodge, and the effect of the songs accompanied with the rattle and tom-tom was very striking. The chief also made a speech laudatory of his white friends in Washington, Rev. J. W. Gilfillan interpreting. The paper was discussed by Miss Fletcher and Mr. Wead, and Miss Densmore answered a number of inquiries.

Walter Hough,
General Secretary

DISCUSSION AND CORRESPONDENCE

TOXICITY AS A FACTOR IN THE PRODUCTIVE CAPACITY OF SOILS

The U. S. Department of Agriculture in 1903 promulgated, through its Bureau of Soils, in Bulletin 22, the teaching (1) that practically all agricultural soils contain sufficient plant food for good crop yields and that this supply will be indefinitely maintained; (2) that not only is the soil moisture a natural nutritive solution, but that it has sensibly the same concentration in productive and unproductive soils; (3) that this concentration is by natural processes constantly maintained of sufficient strength to meet the needs of crops giving good yields; and (4) that the good effects observed in all parts of the world to follow the practise of proper rotation of crops, the application of stable and green manures and of mineral fertilizers, must be due to some other mode of action than that of supplying the crop on the ground with needed additional plant food.

During the four years since the publication of these views the Bureau of Soils has devoted much of its time, energy and funds to an attempt to show (1) that crops excrete through their surfaces, and leave in the soils or upon the field toxic substances which, when tilth and climatic conditions are right, are the chief cause of reduced yields and runout lands; and (2) that proper crop rotations, stable and green manures and mineral fertilizers owe their observed good effects on crop yields to destroying or removing these toxic principles rather than to contributing plant food to the crops.

In the support and promulgation of these views there have now been published four other bulletins from the Bureau of Soils and one circular from the office of the Secretary of Agriculture in reply to adverse criticisms made upon them. It is the purpose here to discuss broadly but concisely what basis there may be for these views.

Amount of Plant Food Carried by Soils.

When no distinction is made between the amount of *plant food proper* and the amount of the elements and substances from which plant food may be derived there is no doubt but that the amount present, even in the poorest soils, is very large when measured in units of yearly crop demands. But the amount is not so large, either absolutely or in the rate of renewal by rock weathering, as to be inexhaustible if only it could be made continuously available at the rate required for good yields. Indeed the untruth of an assertion that by establishing good mechanical facilities for a high rate of removal of coal and thorough sanitary conditions for the miners, the supply of coal in a given mine will be indefinitely maintained, is no more certain than the contention that by a proper rotation of crops and the maintenance of good tilth and proper sanitary conditions uniformly large yields may be indefinitely maintained on any and all fields without a return to the soil of the plant food removed. We have in Wisconsin residuary soils whose absolute content of potassium is only 4.6 tons, of calcium 5.3 tons, of magnesium 3 tons, of nitrogen .9 ton and of phosphorus .8 ton per acre-foot of field. But it is very important to recognize that by very far the larger proportion of these plant food elements existing in the soil is, properly speaking, no more to be regarded as plant food for the crop growing upon the ground than it is food for the cattle feeding upon pasture grass, hence there is never present in the soil of a field any such large amounts of plant food proper as have been stated.

But, considering these amounts as capable of being converted into plant food proper as rapidly as large yields of crops would demand, the whole amount of the phosphorus finds its equivalent measure in the amount carried in 268, and the whole of the potassium in but 634, 20-bushel-per-acre crops of wheat, allowing nothing for losses by leaching. And yet the rate of surface erosion which will expose uncropped material from below as rapidly as one foot in 4,000 years could supply phosphorus only one fifteenth and potassium one sixth as fast as would be demanded by the 20-bushel crops of wheat. It follows, therefore, that for the soil in question to have a productive capacity of 20 bushels per acre per annum, indefinitely maintained without the application of phosphorus and potassium, the rate of surface erosion and of subsoil and rock weathering must equal one foot in every 268 years for the phosphorus, and one in every 634 for the potassium. But these are rates seldom if ever experienced in any agricultural region and the mean rate of erosion for the whole Mississippi Valley has been placed by geologists at not more than one foot in 4,000 to 6,000 years.

Nature's method of developing and of maintaining the productive capacity of fields has always been that of returning to the soil the whole crop, but, even so, nowhere has the concentration of the mineral elements of plant food been large as a result of soil formation by rock weathering under plant growth. The reverse rather has been the rule and very emphatically so with lime and magnesia. Only organic matter, with its ash, has at times and places accumulated to form peat and coal but always under non-agricultural conditions. There appears, therefore, no ground for a difference of opinion as to the point that it is possible for a mere rotation of crops, coupled with good tillage, and ample and timely moisture supply, to indefinitely maintain high yields where the whole crop above ground is regularly and continually removed from the field.

Concentration of Soil Solutions.

Notwithstanding the contention made in Bulletin 22 of the Bureau of Soils, and reiterated in later publications from the same office, that all soil solutions have essentially the same concentration, it must nevertheless be admitted that no observations yet published can be regarded as indicating even the approximate concentration of a single soil solution as it exists in the soil and functions in the growth of plants under field, greenhouse or pot culture conditions. It must further be admitted that the water solutions which have been recovered from soils do show a very wide range, in both composition and concentration, when judged by any standard admissible from the cultural point of view.

It is of the greatest importance in the consideration of this question to recognize the fact that neither the water solutions decanted from soil samples, the water filtered through soil, nor the solutions separated from field soil by either natural drainage or a centrifuge represent either the relative composition or the concentration of the portion remaining behind in contact with the soil. The only conclusion which is warranted, based upon existing published data regarding the concentration of soil solutions as they exist under field, plant house and pot culture conditions, is that they are certainly an undetermined amount stronger than would be indicated by the observed concentrations of solutions recovered thus far from soils under such cultural conditions.

It had been demonstrated in the laboratory of the Bureau of Soils, before the data presented in Bulletin 22 had been obtained, that when a coarse, thoroughly acid-cleaned and washed sand known to contain 84.71 parts per million of NO_3 in so soluble a form as potassium nitrate was washed three minutes in twice its weight of water, only 73.7 per cent. of the actual amount present was recovered in the first washing, and after ten consecutive similar washings there was still retained in the moisture films closely investing the sand grains 18.02 per cent. of the original amount given to the sand, which amount was subsequently recovered after rendering the sand water-free. After the sixth washing, in this experiment, the strength of successive solutions became constant at .11 part per million of NO_3, the concentration standing as below:

1 washing	31.210	p. m.
2 washings	3.284	"
3 "	.452	"
4 "	.174	"
5 "	.138	"
6 "	.128	"
7 "	.111	"
8 "	.110	"
9 "	.110	"
10 "	.110	"

Schreiner and Failyer, in Bulletin 32, Bureau of Soils, have since published similar results, working with very soluble phosphates and potassium chloride in connection with several soils. The simplest explanation for results like these is to suppose that these salts are retained in solution within the stationary films investing the sand and soil grains and that the salts recovered by successive washings after the concentrations become constant, measure the rate of outward diffusion from the stationary film into the free water. But the Bureau of Soils holds (and presumably the authors of Bulletin 32) that the fact that, after prolonged leaching of soils with pure water, the filtrate appears to attain a constant concentration, furnishes direct proof in support of the contention that all soil solutions have a concentration sensibly the same, the thought being that certain amounts of the salts experimented with had been absorbed by the soils, which were later redissolved by the excess of water on its passage over the soil grain surfaces. It is to be observed, however, that in the case of the solutions and soils reported upon by Schreiner, the salts retained, even in the case of phosphates, had not become sufficient to make the retained water a saturated solution under conditions not affected by the soil surface action. It must, therefore, be admitted, we think, that the data of Bulletin 32 lends little support, such as is being eagerly sought, in defense of the views of Bulletin 22, to wit, that in all cultivable soils the moisture is a nutritive solution having sensibly the same concentration.

So far is this view from being a demonstrated fact that if the data presented in Bulletin 22 in support of it be admitted in evidence quite the reverse proposition must be counted proved by nearly every table there presented. To illustrate: The data on pages 31, 32 and 33 show a range of soluble phosphoric acid varying from 12 parts per million of soil moisture to 203 parts per million, supposing the water content in each soil sample to be 20 per cent., computed on the dry soil. That this wide range in concentration is not due to exceptional cases is made clear by arranging the data of this table in an ascending series; averaging in groups of ten to reduce errors and unusual irregularities, we get the following series of concentrations: 16.8, 28.8, 37.2, 41.7, 45.4, 50.3, 54.6, 59.8, 64.3, 70.6, 86.7 and 165.8, the last average containing but four analyses.

This table here referred to contains only analyses of a single soil type known as Cecil clay as it occurs in the vicinity of Statesville, N. C., and instead of indicating that all soil solutions have the same concentration, if it proves anything, it shows that even one and the same soil type, as mapped by the Bureau of Soils, may carry solutions of phosphoric acid ranging all the way from 16 to 165 parts per million, if indeed not from 12 to 203 parts.

But from what has been demonstrated regarding potassium nitrate from clean sand, and indeed from the data presented in Bulletin 32, referred to above, there is every reason to think that the first three-minute washing to which these soil samples were subjected should not be expected to give a solution which would indicate the true concentration of the fixed water films investing the soil granules and soil grains, and which must be regarded functional in root feeding, and hence the true difference between the extremes in this series of soil samples should be expected to be much greater than that observed.

During the year of preliminary studies regarding the nature and concentration of soil solutions preceding the collection of the data presented in Bulletin 22 a very carefully selected series of samples of soils was taken by the writer from 67 localities covering 41 of the bureau's soil types, distributed in seven states, each sample being always a composite of four cores taken with the soil tube instead of with the auger. The total water soluble salt content in the surface foot of 66 samples from these soil types were determined by the gravimetric method, the residues being dried at 110° C. before weighing. These results showed an extreme variation ranging from 105 parts per million of soil solution, computed to a moisture content of 20 per cent. of the dry soil, to as high as 1,962 parts; and when this series of determinations is arranged in an ascending order and the analyses averaged in groups of ten the concentrations stand 239.5, 418.1, 546.8, 673.7, 810, 950 and 1,530 parts per million, and when these differences are shown with only three-minute washings in water equal to five times the weight of the soil, in its fresh, normal field condition, a liter of the solution being evaporated in each case, it is difficult to understand how such data, originating in the bureau, should have been ignored in drawing conclusions so at variance with the experimental records. In the case of the phosphoric acid for this series, which was determined for each of the surface four feet separately and the data published in Bulletin 26 of the bureau, the extreme range of phosphates is from 1.64 to 39.56 parts per million, and when grouped and averaged in tens as in previous cases, the results are 3.64, 6.65, 9.65, 12.43, 17.57, 26.73 and 35.56 parts per about 4,000,000 of dry soil. In Bulletin 26 there are also given data from various sources regarding drainage waters from England, analyzed by Way, Frankland and Voelcker, all of which show strong differences in the concentration of soil moisture as it leaves natural field soil by way of underdrains. It must be conceded, therefore, that there is no good foundation in observation or, indeed, from *a priori* considerations, for the contention that all soil solutions have essentially the same composition and concentration when viewed from the standpoint of their function in plant growth.

Soluble Salt Content of Soils in Relation to Yield of Crops.

It is further contended, from data presented in Bulletin 22, that there is no apparent relation between the yield of crops and the soluble salt content of soils and the statement is quite true when thus based. But it should be generally understood that were the converse of this contention very strongly marked such data as are collected and presented in Bulletin 22 must be expected to fail utterly to reveal the fact. These are the facts regarding the data used: (1) Assumed, not measured, yields of crops form the basis of comparison; (2) single and isolated soil samples for determination are taken to reveal field conditions, which they seldom do closely; (3) much of the chemical work was done outside the laboratory under conditions prohibitive of the necessary accuracy; (4) duplicate solutions prepared from the same sample of soil are recorded as differing by as much as 6.38 and 12.34 parts per million for PO_4; 3.15 and 23.39 for NO_3; 9.43 and 15.33 for K. It would be strange indeed if, under such conditions, anything but a medley of results were secured.

But the results of a whole season of much more critical and reliable work along these lines which preceded the gathering of the data in Bulletin 22 and a second year's work following this, still more critical and exhaustive, are left out of consideration wholly in reaching the conclusion under discussion. The first year's work referred to pointed strongly to the conclusion that, where other conditions of growth are equally favorable, the largest yields of crops are not only associated with the soils yielding the largest amount of water-soluble salts, but that the sap of crops growing on such soils is also richer in the same salts. In other words, it had been shown that on soils from which the largest amounts of water-soluble salts could be recovered more of the same salts were carried in the sap of the plants growing upon these soils, and the data may be found in Bulletin No. 26 of the Bureau of Soils, in which the letter of transmittal acknowledges the accuracy of the data but rejects the conclusions drawn therefrom.

The second year's work, whose results are throughout in accord with those of the first year, show the following relation between yields and the water-soluble salts which had been recovered from eight soil types upon which two crops were grown to maturity under normal field conditions and where the yields were accurately determined by weighing. The soil types used were selected with a view to having those of different productive capacity, and four of those were rather above, and the other four rather below, the average of good soils. Taking the yields and the water-soluble salts recovered from the poorer soils as 100, the relations found are as stated below:

	Four Poor Soils	Four Good Soils
N+P+K in samples once washed..	100	188.5
N+P+K in " 11 times " ..	100	193.1
Yield of shelled corn............	100	191.7
Yield of potatoes................	100	271.4

It is here clear that there is a marked increase in yield, both of corn and of potatoes, where the water-soluble salts carrying nitrogen, phosphorus and potassium are present in largest removable amounts, whether this is shown by one or by eleven washings of the same sample.

Not only was this strongly marked relation shown to exist when the soils are thus grouped, but four equal areas of each of the eight soil types were treated to 300 pounds of guano and other fours to 5, 10 and 15 tons of stable manure respectively, and the differences in recoverable water soluble salts determined throughout the season, together with the yields of corn and potatoes, with the results given below. In this table each value is a mean from 32 field plots.

	Soluble N + P + K	Yield of Corn	Yield of Potatoes
No fertilization ...	100	100	100
300 pounds guano..	103.1	110.5	117.2
5 tons manure....	106.8	120.9	131.7
10 " "	109.7	135.9	141.9
15 " "	113.5	140.0	157.4

It is thus here shown that with each increase in the amount of the three plant food elements which could be recovered from the soil there was a regular and corresponding increase in the yield of each of the two crops, the gain in the corn being almost directly proportional to the increase of the three plant food elements recovered by water from the soil. With data thus strongly indicating larger yields associated with increasing amounts of water-soluble salts recovered from the soil, collected before the data of Bulletin 22 and confirmed by a second year of still more critical work, the whole work is ignored and the reverse relation held to be demonstrated by data of the character stated.

Soluble Salt Content in Soils Constantly Maintained.

This is another of the contentions woven into the fabric of Bulletin 22 but without basis in recorded data other than that spread upon its pages in the form of analyses of some Rothamsted soils which are offered to introduce the statement "that the decreasing yield from the continuously unmanured wheat plot has not been due to a loss of water soluble material, or rather that there has been no permanent disturbance of the solution equilibrium and concentration," citing especially the bureau's analyses of soils from plots 3 and 11 of the Broadbalk field. Such data are given in evidence, utterly ignoring the detailed, full and careful data published from the Rothamsted laboratories pointing strongly to the very opposite conclusion, as may be seen from the tables, Bulletin 26, Bureau of Soils, pp. 23, 24, 80, 83. The detailed analyses of the soil solutions leaving the Rothamsted plots as drainage water show that that from the plot continuously unfertilized are not only the least concentrated of any in the whole series of 16 plots, but that the total solids in solution from this plot stand as 246.4 to 425.9 coming from plot 11, or as 100 to 173, while the relative mean yields of wheat stand as 100 to 215. Moreover, there is a remarkable and clear relation between the yields of nearly all of the plots of this series and the concentration of the drainage water leaving the respective plots, the yields generally increasing with the soluble salt content of the drainage water. Not only is this true for the total soluble salt content, but the amount of potash carried in the drainage water coming from the plots to which potash fertilizers have been continuously applied, when compared with that from those to which none has been given, stands in the ratio of 425 to 100, as an average, and there is no individual exception.

Such, in brief, is the character of the data spread out by Whitney and Cameron in Bulletin 22. Thus did they ignore pertinent, undoubted facts collected by the bureau or published elsewhere, tending to disprove their views. Such is the almost utter lack of evidence collected either by the bureau or by others which may fairly be placed in support of their main contentions, and yet no work has since been done, or at least published, which can be placed in support of these views. On the contrary, the energy of the bureau is being expended in an effort to accumulate data in support of the theory that poor and runout lands are so because of the accumulation in them of imaginary toxic substances. Bulletins 36 to 40 record their most strenuous efforts along this line.

Toxicity as a Factor in the Productive Capacity of Soils.

In Bulletins 36 and 40 are given general reviews of literature relating to this subject, and in these and No. 28 the main body of experimental data thought to support the theory that soils are rendered unproductive by poisonous excreta thrown off by the roots of higher plants. However plausible and attractive such a theory may appear, a review of the data and discussions presented will convince the unbiased student that little has yet been done which may properly be considered other than speculative contributions to the subject. As pointed out, the main contentions of the Bureau of Soils supposed to make the consideration of the toxicity factor pertinent are not supported by its own work or that of others and are not true. It has made no discovery, therefore, demanding such a factor; but while this fact should be clearly recognized, it may be well to retain the old theory in the list of alternative working hypotheses, although it must be conceded to offer less of promise than many others or than it did when originally proposed, for our present knowledge makes it quite uncalled for in explaining observed relations.

But were it true that toxic excreta do play an important rôle in rendering soils unproductive, it must be admitted that nothing yet has been published, either by the Bureau of Soils or others, to which reference is made by the bureau, which should in any sense be regarded as proof. Indeed, much of the bureau's data can hardly rank as even suggestive evidence regarding the existence of such conditions in the field; because nearly all of the work has been done with seedlings placed under extremely cramped, abnormal and unsanitary conditions, the plants fed chiefly by the small amount of nutrients stored in the seed, and the experiments terminated after a few days or at most after two or three weeks. In illustration, take the experiments with agar agar, where wheat seedlings are grown inside of glass tubes with inside diameters less than that of an ordinary lead pencil (6 to 8 mm.) and 3.3 cm. long; three such tubes placed end to end, supported on a glass rod with their ends separated 2 to 3 mm., thus forming a segmented tube to be filled with transparent agar agar, solid when cold, and standing in similar agar contained in a glass vessel, the whole system arranged to be revolved on a klinostat to neutralize the directive effect of gravity. When previously germinated wheat plants are transplanted into the agar inside one of these tubes before it has solidified, and compelled to grow with its roots thus circumscribed it is held that if toxic excreta are developed they will become so potent as to compel the roots, when they reach a gap between two segments, to turn from their course along the axis of the tube and grow outward into the fresh uncontaminated agar of the outer vessel. It is assumed that if more roots turn outward, the presence of a toxic substance is demonstrated, and further, that the toxic substance was excreted by the roots and is a normal and necessary function under field conditions.

Plants were grown in free agar in large numbers until the roots, by assumption, had charged it with toxic substances; such agar was then remelted and filtered and used to fill other tubes or to surround tubes containing fresh agar, the contention being that if the outside agar is more toxic than that inside the tube a smaller number of roots would grow outward into the poisoned agar. Just why any should grow outward into the poisoned agar is not made clear; probably it is because those particular roots had rendered the immediate contact agar more toxic than that outside! But seriously, the experiments would seem to be quite as conclusive a proof that the roots growing inside the tube, or growing in the free agar, have reduced the water content of the agar or its soluble salt content and that the roots simply turned one or the other way according as available water or soluble salts are more abundant. Our own observations have shown that plant slips placed in water containing sugar, dextrine, agar agar in the condition described by the Bureau of Soils, and even in water holding suspended clay, wilt sooner or become less turgid than check slips placed in pure water, thus indicating that water is less readily obtained under those conditions. It is certainly to be expected that when as many wheat roots grow under such cramped conditions as are here under consideration, as are reported in the bureau's experiments, there must be developed a stress for water and it seems just as rational and quite as certain that the deflection of the roots may have been due to this condition. The growing of large numbers of plants in free agar agar would certainly reduce the per cent. of water and the melting of it over would reduce it still further. As it is not said that strict quantitative measures were taken to secure absolute equality of water and salt content between the inside and outside agar, the results are subject to the same interpretation as that suggested. These ingenious experiments, therefore, can not be seriously held to demonstrate that roots excrete toxic substances, neither can it be held that even if toxic substances were developed as either normal or abnormal conditions the deflection of the roots was due to them, and there is nothing in the whole range of experimental work covered by the three bulletins in question which can be held to establish, or even necessarily suggest, a probability of toxic substances in soils which seriously affect their productivity.

The loose reasoning here referred to, and characterizing the whole of Bulletin 40 and indeed of the other two as well, appear, to the writer, so out of accord with the planning and execution of these particular experiments with agar agar, when coupled with our personal acquaintance with the one whose name appears as senior author, that we are unable to feel that either the language used or the conclusions drawn are his. This I do know: It was my great surprise and misfortune, after having submitted manuscript for publication, to find my own name on the printer's proof as joint author of Bulletin 22, maintaining views directly opposed to those we had submitted and which had been laid aside, not to be published "until after the bureau had expressed its views." This much in justice appears necessary to avoid placing criticism where it may not belong. It can never be the privilege of the head of a government bureau to subscribe the names of subordinates to views he knows they do not hold. Indeed, the interests of science, if not a sense of justice, should impel any chief to encourage in his subordinates the greatest freedom of expression of views on scientific problems of investigation and to avoid in every way indicating the supposed trend of lines of experimentation from which data are sought.

The true character of some of the more recent evidence being presented in defense of Bulletin 22, along the line of toxicity studies, can be better understood from the closing sentence in Cameron's preface to Bulletin 28, when the facts in the case are known. Cameron says:

> The authors of the present paper have had a leading part in the development of the work which the bureau has been conducting along these newer lines of soil investigation, and it is believed that the description of the investigations which have made possible the production of a luxuriant lawn upon a naturally unproductive soil at Takoma Park, Maryland, as well as helped in a very large measure in the development of our present views concerning soil fertility, will mark a decided step forward in soil studies and prove suggestive to other investigators in this most important branch of applied science.

The facts regarding the investigations "*which have made possible the production of a luxuriant lawn upon a naturally unproductive soil*" in Professor Whitney's front yard in Takoma Park, as pointed out by Cameron, are these: In August, 1904, the area to be treated was dressed with stable manure at the rate of about forty tons per acre and the soil, which at the time was filled with a dense network of tree roots, many of them large, making it difficult to dig, was spaded and then seeded to lawn grass which came up and, during the fall, looked well. Cameron thought he saw the utter rout of the bureau's toxicity demon from this lawn and the transformation of a "*naturally unproductive soil*" into one of rare fertility. But the severe root pruning and the loosening of the soil incident to spading in the manure, combined with the fall rains and cool weather which gave the grass seed exceptional facilities for growth, at the same time provided excellent opportunity for the development of new and active tree roots, as was later discovered by the bureau; and early in the spring of 1905, as reported in Bulletin 40, the ground became "almost completely filled with young active growing tree roots." The plain and simple fact is, these roots so thoroughly sapped the soil of its available moisture, rendering it so hard and dry, that early in May the grass had died. Nevertheless the preface was allowed to stand.

The new roots in the lawn soil were discovered and the thought at once arose "*that these might exercise some malignant effect upon the growth of grass.*" Five full tablespoons of soil each were effectually paraffined into the standard wire baskets; in these were carefully transplanted young trees of pine, maple, tulip, dogwood and cherry, two baskets being reserved without trees as checks. This done, equal numbers of germinated wheat seedlings were set out about the trees in the baskets and allowed to grow two to three weeks, replanting as the stress became too severe, until at the end of the season 81 trials had been made under such rigid laboratory control—and with the remarkable result that in all but 10 of the 81 trials the green weight of the wheat trials was less where the wheat grew under the trees! Moreover, the bureau wisely observes, this reduced yield occurred in spite of the fact that the roots of the several wheat crops were left in the soil, which must have acted as green manure and thus tended to counteract the deleterious effect of the tree roots on the wheat (p. 19, Bull. 40). Then again, and with characteristic logic, the better growth of wheat under the trees in the last three crops is ascribed to the trees passing into the condition of winter rest.

It is thus the pages run on and one bulletin follows another, all having the same indecisive and misleading character; all clearly bearing the stamp of two minds, although different authors may be assigned on title pages. If the bureau really has faith in its utterances, why will it not rise to the stature of serious work and get out upon some field with appliances which will enable it to extract from one or more of its highly unproductive soils the toxic substances about which it has written so much and yet in reality accomplished almost nothing? This the farmers of the country have a right to demand, or else that it shall turn at once its energies into channels which have more of promise.

Since writing the above there has been issued from the bureau (November 6) another bulletin, No. 47, along the same line, under the title "Certain Organic Constituents of Soils in Relation to Soil Fertility" which, not to be misleading, and to be true to the subject-matter presented as well as to the facts as known with which the bulletin deals, should read *Certain Organic Constituents in Plants in a Possible Relation to Soil Fertility;* for although it is stated (p. 9) that "The toxic properties of soils have been demonstrated and the existence of toxic bodies is a reality with which it is necessary to deal in future soil studies on the fertility and infertility of our agricultural lands," and further along it says (p. 12): "It has been demonstrated by the studies described in this bulletin that substances commonly used as fertilizers in agricultural practise have in addition to their function as plant nutrients a well-defined power to overcome and actually destroy toxic bodies," yet the facts are nothing which the bureau has yet published can be considered strictly as *demonstrating* either of these propositions even under the strained and highly abnormal conditions of the experiment cited, not to say what does occur under normal field conditions.

In these experiments, as heretofore, ten wheat seedlings are grown but six to thirteen days in solutions contained in 250-c.c. salt bottles, depending for nourishment upon materials stored in the seed, while the chief criteria for differences in growth have been the very misleading and indecisive quantities of transpiration or of green weights, whereas, in such experiments as these, it is perfectly feasible to determine precisely the increase in dry weight, both in tops and roots, and thus obtain quantities which can not be misleading, as those used are known to be, and so acknowledged at page 15 of the bulletin. Moreover, in each of the experiments cited with tyrosine, choline, piperidine, quinone, vanillin, cumarin, cinnamic acid, esculin and heliotropine it is quite as rational to assume as another, among several alternative hypotheses, that the real effect of these substances, instead of being in any sense toxic to the wheat plants, has been to simply diminish the rate at which the stored nourishment in the seed was rendered soluble and available to the growing seedlings. Indeed, the coating of the roots in several of the cases, as cited in the bulletin, suggests that the substance of the kernels may have been markedly affected in such a way as to have retarded its transformation into available plant food, and the failure of the roots to develop into the solution may quite as well have been due to a lack of dissemination of plant food, so that there was little to stimulate root development in those cases, for it is a fact well established by observation in the field that the roots of crops develop most strongly into portions of the soil where nutriments are most abundant and available. It would clearly be a waste of energy and of food materials for a plant to develop its roots into a non-nutritive solution and these experiments were never continued long enough to have developed a stress for water. It is worthy of note in this connection that often there was associated with the substances used a relatively less root development than of top if we may judge by the appearances of the illustrations, supplemented by definite statements to this effect in the text. It is greatly to be regretted that where so much pains has been taken to accumulate data and where the dry weights of the roots and of the tops could with ease and exactness have been determined, it was not done, as the extra time, expense and labor are not worth considering in view of the increased value of the data which would have resulted. We speak advisedly on this point because we have done a large amount of work along the lines of transpiration and green weights in plants in relation to the dry matter produced, the observations covering the full life of the crop, coming to complete and normal fruitage.

In the case where wheat seedlings were grown a second time in the same supposedly toxic solutions a better growth would be expected if these substances had the effect of simply rendering the nutrients of the kernels less readily transformed into available food, and it is quite possible that crushed wheat kernels placed in these solutions, thus eliminating the vital activities of seedlings, might have affected them as favorably as did the growth of the first crop and might have caused a disappearance or a reduction in the amount of the toxic substance. These experiments, therefore, can not be considered fully demonstrative. For the same reason, and because transpiration is not a measure of growth, the experiments with nitrates and with lime are also inconclusive.

But granting that the data of Bulletin 47 do demonstrate that the substances experimented with are truly toxic to wheat seedlings under the highly cramped and abnormal conditions of the experiment, it will be conceded quite rash to affirm that these substances in like quantities would be found similarly toxic in the soil under field conditions until it were known, not only that such substances do exist in the field soils, but also that they are more abundant in those which are unproductive.

The unwarranted publication of such positive conclusions as those quoted becomes still more evident when an effort is made to give quantitative expression to the recorded data of Bulletin 47 in terms of field conditions correlated with other contentions of the Bureau of Soils. It is maintained by the bureau, but without sufficient evidence, that the capillary movement of soil moisture under crop conditions is of negligible magnitude and that for this reason the roots of crops, in order to secure moisture and plant food and also in order to place the active absorbing root tips into fresh soil not poisoned by their own excreta, are compelled to constantly advance into previously unoccupied soil, and they are known to spread throughout a depth exceeding three to four feet in the case of most crops. The toxic substances of unproductive soils must, therefore, be deeply distributed throughout the root zone and to a depth of at least four feet. But the strongest solution used in the experiments of Bulletin 47, of 1,000 parts per million, means not less than 2,800 pounds per acre of field where the water content of the soil is 20 per cent. and it would mean 700 pounds per acre for the surface foot alone. In the case of 100 parts per million the amounts would be 70 pounds and 280 pounds per acre for depths of one and four feet, respectively. In the light of failures up to the present time to isolate these toxic substances from soils it will hardly be seriously contended that any such large amounts of toxic substances do exist in unproductive soils. But the smaller amounts experimented with, as recorded in Bulletin 47, either had little or no effect or they produced positive increases in growth. If, therefore, the data of the bureau along this line of toxic substances are to be given serious consideration at all, Bulletin 47 must be regarded as suggesting that on account of the probably small amounts of these toxic substances present in soils, and on account of their observed small, or else stimulative, effect when present in such quantities, toxic substances are either negligible factors in soil fertility or else they are beneficial to crops.

F. H. King

Madison, Wis.

SPECIAL ARTICLES

A NEW APPARATUS FOR MEASURING ELECTROLYTIC RESISTANCE[1]

The measurement of electrolytic resistance differs from that of a metallic conductor in several respects. The most evident difference is that the electrolyte has no definite shape or size. Cells of various forms have been devised to hold the solution while it is being measured and I would hardly venture to add another to the list were it not for the fact that the

[1] Paper read before Section B of the American Association for the Advancement of Science and the American Physical Society in joint session, Chicago, December 31, 1907.

form shown in Fig. 1 has proved so very useful in the laboratory and also that several teachers who have seen the apparatus have desired a duplicate for their work. And there may be others who would find such a cell as useful as this one has been.

The principal object in the design of this cell is to present the concept of "molecular conductivity" of an electrolyte in such a clear and concise form that no one who is capable of making electrical measurements can misunderstand it. The apparatus consists of a strong glass tube provided with a small side tube for filling. Both ends are ground plane and closed by platinum-faced electrodes, the whole being firmly clamped together in a suitable framework. Good insulation between the electrodes is provided by making a portion of this framework of ebonite, as shown in the figure. Crushing strains due to the unequal contraction of glass and metal are avoided by

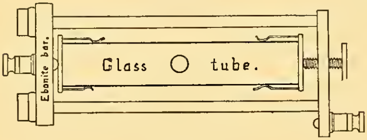

Fig. 1

the use of heavy rubber washers, one on each side, which take up the extra length without much increase in pressure. It has been found that a moderate pressure is sufficient to prevent leakage between the ends of the glass tube and the mental electrodes. The apparatus is supported by four short legs not shown in the figure.

The resistance of the column of liquid contained in this tube is measured by the method of Wheatstone's bridge, using a telephone and alternating current. The specific resistance, s, of such a conductor has the same meaning as for a metallic wire and is given by the same relationship,

$$s = r\,A/L,$$

where A is the cross-section and L the length of the column whose resistance is r ohms. Both A and L can be measured directly, and each has a very definite and unmistakable meaning which is readily understood by the student. This can not be said regarding the equivalent "constant" of a cell which has no definite dimensions.

The specific conductivity, c, or the conductivity of a centimeter cube of the solution from one face to the opposite one, follows at once as the reciprocal of this. Or

$$c = 1/s = L/rA.$$

Since the conductivity of an electrolyte depends upon the amount of the substance in solution—that is, upon the number of ions per cubic centimeter—if the conductivities of different solutions are to be compared it is necessary to express the concentrations in comparable terms. This is usually done by stating the number of gram molecules, m, of substance that are dissolved in each cubic centimeter of the solution. The molecular conductivity, μ, of an electrolyte is then defined as the conductivity of a centimeter cube of the solution per gram molecule of salt within this cube. In symbols,

$$\mu = c/m.$$

Presented thus there is rarely a student who does not understand from the first the meaning and significance of the molecular conductivity of an electrolyte. No claim is made that this apparatus is specially adapted for refined research or that it is the best form for the expert. For example, it can not well be placed in a constant temperature bath as is necessary for all refined measurements. But nevertheless when working at room temperatures, and using solutions which have stood in the same room for some time, very satisfactory results can be obtained, and for the purpose for which it was designed this apparatus has met every requirement.

Arthur Whitmore Smith
University of Michigan

THE AMERICAN ASSOCIATION OF MUSEUMS

The American Association of Museums will hold its third annual meeting in Chicago, May 5–7, as the guest of the Chicago Art

Institute, the Field Museum of Natural History and the Chicago Academy of Sciences.

In addition to the usual program of papers, three special features are proposed for the meeting:

1. *An exhibit of museum devices.* This is intended to include devices of all kinds which, whether original or not, have proved useful in various museums.

2. *A discussion of the future work of the association.* An effort will be made to determine the advisability of undertaking certain lines of work which have been proposed. Among these the most prominent are:

(*a*) Publication of a Directory of American Museums of Art and Science. The secretary will submit data concerning the cost and scope of this work and general discussion of these data is desired.

(*b*) Publication of an annual table of museum statistics, either as a supplement to the directory of museums or independently.

(*c*) Establishment of a bureau of information and permanent exhibit of museum technique, to which museums would contribute plans of buildings and cases, samples of labels and other devices of installation, etc., and to which museums may apply for information on matters of museum practise and perhaps for loan of samples.

(*d*) Advisability of publishing a journal.

3. *A general discussion of topics of special interest.*

(*a*) Educational work of museums. In view of the wide interest manifested in various phases of the educational work of museums, the time seems ripe for a general discussion of the relation of educational work to other museum functions and for a concise review of the educational work actually being done, with a discussion of practicable means of cooperation between museums. It is desired that this discussion shall serve to define the attitudes taken by the various classes of museums of art and science to this subject.

(*b*) Reciprocal relations between museums in securing the services of lecturers and experts, in carrying on field explorations, and in exchange of economic and educational collections.

(*c*) Adaptation of buildings to museums, including a discussion of floor plans, natural and artificial lighting, and the general arrangement of exhibits and grouping of subjects. Exhibits of floor plans will facilitate discussion of this subject.

(*d*) Methods of exhibiting valuable books.

(*e*) Advisability of free distribution of museum publications.

Members who attend the meeting are requested to come prepared to discuss these subjects and to contribute to the exhibit of museum devices whatever is likely to be of interest to others. Inquiries and suggestions may be addressed to the secretary.

Announcement of headquarters and other details will be made shortly by the entertainment committee.

Paul M. Rea,
Secretary
The Charleston Museum,
Charleston, S. C.

SCIENTIFIC NOTES AND NEWS

As a matter of information for those who plan to attend the summer meeting at Dartmouth College, beginning on June 29, the local committee thinks it proper to mention the facilities for reaching that place. The railroad station is known as "Norwich and Hanover" on the Passumpsic Division of the Boston and Maine Railroad. White River Junction, four miles south of Hanover, is the center of four lines of railroad: The Concord Division of the B. & M. system; the Central Vermont Railroad and the Connecticut River Division, B. & M. R. R. (eight hours to New York) and also connecting at Greenfield and Springfield (Boston and Albany R. R.) for the West; the Central Vermont Railroad, making connection with Montpelier, Burlington and the West (thirty hours to Chicago); the Passumpsic Division, B. & M. R. R. (eight hours to Montreal). It may be added for the benefit of members who would come by way of New York that the White Mountain express will probably be put on for the summer about that time. This train has heretofore left New York at 8:40 A.M., and is due at Hanover Station at 4:45 P.M.—a through train from

New York without change of cars. The regular fare is about $5.85, the distance 265 miles.

The summer meeting of the American Chemical Society will be held in New Haven on Tuesday, Wednesday and Thursday, June 30, July 1 and 2.

The celebration of the hundredth anniversary of the birth of Charles Darwin and the fiftieth anniversary of the publication of "The Origin of Species," planned by Cambridge University, will be held on June 22, 23 and 24, 1909. Arrangements are being made by the New York Academy of Sciences and by Columbia University to celebrate the hundredth anniversary of Darwin's birth on February 12, 1909. This is the birthday of Lincoln as well as of Darwin and, being a public holiday in New York State, will give a suitable opportunity for the celebration.

Nature states that Lord Rayleigh will probably be elected to the vacant chancellorship of the University of Cambridge in succession to the late Duke of Devonshire. Lord Rayleigh was professor of experimental physics at Cambridge from 1879 to 1884.

On the nomination of the Prussian Ministry of Education Dr. Max Verworn, professor of physiology at Göttingen, has been appointed to be Kaiser Wilhelm professor at Columbia University for the year 1908–9.

Dr. Robert Koch arrived at New York from Bremen on the *Kronprinzessen Cecilie* on April 7. The German Medical Society gave a banquet in his honor on April 11.

Professor A. Crum Brown, F.R.S., professor of chemistry in the University of Edinburgh, proposes to retire from the chair which he has occupied since 1869.

The British Society of Dyers and Colorists met on April 3, at Bradford, when the president, Professor R. Meldola, F.R.S., delivered his presidential address on "The Founding of the Coal-tar Color Industry." The first awards of the Perkin medal were made to Professors C. Graebe and C. Liebermann for their synthesis of alizarin.

In commemoration of the twenty-first anniversary of Sir William Ramsay's election to the chair of chemistry in University College, London, the professors of the college entertained him at dinner on March 18. The provost, Dr. T. Gregory Foster, was in the chair, and covers were laid for eighty guests.

April 9 marked the twenty-fifth year of service in the United States Department of Agriculture on the part of Dr. Harvey Washington Wiley. An appreciation of his work was evidenced in a dinner given him on the anniversary at Hotel Astor, New York City. About two hundred prominent members of the chemical profession attended. The officials of the committee in charge of the dinner were, Professor Charles Baskerville, chairman; Dr. Walker Bowman, secretary, and Mr. Maximillian Toch, treasurer. Dr. William J. Schieffelin acted as toastmaster. Many prominent chemists spoke, congratulating Dr. Wiley on completing a quarter of a century's work for the government in behalf of its people. An embossed album with the signatures of those attending the dinner was presented to him.

According to foreign journals the Paris Academy of Sciences has appointed a committee, composed of MM. Becquerel, Bouquet de la Grye and Poincaré, to consider a suggestion by M. Bouquet de la Grye concerning the application of wireless telegraphy to the problem of the determination of longitude at sea. The idea is to utilize the wireless telegraph station of the Eiffel Tower in order to send, for instance, every night at midnight a Hertzian signal giving the time of the meridian of Paris. M. Bouquet de la Grye thinks that if a station were established at the Peak of Teneriffe signals could be detected completely around the earth.

The ninth lecture in the Harvey Society course will be given at the New York Academy of Medicine building on Saturday evening, April 18, at 8:30 p.m., by Professor Alonzo E. Taylor, University of California. Subject: "The Rôle of Reversed Ferment Reactions in Metabolism."

A bill has been passed by the Virginia legislature establishing a Virginia State Geological Survey. The bureau is to have its headquarters at the University of Virginia, and the board is to be composed of the governor (*ex officio*), the president of the university, the president of the Virginia Polytechnic Institute, and two citizens. An annual appropriation of ten thousand dollars is provided.

By the conjoint action of the National Academy of Sciences and of the trustees of the Elizabeth Thompson Science Fund a table has been secured permanently for the use of American investigators desiring to work at the International Scientific Station on Monte Rosa. This station offers facilities for work in physics, meteorology and physiology, but any appropriate research may be carried on there. The right of appointment to the American table vests in the trustees of the Thompson Fund. Applications for appointment should be addressed to the secretary, Dr. Charles S. Minot, Harvard Medical School, Boston, Massachusetts.

A movement is under way to secure the use of the new congressional office building or a part of the capitol to house the International Congress on Tuberculosis that is to be held in Washington next September. A great exhibition illustrative of what is being done, the world around, in the fight against the disease, will be held in connection with the congress, and the two will continue from September 21 to October 12.

The International Congress of Navigation, which is to be held in St. Petersburg in June, is organized by the International Association of Congresses of Navigation, which has its permanent commission in Brussels, composed of delegates from the various states that have joined the association. The chief aim of the congress will be the consideration of questions connected with river and canal navigation and the industrial and commercial use of waterways and seaports.

The Paris Academy of Sciences has received a legacy of £400 from M. Sabatier to found a biennial prize to be known as the Sabatier prize.

Advices from Sydney state that the zoological gardens there are at present particularly interesting to visitors by reason of the inclusion of over 100 rare birds and animals destined for the London Zoological Society's show at the Franco-British Exhibition this summer. These specimens will be shipped for England by a steamship scheduled to sail from Sydney on April 11 and due in London on June 7.

UNIVERSITY AND EDUCATIONAL NEWS

Princeton University has received $250,000 from Mrs. Russell Sage for a freshman dormitory. The university has also received $130,000 from other sources, including over $50,000 from the General Education Board.

Columbia University has received $100,000 from the children of the late Rev. Orlando Harriman, who graduated from Columbia in 1835, to be used for the endowment of a chair in English. Other gifts to the university, amounting to $40,000 are also announced.

The medical schools of Indiana University and of Purdue University will be united and conducted under the charge of Indiana University. A complete medical course of four years will be conducted at Indianapolis, while the first two years will also be given at Bloomington. It will be remembered that Purdue University, which is primarily a school of engineering, was instrumental in consolidating various proprietory medical schools at Indianapolis, where Indiana University also conducted a medical school. There had been some conflict between the two schools, and it is fortunate that Indiana will now have a strong medical school under the auspices of its state university.

Mr. George S. Davis, associate superintendent of schools in New York City, has been chosen president of the New York Normal College. The salary of this position is $8,250 with an annuity of $5,000.

The Rev. Dr. S. Parkes Cadman, of Brooklyn, has declined to become president of Wesleyan University.

Dr. M. E. Wadsworth, dean of the School of Mines and professor of mining and geology in the Pennsylvania State College, was elected last year as dean of the School of Mines and professor of mining geology in the Western University of Pennsylvania. The call was accepted with the understanding that he was to hold both positions and to discharge the necessary duties of both until September 15, 1908, when he would take up his permanent residence in Pittsburgh. The Western University having purchased a new site near the Carnegie Institute and the Technical Schools, Dr. Wadsworth has completely reorganized the School of Mines and prepared plans for the new $175,000 mining building, which is to be erected next summer. During the less than seven years of Dr. Wadsworth's charge of the School of Mines at the State College it has been raised from the nineteenth to the sixth in size in the United States. It has been completely reorganized and now has some of the most advanced courses of any school of mines.

Professor H. A. Winkenwerden, of the U. S. Bureau of Forestry, has been appointed professor of forestry at the Colorado School of Forestry, Colorado Springs, in place of Professor J. F. Baker, who has resigned. The curriculum of the school has been considerably enlarged, and, beginning in 1909, it is to be extended to cover four years and to lead to the degree of bachelor of forestry. The summer course will be continued as heretofore, both as a required part of the regular curriculum and as a separate course for special students, but the length of this course has been reduced to two months. During the coming summer extensive experiments on the growth of yellow pine will be begun by the school in cooperation with the U. S. Bureau of Forestry, on the Manitou Park Reserve belonging to the school.

New York University has appointed as professor of pathology and director of the laboratory of pathology of the University and Bellevue Hospital Medical College, Dr. Richard Mills Pearce, Jr., of Albany. Dr. Pearce received his degree from the Harvard Medical School in 1897. Subsequently he studied at the University of Leipsic. He was resident pathologist at the Boston City Hospital 1896–9; instructor in pathology at Harvard 1899–1900; demonstrator and later assistant professor of pathology in the University of Pennsylvania, 1900–3, and since 1903 has been director of the Bender Hygienic Laboratory at Albany; director of the bureau of pathology and bacteriology, New York State Department of Health; professor of pathology and bacteriology at the Albany Medical College.

Mr. A. O. Lovejoy has accepted a call to the professorship of philosophy in the University of Missouri, and will therefore sever his connection with Washington University, St. Louis, at the close of the current academic year.

H. B. Alexander, A.B. (Nebraska, '97), Ph.D. (Columbia, '01), now engaged in literary work at Springfield, Mass., has been elected professor of philosophy at the University of Nebraska.

The following promotions have been made at Harvard University: W. E. Castle to professor of zoology, H. J. Hughes to be assistant professor of civil engineering, John Warren to be assistant professor of anatomy. David Cheever to be demonstrator of anatomy and J. H. Woods to be assistant professor of philosophy.

President E. R. Nichols, of the Kansas State Agricultural College, has resigned, the resignation to take effect July 1, 1909. Professor C. H. Burkett, director of the experiment station, and Mrs. H. W. Calvin, professor of domestic science in the same institution, have also resigned their positions.

Mr. R. H. Biffen has been elected to the recently established chair of agricultural botany at Cambridge University. Mr. Biffen is, as recorded in *Nature,* the author of numerous papers, the earlier of which dealt with the preparation of india-rubber and the coagulation of latex, and he has devoted a great deal of attention to fungi. His researches on the hybridization of wheat and barley have attracted the attention of civilized governments throughout the world, and attempts have been made to induce him to leave England and place his services at the disposal of at least one foreign government.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, APRIL 24, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION K—PHYSIOLOGY AND EXPERIMENTAL MEDICINE

SUMMARY OF THE PROCEEDINGS

THERE were four meetings of the section at the University of Chicago during convocation week, as follows:

First Meeting.—Manual Training School Building. Tuesday afternoon, December 31, 1907. Presiding officer: Vice-president Ludvig Hektoen. A large audience was present to hear the address of the retiring Vice-president, Simon Flexner, on "Tendencies in Pathology." (See SCIENCE, XXVII., p. 128, 1908.)

Second Meeting.—Physiology Building. Tuesday afternoon, December 31, 1907 (immediately after the adjournment of the first meeting). Joint session with the American Physiological Society. Presiding officer, Frederic S. Lee. Eight papers were read. (See the scientific proceedings.)

Third Meeting.—Reynolds Club Theater. Wednesday afternoon, January 1, 1908. Presiding officer, Vice-president Ludvig Hektoen. This session was devoted to a symposium on *Immunity* (see the scientific proceedings) and to the election of officers and other executive matters (see the executive proceedings).

Fourth Meeting.—Reynolds Club Theater. Thursday afternoon, January 2, 1908. Presiding officer, Charles E. Marshall. Joint session with the Society of

American Bacteriologists. Six papers were read. (See the scientific proceedings.)

EXECUTIVE PROCEEDINGS

The following officers were elected for the year 1908–9:

Vice-president of the Association and Chairman of the Section—William H. Howell.

Secretary—William J. Gies.

Sectional Committee—Ludvig Hektoen, vice-president, 1907–8; William H. Howell, vice-president, 1908–9; William J. Gies, secretary, 1905–9; J. McK. Cattell (one year); Frederick G. Novy (two years); Graham Lusk (three years); Jacques Loeb (four years); Charles S. Minot (five years).

Member of the Council—Edwin O. Jordan.

Member of the General Committee—H. T. Ricketts.

The following resolutions relative to research in tropical medicine were presented by the secretary, were unanimously recommended for consideration by the association and were ultimately endorsed by the association in general session:

Whereas: There exists at the present time in Panama an extraordinary opportunity for research work in certain phases of tropical medicine, through the existence there of well-equipped hospitals and well-trained medical men under the supervision of an expert sanitarian, himself a member of the Isthmian Canal Commission, and

Whereas: The solution of problems connected with this branch of medicine is of the highest importance to the welfare of this and other countries, be it

Resolved, That it is the sense of the American Association for the Advancement of Science that Congress at its present session should appropriate funds for the purpose of establishing a research laboratory on the Isthmus, to be devoted to the solution of existing problems in tropical disease.

SCIENTIFIC PROCEEDINGS

First Meeting.—Vice-presidential address: "Tendencies in Pathology," Simon Flexner. (Published in Science, this volume, p. 128.)

Second Meeting.—Papers in joint session with the American Physiological Society.

Program

"A Comparative Study of the Cilium as a Key to the Structure of Contractile Protoplasm," by C. F. Hodge and O. P. Dellinger.

"Daily Life of *Amœba proteus*," by C. F. Hodge, D. Gibbs and O. P. Dellinger.

(1) "The Reaction of *Amœba* to Stimuli of Small Area," (2) "The Effects of Prolonged Centrifugal Force on *Paramœcium*," by J. F. McClendon (by invitation).

"The Relation of Plasticity to Age in the Dancing Mouse," by R. M. Yerkes.

"The Bacterio-agglutinating Action of Lymph under Different Conditions of Lymph Formation," by B. Brande (by invitation).

"The Relative Hemolytic Action of Serum and Lymph under Different Conditions of Lymph Formation," by T. Hughes (by invitation).

"The Effect of Stimulation of the Vagi upon the Onset and Development of Rigor Mortis of the Mammalian Heart," by S. J. Meltzer and D. R. Joseph.

"The Osmotic Concentration of the Blood during Anesthesia," by A. B. Luckhardt (by invitation).

Third Meeting.—Symposium on Immunity.

Program

Introductory remarks by the chairman, Ludvig Hektoen.

"A Review of Anaphylaxis, with Especial Reference to Immunity," by M. J. Rosenau and John F. Anderson.

"Hypersusceptibility and Immunity," by Victor C. Vaughan.

"The Hemolysins of Animal Toxins," by Preston Kyes.

"The Differentiation of Homologous Proteins by Serum Reactions," by S. P. Beebe.

"On Spirochetal Immunity," by Frederick G. Novy and R. E. Knapp.

"Immunity in Rocky Mountain Spotted Fever," H. T. Ricketts and L. Gomez.

"Artificial Immunity to Glucosides," by William W. Ford.

"Virulence of Pneumococci in Relation to Phagocytosis," by E. C. Rosenow.

"The Mechanism of Streptococcus Immunity," by Gustav F. Ruediger.

"Immunity in Tuberculosis," by Mazÿck P. Ravenel.

"Chemical Aspects of Immunity," by H. Gideon Wells.

General discussion, in which many of the members participated.

ABSTRACTS OF IMMUNITY PAPERS

A Review of Anaphylaxis, with Especial Reference to Immunity: By M. J. Rosenau and John F. Anderson.

Anaphylaxis (ἄνα against, and φυλός guard or φυλάξις protection), also called the Theobald Smith phenomenon, hypersusceptibility, supersensitiveness, is a condition of unusual or exaggerated susceptibility of the organism to foreign substances. Anaphylaxis may be congenital or acquired; it is specific in nature. The condition of anaphylaxis may be brought about by the introduction of any strange protein into the body. Hypersusceptibility to proteins that are non-poisonous in themselves may readily be induced in certain animals.

An animal may be in a condition of hypersusceptibility and immunity at the same time. The two conditions are closely interwoven. The one may be dependent upon the other. Pirquet advises that the term *immunity* be limited to indicate the condition of complete resistance in which no clinical reaction occurs, when poisons (such as diphtheria, tetanus, etc.) are introduced into the organism. He suggests the term "Allergie" to indicate conditions of acquired immunity associated with anaphylaxis, such as that induced by vaccinia against variola, that of the luetic against syphilis, or of that produced by one attack of some of the acute specific infections. This condition of allergie manifests itself in the renewal of the infection in an entirely different manner from the reaction to the primary infection.

The tuberculin and mallein reactions are well-known instances of anaphylaxis. These substances are not poisonous when introduced into a healthy individual, but the tuberculous individual is anaphylactic to tuberculin and an individual suffering with glanders is in a state of hypersusceptibility to mallein.

The best studied instance of anaphylaxis is that produced in the guinea-pig by the injection of a foreign protein, for example, horse serum, egg white, milk, etc. Especial study has been made of the anaphylactic reaction of the blood serum of the horse, partly because that serum is so much used in serum therapy.

The first injection of horse serum into the guinea-pig sensitizes it to a subsequent injection of horse serum. A definite time must elapse—about eight or ten days—between the first and the second injections. A very minute quantity given at the first injection is sufficient to sensitize a guinea-pig.

The reaction is specific in nature. Guinea-pigs may be in a condition of anaphylaxis to three protein substances at the same time. The guinea-pig differentiates each anaphylactic-producing protein in a distinct and separate manner. This adds weight to our belief that profound chemical changes, perhaps in the central nervous system, constitute the essential features of the phenomenon rather than morphological alternations.

Hypersusceptibility to horse serum is transmitted from the mother guinea-pig to her young.

There are certain analogies between the action of tuberculosis (tuberculin) and serum anaphylaxis.

Guinea-pigs may be actively immunized against anaphylaxis. The immunity, however, can not be transferred passively to other animals in the blood serum or body juices.

Hypersusceptibility has an important bearing upon the problems of immunity. Anaphylactic symptoms may be produced in guinea-pigs by the protein extracts obtained from bacterial cells. In the case of typhoid and colon bacilli this is followed by a definite immunity. In the case of anthrax, however, immunity does not follow hypersusceptibility to the anthrax protein. We are therefore not dealing with a general law applicable to all infections, but with certain limitations as in the case of antitoxic immunity.

Hypersusceptibility and Immunity: Victor C. Vaughan.

In order that I may be correctly understood I wish to state at the beginning that in my opinion the mechanism of immunity to all infections and intoxications is not the same and the time has come when it is well for us to distinguish between the different forms of immunity. I believe that there is already sufficient ground to justify us in holding that there are at least three forms of immunity and these I would designate as follows:

1. *Antitoxin Immunity.*—The poison to which this form of immunity may be secured are the venom of serpents, the vegetable poisons, abrin and ricin, and the toxins of bacillus diphtheriæ, b. tetanus and b. botulinus. Possibly others may be added to the list. These poisons certainly belong to a distinct group. They resemble ferments in three striking particulars: (*a*) in aqueous solution they are destroyed by a temperature of 100° or less; (*b*) they are active in solutions so dilute that they do not respond to the three most characteristic proteid color reactions, the biuret, Millon and Molisch tests; (*c*) animals treated with successive doses at short intervals develop anti-bodies. For the present at least Ehrlich's theory must be regarded as the most satisfactory explanation of this form of immunity. There is no proof, so far, that either phagocytic action or proteid cleavage has anything to do with the production of this form of immunity.

2. *Phagocytic Immunity.*—This form of immunity has been most thoroughly studied with the cocci, and as we are to have two papers on it to-day I will refrain from expressing any opinion of my own on the subject.

3. *Lytic Immunity.*—This is generally designated as bactericidal or bacteriolytic immunity, but there is serious objection to the employment of either of these terms, for the following reasons: (*a*) bacterial proteids are not the only proteids that may be and are split up in the animal body. Most foreign proteids when introduced into the circulation directly and without previous subjection to the digestive juices undergo specific proteolysis, and this is true whether these proteids are living or dead. (*b*) The cleavage of poisons in the body is probably not confined to those of proteid composition. (*c*) The term bactericidal is inappropriate because the bacteria may be so altered chemically that they are robbed in part or wholly of their harmful properties and still are not killed. Examples of the persistence of specific bacteria in the body after recovery from the disease are well known and immunity to disease may coexist with the specific bacteria of that disease still living in the body. The bacterial proteid owes its poisonous action to its molecular structure and this may be so modified as to render the organism a comparatively harmless guest without destroying its life. (*d*) The term bacteriolysis is certainly inappropriate, first because all these poisons are not bacterial and second because the word bacteriolysis means that the bacterial cell is destroyed, and we have just seen that this does not happen in all cases. In view of the facts here briefly condensed I prefer the word "lytic" to designate this form of immunity. I am not altogether satisfied with

this term and hope that some one will suggest a better.

I desire it plainly understood that in what I am to say to-day about hypersusceptibility and immunity I am speaking exclusively of what I have designated as "lytic immunity." The following statements are based largely upon work done in my own laboratory and I will condense as much as possible; and in doing so my statements may seem dogmatic, for I can not take the time to prove each of them, but such proof may be found in the papers that have been published by my students and myself.

All true proteids contain a poisonous and a non-poisonous group and can be split into these groups by the action of dilute alkali in absolute alcohol at 78°. The presence of the amino-acid tyrosin is apparently essential to the poisonous group, and those albuminoids, such as gelatine, that do not contain tyrosin yield no poisonous group. So far we have tested more than twenty different proteids, bacterial, vegetable and animal, and all that contain the tyrosin group yield a poison. Please understand that I do not claim that tyrosin is the poisonous group, but I believe it to be a constituent of the poisonous body. The poison does not contain a carbohydrate or a nuclein group, the absence of the latter being demonstrated by the complete absence of phosphorus. The non-poisonous group consists largely of nuclein, the carbohydrate being a sub-group in the nucleic-acid molecule.

The poisons obtained from these different proteids, although not identical, are similar and probably owe their poisonous action to the same or similar atomic arrangement. Much of the poison is destroyed by our crude method of obtaining it. The effect of the poison on animals is characteristic or pathognomonic and manifests itself in three stages. The first is a period of peripheral irritation manifesting itself in animals by violent scratching and in man by itching, erythema or urticaria. The second may be designated as the period of depression with or without partial paralysis. The third or convulsive stage is characterized by more or less violent clonic convulsions, generally beginning with opisthotonos and terminating in death. These symptoms are identical both in character and in sequence whether induced in a fresh animal by the injection of the free poison or in a sensitized animal treated with the unbroken proteid. When a non-lethal dose of the free poison is given, the first and second stages only appear, and the same is true when a non-lethal dose of the unbroken proteid is administered to a sensitized animal. The proteid contains the poison, which can be extracted by chemical means. The free poison and the unbroken proteid in appropriate animals induce the same symptoms, in the same sequence and in the same time. There is therefore no more doubt that the animal that dies from the free poison and the one that dies from the unbroken proteid die from the same poison than there is that the man who dies from morphine and the one who dies from opium die from the same poison. The poisonous portions of these proteids produce no antibodies when repeatedly injected into animals, and only slightly increase the tolerance for themselves. Likewise they slightly increase tolerance for the unbroken proteid in sensitized animals. Even in this, however, their action is not specific. It seems evident from these findings that the poisonous or the toxophore group in the proteid molecule plays no part in the production of lytic immunity. In this respect the production of lytic and antitoxic immunity agree, but in the former there is no antitoxin formed.

When a foreign proteid is injected into an animal and a certain interval of time is allowed to elapse, a second injection of the same proteid is likely to cause the development of untoward symptoms and possibly death in a short time. These symptoms are exactly those which I have described as being due to the free poison, and I can see no reason for doubting that they are due to the same poison which is set free in the animal body by a cleavage process giving analogous but much more perfect results than those obtained by the action of alkali and alcohol in the retort. With some proteids, the first or sensitizing dose need not be the unbroken proteid, but its non-poisonous or haptophore group. For instance, the haptophore group of the egg-white molecule sensitizes to unbroken egg-white quite as well as the unbroken molecule itself does. If the proteid of the colon or typhoid bacilli be split into haptophore and toxophore groups and animals be sensitized with the former, such animals will bear several times the ordinarily fatal dose of the homologous living bacillus. An animal sensitized with the haptophore group of a dead proteid dies on the subsequent injection of the same proteid in unbroken form, provided that the time interval between these injections has been a certain minimum or greater, this minimum varying with different proteids. An animal sensitized with the haptophore group of the colon or typhoid bacillus survives a subsequent inoculation with the living homologous bacillus. These results have struck observers as being antipodal and so they may seem, when in one instance death results in an animal apparently perfectly normal and, in the other, an animal treated with a fatal dose of toxicogenic bacterium remains unaffected. The animal that has been previously treated with the egg-white haptophore is said to be in a state of hypersusceptibility or in an anaphylactic state (without protection), while the one that has received the bacterial haptophore is said to be immune. Yet, a close study of these two sets of phenomena will, I think, convince any one that the apparently antipodal are in reality identical. In both the process is certainly identical and consists in the cleavage of the molecule of the foreign proteid and the liberation of the toxophore group. How has the one animal been sensitized or brought into this state of hypersusceptibility and how has the other been immunized? Both of these conditions have been brought about in the same manner; indeed the processes are identical. In both there has been developed in certain cells in the animal body a specific zymogen, which on the second treatment is converted into a proteolytic ferment, and this splits up the proteid into its poisonous and nonpoisonous groups. The animal treated with the second injection of egg white is not killed unless the proteid given is sufficient in quantity to yield a fatal dose of the toxophore when it is split up, and the animal immunized to the typhoid bacillus is certainly killed if the inoculated bacilli be sufficiently numerous to yield a fatal quantity of the toxophore when their proteid substance is split up. Ordinarily more than a fatal dose of the dead proteid is administered at the second treatment and the animal promptly dies. What we call the minimum fatal dose of a bacterial culture does not contain enough toxophore to kill the animal, even without any acquired immunity, but it develops that amount during what we call the period of incubation, which in guinea-pigs inoculated with colon or typhoid bacilli means generally from ten to twelve hours. Now, it must be evident that if the proteid substance of the injected bacilli be split up before the living organisms have time to develop a fatal amount of the toxophore, the animal does not succumb to the inoculation and is said to be immune. By carefully regulating the size of the second dose one can develop in both the egg-white and the typhoid animals the first and second stage of the symptoms of proteid poisoning without reaching the convulsive stage.

The effect of the poison depends not only upon the amount set free, but also upon the rapidity with which it is liberated. The poison kills by its action on the respiratory center. This is demonstrated (1) by the continued beating of the heart for some minutes after respiration has ceased, (2) by the symptoms which are those of asphyxiation, and (3) by the post-mortem findings, such as a fluid state of the blood and the engorgement of certain internal organs with ecchymoses, as found by Gay and Southardt. I infer that the poison does not destroy the cells of the respiratory center, but puts them out of commission or interrupts their normal function. The basis for this inference is the ready and apparently complete recovery of animals after manifesting the first and second stages of poisoning. Recovery after the development of the convulsive stage occurs but rarely. My reason for concluding that lytic immunity consists in the development of a proteolytic ferment is founded upon what seems to me a demonstrated fact that the symptoms are due to a cleavage of the proteid molecule into a haptophore and a toxophore group, and we know of no agents in the animal body save enzymes that are capable of splitting up proteids. I am inclined to the opinion, subject, of course, to change with additional knowledge, that the cells that become sensitized and in which the zymogen is stored are connective tissue cells and that in order to be sensitized they must come into direct contact with the haptophore group of the proteid, and the presence of the same group is necessary to convert the zymogen into an active enzyme. I think it most probable that the sensitization of a cell consists in causing a rearrangement in the molecular structure of some one of its proteid constituents. Sensitization may be local or general; it can exist only in those tissues that have come under the direct influence of the haptophore. This explains why the soluble haptophore split off from the bacterial cell is more efficient both in sensitizing and in activating the body cell than is the unbroken bacterial cell. Typhoid bacteria introduced into the abdominal cavity of an unsensitized animal may be acted upon by phagocytes, but no lytic action takes place until the body cells have been sensitized by the bacterial proteid; and their sensitization is at first local. When a coagulated proteid is injected into the peritoneal cavity of a sensitized animal the lytic action is local and the phenomenon of hypersusceptibility is never manifested, except when the activating dose is introduced into the animal in soluble form; then a large number of cells are activated at once, the proteid is split up with explosive rapidity and the poison, being set free in the circulating blood, reaches the respiratory center promptly and death as a rule follows speedily. The striking experiments of Pirquet with vaccination are, according to my interpretation of them, beautiful examples of local sensitization and consequently of local reaction. The same is, I think, true of the Calmette eye reaction with tuberculin. In some tubercular individuals the tissue of the conjunctiva has become sensitized by the split products resulting from the breaking up of the tubercle bacilli and the first application causes a reaction. But the same thing is shown more strikingly when the eye of a non-tubercular individual is sensitized by a first application and then activated by a second when the reaction is prompt, sometimes quite violent, and confined sharply to the parts touched by the first application.

I believe that lytic immunization will prove in the near future of great service not only in affording protection, but in the treatment of some infectious diseases, yet it will be well to understand at the outset that it will have its limitations and also its dangers. We can not hope for the high degree of protection that is secured by the antitoxic treatment of diphtheria. From my experiments upon animals with the haptophores of the colon and typhoid bacilli I believe that an immunity to from ten to twelve times the minimum fatal quantity of the living bacillus is as much as we can reasonably hope.

The Differentiation of Homologous Proteins by Serum Reactions: S. P. Beebe.

It is now admitted by all laboratory workers in the field of immunity that one can differentiate between the proteids of different species of animals by means of serum reactions. Such reactions are not absolutely specific, as it is well known that closely related species of animals show a mild reaction, but in point of time and completeness of the reaction it is possible to differentiate sharply between species.

With homologous proteids there is no such unanimity of opinion, although comparatively little work has been done. The serum reactions are capable of showing differences in structure which we can not demonstrate by other means, and it seems reasonable to believe that we may be able to differentiate between proteids from the same species, but from organs having widely varying functions, such as the liver and the kidney. For the purpose of developing the anti-serum the nucleoproteids of these organs have been injected into alien species of animals. The nucleoproteids were chosen because they are readily prepared and because they probably represent the most important of the cell constituents. By means of such serum one may obtain precipitin and agglutinin reactions, which are specific in the same sense that heterologous reactions are specific.

On Spirochetal Immunity: F. G. Novy and R. E. Knapp.

The question of the plurality of species of spirilla in relapsing fever, raised by us two years ago, has been answered since in the affirmative, for we now have four, and possibly five, essentially distinct strains in human relapsing fever. These several species, strains or varieties are:

S. Obermeieri—origin, Moscow, Uhlenhuth and Haendel.

S. Novyi—origin, New York, Norris.

S. Kochi n. sp.—origin, East Africa, Berlin, Koch.

S. Duttoni—origin, West Africa, Runcorn, Dutton and Todd.

S. Carteri—origin, Bombay.

The specific differences for the first four have been fully established and it is quite certain that when direct comparative tests are made with the Bombay spirillum this will also be found to be distinct. In view of these facts it may well be asked whether a still greater number of strains will not be found when further comparisons are made with the spirilla from different parts of Russia, Africa, Asia and America. From our studies on the immunity reactions of the first four spirilla we are inclined to believe that such will be the case and that a considerable number of apparently different species or strains will be discovered. The necessity for recognizing this condition of affairs will be apparent, for, as will be shown, the curative action of the serum of an animal immunized to one strain is manifested only in animals infected with that particular organism and is without appreciable effect upon the other strains.

The four strains in the order as listed above show a marked gradation of properties. This is seen in the duration and severity of the initial attack, in the frequency and intensity of relapses and in the mortality following upon the injection of a uniform dose of 0.25 c.c. of spirillar blood, the infection with *S. Obermeieri* is mildest with barest indication of relapses and that with *S. Duttoni* is most severe; death usually results, or relapses occur regularly and are repeated, time and again. In general, the four spirilla can be readily separated into two groups, the Moscow and New York strains falling together, while the two African strains are more closely allied than with either of the others. In the African strains a notable feature is the peculiar massing of red-blood cells, which feature enables one by mere microscopic examination of the fresh blood to decide which of the two groups is concerned. There are also differences in size, the African group showing spirilla which are fully twice as long as those of the first group. A full discussion of the differences will be taken up elsewhere.

The study of the immunity or serum reactions of these four strains of spirilla presents interesting facts regarding their relationship and incidentally brings up the question of the value of the so-called specific reactions as a reliable means for the differentiating of species. The question as to what constitutes a species, itself a difficult one in connection with the higher forms of life, becomes far more difficult to answer when it concerns the unicellular organism which seemingly is incapable of presenting any fixed characteristic. Variation in the ordinary morphological and biological properties is the rule among protists and the serum reactions which are looked upon as the most specific characteristics seem to offer no exception. The differences in these reactions must be considered as an expression of changes in the molecular composition of the living protoplasm, and for each set of new conditions a new equilibrium in the arrangement of atoms must be established. The known examples of tautomerism among the relatively simple organic compounds may serve to illustrate the conception as applied to living matter.

In a previous paper we clearly demonstrated the preventive and curative action of the serum of animals immunized to the New York spirillum, and it was, therefore, desirable to ascertain whether similar results could be obtained, under like conditions, with the other three strains. Without going into unnecessary detail at the present time, it may be said that the serum of an immunized rat exerts a prompt curative action in rats infected with the corresponding or homologous spirochete, and that in like dosage it is without effect upon the remaining three organisms. This fact can best be seen from the following table:

TABLE I

Curative Experiments with Immune Sera

Rats infected with	Effect of 2 c.c. of serum of rat hyperimmunized with			
	S. Obermeieri.	*S. Novyi.*	*S. Kochi.*	*S. Duttoni.*
S. Obermeieri	+ cure	+ cure	——	——
S. Novyi.	——	——	——	——
S. Kochi.	——	——	+ cure	——
S. Duttoni.	——	——	——	+ cure

It will be seen from the above that of four rats infected with *S. Obermeieri,* and containing at the time large numbers of spirilla in the blood, the one which received the serum from a rat hyperimmunized to that organism was promptly cured, whereas the sera of the other hyperimmune animals were without any apparent effect. A like specific curative action is obtained with the other organisms when the homologous serum is used. By a "cure" is meant the total disappearance of the spirilla from the peripheral blood in from one half to four or six hours. This curative effect may be permanent or it may be followed by a slight relapse in the course of seven or ten days.

Such relapses are practically absent with the Moscow strain, very slight with that of the New York and more common with the African strains.

In the case of *S. Duttoni* the "cure" is not always as marked as with the other three, depending as it does, first, upon the dose and efficiency of the serum employed, and, second, upon the stage of infection. The latter is a most important factor. Rats in the early stage of infection with this organism (that is, on the first day following the injection of spirilla) are readily cured within half an hour without any untoward effect. The administration of the serum on the second day of the disease, at a time when the blood is swarming with spirilla, leads to agglutination and solution of such masses of organisms that death from intoxication and obstruction is the usual result. When the animal survives, the spirilla may continue to persist in somewhat lessened numbers. This latter fact is due to the presence of "immunized" or "serum-fast" spirilla. Hence, in the treatment of this disease it is not advisable to employ a curative serum, in large doses, at the time of maximum infection.

The *S. Duttoni* is especially prone to reciprocal immunization, since this organism can be found at times in large numbers, in the blood of hyperimmunized animals. This serum-fast property, first demonstrated for *S. Kochi* by Levaditi and Roché, is especially marked with *S. Duttoni,* and the recognition of this state offers a most rational explanation of the cause of ordinary relapse as well as that following the curative treatment. Hitherto it was believed that the relapse was due to the survival, in extravascular spaces, of spirochetes which after the partial destruction or elimination of the specific antibodies were able again to invade the circulation. In the light of the facts now known it is clear that the relapse is due to the survival of a few individuals which have acquired more or less immunity to the specific germicidal bodies elaborated in the infected animal. As a result a new "serum-fast" strain develops, which in turn calls for a new anti-body. The latter is apparently not as active as the first, or is more unstable, or is more readily eliminated, and hence the continuance of the relapses with this organism. This adaptation of spirilla would appear to be least marked with the Moscow spirillum, since with it relapses in rats are scarcely recognizable. On the other hand, *S. Duttoni* is at the other extreme, and from what is known of the mortality in the Bombay fever, it may be inferred that the *S. Carteri* will be found to be even more prone to relapse in rats.

As pointed out by Levaditi, the serum-fast character is perhaps a fixed property of *S. pallidum,* and without doubt this conception accounts for the persistence of that organism within man better than any other theory. The difficulty of producing a curative serum for the syphilitic spirochete will be readily seen. The phenomenon of reciprocal immunization is not limited to this group, for, indeed, it was first recognized in the study of trypanosomes. Neither can it be adduced as a characteristic of protozoa, for like conditions are now known to exist with various bacteria, and this fact must, therefore, be taken into consideration in the treatment of bacterial disease with anti-sera. Many data are now at hand which go to show the existence of a plurality of strains for nearly every pathogenic organism. And, moreover, such modifications must be expected if we assume, as there is good reason to, the existence of labile groups in the living molecule.

The practical application of the curative action of a given immune serum, it will be seen, is restricted to the infection caused by the corresponding spirochete, and hence the need of an exact diagnosis as to kind of spirillum present. The use of a polyvalent serum, obtained from animals immunized to all four strains (and more), as can readily be done, will perhaps be desirable, especially in localities where several strains are known to occur. At present the one obstacle in the way of a realization of a perfect means for the prevention and cure of the various forms of relapsing fever is the failure to obtain artificial cultures of the spirochetes.

While the curative experiments indicate a marked specific action of each serum, this specificity disappears to a certain extent when the serum is used for preventive purposes. It will then be found that a given serum may prevent or modify the infection by two or more strains and this fact must be interpreted as indicating a close relationship of such strains. This conclusion is further borne out by cross-immunization experiments with recovered or hyperimmune animals. Certain it is that the differences between any two spirochetes, as, for example, Moscow and New York, is no greater than between *S. Duttoni* and its serum-fast strain.

TABLE II

Prevention Experiments with Immune Sera

Rats infected with 0.1 c.c. spirillar blood.	Effect of 1 c.c. of serum of rat hyperimmunized with			
	S. Obermeieri.	*S. Novyi.*	*S. Kochi.*	*S. Duttoni.*
S. Obermeieri	+	+	± slight action	± very slight action
S. Novyi.	± decided action	+	± decided action	—
S. Kochi.	—	—	+	+
S. Duttoni.	—	—	—	+

From the above table it will be seen that while a given serum has a perfect preventive action with respect to its own strain, a more or less like action is exhibited with reference to the nearest strain. The + sign shows full protection, whereas the ± indicates considerable action as revealed by delayed or mild infection. With a larger amount of serum an even more marked overlapping of immunity can be expected, and this is what actually is observed when cross-infection is attempted into recovered or hyperimmunized rats. The large amount of immune blood in these animals ensures a greater preventive action, as will be seen by comparing Tables II. and III.

TABLE III

Prevention in Hyperimmunized Rats

Rats infected with 0.25 c.c. spirillar blood.	Effect in rats hyperimmunized with			
	S. Obermeieri.	*S. Novyi.*	*S. Kochi.*	*S. Duttoni.*
S. Obermeieri	+	+	+	+
S. Novyi.	+	+	+	—
S. Kochi.	—	—	+	+
S. Duttoni.	—	—	—	+

The details of all these and other experiments must of necessity be omitted at the present time. The facts given, however, clearly show that in relapsing fever we are dealing with a group of related organisms which, while in one sense they can be regarded as distinct species, after all must be considered as derived from one stem. Further comparative studies must show whether or not this variation is even more common than is indicated by the known four strains. As to the determining factors which bring about these modifications nothing definite can as yet be stated, though the conditions involving the preservation of the virus, as pointed out by Marchoux for the chicken spirochete, may be of prime importance.

Immunity in Rocky Mountain Spotted Fever: H. T. Ricketts and L. Gomez.

An attack of Rocky Mountain spotted fever, produced experimentally in the monkey or guinea-pig, is followed by strong and prolonged immunity to second inoculations. The offspring of an immune female guinea-pig are immune and their immunity does not depend on the ingestion of immune milk.

Immune defibrinated blood in doses of 0.1 c.c. to 0.3 c.c. protects against twenty to forty times the minimum pathogenic dose of infected blood, the two being mixed before injection. One cubic centimeter of immune blood given subcutaneously protects against 20 to 40 minimum pathogenic doses of virus given subcutaneously 10 to 15 days later. This passive immunity may have a longer duration, since its limits have not yet been determined accurately.

The immune blood has little curative power when spotted fever is well established, but when given early and in sufficient quantity will shorten the course of the fever by three or four days.

Vaccination of guinea-pigs may be accomplished by a single injection or by two or more injections of immune blood mixed with virus in appropriate quantities, with the result that two months later they resist infection by twenty to forty pathogenic doses of the virus. The immunity of vaccinated guinea-pigs finds expression in the strong protective power of their blood when the latter, mixed with virus, is injected into normal guinea-pigs.

The results indicate that immune serum may be effective in preventing spotted fever in man, provided that it is given within a reasonable time following the bite of an infected tick.

It is also hoped that the vaccination method will be sufficiently satisfactory and safe to warrant its use in preventing spotted fever in man. Its value is yet to be proved on the monkey.

The nature of the anti-bodies has not been definitely established.

Artificial Immunity to Glucosides: William W. Ford.

In considering the subject of artificial immunity to glucosides, as compared with the immunity produced by the injection of poisonous proteids it should be emphasized that bacteriologists employ the term *poisonous proteids,* in a rather indefinite way, hardly ever approved of by the physiological chemists. The designation *poisonous* or *toxic proteids* or *toxalbumins* is thus applied to a group of substances embracing the true toxins characterized by certain definite physiological reactions, but never yet isolated chemically, or obtained in any condition at all resembling chemical purity. These substances are highly poisonous to animals, produce well-marked lesions peculiar to each poison injected, act upon the animal body or show their effects upon this body only after a considerable period of incubation; and by the introduction of sub-lethal doses give rise to the production of substances in susceptible animals, which neutralize their poisonous action. They are always closely associated with proteids, and are precipitated by all the well-known proteid reagents, such as alcohol, uranium acetate, aluminium sulphate, ammonium sulphate and a number of others.

They have not thus far been separated from the proteids with which they are associated, and since the purest products hitherto obtained still give the biuret reaction and still contain nitrogen and sulphur it is concluded that these substances must be proteid or proteid derivatives. A more popular designation, *proteid-like,* or *Eiweiss-ähnlich,* while possibly less objectionable from the chemical point of view, does not obviate the difficulty resulting from the use of these chemical terms, since it is rather hard to say just what constitutes the difference between a true proteid and a proteid-like body. Although one or two authorities, notably Oppenheimer,[1] believe that the toxins are not pro-

[1] Oppenheimer, "Die Bakteriengifte," in Kolle und Wassermann's "Handbuch der pathogenen Mikroorganismen," Erster Band, s, 344.

teid, it is generally accepted that successful immunization can be carried out on animals only with substances belonging in this group, variously designated as toxic proteid, proteid derivatives, proteid-like bodies, or tox-albumins, since immunization with such elements as *arsenic,* with such alkaloids as *morphin* and *strychnin* and with glucosides like *saponin* and *solanin,* and those found in digitalis and ergot has not been accomplished. Pohl[2] indeed claimed to have so treated rabbits with solanin as to render their blood serum more antagonistic to the action of solanin on blood corpuscles than the normal rabbit's serum, but his experiments could not be confirmed by Bashford,[3] in the light of whose investigations Ehrlich[4] has become positively convinced that artificial immunization with glucosides is impossible. When we consider the large number of poisonous glucosides, already isolated with a fair degree of success, and in considerable chemical purity, with but a few of which experiments have been reported, and then take account of the vast amount of work done on the toxic proteids, it is a fair inference that to deny the possibility of immunization with glucosides is to base a broad generalization upon a relative paucity of data.

Our own observations in this field originated with the attempt to immunize animals with extracts of the poisonous fungus *Amanita phalloides,* the active principle of which had been stated by Kobert[5] some years previously to be a tox-albumin powerfully hemolytic for a great variety of corpuscles. We found that saline extracts of the fungi were highly hemolytic as Kobert had stated, and that they produced very definite lesions in animals, including extensive subcutaneous edema, hemorrhages in the serous membranes, a marked degree of fatty degeneration, and a great increase of pigment in the various organs, especially in the spleen. During the treatment of animals with these extracts we experienced no difficulty in producing an active immunity, in which the animals would withstand the inoculation of two or three times a fatal dose. The serum from these immunized animals was *anti-hemolytic*[6] in a dilution of 1/1,000 or even in one of 1/5,000. When tested upon animals, one cubic centimeter of this serum would neutralize two or three multiples of a minimum fatal dose. The most powerful serum obtained was one in which 1 cubic centimeter neutralized six or seven times a fatal dose, but this serum contained such a powerful anti-hemolysin that we were led to believe that a serum from large animals more highly immunized might prove of practical value. In a chemical investigation of the fungus in the Pharmacological Laboratory, in association with Dr. Abel[6,7] it has since been shown that the *Amanita phalloides* contains two poisons, one hemolytic and precipitated by alcohol, the other non-hemolytic and soluble in alcohol. The presence of this latter substance, the *Amanita*-toxin had already been suspected because of the poisonous character of extracts of the fungus heated to 65° C. to destroy their hemolysin, and we found that Kobert[8] had made a similar observation, publishing it in an almost inaccessible

[2] Pohl, *Arch. internat. de Pharm. et de Ther.,* 1900, 7, p. 1; 1901, 8, p. 437.

[3] Bashford, *Arch. internat. de Pharm. et de Ther.,* 1901, 8, p. 101; 9, p. 451.

[4] Ehrlich, "Collected Studies on Immunity," New York, 1906, p. 433.

[5] Kobert, *St. Petersburger med. Wochenschr.,* 1891, 16, pp. 463, 471.

[6] Ford, *The Journal of Infectious Diseases,* Vol. III., No. 2, April, 1906.

[7] Abel and Ford, *The Journal of Biological Chemistry,* Vol. II., No. 4, January, 1907.

[8] Kobert, *Sitzungsberichte der naturforschenden Gesellschaft zu Rostock,* 1899, p. 26.

journal. It was further shown by Dr. Abel and myself that this *Amanita*-hemolysin is not a tox-albumin as Kobert had stated, since all proteid can be removed from it, by the use of freshly prepared metaphosphoric acid, and by uranyl acetate, without any appreciable impairment of its hemolytic activity. Our hemolytic solution thus treated no longer responds to any of the well-recognized tests for either native or derived proteids. Although this hemolysin has by no means been obtained in a condition of chemical purity, it must, for the present at least, be classified as a glucoside because of the following reactions which our purest substance gives.

1. It reduces Fehling's solution and ammoniacal silver solution only very slightly without previous hydrolysis with acids, and very powerfully after such hydrolysis.

2. It does not ferment with brewers' yeast either before or after hydrolysis.

3. It gives characteristic tests for pentoses with (*a*) α-napthol and sulphuric acid, (*b*) phloroglucinol and hydrochloric acid, (*c*) orcinol, hydrochloric acid, and ferric chloride. It also decolorizes an alkaline solution of potassium permanganate at room temperature, and after hydrolysis gives a yellow color with sodium hydrate.

The alcohol-soluble *Amanita*-toxin, which probably is more important in cases of poisoning in man because of its resistance to the action of heat and acids than the *Amanita*-hemolysin has been shown by Dr. Schlesinger and myself[9] to be either an *indol* or *pyrrol* derivative or an *aromatic phenol* so combined with an amine group that it readily forms an indol or pyrrol ring on fusion. This substance can be obtained free from both the glucosides and the native proteids present in the plants.

[9] Schlesinger and Ford, *The Journal of Biological Chemistry*, Vol. III., No. 4, September, 1907.

Since publishing these various observations a number of experiments have been completed which confirm our earlier conclusions and throw light upon some of our difficulties, and it is desirable at the present time to take up these further experiments in brief detail. In the first place, Dr. Kinyoun while at the Mulford Laboratories at Glenolden, Pa., was good enough to immunize a horse for me with aqueous extracts of *Amanita phalloides* and found that its serum contained anti-bodies for the poisons of this fungus of such a strength that one fourth of a cubic centimeter would neutralize the poisonous dose for a 500-gram guinea-pig. While this is of hardly more than theoretical value, in studying this serum during the past year we have found that it contains a strong and permanent anti-hemolysin operative in a dilution of 1/1,000, using as an index that quantity of hemolysin which will dissolve 1 cubic centimeter of a 5-per-cent. suspension of blood corpuscles, and this anti-hemolysin is still present, even though the serum is nearly a year old.

Again, it has been shown that both the *Amanita*-hemolysin and the *Amanita*-toxin are poisonous to small animals, the lesions produced by the latter substance being similar to those seen in fatal cases of poisoning in man. The *Amanita*-hemolysin apparently owes its toxicity entirely to its blood-making properties, the pure toxin acting as a cellular poison, producing both the hemorrhages and the fatty degeneration.

The *Amanita*-hemolysin, moreover, tends to lose its activity on heating to 65° C. for one half hour and may play but a secondary rôle in fatal cases in man, the toxin possibly being the more important principle. Various animals have been immunized to the two poisons in the *Amanita*, the hemolysin and the toxin. Immunization with the hemolysin proceeds without difficulty, the animals reacting well and retaining their weight. Their serum is always powerfully anti-hemolytic, a strength of 1/1,000 being found after four or five injections. Active immunity with the toxin can also be produced, the animals resisting the inoculation of two or three fatal doses and their serum conferring passive immunity upon other animals up to a limited point. At no time, however, have we obtained a higher degree of either active or passive immunity with this portion of the fungus than with the "whole extracts." We are thus confronted with the paradoxical condition that the glucoside in the fungus for which on theoretical grounds an anti-body would be supposed to be impossible will readily stimulate animals to the production of an anti-hemolytic serum, while the non-glucosidal substance is thus far the barrier to the production of a high degree of immunity. To just such an extent as the hemolysin acts in man can we obtain an efficient antitoxin, but since the toxin is apparently more potent in this respect than the hemolysin, no practical results can possibly be hoped for until some method of obtaining a stronger serum for this fraction of the fungus can be devised.

Finally, it has seemed to Dr. Abel and myself, in view of the direct contradiction which our results bear to those of Kobert, an important matter to repeat some of our earlier observations, and we have confirmed the conclusions as to the non-proteid character of the hemolysin in *Amanita phalloides* by obtaining proteid-free hemolysins from other specimens of this fungus from New York State and from Massachusetts, thus covering in these studies three widely separated localities. The hemolysins in the fungi from these three different sources can all be completely neutralized by the serum made by Dr. Kinyoun from the Maryland fungi, a fact which further points to the identity of this substance in various examples of the plant, and its wide distribution. Indeed, no typical specimens of *Amanita phalloides* have thus far been studied in which the *Amanita*-toxin, when present, was not accompanied by this blood-laking principle.

Having thus shown that an anti-hemolysin can be made for a hemolytic glucoside, it became imperative to determine whether this was a fortuitous circumstance, dependent upon some peculiar composition of the substance employed, or whether there were not other poisonous glucosides with which animals could be successfully immunized.

The most important poison available for these studies was the active principle of *Rhus toxicodendron*, or poison ivy, from both the theoretical and practical standpoint. It had some years previously been shown by Pfaff[10] that the poison of this plant was a non-volatile oil, decomposed by heat, soluble in alcohol, ether, benzine, chloroform, etc., but insoluble in water. The name *Toxicodendrol* was given to this oil. Subsequently Syme[11] has concluded, on the basis of extensive experimental work, that the irritating substance of poison ivy is a glucoside, a compound of *rhamnose, gallic acid* and *fisetin*. To this substance the name *Toxicodendrin* is applied.

It is possible to obtain this active principle in the fluid extract of *Rhus toxicodendron*, an alcoholic extract of the fresh leaves of the plant, from which a tincture

[10] Pfaff, *Journal of Experimental Medicine*, 1897, Vol. 2, p. 181.

[11] Syme, "Some Constituents of the Poison Ivy Plant (*Rhus toxicodendron*)," Johns Hopkins University Dissertation, Baltimore, 1906.

is made and employed in a number of affections by a certain group of medical men. Pfaff had previously pointed out that the internal administration of toxicodendrol to rabbits killed them at the end of 12–15 days by nephritis, although some animals died in convulsions within the first 24 hours. The subcutaneous inoculation of the fluid extract of *Rhus toxicodendron* produced in rabbits an intense nephritis with large quantities of albumin and many casts in the urine, the animals dying in from 8 to 15 days. Rarely some of the rabbits died in convulsions on the first day. The effects of the fluid extract being identical with those described by Pfaff for toxicodendrol, there could be no doubt that this extract contained the active principle. In addition to the nephritis, a huge necrosis and slough developed at the site of the subcutaneous inoculation. Guinea-pigs are more susceptible to the poison than rabbits, a small quantity producing a similar local necrosis and nephritis. The fatal dose for rabbits varies from one half to two cubic centimeters, and for guinea-pigs from one fourth to one half cubic centimeter. With both species, if small doses be given at first, followed by increasing doses at appropriate intervals, active immunity can be established. Large quantities of the fluid extract can eventually be given, three to four cubic centimeters in guinea-pigs and eight to ten cubic centimeters in rabbits, in both cases representing a considerable multiple of a minimum fatal dose. The time of the dosage must be carefully graduated, the most favorable interval between the periods of administration being apparently ten to twelve days, corresponding to about the period of incubation. With low multiples of a fatal dose, the animals react well, develop no local lesions, and can be kept alive almost indefinitely, no late manifestations of intoxication appearing. If too large quantities be given, the animals die of nephritis, and occasionally local lesions are found. In general, however, the local action of the poison on the epithelial cells of the skin is less likely to appear during immunization than the destruction of the kidney cells.

The serum from these actively immunized animals will confer passive immunity upon other animals. For these experiments guinea-pigs were always selected because of their more regular susceptibility. The poison and serum must be administered separately to avoid the precipitation of the serum by the alcohol in the fluid extract, and even in the severe test of giving both doses at the same time the serum will completely neutralize the poison. In certain instances by this method of testing, one cubic centimeter of serum neutralized five or six fatal doses for guinea-pigs. When the effects of the *Rhus toxicodendron* are not completely obviated, the test animals die of nephritis. Careful dissection of the skin at the site of inoculation shows no necrosis or slough.[12]

In connection with the effect of *Rhus toxicodendron* upon the kidney in the production of active and passive immunity, it may be mentioned that the only human beings who have died as a result of ivy poisoning have apparently succumbed to kidney affections.

Large animals can also be immunized; a fifty-pound goat was eventually given twenty cubic centimeters without the development of subcutaneous lesions or nephritis.

Finally, it is interesting to inquire whether *natural immunity* to poison ivy occurs in man, and whether immunity develops after recovery from its effects. In regard to the first point, there is no difficulty in showing that many persons are

[12] Ford, *The Journal of Infectious Diseases*, Vol. 4, No. 4, November, 1907.

quite resistant to the action of the irritating substance. I know personally of a number of individuals who have been able since early childhood to handle poison ivy with impunity, no dermatitis resulting from contact with the fresh leaves. Opinions differ much in regard to the acquired immunity. Some people are extremely susceptible, the severest lesions following the slightest exposure. In many instances it is claimed that no immunity results from the first attack, a second, third or even a fourth attack of dermatitis occurring with painful regularity. A belief is common, moreover, that these subsequent attacks recur, without a second exposure, at the same season in which the first attack developed. There are, nevertheless, many cases in which a certain degree of immunity develops, the severe types of dermatitis never being reproduced, the subsequent exposure bringing out only a few vesicles and pustules on the skin.

It is interesting to speculate whether these cases of *natural immunity* are not really examples of *acquired immunity*, individuals in whom as children the effects of handling the ivy have gradually worn off, the original dermatitis having been so insignificant as to have escaped notice or being so many years distant as to be forgotten.

There is some evidence also as to the possibility of vaccinating against ivy poisoning. The internal administration of the tincture of *Rhus toxicodendron* is believed by many to completely prevent attacks of this affection, and in the survey for the Union Pacific Railway, when the line was pushed through a wild country much overgrown with the ivy, some of the engineers discovered that by chewing and swallowing the fresh leaves early in the spring, they could ward off attacks during the summer. It is stated that a similar precautionary measure is resorted to in the Adirondack Mountains, where the plant is so abundant as to be a troublesome pest.

In conclusion we have in the *Amanita phalloides* and in *Rhus toxicodendron* two poisonous substances, acting in one case upon the blood corpuscles, in the other upon the epithelial cells of the skin and kidney, in both of which the evidence at hand points to a glucoside as the carrier of the poisonous properties, and in both of which active and passive immunity may be experimentally produced. Whether these observations have anything more than theoretical value remains still to be determined, a practical application of these results being possible only when sera of considerable antitoxic power can be obtained from large animals.

Virulence of Pneumococci in Relation to Phagocytosis: E. C. Rosenow.

Virulent pneumococci do not absorb opsonin from serum nor are they susceptible to phagocytosis, while non-virulent pneumococci absorb opsonins and are freely susceptible to phagocytosis. The pneumococci isolated from the blood in pneumonia resist phagocytosis in normal and pneumonic blood, while those isolated from the sputum are more susceptible and show a correspondingly lower grade of animal virulence. It seems that the pneumococci in the blood in lobar pneumonia are there because of their resistance to opsonification and phagocytosis.

The pneumococci isolated from the blood of cases of pneumococcus endocarditis are freely susceptible in vitro, to phagocytosis, both in normal and homologous blood, and yet in some way they are able to protect themselves against the action of the leucocyte and other cells in vivo because constantly present in the circulating blood. The recently isolated pneumococci in these cases when grown in the homologous serum from 24 to 48 hours instead of being freely susceptible to phagocytosis, as is the case when grown in broth or upon agar, have become fairly resistant instead. When grown in normal serum they fail to acquire this resistance to the action of opsonin and the leucocyte.

Extracts from highly virulent pneumococci contain a substance or combination of substances which neutralize the opsonin in serum. This substance unites with virulent pneumococci quantitatively and by so doing confers upon them a degree of resistance to phagocytosis as well as to animal virulence. The extracted virulent pneumococci now acquire the power to absorb pneumococco-opsonin. In other words, it seems possible to extract from virulent pneumococci the substance upon which virulence probably depends and to which the name "virulin" has been given. While the action of virulin may be the subject of several hypothetical explanations, at present it is probably best to look upon it simply as a substance or mixture of substances which when united with the pneumococcal cell prevent the cell from taking up opsonin, and which substance, when free, has special affinity for opsonin. That it does not merely concern free opsinophile cell receptors seems likely because virulent pneumococci when extracted, that is, freed from virulence, are found to absorb pneumococco-opsonin freely.

The Mechanism of Streptococcus Immunity: Gustav F. Ruediger.

In a previous paper it was shown that, in test-tube experiments, suspensions of rabbit leucocytes in normal rabbit serum or blood destroy avirulent streptococci but not the virulent organisms. Suspensions of the leucocytes in heated serum or in 0.85-per-cent. NaCl solution do not destroy the avirulent streptococci. Dr. Hektoen and I have shown that the avirulent streptococci are freely taken up by rabbit leucocytes in normal serum, but the virulent organisms are not taken up. Washed rabbit leucocytes in heated serum or in 0.85-per-cent. NaCl solution do not ingest the avirulent streptococci.

Rabbits were now immunized according to Neufeld's method by injecting them first with a large dose of heated virulent streptococci and then with several doses of the living culture. These animals acquired an immunity so that they did not succumb to a subcutaneous injection of twice the minimum fatal dose of the streptococcus. In test-tube experiments it was now found that normal rabbit leucocytes, or washed leucocytes from an immune rabbit, when suspended in the immune rabbit serum, freely ingest the virulent streptococci. If, however, these leucocytes are suspended in normal rabbit serum they scarcely take up any of these streptococci. No difference could be detected between the normal leucocytes and those coming from an immune rabbit. The immunity is dependent upon a change in the serum, as the following experiment shows. Virulent streptococci were sensitized in the immune rabbit serum and another lot was treated similarly with normal serum. These cocci were suspended separately in salt solution and each suspension was added to a suspension of washed rabbit leucocytes in salt solution. It was found that the streptococci which had been sensitized in the immune serum were taken up by the leucocytes to the extent of eight per leucocyte, whereas those which had been sensitized in the normal serum were not taken up at all. That is, the serum had acquired something by virtue of which it was enabled to sensitize the virulent streptococci so that they were ingested by the rabbit leucocytes.

The immune rabbit serum does not possess anti-streptolytic properties.

Fourth Meeting.—Papers in joint session with the Society of American Bacteriologists.

Program

"Passive Diphtheritic Immunity in Rabbits," by H. M. Goodman.

"The Changing Flora of Chronic Suppurations: Its Relation to Opsonotherapy," by A. P. Ohlmacher.

"Blackhead: A Coccidial Disease of Turkeys," by P. B. Hadley (by invitation).

"The Cause of the So-called Germicidal Property of Milk," by M. J. Rosenau and G. W. McCoy.

"The Significance of Leucocytes and Streptococci in the Production of a High-grade Milk," by Mary E. Pennington.

"A Note on the Occurrence of Leucocytes and Streptococci in Milk," by S. C. Prescott.

William J. Gies,
Secretary

PUBLICATION IN GERMAN JOURNALS OF THE RESULTS OF AMERICAN CHEMICAL RESEARCH

In the course of an address on "American Chemical Research," delivered before the American Chemical Society last June,[1] a brief reference was made to the practise of some American chemists of publishing the results of their investigations more or less systematically in German journals. Since the address was printed I have had opportunities of discussing the topic with various friends, several of whom publish in the manner indicated, and it has been suggested that it might be useful—and even interesting—to deal with the question at somewhat greater length.

It will, perhaps, be wise to state at the outset that, in my opinion, there can be no question as to the absolute *right* of an investigator to offer his results for publication when, where, how and to whom he pleases, but "all things that are lawful are not expedient," and it is really on this that the question turns. Closely interwoven with it are two other questions: Should the chemists of America combine to form a society? Should this society publish a journal?

The answers given by the chemists of the country have been unmistakably in the affirmative, consequently, it would appear to be the merest common-sense on the part of all interested, to endeavor to make both the society and its journal the best possible. It has sometimes been urged against the society that its admission requirements are too lenient and that it would be advantageous if its membership were limited to persons possessing some "qualification." Just what the nature of their "qualification" should be it is difficult to discover. Although this idea is, perhaps, attractive at the first glance, a little thought will show many serious objections to it. Only two of these need be mentioned at present. The one concerns the expenses of publication and is dealt with more fully below. The second objection may be expressed by saying that no society can be truly national in its scope and aims unless its membership includes all or nearly all of those professing the subject with which it deals. In the case of the American Chemical Society this battle has been fought and won. In numbers it ranks as the third largest association of chemists in the world and very soon it will take the second place. The fact that the names of all the better-known chemists of the country are on its roll proves that quality has not been sacrificed to quantity.

We may now consider the subject of publication. In his recent address to the American Chemical Society, during the Chicago meeting, President Bogert was understood to say that the *Journal of Physical Chemistry* and the *Journal of Biological Chemistry* have each a circulation of about 200, and that they do not pay their expenses; moreover, the editors give their services. No information could be

[1] Science, 26, 625 (1907).

obtained regarding the *American Chemical Journal,* although a request for it had been made. It is fair to assume that the wider scope of this last journal is probably correlated with a somewhat larger circulation; the editor's services are also gratuitous, and it is generally understood that, whatever may be the case at present, for many years its publication involved a financial loss. The *Journal of the American Chemical Society,* on the contrary, does pay expenses, including a small honorarium to its editor. Its solvency is due, of course, to its large subscription list. To put the matter in another way, chemists engaged in research do not pay the cost of publishing their results and, indeed, can not afford to do so. Consequently, in order that they may be truly independent not only of the munificence of individuals, but also of the control which this munificence necessarily involves, it is essential that those chemists who do research should combine with those who are otherwise engaged; the partnership is a thoroughly honorable one on both sides, the one furnishes the money, the other the results.

This mutual dependence has, however, another phase. We can not expect the "man who pays" to continue to pay unless he receives value for his money, but the value of a scientific journal, unlike that of a popular magazine, is dependent entirely on gratuitous contributions. It can not buy its talent, but must take what material is sent to it.

It would appear, therefore, that every paper by an American chemist which is printed in foreign journals is not only a distinct loss to his non-publishing chemical brethren, but it also acts injuriously on the interests of those who are actively engaged in research, because it renders the native journals less valuable and, therefore, tends to restrict their circulation. Moreover, this loss and injury are greater in direct proportion to the value and general interest of the papers in question. Few who have not looked into the matter realize how much the *Zeitschrift für physikalische Chemie* owes to its American contributors. A similar state of things prevails in the domain of organic chemistry, which is indebted to American chemists for two of the most interesting and important conceptions which have enriched it within recent years; unfortunately—as I venture to think—they have been developed in the *Berichte der deutschen chemischen Gesellschaft,* and in *Liebig's Annalen der Chemie,* respectively.

Some of the most valuable results obtained by a few American chemists appear in the publications of certain of the learned societies. Very frequently the society in question has contributed funds towards the cost of the research. In such cases it is only fair that the society should have an opportunity of making known the discoveries. The "American Academy," which is, doubtless, the most important association of this nature, publishes 850 copies of its *Proceedings,* 200 of which are supplied to the author. Of the remainder, about 450 go to various libraries and learned societies all over the world and the other 200 to the foreign honorary members and to those members and associate members who desire to receive them. Other people can obtain the articles at a relatively small cost. It is impossible to doubt that the circulation of the *Proceedings* is of a very high order, but I fear that it is equally certain that their contents fail to reach the mass of American chemists, and it is with their interests that I am immediately concerned; the specialist can generally take care of himself. For many years it has been customary for the *American Chemical Journal* to reprint articles which have appeared in the publications of various societies; possibly a similar course might be followed by other journals.

Of the reasons which have been given in support of the habit of publishing in German journals, three only need be considered very seriously. An article may appear in the *"Berichte"* six weeks after the copy has been mailed from this side of the water, but if it be sent to one of the American journals the time which elapses before publication is often greater. The fact that the domestic journals are all monthlies, whereas the *"Berichte"* appears seventeen times per annum, accounts for some of the delay, which, in any case, is not very great. I am informed that the average length of time required for publication in the *Journal of the American Chemical Society* is five to nine weeks, according to the date of the receipt of the manuscript. As a rule, the delay, as compared with the *"Berichte"* is not greater than the length of time, three weeks, required for the double journey across the ocean. In the case of very brief papers, or when special reason can be shown for haste, the time mentioned above can almost always be shortened. In my own experience of this journal a paper appeared about two weeks after the copy was sent to the editor. During the Chicago meeting of the American Chemical Society statements were made to me by several people regarding the great delay attending publication in the *American Chemical Journal.* One gentleman from the middle west declared that a relatively short paper of his would have to wait six months before appearing. In some cases even a longer period is necessary, as I have found, but it was also the custom of the editor of this journal to expedite the printing of papers when the authors showed that their interests would suffer materially from delay.

The second of the three reasons referred to is embodied in the following statement: "Germany is the leader of the chemical world, and papers published there reach directly, with a minimum expenditure of time and trouble, those for whom the contents are specially designed." As regards the first part of this statement, it may be pointed out that Germany is likely to continue to lead the world so long as the results of the best work done in other countries are published within her borders. Are we all to publish everything in German? If not, where is the line to be drawn?

The third reason referred to above surprised me a good deal, but it was made by a high authority. "Few Germans can read English with facility, whereas most English-speaking chemists have no difficulty in dealing with German, and it is not right to say to the Teuton 'if you will not learn my language you shall not know of my work.'" To this it may be replied that the German chemist shows no indication of any anxiety to consider the susceptibilities of other people concerning the language question and, consequently, there is no special necessity to consider his feelings. If he can not or will not trouble to learn English let him get his information at second hand, from abstract journals, or let there be duplicate publication in each language. Provided that the paper appears *first* in English, and a clear indication is given in the German edition that this latter is a reprint, then, personally, I have no serious objection to offer to its duplication. The question is essentially one between the German editor and his subscribers. As regards the general ability of the English-speaking chemists to read German I fear that my friend has overrated them. Enquiry shows that it is very doubtful if fifteen per cent. of the members of the American Chemical Society see the "*Berichte*" regularly, and probably less than five per cent. read any other German journal. The relatively small number of Americans who belong to the German Chemical Society speaks for itself.

Science is world-wide but "charity beginneth at home." It would appear to be only fair that the country which provides the expenses of an investigation should have the first opportunity of enjoying its results, whether these be in the realm of pure or of applied chemistry. Is it too much to ask those American chemists who are so happy as to combine unusual natural ability with the most favorable opportunities for its cultivation, if they will not make the results of their work more directly and easily available to those of us who are less highly favored? Publication in American journals, even when it involves delay, will in no way diminish the authors' fame and will undoubtedly prove to be a great help and inspiration to their younger and less well-known colleagues.

J. Bishop Tingle
McMaster University,
Toronto, Canada,
March, 1908

SCIENTIFIC JOURNALS AND ARTICLES

Some months ago it was announced that the publication of *The Journal of Morphology* would be resumed under the auspices of the Wistar Institute. The first number of Vol. XIX. has just been issued.

The reorganization of this journal suggested the possible advantages which might accrue from a centralization in one publication office of a number of anatomical and biological periodicals. There seemed to be no doubt that more material could be published with the same funds and that there might be other advantages in publishing a number of journals from one office. The economies are too evident to need enumeration. The most vital point, however, and the one which seems to offer reasonable doubt is the question of representative editorship. It is essential that our best anatomical and biological periodicals continue as national organs edited by representative anatomists and biologists. The danger of a central office of publication is that the journals, thus centralized, may perhaps become local organs of the institution producing them. This danger must be carefully guarded against.

The Wistar Institute, by means of its advisory board, is making every effort to do national work and for this reason the danger referred to seemed so remote that four other journals, namely, *The Journal of Comparative Neurology and Psychology, The American Journal of Anatomy, The Anatomical Record* and *The Journal of Experimental Zoology,* have been assigned to the Wistar Institute. The institute has accepted these journals on condition that the same editorial boards shall continue responsible for the scientific material published, and that these boards be made up of representative men. The institute accepts the responsibility as an opportunity to aid by cooperation in the increase and improvement of the various means for publishing contributions in the field of anatomy and biology, and to relieve the various editors of some of the more arduous duties connected with an editorial office.

Any financial support which the institute may be called on to give will be at the expense of its own research work, and it must be understood that other institutions are not released from their responsibilities by the fact that the Wistar Institute has assumed the burden of publishing these journals in the interests of economy and improvement.

Fortunately, the financial burden is borne, for the present, by private contributions, but it is hoped that institutions and individuals will, nevertheless, take active interest in placing all these journals upon a self-supporting basis.

Acting through its advisory board and through the various editorial boards of the above mentioned journals, the Wistar Institute will make every effort to establish high standards in the various departments of its publication work and cooperate in every possible way to secure for the biological workers of the country the form of publication and distribution which their researches deserve.

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

Mr. C. G. Abbot, the director of the Astrophysical Observatory of the Smithsonian Institution, delivered before the academy, March 24, an address on "Recent Studies of the Sun."

Mr. Abbot gave a summary of the researches included in Volume II. of the *Annals of the Astrophysical Observatory of the Smithsonian Institution,* now about to be issued. Besides this he gave a brief account of the Smithsonian expedition to observe the total solar eclipse of January 3, 1908.

The mean value of the solar constant of radiation in calories per square centimeter per minute from 44 observations at Washington, D. C., 1902–6, is 2.061; from 59 observations on Mt. Wilson, California, in 1905, it was 2.024, and from 62 observations at Mt. Wilson in 1906 it was 2.020. Langley thought it necessary to add about one third to his solar constant value from Mt. Whitney observations of 1881 because of a supposed failure of Bouguer's transmission formula. This correction does not appear to be justified, and Langley's values should be as follows: For Lone Pine 2.06, for Mountain Camp 2.22, and their difference is reasonably attributed to experimental error, not difference of altitude. The fact that so good agreement between the Washington, Lone Pine, Mt. Wilson and Mt. Whitney values is found makes it most probable that the true solar constant value differs very little from 2.1 calories. It was shown from the temperature of the earth's radiating surface that the solar constant can not exceed 2.33 calories unless the reflecting power of the earth as a planet exceeds 37 per cent. The latter value was derived by measuring the reflecting power of clouds and other terrestrial surfaces.

Variations of the solar constant values were noted both in Washington and on Mt. Wilson, and these are so large and so well established by observation as to warrant the continuation of solar constant work at two observatories in cloudless regions of the earth well separated from one another. A study of the surface temperatures of the earth at 48 inland stations widely distributed over the globe indicates that general variations of temperature have occurred which may have been caused by solar variations of short period. The sun-spot cycle is clearly associated with a temperature variation; for higher temperatures occur at sun-spot minimum.

The variation of brightness of the sun's disk from center to limb has been observed for various wave-lengths of light, and on numerous days of observation. Changes of the rate of this variation have been noted from time to time, and these changes may prove to be associated with variations of the solar constant of radiation. Probably the cause of the decreased brightness near the sun's limb is the lower temperature of the sources of light near the limb, due to the fact that the scattering of light by the molecules of the gases of the sun prevents us from seeing as deep near the limb as at the center of the disk. The scattering of rays is so great in the atmosphere of the earth that, reasoning by analogy, scattering probably prevents us from seeing at the center of the sun's disk as much as 1 per cent. of the solar radius below the outer photospheric layers, and far less even than this at the sun's limb, owing to the greater length of path of the rays to a layer of given depth. This explains the apparently sharp boundary of the sun's disk, notwithstanding the necessity of admitting the gaseous nature of the sun on account of its extremely high temperature.

The Smithsonian Institution sent Messrs. Abbot and Moore to Flint Island by invitation of Director Campbell, of the Lick Observatory. They observed there, on January 3, 1908, the intensity of the rays of the solar corona at five points, and found them at brightest only 1/1,000,000 as bright as sun rays. They employed a bolometer in focus of a twenty-inch equatorial reflecting telescope. Glass was in front of the bolometer to prevent exchanges of long wave-length rays. By means of an asphaltum varnish screen it was found that the quality of coronal and solar radiation transmitted by glass differed little in relative proportion of visible and infra-red rays. From this and other observed facts it was inferred that the coronal radiation may probably be mostly reflected sun rays. The absence of Fraunhofer lines in light of the inner corona was attributed to the bright line spectrum of hot gases in the corona superposed on the spectrum of reflection.

In the discussion that followed Mr. Abbot's address, Professor Frank H. Bigelow reviewed the difficulties of determining the solar constant and Professor C. F. Marvin remarked upon the great ingenuity and skill shown during this investigation in devising instruments and making observations in a difficult field.

Mr. J. F. Hayford expressed his ardent admiration of the research presented in Mr. Abbot's address and stated that as he had heard of the research during its progress and read the proof of the complete paper of which his address is an abridgement his view-point was intermediate between that of the expert—Mr. Abbot—and that of the audience.

According to Mr. Hayford the grand tactics of this research are especially admirable. They involve broad principles, skilfully applied, which are of general importance in any line of scientific research.

This has been a long investigation, extending over a series of years. The judgment of the investigator has had time to become mature.

The investigator has been wise in extending the effective period of his investigation backward by utilizing the work of those who came before him, by being careful to supplement their work rather than to supersede it. Similarly, he has greatly increased the forces brought to bear upon the problem by supplementing, rather than by attempting to supersede or to repeat, the work of contemporaries.

Mr. Abbot has evidently been keen and skilful in his search for the lines of least resistance, along which greatest progress may be made for a given expenditure of energy. His reward has been the unusual progress made.

These are some of the reasons for confidence in this research, for confidence that its only weak points are those pointed out by Mr. Abbot by cautious wording in the formal printed report.

It may be well to emphasize certain ideas, developed in this investigation, which help one to see the earth in proper perspective.

"The true radiating surface of the earth as a planet is chiefly the water vapor of the atmosphere at an elevation of 4,000 meters or more above the sea level." In other words, the man in the moon, when he looks at the earth, is, in general, blinded to the small contrasts in color on the surface of the earth by the light which comes to him from the air and its contents. He secures but fleeting glimpses of the outlines of the continents.

The layer of air 13,000 feet thick, with its load of other material, including water, is a great blanket of peculiar kind such that it allows the sun's radiation to penetrate downward through it more readily than it allows the radiation to return upward in the somewhat changed form in which it then exists. The result is that, while the radiating layer has a temperature of about — 10° C. the surface of the earth is maintained at about 14° C.

It seems to be conclusively proved that the amount of the radiation sent to us from the sun varies 5 per cent. in each direction from its mean value. The variation is irregular, not periodic, and the intervals of marked excess or defect are only a few days or a few weeks, as a rule.

It was hoped, at the beginning of this investigation, that it might lead to the discovery of means of forecasting climatic conditions for some time in advance. The investigation shows that the 5 per cent. variation in the radiation produces only about 1° C. change in temperature at favorable inland stations and a fraction of a degree only at island and coast stations. This direct effect is, therefore, very small.

J. S. Diller,
Recording Secretary

DISCUSSION AND CORRESPONDENCE

WILD JAMAICA COTTON

To the Editor of Science: I send you herewith a letter from Dr. N. L. Britton, who is now engaged in a botanical expedition in the West Indies. As you will see, Dr. Britton wishes to have the information in his letter published in Science. The seeds received from him were turned over to Mr. O. F. Cook, who has examined them and prepared a memorandum, a copy of which I enclose.

This most interesting cotton will be grown for comparative study with other Central American and West Indian cottons, which Mr. Cook is engaged in acclimatizing and breeding.

Frederick V. Coville

Washington, D. C.,
April 9, 1908

Schooner "Nellie Leonora"
Off Bluefields, Jamaica,
March 6, 1908.

Mr. F. V. Coville,
U. S. Department of Agriculture,
Washington, D. C.

My dear Coville:

I am sending you by mail a small box of cotton, with seeds collected yesterday near Portland Point, Jamaica, by Mr. Wm. Harris and myself. We were very much interested in observing this cotton plant, which is growing in great abundance at that point in the extreme southern part of Jamaica, in coastal thickets both in sand and on nearly level limestone rock where there is scarcely any soil; we noticed it over an area about a mile long and several hundred feet wide. There is a total absence of weeds of cultivation, the cotton being associated with characteristic plants of the coastal lowlands. The flowers are small, the petals white with a crimson spot at the base, fading through the day to pink; the pods are small, nearly globular, the foliage pubescent or very nearly glabrous.

There are no white residents at the place; the negroes say that the cotton was brought there in slavery times and planted, but the soil is such that no cultivation would be practicable and the remarkable absence of weeds indicates that no cultivation was attempted there; the negroes say that it was formerly collected and shipped.

The occurrence of the plant at this place, associated only with native species, has given us a strong impression that it is indigenous, though it may not be; at any rate it is a race of cotton that has probably been quite unchanged from its pristine condition.

It at once occurred to us that this race might prove a very valuable one for breeding purposes, inasmuch as it furnishes a new point of departure. I therefore ask that you transmit the seeds sent by mail to such officer of the Department of Agriculture as will be most interested; I have good museum and herbarium specimens of the plant which we will share with you.

I ask also that you send a copy of this letter for publication in Science.

Yours very sincerely,
(Signed) N. L. Britton

Note on Professor Britton's Wild Jamaica Cotton

Professor Britton's account of the conditions under which this primitive type of cotton grows would seem to establish beyond doubt that it is really a wild plant. The very small bolls and sparse lint would seem to preclude the idea that this cotton was introduced into the island for civilized agriculture. If not truly indigenous it must have been brought in aboriginal times, or by accident.

The existence of wild cotton in Jamaica has been claimed by Macfayden and others, but the evidence has not been convincing. Macfayden described two species of cotton (*Gossypium jamaicense* and *G. oligospermum*) as native of Jamaica, but both are said to have yellow flowers and have been reckoned as forms of Sea Island cotton (*Gossypium barbadense*). White flowers are not known in any cottons of the Sea Island series.

In the characters of the seeds and bolls Professor Britton's cotton closely resembles a type which grows wild on the Florida Keys. Sir George Watt's recent monograph refers this Florida cotton and other reputed wild cottons from Florida, Jamaica, Curacao and other West Indian localities to *Gossypium punctatum,* a species originally described from Africa. The same author reckons *Gossypium punctatum* as one of several ancestors of our

United States upland varieties, because a few of our upland cottons have the red spots at the base of the petals. The argument is far from conclusive, for red spots occur in many widely different types, and are probably an ancestral character of the genus.

The seeds of this wild Jamaica cotton show a very interesting diversity. In addition to the lint a majority of them have a dense adherent covering of brown fuzz, but on some the fuzz has a dull greenish tinge, while in still a third group most of the surface is smooth and naked, the hairy covering being limited to a tuft of brown fuzz at the base of the seed, and a tuft of lint at the apex. The presence of all three conditions in the same lot of seeds of this primitive wild type of cotton may help us to believe that similar diversities inside our upland varieties do not, of necessity, prove hybridization, but may represent a normal range of ancestral diversity in this group of plants.

The usual correlation of greater length and smaller quantity of lint on smooth seeds also holds good. The lint from the smooth seeds averages 31.3 millimeters, that of the fuzzy seeds 30 millimeters. The lint represents 16.03 per cent. of the total weight of the smooth seeds, and 18.27 per cent. of the fuzzy seeds. The smooth seeds weigh, without the lint, at the rate of 4.23 grams per hundred, the fuzzy at the rate of 4.97 grams. If the fuzz were removed and weighed with the lint, the proportion of fiber to seed would appear still higher with the fuzzy seeds. The slight increase of length of fiber on smooth seeds is accompanied by a disproportionate reduction of the quantity of fiber.

O. F. Cook

THE CORROSION OF IRON

To the Editor of Science: In a recent publication under date of May 10, 1907,[1] entitled "The Corrosion of Iron," the writer discusses the possibility of using certain inhibitors in the priming coats of paints and other protective coverings. The suggestion was publicly made that slightly soluble chromates should be theoretically the best protectives to apply to iron and steel surfaces. Numerous chrome pigments have been tested by the writer in reference to their inhibition value, the work having been done in large part previous to the publication of the bulletin above cited. Owing to included impurities, many of the commercial chrome pigments have been found to stimulate rather than inhibit corrosion, and the use of these for such purposes should be carefully guarded against. It has been found, however, that zinc chromate and a pigment made by precipitating barium and calcium chromates in molecular proportions give excellent results in the absence of impurities, such as sulphates, chlorides, etc. Prussian blue has also proved itself among the best of the rust inhibitors, so that excellent formulæ can be devised for good greens, using the above pigments with small amounts of pure calcic carbonate, and magnesium silicates, etc. Certain of the basic orange chromates also give good results.

[1] Bulletin No. 30, Office of Public Roads, U. S. Department of Agriculture.

It has been reported that patents have recently been applied for on a combination of zinc chromate with linseed oil as an inhibitive coating for iron and steel. The details of the claims can not yet be known, but in view of the general publication of the writer's results, it does not seem that the grant of such a patent would be justified. It is the policy of this department to give out the information it obtains for the free use of every one in the country, and particularly to safeguard the interests of the farmers. It would be a misfortune, in case these inhibitive formulæ prove themselves of high protective value, that their general use should be tied up by individual patent claims.

Allerton S. Cushman

Office of Public Roads,
U. S. Department of Agriculture

THE DISCOVERY OF THE SATELLITES OF MARS

To the Editor of Science: In its issue of November 26, 1907, the Boston *Evening Transcript* published an article on the late Professor Asaph Hall, U. S. Navy, by John Ritchie. This paper contained the following statements; the first concerning the discovery of the satellites of Mars:

It was an accidental discovery, interesting because it concerns the system of our nearest neighbor in space, useful because it has furnished a new means of considering certain problems in astronomy, but not to him a crowning achievement.

He was not easily carried away by any of the psychological waves that come and go in astronomy. During one of these at the Naval Observatory it was quite the fad to observe the companions of a certain well-known star. Each man, it proved, had his own companion that he thought he saw, and comparison showed later that no two had the same one. Only Hall of all the staff resisted the opportunity, and only he, it afterwards proved, was right, for all of the little companion stars were of the imagination.

The above statements were so inconsistent with the facts that I wrote to the editor on December 4, 1907, giving him a brief but true account of the matters at issue, asking that my communication be given as wide a circulation as was given to the incorrect article. It was not printed. When asked if my article had been received the editor replied, on December 17, that it had, and had been referred to the author of the article printed November 26, 1907. Nothing has since been heard from the editor or the author, and apparently neither is willing that the facts be known. Therefore, in the interest of truth and also of justice to Professor Hall I ask that the following comments on the *Transcript* article be printed in Science.

The statement that the discovery of the satellites of Mars was an accident is not only entirely without foundation but it is unjust to the professional reputation of Professor Hall. I knew Professor Hall intimately, had worked in the same building with him for fifteen years, we lived in adjoining houses and we walked together to and from the observatory nearly every day and frequently at night. His scheme for observing Mars was discussed with him in these walks and in his home, and I know that the discovery was the definite result of a carefully devised plan for an exhaustive search for satellites. At the time of the discovery an effort was made to divert the honor of the discovery from Professor Hall, but, fortunately, that attempt failed. To say now that the discovery was an accident is a wide departure from historic truth.

With regard to the statements: "it was quite the fad to observe the companions of a certain well-known star"; "each man had his own companion that he thought he saw," and "only Hall of all the staff resisted the opportunity," it may be said, briefly, that they are absolutely untrue. None of the trained observers of the Naval Observatory saw these "companions." The discovery of these companions was made by an amateur, not a member of the observatory staff. The note books of that period will show the folly of the statement in the *Transcript*.

Another recent statement concerning the discovery of the satellites of Mars may be mentioned in this connection. In the March number of the *Cosmopolitan* magazine, page 343, Professor Todd, of Amherst College, tells a curious story of the discovery of Phobos, the inner satellite of Mars. He writes: "So mine was the first human eye that ever saw Phobos, recognizing it as a satellite."

This statement is remarkable in two ways: First, because this information has been withheld from the public and from astronomers for thirty years and only published after the death of Professor Hall; second, the statement will not deceive trained astronomical observers, but the general public ought to know that *before* and *since* that event it has been impossible for an astronomer to recognize the difference between a small star and a satellite, near the limit of vision, without extended observation or careful measures, which were not employed at the time mentioned in the magazine.

John R. Eastman,
Professor of Mathematics
U. S. N. (retired)

Andover, N. H.,
April 2, 1908

SPECIAL ARTICLES

PRE-CAMBRIAN SEDIMENTS AND FAULTS IN THE GRAND CANYON OF THE COLORADO[1]

The work of Powell, Walcott and others

[1] Published by permission of the director of the U. S. Geological Survey.

has familiarized geologists with the great horizontal wedge of Proterozoic (Algonkian) sediments which thins out to the west just south of Vishnu Temple, but there is nothing in the literature of the Grand Canyon which prepares the visitor for encountering a mass of the same sediments some ten miles west of Vishnu Temple and directly opposite the hotels at the end of the Grand Canyon Railroad.

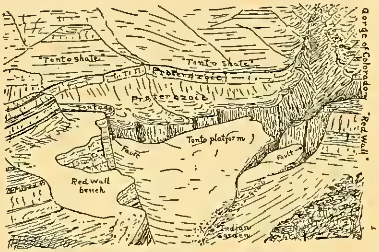

Fig. 1. Sketch from Bright Angel trail looking northward across the inner gorge of the Colorado and up Bright Angel Creek. The Bright Angel fault is shown on the right crossing a spur of gneiss capped by a small mass of Proterozoic sediments.

Doubtless other eyes than mine, practised in geological observation, have recognized the Proterozoic rocks in that part of the northern wall of the canyon lying just west of Bright Angel Creek, for the beds are visible from El Tovar hotel. It seems appropriate, however, that there should be published some accessible note calling attention to the interesting features there displayed, for the benefit of the thousands of people not necessarily geologists, who study with intelligent interest this, the most frequented part of the great chasm.

Although the general relations of the Proterozoic rocks can be made out from the southern rim of the canyon they may best be studied from the edge of the Tonto platform just west of Pipe Creek and overlooking the inner gorge—a vantage point easily gained by leaving the traveled Bright Angel trail at Indian Garden and walking or riding northward over the comparatively smooth upper surface of the Tonto sandstone (see Fig. 1). From this place the structure shown in the accompanying section (Fig. 2) is superbly displayed. The long straight gorge of Bright Angel Creek coincides with a fault of which the throw is at least 300 feet, the west side being relatively depressed. This fault-zone is visible at many points on the south side of the canyon, being crossed and recrossed by the Bright Angel trail as it zigzags down the steep slopes of gneiss along Pipe Creek. On the east side of the gorge the much contorted, truncated, Archean gneiss is capped by horizontal "Tonto sandstone" conformably overlain by the "Tonto shale" and the "Red Wall limestone"; on the west side the red sandstones and shales of the "Unkar terrane" rest, also uncomformably, upon the Archean with a low dip to the east. About two miles west of the mouth of Bright Angel Creek the pre-Cambrian sediments are cut off by a second fault which, as shown in the section and sketch, does not displace the overlying "Tonto sandstone."

A partial and brief summary of the history of events recorded in this section is as follows: (1) The reduction of the Archean rocks to a plain of erosion. (2) The deposition of the Proterozoic sediments, (3) Faulting, by which a mass of the sedimentary rocks was inset into the Archean. (4) Peneplaination of the region. At the end of this erosion period, part of the inset block of pre-Cambrian rocks was left as a low monadnock above the general

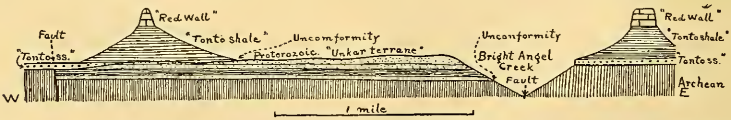

Fig. 2. Diagrammatic section of part of the north wall of the Grand Canyon near the mouth of Bright Angel Creek. Vertical and horizontal scales the same.

level. (5) The deposition of the Cambrian "Tonto sandstone" (which, however, did not cover all of the Proterozoic monadnock), succeeded by the accumulation of the "Tonto shale," "Red Wall limestone" and later Paleozoic formations.

It is clear that the present vertical distance between the pre-Tonto and pre-Unkar unconformities affords only a minimum measure of the throw of the pre-Cambrian faults. That there has been some slight post-Paleozoic movement along the Bright Angel fault, enough to fissure the "Red Wall" and "Aubrey" formations, is shown by the erosion of the Bright Angel gorge, the alcove of Indian Garden, and the shallow drainage trench followed by the Grand Canyon Railroad near the southern rim of the canyon. As may be seen from the Bright Angel topographic sheet of the U. S. Geological Survey, the three features mentioned together constitute a remarkable rectilinear depression at least 20 miles in length. F. L. RANSOME

WASHINGTON, D. C.

AN EARLY FIGURE OF THE KING-CRAB (LIMULUS POLYPHEMUS)

THERE has recently been placed on exhibition in the gallery of arthropoda in the Zoological department of the British Museum a copy of a water-color drawing made about 1585 and containing what is believed to be the earliest representation of the American king-crab (*Limulus*, or *Xiphosura*, *polyphemus*). As the subject is one of special interest to American naturalists, it may be worth while to place on record here some of the facts relating to it.

The original drawing was made by John White, who was one of the first settlers in, and for some time governor of, Virginia, and acted as lieutenant to Sir Walter Raleigh on several voyages to North America. Three volumes of drawings by him are preserved in the Department of Prints and Drawings in the British Museum, and have recently been described in detail by Mr. Laurence Binyon in the fourth volume of his "Catalogue of Drawings by British Artists . . . in the British Museum" (1907, pp. 326–337). Many of White's delineations of natural objects are of great beauty and show a fidelity to nature which was very rare at the period when they were executed.

The drawing in which the figures of the king-crab are introduced is a view of Indians spearing fish, and two specimens of *Limulus* are roughly but quite unmistakably sketched among shells and other marine objects lying on the beach in the foreground. Like many of White's drawings this one was engraved for de Bry's "America"[1] in 1590. In the engraving the figures of the king-crabs, like some other portions of the picture, are drawn in somewhat greater detail, suggesting that the engraver was working from some other drawing now lost. As Mr. Binyon suggests, "doubtless White made many repetitions of drawings which would have such lively interest for his countrymen." In de Bry's volume the text accompanying these drawings is a translation of Thomas Harriot's "A Brief and True Report of the New Found Land of Virginia, &c.," first published in 1588 and afterwards reprinted in Hakluyt's "The Principal Navigations, &c." in 1598 (the following quotation is from the Hakluyt Society's edition, 1904, Vol. VIII., p. 370). In his list of the natural products of Virginia Harriot mentions "Seekanauk, a kinde of crusty shel-fish, which is good meat, about a foot in bredth, having a crusty taile many legges like a crab, and her eyes in her backe. They are found in shallowes of waters and sometime on the shore." This doubtless refers to the king-crab. It would be interesting to know whether any readers of SCIENCE can give a reference to any earlier mention of this animal.

W. T. CALMAN

BRITISH MUSEUM (NATURAL HISTORY),
LONDON,
January 7, 1908

A PLAN FOR INCREASING THE EFFICIENCY OF MARINE EXPEDITIONS

APART from their work in deep-sea sounding, and in the accumulation of meteorolog-

[1] Grands Voyages, Part I., pl. 13.

ical observations, marine expeditions of the past have been merely extensive collecting trips. Only few and unimportant studies of living forms are possible upon a ship at sea, and practically all of the animals and plants collected are thrown immediately into preservative fluids in order that their more or less distorted remains may be sent ashore for distribution among specialists of research. In anthropology, geography, geology and kindred sciences the results are hardly more satisfactory, for it is only rarely that a vessel can remain in any one port long enough to enable her scientific staff to do more than make a mere reconnaissance.

Yet modern science is being advanced by intensive and accurate, not by extensive and cursory, observations. As time goes on the superficial in science commands less and less of our respect; and yet after an expenditure of millions by all civilized nations upon a score of marine expeditions we find that these projects have achieved practically nothing in the advancement of physiology, embryology, cytology, ecology; or in any studies requiring that plants or animals be maintained alive for any considerable time, or that use be made of the complex processes of experimentation in vogue in the modern laboratory.

My own experience, which results from having been upon many marine expeditions in all of the great oceans, forces me to conclude that not more than one fifth as much work can be accomplished on ship-board as is possible even in a moderately well-equipped land station. Really good days at sea are rare, and too often occur when the vessel must either lie idle, hasten toward some distant port, or be otherwise prevented from carrying out scientific studies. Even if one be not affected by sea-sickness, the constant rolling of the ship, shaking due to engines, and uncertain fluctuations of light in the laboratory are most discouraging to accurate work.

In future let us establish temporary land stations for the scientific staff and use the ship to supply such laboratories with their equipment and with material for study as it travels from station to station in accordance with the requirements of its work.

Only a few years ago such a plan would have been impracticable, but within the past five years the naphtha engine has been so far perfected to marine use, and so many sailors have become trained to its management, that it now gives us an opportunity to provide each temporary land station with a fast-moving collecting boat always ready for immediate service and capable of exploring every detail of coast or ocean current within a radius of many miles.

Moreover, the modern perfecting of easily transported portable houses which can readily be erected on barren shores, and the great variety one may now obtain of preserved foods, render it possible to house and supply investigators in temporary stations in regions which only a few years ago were practically inaccessible.

The marine expeditions of the future should, I think, aim to establish well-equipped but temporary shore stations at salient points, landing investigators here and there and leaving them with servants, food, lodging, apparatus and naphtha launches to avail themselves of all the varied advantages afforded by a land laboratory. In this manner a larger number of investigators than is at present possible could be carried on the expedition; for most of them would make use of the vessel merely for transportation from station to station, and for necessary supplies. A small staff permanently resident upon the steamer itself would suffice for the prosecution of such deep-sea studies as must needs be accomplished while at sea.

There is sufficient room upon any sea-going vessel for the transportation of several portable houses, half a dozen or more naphtha launches, and for collectors, engineers, sailors and cooks required for the service of the various shore stations.

Such a plan would not interfere with the constant use of the ocean-going vessel itself, which could readily carry out her proper scientific work while traveling from station to station, either to remove parties of investigators to other sites or to provide them with specimens or supplies.

We see, then, that this plan has the double advantage that it enables the expedition to carry many more investigators than if all were to remain constantly on board, as of old; and it also greatly widens the scope and increases the efficiency of their individual researches.

There are many problems, yet awaiting solution, which previous marine expeditions have either been obliged to neglect or have studied in a superficial and unsatisfactory manner. Such are:

1. The determination of the depth of the "red clay" which covers the floor of the deepest parts of the open oceans. Since the oceans ceased to boil this deposit has been gathering upon the floor of the deep sea, and a determination of its depth would enable us to form an approximate estimate of the age of the oceans themselves.

2. The character of and influences affecting ocean currents, especially at considerable depths.

3. The embryology of numerous creatures of the open ocean and of the deep water, such as *Nautilus*, the trachylina medusæ, etc.

4. A more accurate and intensive study of the nature and origin of coral atolls.

5. A more accurate study of the phenomena of oceanic volcanic islands.

6. A comparative study of the distribution of life over the great oceans; both near the surface, and at the bottom, over the open sea and in the neighborhood of coasts.

7. An intensive study of the arts, legends and habits of the native races of relatively inaccessible regions.

8. A more accurate study of meteorological conditions, leading to a more perfect understanding of the nature of the trade winds, tropical hurricanes, etc.

The nature and scope of the problems must, however, be determined by the capacities and training of those constituting the scientific staff of such an expedition. With a wisely selected corps of able, energetic students more might be accomplished upon an expedition planned in accordance with this which we have here crudely outlined, than has resulted from even the most expensively equipped marine expeditions of recent years, all of which have adhered to the old plan of attempting to constitute of the vessel a floating and traveling laboratory.

Alfred Goldsborough Mayer

THE MARYLAND GEOLOGICAL SURVEY

The Maryland legislature, which adjourned a few days ago, provided $1,000,000 for the work of the State Geological Survey during the coming biennial period—$50,000 for the geological investigations, topographic surveying, and maintenance of the testing laboratory; $150,000 for the continuation of the construction of the Baltimore-Washington road, and $800,000 for the work under the State Aid Highway Law, one half of the latter to come from the state treasury and one half from the county treasuries. Under the State Aid Law the roads must be built in accordance with the plans and specifications and under the supervision of the engineers of the Geological Survey.

The Mayland legislature also passed a bill providing for a bond issue of $5,000,000 for the construction of a main artery system of state highways 1,000 miles in length during the next five years, $1,000,000 to be available each year. A long and bitter fight developed over the administration of this new fund, the senate desiring it placed in the hands of the State Geological Survey and the house wishing a new commission. Just as the legislative session was closing a compromise was effected by which a new commission of six members was provided for, three to come from the Geological Survey. The understanding reached was that Governor Crothers, President Ira Remsen, of the Johns Hopkins University, and Dr. Wm. Bullock Clark, director of the State Geological Survey, should be selected to represent the survey. It was also agreed that after this new commission had designated the 1,000-mile system the roads should be turned over to the Geological Survey for construction. The leading newspapers of the state, including all of the daily papers of Baltimore, strongly advocated the placing of the work under the Geological Survey, where it would be effectively managed and free from political influence. The leading business bodies of Baltimore and the farmers' organizations throughout the state passed resolutions to the same effect. No subject before the Maryland legislature this past winter occasioned such widespread interest.

The Maryland Geological Survey began highway work ten years ago with the establishment of a highway division and has gradually developed the public interest that has made possible the present progressive highway movement in that state. Four years ago the State Aid Highway Law was passed and two years later an appropriation was made for commencing the construction of the Baltimore-Washington road under the Geological Survey. This is the first instance on record where a state geological survey has been entrusted with a great public work of this character and it is a matter of no small interest that a bureau which has been successfully maintaining its scientific work has at the same time secured the support of the people of the state in the largest undertaking in its history.

INTERNATIONAL CONGRESS FOR THE SUPPRESSION OF ADULTERATION

The general committee of organization of the First International Congress for the Repression of Adulteration of Alimentary and Pharmaceutical Products, to which attention was called in your issue of March 20, 1908, has published the following additional items respecting the work of the congress:

The committee particularly asks from chemists a report of general interest on any subject of their own choice relating to the principal topic of the congress or a report treating of special questions entering into the restricted elements of one of the eight sections of the congress.

The committee further asks of all manufacturers and dealers definite notes indicating, in the group of foods or drugs which most specially interest them: first, the frauds and adulterations of which they have most to complain; second, the measures of protection they ask for; third, criticisms of the laws and regulations in force; fourth, the additions, viz., coloring matters, preserving agents, etc., which they ask to be authorized for their products or which they complain of seeing authorized.

The committee further asks that there be forwarded as soon as possible the titles of papers which are to be sent from the United States, the whole paper or abstract thereof to follow later. Inasmuch as the congress is fixed to begin on the eighth of September, it is important that American contributors do not delay in preparing the reports they wish to present. I further urge all who are intending to prepare papers for the congress to send me their titles without delay in order that they may be transmitted to the general committee.

The general committee also gives notice that the exhibition of pure and adulterated foods and drugs which it was intended to prepare has been postponed on account of the short time intervening before the opening of the congress.

I extend a second invitation to American chemists, manufacturers and dealers to subscribe to the congress, and will gladly undertake to forward such subscriptions, if sent to me at Washington. As before stated, the subscription price for an ordinary member is $4 and for a donating member $20. I am pleased to add that I have already received and forwarded to Geneva a goodly number of subscriptions of American members.

H. W. Wiley,
President of the American committee and vice-president of the congress

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CORRESPONDENCE IN REGARD TO THE PENSIONING OF WIDOWS OF PROFESSORS BY THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

Columbia University
division of
philosophy, psychology and anthropology
Garrison-on-Hudson, N. Y.,
March 21, 1908

President Henry S. Pritchett, LL.D.,
The Carnegie Foundation for the Advancement of Teaching, New York City

Dear Dr. Pritchett:

May I venture to ask whether Provision (6) under the rules adopted for the granting of normal retiring allowances by the Carnegie

Foundation applies to all cases in accepted institutions? It reads: "Any person who has been for ten years the wife of a professor in actual service may receive during her widowhood one half of the allowance to which her husband would have been entitled." This provision might mean that all widows of this class would receive the retiring allowance on proper application, or it might mean that the allowance may, or may not, be granted after recommendation of the president of the institution concerned and consideration of the merits of the professor and the needs of his widow. I fear that the latter interpretation is correct, but I trust not, as it would seriously interfere with the position of the Carnegie Foundation as an agency for promoting the dignity and honor of the teaching profession.

In your annual reports you have wisely emphasized the fact that the Carnegie Foundation is not a charity, but an educational agency. You say: "No body of men is wise enough to administer a system of pensions upon considerations of individual merit only, without a strong probability that the administration will in the end degenerate." Does this not apply to pensions for widows, as well as to annuities? It appears to me that most healthy-minded men are more concerned with provision for their families in case of disablement or death than with anxiety as to their own old age. I sympathize with those who take out life insurance, not with those who buy annuities, and it gives me no satisfaction to be put by force of circumstance into the latter class. I should like to exchange my annuity for life insurance of equal value, and I believe that this would be the nearly unanimous preference of my colleagues.

The Carnegie Foundation adds substantially to the incomes of accepted universities and colleges, but it does not greatly assist the individual professor. The provision for retirement for age does not help at all in institutions that already had a pension system; in other accepted institutions the salaries will be adjusted with reference to the pension, and the only individuals who benefit are some of the older men in institutions without a pension system for whom the benefit is retroactive. Apart from this group, the benefit to the individual—and only until readjustment of salaries takes place—is confined to the length of service provision, the wisdom of which is doubtful, and the widow's pension, which only applies at the age when it is least needed, and if administered as a charity would in the long run be, as you say, "sure to harm rather than to help the teacher and the cause of education."

If the professor must be the *Versuchstier* of paternalism, is not the German system—by which he receives his salary for life, being relieved from service if disabled by illness or old age, and his widow and each of his minor children receive a pension—the best plan both for the professor and for the university? And, if so, could not the Carnegie Foundation bring about this system by offering endowments to those institutions that would adopt it?

May I print in SCIENCE this letter and your reply? Very truly yours,

J. McK. Cattell

Office of the
President
The Carnegie Foundation
for the Advancement of Teaching
576 Fifth Avenue
New York

March 24, 1908

Dear Professor Cattell:

Your letter of March 21 I can answer with more definiteness after next Tuesday, when the matter of widow's pensions is likely to be put upon a completely definite basis. I will, therefore, delay my answer until next week, when I will endeavor to answer your questions completely. Very sincerely yours,

Henry S. Pritchett

Professor J. McKeen Cattell,
Garrison-on-Hudson,
New York

Office of the
President
The Carnegie Foundation
for the Advancement of Teaching
576 Fifth Avenue
New York

April 13, 1908

Dear Professor Cattell:

I beg to acknowledge the receipt of your letter of March 21, the answer to which has been delayed by an unusual pressure of work.

As you state in your letter, our rule relative to the widow of a professor does not now definitely assure her of a pension. The executive committee has, however, voted to recommend to the trustees that this rule be amended by changing the word "may" to "shall." I have no question that this action will be taken.

I regret that it seems to you that the Carnegie Foundation does not assist the individual professor, but adds to the income of universities. I do not think this view justified, nor is it one which the foundation seeks to promote. We are just issuing a bulletin giving the financial status of the American professor and making clear the fact that it is the effort of this agency not only to bring to the teacher's profession a greater security, but, so far as it can, to assist in giving a more adequate salary. I believe that this will be its effect.

The provision for permitting a retiring allowance to be gained upon length of service seems also to us to add much to the value of the retiring allowance system. Under this provision a professor may, at the end of twenty-five years, retire on a stated proportion of his salary, the proportion increasing with each year of service. It is not likely that many professors will avail themselves of this provision. The man whose heart is in his teaching will not wish to give it up until a much later period. There are, however, teachers to whom this provision will be specially attractive, and that is to those who desire to spend the remainder of their active lives in scholarly research or literary work rather than in teaching. I can imagine no better thing for an institution of learning than to have about it a group of men who are engaged in active research and who are not burdened with the load of teaching which falls to most American teachers. In this way the retiring allowance will contribute directly to research.

A retiring allowance system, to be effective in the case of a profession like that of teaching, ought to do at least three things: (1) furnish a temporary salary in case of illness; (2) guarantee a fair proportion of the active pay as a retiring salary upon the completion of a certain service or upon arriving at a certain age; (3) guarantee a pension to the widow of a professor who has himself earned a retiring allowance. The system of retiring allowances established by the Carnegie Foundation does all these things and I can not but believe that to give this security to the teacher's calling will add to its dignity and attract to it good men. Furthermore, I am sure that these results will be brought about without a diminution of salaries which could otherwise be obtained. Yours sincerely,

Henry S. Pritchett

Professor J. McKeen Cattell,
Garrison-on-Hudson,
New York

Columbia University
division of
philosophy, psychology and anthropology
Garrison-on-Hudson, N. Y.,
April 17, 1908

President Henry S. Pritchett, LL.D.,
The Carnegie Foundation for the Advancement of Teaching, New York City

Dear Dr. Pritchett:

I learn with much pleasure of the action of the executive committee of the Carnegie Foundation in recommending that the pensions of widows shall hereafter be a matter of right and not of charity, and I am gratified if my letter had something to do with this. I trust that it will be followed by a similar provision in the case of disability. You say in your letter that the foundation furnishes a temporary salary in case of illness. This, however, is not as yet a matter of right and contract, but of favor; and, as it now stands, the dangers appear to more than counterbalance the advantage to certain individuals. We need especially insurance against disability, as this is not provided, as are life insurance and annuities, by commercial enterprise. It is of course his wife and children, not himself, which make disability such a serious matter to the professor. His capital is his ability and his education. If it is lost as a direct consequence of attendance to his duties, we have the best warrant for special provision.

The whole question of enforced pensions is endlessly complicated, the conflict between individualism and socialism being the most pressing of our civilization. It seems self-evident that if part of the salary of a professor is paid in the form of an old-age annuity, he must receive so much less salary at the time. It costs the same to pay a professor $3,500 a year, or $3,000 plus an annuity, the annual expense of which is $500. The question is which is better for the professor and for society. The Carnegie Foundation descending, as it were, suddenly from heaven is certainly a windfall for a professor in an institution that did not have a pension system—perhaps he would like it still better if he were paid the cash value of his annuity, which in some cases would be as much as $20,000. The foundation is also a godsend to the college president, the income of whose institution is generously augmented.

But these present gains to the individual may obscure our appreciation of what will happen twenty years hence. Our educational system will be richer by the income of $15,000,000; but will the professor be better off because part of his salary is paid in the form of an enforced annuity? There are obvious advantages to the individual, to the institution and to society; but there are also difficulties and dangers. If we are to have an extension of paternalism, it appears that it should apply first to children and to the ignorant, rather than to university professors. Economic socialism may be inevitable and even desirable, but we must try to maintain intellectual and moral individualism. If we make an economic caste of university professors and put it under the care of a board of university presidents, the outcome may be a deadening of intellectual vigor and moral freedom in the university.

In accordance with your kind permission I shall print this correspondence in Science.

Very truly yours,

J. McK. Cattell

ACADEMIC FREEDOM IN AUSTRIA

We learn from the London *Times* that the professorial senate of Vienna University has issued a pronouncement in regard to the case of Professor Wahrmund, of Innsbruck, which deals with the questions whether a professor of canon law can be deprived of his chair in the juridical faculty of a state university if he comes into conflict with the doctrines of the Roman Catholic Church, and whether it is admissible that the church should exercise control over the agreement of his teachings with her doctrine. It holds that if the principle that the teachings of a professor must coincide with religious doctrine were to be recognized, no department of human knowledge would remain unaffected, since all departments of knowledge have some bearing upon religious doctrine, and concludes that, inasmuch as a mere adroit attempt to influence the exercise of the right of the state or superintend the universities might in future introduce ecclesiastical influences into the management of the universities, the academic senate considers "inflexible resistance to efforts of this kind, however they may be made, to be a necessity enjoined by the vital principles of science." Professor Wahrmund has been requested by his colleagues of Innsbruck University to suspend his lectures for the time being, lest academic disturbances necessitate premature closing of the university.

PREDATORY POLITICS IN OKLAHOMA

Many of our state universities and state educational systems have passed through a period of predatory politics. Fortunately, the good sense of the people must in the end prevail, and the more important the institution, the less danger is there from the methods of the ward politician. We regret that it is now the fate of the new state of Oklahoma to suffer disgrace in the hands of its politicians. Every republican has been deposed by the democrats from the head of the state institutions, including the University of Oklahoma, the College of Agriculture and the Mechanic Arts, the University Preparatory School, the Central State Normal School, the Northwestern State Normal School and the Southeastern State Normal School. We are tempted to print as a roll of dishonor the names of the Democrats who have accepted these positions, but this might be unjust in special cases.

SCIENTIFIC NOTES AND NEWS

Dr. William H. Walker, professor of technical chemistry at the Massachusetts Institute of Technology, has been presented by the New York Section of the American Chemical Society with the Nichols medal.

The Rumford medal of the American Academy of Arts and Sciences has been awarded to Dr. Edward G. Acheson, of Niagara Falls, for his work with the electric furnace. The Rumford committee of the academy has made the following grants. To Dr. Lawrence J. Henderson, of the Harvard Medical School, $200—in aid of his investigation upon the direct determination of physiological heats of reaction. To Professor Joel Stebbins, of the University of Illinois, $100—for his investigation on the use of selenium in photometry. To Mr. Willard J. Fisher, of Cornell University, $100—for his investigation on the viscosity of gases.

We noted last week the banquet at the Hotel Astor on April 9, to celebrate the silver jubilee of Dr. H. W. Wiley as chief chemist of the U. S. Department of Agriculture. On the following day in Washington a banquet was tendered Dr. Wiley by the chemists and scientific assistants who have been associated with him in the work of the Bureau of Chemistry in expression of their loyalty and good will.

Professor Raymond A. Pearson has resigned the chair of dairy industry at Cornell University to become New York state commissioner of agriculture.

The Observatory states that Mr. R. H. Tucker, now of Lick, has been offered the directorship of the proposed Southern Observatory to be established by the Carnegie Institution either in New Zealand, South America or South Africa, for the purpose of making observations of position of stars of the southern hemisphere, according to a scheme suggested by Professor Lewis Boss, of the Dudley Observatory. The Pistor and Martins meridian circle of that observatory is to be transferred to the new establishment.

The directorship of the Toulouse Observatory, vacant by the appointment of M. Baillaud to the National Observatory, has been filled by the election of M. E. Cosserat.

M. Henri Deslandres, who since 1897 has been assistant director of the observatory at Meudon, has been appointed director to succeed the late Dr. Janssen.

The Town Council of West Ham, London, has passed a resolution authorizing the placing of a bronze tablet on the house in Upton Lane, Forest Gate, now St. Peter's Vicarage, where Lord Lister was born.

We have noted the election of Professor A. A. Michelson as honorary member of the Royal Irish Academy. The other honorary members elected at the same time in the division for natural science are: Sir Archibald Geikie, Professor J. C. Kapteyn, Professor J. D. van der Waals and Dr. A. R. Wallace.

Dr. C. F. Brackett, Henry professor of physics at Princeton University since 1873, has resigned the chair and has been appointed professor emeritus.

Professor Boyd Dawkins has resigned the chair of geology at the Victoria University, Manchester, which he has held since the year 1874. In accepting the resignation the council expressed the great regret its members felt at the professor's retirement from the chair, which he had held with such distinction and with such benefit to the university. It was gratifying to the council to know that Professor Dawkins would retain his association with the Manchester Museum, where he had done valuable work, and would also continue his popular lectures and special courses of lectures.

We learn from *Nature* that Professor P. J. White having been granted leave of absence for six months on account of ill-health, the senate of the University College of North Wales has appointed Dr. W. A. Cunnington acting head of the department of zoology for the summer term.

DR. WALLACE W. ATWOOD, of the University of Chicago, will spend the coming field season in Alaska, continuing his investigations under the auspices of the U. S. Geological Survey of the coal resources of Alaska. The special fields of work during the coming season will be in the neighborhood of Unga, Herendeen Bay and Chignik on the Alaskan peninsula, and in the Matanuska valley at the head of Cook Inlet. His address during the summer season will be Seward, Alaska.

THE Martin White studentship of £100, at London University, lately vacated by Mr. Gerald Camden Wheeler, B.A., has been extended to him for a further period of one year, in order to enable him to accompany Dr. Rivers to the Solomon Islands for the purpose of investigating the sociology of a mother-right community. This extension was rendered possible by the generosity of Mr. Martin White in offering to provide a further sum of £100 for the purpose.

DR. W. G. MACCALLUM, associate professor of pathology in the Johns Hopkins University, lectured before the faculty and students of the College of Medicine of the University of Cincinnati and many physicians of the city on April 17. He spoke of his recent research, including his discovery of the function of the parathyroid glands.

DR. L. A. BAUER gave an illustrated address on the "Magnetic Survey of the Pacific Ocean by the Carnegie Institution of Washington," on March 10, before the Scientific Association, Wesleyan University, Middletown, Conn.

ON Friday evening, April 10, Professor David Todd, of Amherst College, lectured before the Stamford Scientific Society on "Mars, as seen from the Andes."

AT a technical conference of the faculty and student officers of United States Army Signal School, at Fort Leavenworth, Kans., held on March 25, a resolution was adopted in the name of the school favoring the adoption of the word *Kelvin* to designate the commercial unit of electrical energy at present known as the *kilowatt-hour*, as a recognition of the services of the late Lord Kelvin in the advancement of electrical science.

THE body of Emmanuel Swedenbourg has been removed from the Swedish church in London, where it was interred on his death in 1872, and taken by a Swedish man-of-war to Stockholm, where it will be interred.

DR. G. VON HÜFNER, professor of physiological chemistry at Tübingen, has died at the age of sixty-seven years.

THE death is announced of Professor J. L. Mierzejewski, who has been called the father of Russian psychiatry. He published extensively on insanity, neurology and pathological anatomy.

SIR COWASJEE JEHANGHIR has given four lakhs of rupees (about $130,000) for the promotion of science teaching in Bombay.

THE city council of Lincoln has passed a resolution which gives the Nebraska State Historical Society a half block of ground facing the capitol upon which to erect the building provided for by the last legislature. Mr. Charles H. Morrill, of Lincoln, has presented to the society valuable collections of objects of Indian archeology.

THE Royal College of Surgeons of England has presented to the Harvard Medical School, through Dr. Walter G. Chase, about seventy engravings and mezzos of celebrated medical men. These, together with loan collections of Dr. Chase and Dr. E. B. Young, numbering about six hundred, have been arranged for exhibition in the Warren Anatomical Museum, in the administration building of the Harvard Medical School, Longwood Avenue.

PROFESSOR JOSEPH JASTROW'S work, "The Subconscious," has been translated into French by Mr. E. Phillipi, with an introduction by M. Pierre Janet, and is published in Alcan's Bibliothèque de Philosophie Contemporaine.

A REUTER telegram from Rome states that the International Congress of Mathematicians was opened on April 6 at the capitol. Signor Rava, minister of public instruction, the mayor of Rome, Signor Blaserna, vice-president of the senate, the rector of the University of Rome, Professor Volterra, the mathematician, and a numerous body of the members of the congress from all parts of the world were present at the ceremony. The mayor welcomed the members in the name of the city of Rome, Signor Blaserna in the name of the academy and Signor Rava in the name of the government. Professor Volterra made the opening speech.

The proposal for the establishment of an International Sickness Bureau having fallen through, at any rate for the time being, the British government has decided to take independent action, and it has been determined to establish a British national bureau in London, to be maintained by annual grants made from the imperial and Soudanese governments.

The International Peace Bureau, Berne, Switzerland, has issued a circular letter embodying the resolutions adopted by the sixteenth Universal Peace Congress, which met at Munich in September, 1907. The substance of the resolutions is as follows: (1) That Esperanto be taught as an international auxiliary language in the schools; (2) that, inasmuch as the French minister of public instruction is disposed to initiate an intergovernmental conference to consider the best means of organizing an international system of education, and since the adoption of this system would entail the elaboration of programs which would enable students to pass from the institutions of one country to those of another with suitable diplomas, the congress expresses the hope that the different governments will speedily indicate their willingness to participate in this conference, and invites the "pacifistes" (or promoters of peace everywhere) to take the necessary steps to bring this about. (3) The congress, considering the importance of the measures taken, two years since, by the Italian minister of public instruction, which were also adopted by the Hungarian minister, to have all the pupils of the state schools participate in a peace festival on February 22, with a view to inspiring them with sentiments of peace and humanity, extends its felicitations to the governments of Italy and Hungary, and wishes to bring their beneficent example to the attention of all peace societies in order that through their instrumentality their own governments may adopt similar measures.

The public lectures of the University of Cincinnati ended March 26, the last being "Civic Opportunities for Educated Women," by Miss Sophonisba Breckenridge, instructor in household administration and assistant dean of women in the University of Chicago. The preceding titles and lectures were as follows: "The Hygiene of Woman's Employment," Professor C. A. L. Reed; "Local Self-government in Cities," Dean William P. Rogers; "The Rôle of School and Workshop in the Production of Deformities," Professor A. H. Freiberg; "The Force of Ideas," Professor B. B. Breese; "Modern Hospitals," Professor C. R. Holmes; "Pragmatism," Professor H. H. Bawden; "Expert Testimony," Professor Joseph Ransohoff; "Fair Play for People and Corporations," Milo R. Maltbie, of the Public Service Commission of New York; "The Nature of Political Corruption," Professor Robert C. Brooks, of Swarthmore College; "Bacteria and Disease," Professor John E. Greiwe; "Petra, and the New Way Thither," Professor P. V. N. Myers, late of the University faculty.

A press bulletin of the Forest Service calls attention to the fact that on the Pacific coast, especially in Oregon and California, there is an immense amount of white fir (*Abies concolor*) timber now going to waste for lack of some commercially profitable means of disposing of it. At present it is very little used for lumber, and since it is not cut to any extent its proportion in the forest tends to increase at the expense of other and more valuable trees. Experiments conducted at the Forest Service laboratory at Washington show that this wood is admirably adapted for the production of paper pulp by the sulphite process. The wood is found to yield very readily to the action of the sulphite liquors used, which is of the usual commercial strength, viz., about 4 per cent. total sulphur dioxide, 1 per cent. combined and 3 per cent. available.

The length of treatment has varied, in the different tests, from eight to ten hours and the steam pressure from 60 to 75 pounds. These pressures correspond to maximum temperatures of 153° to 160° C. The pulp produced in these experiments is from nearly white to light brown in color, according to the variations in the method of cooking, and by selecting the proper conditions of treatment it would be readily possible to produce a grade of fiber which could be used in many kinds of paper without the least bleaching. If, however, it is desired to employ the fiber for white book or writing papers it could be readily bleached to a good white color. It is claimed that, so far as the product is concerned, the manufacture of fiber from white fir would be a commercial success and that the fiber produced would find its greatest usefulness in the production of manilas, where great strength is required, and in tissues which need very long fibers. It seems probable, also, that it would make very good newspaper, for which purpose its naturally light color would particularly adapt it.

According to the *Pacific Commercial Advertiser,* as quoted in the *Geographical Journal,* a body known as the Pacific Scientific Institution has been successfully organized, with a view to undertaking a complete scientific exploration of the Pacific ocean and its many islands. While the chief energies of the institution will be devoted to ethnology, the geology and configuration of the region will also be investigated, and studies in zoology and botany will be carried out, as also of winds and ocean currents with a view to throwing light on the distribution of animals, plants, and of the human race. Expeditions are to be despatched in a specially equipped vessel, and it is anticipated that fifteen years may be needed for the work. The moving spirit in the organization of the project is said to be Mr. W. A. Bryan.

The London *Times* reports that the departmental committee of the Irish Board of Agriculture appointed to inquire into the best means of promoting the reafforestation of Ireland have concluded their labors and that their report will be laid upon the table of the house in the course of a few days. It is expected that the report will recommend that the crown quit rents in Ireland, which yield something like £60,000 a year, shall be applied to the purpose of Irish reafforestation. The report, it is understood, suggests that the work should be carried out under the Wyndham Land Purchase Act of 1902 through the medium of the county councils of Ireland. Already the estates commissioners have acquired two large forests in Ireland for this purpose, one in county Wicklow and another, the Montalt Estate, in county Tipperary. The estates commissioners will manage these forests, preserve the timber, and plant trees where necessary, engaging a staff of foresters for the purpose.

Trees from the United States, Europe and Australia are being systematically introduced into the native forests of New Zealand. In the climate of that country trees from almost anywhere will thrive, and this fact is taken advantage of to plant the most profitable species. Eleven million larches, oaks, spruces, Douglas firs and Eucalypts have been set in plantations, and vast numbers of seedlings are coming on in nurseries. These are rapidly growing species which also make excellent timber. The reason given for introducing foreign trees is that the native trees of New Zealand are too slow in growth. Some of them, as the kauri pine, grow to gigantic size and produce excellent timber, but it takes from 200 years up. Successful forestry demands quicker returns. More rapid changes in animal and vegetable life are taking place in New Zealand than almost anywhere else in the world. The native Polynesian race is rapidly disappearing before the European. The wild animals, native to the islands, amount to little in the contest with animals brought in, many of which now run wild. The streams are full of American and European trout, which grow to enormous size. The very forests are to be replaced, tree by tree, by planting foreign species as the native woods disappear. New Zealand has one million two hundred thousand acres of forest, with two hundred kinds of trees. It is estimated that the native forests will last, at the present rate of cutting, for seventy years. The replacement will therefore be gradual. But in the end, if the imported trees prove to be more valuable economically than the native ones, they will make up the future forests of the country. Forestry was taken up in New Zealand over thirty years ago, but was abandoned after a few years. The reason given for dropping it was that it cost more than it was worth. After several years of exploitation, it was generally conceded that the abandonment of forestry by the government was a serious mistake, and it was taken up again with renewed energy. Nurseries and plantations are being extended as rapidly as circumstances will allow. The yearly timber cut of New Zealand is about a half billion feet, nearly the same amount as the annual cut of British Columbia.

UNIVERSITY AND EDUCATIONAL NEWS

By the provisions of the will of the late E. W. James, Esq., of Norfolk, Va., the sum of $250,000, in round numbers—the bulk of his estate—will come to the University of Virginia. One half of the income from the bequest, however, is to be paid for a period of fifteen years to the Soldiers' Home at Richmond.

The legislature of Ohio has passed a bill, amending the municipal code of Ohio, so that municipalities may issue bonds for "university purposes." In effect, the law applies only to the University of Cincinnati and provides it with a new source of income, provided the city council approves its desires. Plans for an elaborate extension of the present buildings of the university have been adopted by the board of directors. They include new buildings for the College of Engineering and the College for Teachers, museum, auditorium and combined students' club house and gymnasium. Present conditions indicate that these structures can be built within the next five years, at the most.

By the expiration of life interests and under the will of the late Benjamin D. Stillman, of Brooklyn, Yale University has just come into possession of a scholarship of $10,000. Under the terms of the will the income of the fund is to go to a graduate of the academic department selected annually by the academic faculty for personal merit and good scholarship.

Under the will of the late Mrs. John Rylands, the University of Manchester receives £75,000.

The Goldsmiths' Company has made a grant of £10,000 to found a readership in metallurgy at Cambridge University.

C. H. Beach, professor of dairy husbandry at the University of Vermont, has been elected president of the Connecticut Agricultural College at Storrs.

At the April meeting of the board of regents of the University of Nebraska, Professor C. C. Engberg was promoted from associate professor of applied mathematics to professor of applied mathematics; and Professor W. C. Brenke was promoted from adjunct professor of mathematics to assistant professor of mathematics.

Robert C. H. Heck, of Lehigh University, has been appointed professor of mechanical engineering at Rutgers College. Dr. Ralph O. Smith, of the Pennsylvania State College, has been appointed associate professor of chemistry in the same institution.

Dr. C. H. Neilson has been advanced from associate professor of physiological chemistry to professor of physiological chemistry, in the St. Louis University.

Professor Robert C. Brooks, of Swarthmore College, has been appointed to the new chair of political and social science in the University of Cincinnati.

Mr. H. L. Hollingworth, assistant in psychology in Columbia University, has been appointed instructor in psychology in the University of Nebraska.

Dr. G. H. F. Nuttall, F.R.S., Quick professor of biology and fellow of Christ's College, Cambridge, has been elected to a professorial fellowship at Magdalene College.

Lord Rosebury has been elected chancellor of the University of Glasgow.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MAY 1, 1908

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LABORATORY ORGANIZATION[1]

PROBLEMS incident to a complete reorganization of a growing department, construction and equipment of a laboratory with adequate provision for a thousand students, and the laying out of suitable courses of instruction for a college proper, have so engrossed my time during the past two or three years, that I have had to forego in a large part the pleasure of the pursuit of research in my special field of inorganic chemistry and offering the results for your consideration. Such is the price the teacher, who loves his work, must and does pay. As the coming half year promises a consummation of the work in this direction to a fair degree and as it is the purpose of the authorities of the college to formally dedicate the new buildings in May next, to which ceremony it will be our pleasure in due time to request your attendance, it has appeared appropriate, in preparation for your visit, to present to you this evening and at the two succeeding meetings of the section, a series of three short papers under the titles "Laboratory Organization," "Principles of Laboratory Construction" and "Courses in Chemistry for Colleges." That such hackneyed titles offer little that is attractive is recognized, yet I am constrained to believe that what I shall have to say will serve as an incentive for discussion. In this connection allow me to remind you of the fact that the institution to which I shall refer more particu-

[1] Read before the New York Section of the American Chemical Society, February 7, 1908.

larly, belongs to you, to me, to every man, woman or child in this great city, who pays taxes or rent. I am merely one of the instruments for making it most effective. Having centralized my efforts, for the time at least, upon it, I shall welcome every suggestion by which the ideal may be more nearly approached. Human nature prompts a desire for helpful advice and sympathetic criticism. I may add, what is presented this evening will likely provoke an amused smile on the part of those of you who are associated with large well-organized corporations.

Every department of an educational institution requires some form of organization. A chemical department is more acutely affected by lack of organization than any other of the various subdivisions of an educational plant. The nature of the work classes a chemical laboratory under the head of department stores. Every chemical department has some style of organization. Much consideration of the subject has resulted in settling upon the plan here outlined as most suitable to an institution as the College of the City of New York, which is of collegiate grade only, not offering graduate or technical courses of study. Perhaps with slight variations parts of the plan may commend themselves to other institutions.

The pedagogic phase of the subject, first in importance, is to be considered as the last of the three topics. The material arrangements for securing the best results will be taken up next time. This evening I desire to direct your attention to the consideration of the executive phase, which involves the selection of a staff, the proper care for a large plant, its upkeep and control over current expenses, whereby the largest output and the greatest use may result with the least expenditure.

Complaint is frequently made in this country on the part of directors of laboratories and teachers of chemistry, that they are overcome with detail work. This complaint is, as a rule, well founded, but it is my belief that a system of organization can be adopted which will relieve the directors of much of the detail work, subdividing it in such a manner that it does not become too great a burden for any one individual.

CLERICAL HELP

In the first place it is uneconomical to require the head of the department to do much of the clerical work, which may be done by one who has not had to spend so much time in preparation for the duties of a directorship. In short, fuller return is made to the institution by the employment of a clerk or secretary, or both.

SELECTION OF A STAFF

As the head is held responsible for the department, his advice in the selection of subordinates should carry great weight. This is a principle generally recognized in all reputable institutions of learning, although not always lived up to. Many factors are involved in the selection of a staff. I shall limit myself in this connection to two pertinent remarks. Naturally we know our own graduates better than those who come from other institutions, and whom we have met incidentally. Our own graduates are more familiar with the local problems and it is easier to meet the difficulties with sympathetic help. In not a few institutions, however, in-breeding has resulted, if not in stagnation, at least in bringing about a state of affairs which has prevented the department from producing its best results. It is desirable, therefore, to hold enough of the men who know the inside life of the institution to preserve its traditions, yet new blood should be brought in continually to show the best of other places and act as a stimulus for the whole. Withal it is better to have a man two years whom other people want, than to have a man twenty years whom nobody wants.

TIME FOR RESEARCH

It does not follow that the investigator is the best teacher, but a man of research at least has had a taste of the sweets of discovering the unknown, and consequently, with rare exceptions, is more capable of imparting some of that spirit to students than he who knows nothing of such experience. Research must be the prime means by which the young teacher can hope to attract such attention as may bring him preferment elsewhere. Yet he may not be wanted elsewhere, if he neglects the work at hand, namely, his teaching.

The controlling powers are often unfair to the young men who occupy the inferior positions in placing heavy teaching burdens upon them. Time for research, for by it advancement is hoped, is secured often only at the sacrifice of hours of needed rest and recreation, or by neglect of the little but important things of their teaching. I regard it really better business, if I may assume to speak from that point of view, to require less teaching hours for these young men, and to assign them certain times to be used for research, which may or may not be in cooperation with a colleague.[2] The freshness and vigor of his instruction will be improved and the responsibility for advancement will in a greater degree rest upon the man himself. A staff of ambitious young men secured under the same title and compensation gives an opportunity for competition for preference.

[2] We have provided one room where twelve tutors may have each a private place. Ten private laboratories are provided for those of higher grade.

STAFF ASSIGNMENTS

When a staff, or a nucleus of a staff, has been secured, it is advisable to organize the department into divisions. The extent of the subdivision and the duties assigned to the chief of each division will depend upon the number of men available and their qualifications. We have found it convenient so far to divide our department into divisions of general, analytical, organic and physical chemistry, and supplies. Each chief is held responsible not only for the instruction in his division, all details of equipment, etc., going first to him also, but for certain other matters, for example, the chief of the analytical division has general superintendence of the upkeep of the department; the chief of the physical division supervises the electrical equipment; the chief of the organic division oversees the museum and library, etc. A weekly conference of the whole staff gives an opportunity for suggestions and their discussion.

CONTROL OF NUMBERS

In a separate building given to any one subject in the curriculum of a college, there must be a fairly large assemblage of students at some time or other, particularly when a portion of the instruction is given by lectures to several hundred at once. Not only must the building be so constructed, but the organization so effected, that there may be rapid assembly and quick dispersion of people. Counter currents of the throng are avoided by having one stairway for going up and another for descending. Inevitable friction in the passages caused by discharging several groups of students into the corridors at once is avoided by a little foresight in arranging the schedule of recitations and laboratory practise. After three o'clock in the afternoon, after which hour no new class now begins, or in times of emergency, all means of exit are used. They are so arranged that there is no converging of currents, the upstairs leading out one way, and the downstairs leading another. The exemplary conduct of the children in our public schools of New York at times of alarms of fire have often demonstrated the wisdom of such precautions.

STUDENTS' SUPPLIES

The problem of supplies is an ever vexing one with every chemical department. The College of the City is unique in requiring no fees, and by law we must provide sufficient apparatus and chemicals for each student to complete a first-class course in chemistry without cost to him. The cost for the average student, therefore, must be determined for each course. The student has that amount, in terms of supplies, to his credit upon which he may draft as his requirements arise. At the point of overdrawing on the part of an extravagant or careless student, his credit ceases and he must make good any excesses.

CARD CATALOGUE SYSTEM

Satisfactory bookkeeping is therefore a necessity. We have adopted the card catalogue system. The system for the division of supplies, including four auxiliary supply rooms, provides requisitions for immediate or temporary use, import orders, desk equipment and private laboratories; shipping instructions, inventory, labels, tags, etc.

A budget is prepared. The amount of the appropriation is known to the director. All requisitions are recorded with the estimated cost opposite in one column. When the bill for that particular requisition is presented the actual expenditure is placed in an adjoining column. By this means we live within our means, whether they be meager or extravagant. The Board of Estimate usually avoids the latter, even if we were inclined to extravagance.

The executive side of the system cares for students' registration, division registration, advancement, admission to advanced standing, record cards, requests for permit to work out of hours, notices of poor work and regular students' reports, etc. The cards are colored, which facilitates classification, as yellow for analytical, red for organic, etc. The selection of any designating color once decided upon is adhered to.[3]

In elaborating this system I have received hearty aid from my colleagues, Associate Professor H. R. Moody in particular.

PLACING RESPONSIBILITY ON THE STAFF

The use of a time stamp to indicate the receipt of invoices, date of approval of bills, for stamping of notebooks, etc., has proved of great value in our department in serving to place the responsibilities. In this connection it may be stated in anticipation of a subsequent discussion of certain pedagogic problems that we have the "section system" for laboratory instruction. We do not have large laboratories, but small ones, accommodating, as a rule, not more than twenty-five students at one time. The reasons for this will be discussed in a later communication. The instruction in each laboratory is given by one instructor. He is held absolutely responsible for the conduct of that room, including its physical condition. Instructors are human and when the responsibility is divided, one usually bears the brunt of the work and the filthy condition of a laboratory is always attributed to the "other fellow." This is a principle and one of fundamental importance. Its application

[3] Samples of the cards in use were exhibited. They may be had on request to the author.

discloses the slipshod clock-watcher, while it rewards the earnest and worthy.

UNIFORM REAGENTS

To bring about uniformity in the use of chemicals throughout the laboratory, where it is possible, reagents are made up in bulk according to a standard, which has a normal basis. These reagents, on requisition to the main stores, are distributed in proper vessels and charged to the respective laboratories to which they are issued. As the instruction in one laboratory is as a rule limited to a particular kind, and as several laboratories are carrying on the same kind of instruction, it is comparatively easy at the end of the semester to determine the consideration given to economy by the instructor in charge. Parsimony may not be a desirable quality in a man, but economy is not a bad habit.

REAGENT BOTTLES

The missing reagent bottle has been the source of unending worry to instructors and the cause for much useless delay to the student in his work. When the number of reagent bottles goes beyond ten thousand, the problem is serious and the exasperation resulting is likely to be beyond words. It may be solved in large part by burning numbers indicating the floor, room and desk in with the label. The number of the stopper and bottle is cut by a diamond or etched. A glance shows the completeness of a set of reagents or the location of a misplaced bottle, for bottles will be misplaced as long as human beings use laboratories. There is only one system which will prevent that, and it is not allowed by the law. I mean the shotgun system.

LOCK SYSTEM

In order to hold a student responsible for the apparatus with which he is charged, he must be provided with locked cupboards and drawers. These in some laboratories have combination locks. They get out of order and are wasteful of the instructor's time in the semestral cleaning up and refitting. Therefore, we adopted the separate key system, the instructor being supplied with a master-key. To avoid the frequent excuse of leaving keys at home, they are kept upon numbered hooks within a cupboard, provided with a clear glass front, next the bulletin board, which is conveniently placed in each laboratory by the entrance door. The cupboard is opened only by the instructor's master-key. A glance indicates absences and prevents the use of the laboratory by students out of hours without a special permit.

The key system adopted for the entire department may be of interest. The stock-room system (six rooms) are under one key. Each stock-keeper has one. All students' laboratories, lecture and quiz rooms, the key cupboards, students' desks, toilets, janitor's closets, switch boxes for lighting, library and doors to the building are opened by one master key. Each member of the staff has one of these. The toilets, janitor's closets, and laboratories are under one key for the cleaners. The suite of executive rooms, including the private laboratory of the director, is under one key. The director's secretary, private and lecture assistants have one. Each private laboratory is under a separate key, that of the chief of the division of physical chemistry controlling the switchboard, storage battery and electric furnace rooms. The director is provided with a grand master key which opens every lock in the building except the private desk of each member of the staff.

ELECTRIC CURRENT SYSTEM

In pursuing the pedagogic policy to which reference has been made, it is necessary to provide students with electric current from storage batteries. These delicate sources of energy require systematic and intelligent supervision. The instructor in charge of a particular laboratory makes requisition upon the chief of the division of physical chemistry for current of definite voltage and an outside limit of amperage. The cells are connected with plugs carrying fuses with the limit of amperage wanted. A careful record of the condition of the cells, when put in service and when disconnected, is made. Communication among the offices, private laboratories (for a staff of thirty), stock rooms, preparation rooms, etc., is facilitated by an intercommunicating telephone system, whereby eight different conversations may be carried on simultaneously and without interference.

SEMI-ANNUAL CLEANING UP

The semi-annual cleaning of movable ironware like files, tripods, etc., may best be accomplished by dumping the pieces into an electrolytic tank containing water to which salt has been added. After the passage of the current for a few minutes, the cleaned metal is washed with tapwater and placed in a drying oven. Those articles requiring painting are then dipped in a tank of acid-proof paint and allowed to drain on an incline which leads the excess of paint back to the tank.

CONTROL OF PLATINUM

We have found it advisable to mark all our platinum ware by a special stamp and register it with each dealer in platinum with the request that any of that metal bearing the "Sign" presented for sale without an accompanying letter of the director, be held pending communication with the department. We have met with gratifying cooperation on the part of the dealers.

FIRE PRECAUTIONS

It goes without saying that precautionary measures must be taken against the inevitable fires often recurring in laboratories. In each laboratory, depending upon the size of the room, we decided to place tube powder fire extinguishers. The larger rooms have a tube at each end. In the corridors on each floor and in the organic laboratory is an improved Babcock machine. That failing, recourse is had to the fire hose conveniently placed. Each laboratory is connected directly by enunciator bells with the office of the assistant to the director, who is chief of the division of supplies and *ex-officio* chief of our voluntary fire brigade.

In the event that an accident has resulted in setting fire to an individual, recourse is had to the shower which extends over the exit door of each laboratory for students, and the fire-proof blanket hung nearby. Emergency medical closets are in the corridors of each floor. An accurate detailed statement of each accident, however small, is filed with the director by the responsible instructor within twenty-four hours. These records are kept open for court or medical inspection.

By the system outlined the head professor secures some time for service on many important committees involving general problems concerning the welfare of the institution. The division of labor has not resulted in any complaints about having placed too heavy a burden upon any one of my associates. Each member of the staff not only earns his salary legitimately, but secures some hours for investigation. The city gets a constant rich return for the investment, for the service is not only good, but fuller, when the work of the individual is stimulated by a happy ambition.

Charles Baskerville
College of the City of New York

THE CARNEGIE FOUNDATION NOT A CHARITY BUT AN EDUCATIONAL AGENCY[1]

The year and a half of experience in the administration of Mr. Carnegie's great gift has served to reveal not only some of the results likely to accrue from it, but also some of the tendencies in administration which are to be avoided.

The gift was intended to serve primarily in the establishment of retiring allowances for teachers in the higher institutions of learning in the United States, Canada and Newfoundland, but the donor left it to be administered for this purpose in such manner and under such regulations as the trustees might decide to be wise.

The fears which have been expressed in certain publications that a great gift like this in the hands of a limited number of men might prove a centralized power which would hinder rather than aid the progress of education, do not seem to me well founded. The trustees of this foundation are in the main college and university presidents who have come up through the profession of the teacher and who are not likely to lose touch with the needs and aspirations of teachers. Furthermore, they compose a board which while continental in the interests represented has no constituency to cultivate either for the sake of numbers or of revenue. If the board gain influence it can come only through a just and wise administration of its trust. It is, in my judgment, a wholesome influence in education to have a few such centralizing influences. Our tendencies in the past in the founding and maintenance of colleges have been almost wholly along competitive lines. Colleges and universities have grown up not only without any effective outside criticism, but without any conscious attempt to serve the larger interests of education, letters and science or to operate on a national scale. Here for the first time is created an agency which is conscientiously seeking to consider the problems of institutions from the larger view of the welfare of the teachers in all colleges and universities, and to take into account the interests not alone of a community or of a section, but of a continent. The two viewpoints are vastly different. Heretofore the tendencies have nearly all been centripetal and the outcome is seen in the multitude of weak, badly organized, and in some cases unnecessary institutions. The establishment of an agency which is concerned with the larger outlook and the wider field can scarcely fail to make for educational coherence and in the end for educational unity.

There lies also in the work of such an agency increased possibilities for international understanding and betterment. Canada and the United States can each learn from the other in the matter of education. The common school systems of the two countries are remarkably similar in their organization and in their methods. The Canadian institutions have naturally followed more closely than American colleges English precedents. Just at this time, however, the American college is undergoing a searching examination and methods are again being developed which look toward the English college ideals and organizations. Each country will gain by an acquaintance with the educational methods of its neighbor and such acquaintance makes for improved international relations.

The year and a half of experience in the administration of the foundation has served to make clear at least one principle, namely, that the retiring allowance must come as a right, not as a charity; as a thing earned in the regular course of service, not a

[1] From the second annual report of the president of the Carnegie Foundation for the Advancement of Teaching.

courtesy. The establishment of a retiring allowance system upon definite rules under which a professor receives his retired pay through his college in due course can not fail to strengthen the teacher's profession enormously. The administration of this fund as a charity would in the long run be equally sure to harm rather than help the teacher and the cause of education.

For the demoralizing effect of a pension system supposedly administered on the ground of personal merit one has only to look at the history of government pensions in this country. These pensions were originally instituted to dignify and assist men who had served the country honorably and unselfishly. Their administration has become the greatest single source of political corruption of which our national government has been guilty, a contagion which has touched presidents, members of congress and, most of all, the class intended to be benefited. Human nature in teachers is not materially different from human nature in congressmen and soldiers. No body of men is wise enough to administer a system of pensions upon considerations of individual merit only, without a strong probability that the administration will in the end degenerate.

The preconceived ideas in the minds of the public and in the minds of many teachers concerning the work of this board contemplated a very simple task. On the face of it the allotment of pensions to worn-out but deserving teachers who might apply directly or through their friends did not seem to involve any very difficult problems. Such a picture of benevolence appeals to much that is best in our human nature. But such an administration of the funds of this trust would be comparable in its ethical results to that which might be had by standing on a street corner and giving a gold piece to any aged passerby who seemed on the whole to merit it and to need it.

There are many deserving men who have grown old in teaching who assumed that the funds of this board would be distributed in some such way and who have felt disappointed that they have not been so distributed. A considerable proportion of these teachers have done their work in schools below the college, many are in denominational institutions and are thereby excluded, and very few of the remainder have rendered to education such a service as would justify an exception in their cases. The very making of exceptions is itself to be regretted. At the beginning of its work the board of trustees of the foundation decided that it was desirable, as far as possible, to confer retiring allowances through the institutions themselves, but that it was just and fair to extend the benefits of the retiring allowance system to a number of individual teachers, particularly to men who had done pioneer work in education or who had rendered extraordinary and unusual service in its cause. This policy has thus far been continued, and I believe without unfavorable results, although experience shows that the number of teachers who are believed by their friends and acquaintances to have rendered extraordinary and unusual service is practically without limit. In fact, every region and almost every institution has its representative who in the opinion of those near him is deserving of special consideration. To provide pensions for certain of these deserving teachers and to refuse them to others will not work for the betterment of the teacher's calling, the improvement of colleges, or the progress of education. In a word, the awarding of the retiring allowance in any other way than through institutions and in compliance with fixed rules under which the retiring pay comes as a right, not as a favor, is at best a process of doubtful value. Within a limited time it will, in my judgment, be necessary to grant retiring allowances only through institutions.

The true task of this board is not to pass upon the merits of individuals, but of colleges; to decide upon such educational standards as seem fair and wise, and then to proceed to admit to the system of retiring allowances such institutions as, complying with these standards, come within the provisions of the charter and the deed of gift. To do this involves a study of the educational situation in the United States, Canada and Newfoundland. The first step toward such a study is the bringing together of the facts themselves concerning these institutions, such as their method of government, their denominational relations, the value of each institution as a center of intellectual and moral influence, their financial resources, and, most important of all, their academic standards of work. In a word, the Carnegie Foundation for the Advancement of Teaching must be first an educational agency before it can act wisely in awarding retiring allowances. It is charged with the duty of administering a fund for higher education, for teachers in colleges, universities and technical schools of college grade. Its first concern is to ascertain how many such institutions there are and which of them are entitled on fair and reasonable conditions to the privilege of this fund.

SCIENTIFIC BOOKS

Electro-analysis. By EDGAR F. SMITH, Professor of Chemistry in the University of Pennsylvania. Fourth edition, revised and enlarged, with forty-two illustrations. Pp. 336. Philadelphia, P. Blakiston's Son and Co. 1907.

The introduction of modern electrolytic methods into chemical analysis has brought about in that science a veritable revolution, in which the author of this compendious but handy volume has been a prominent leader. It is with authority that he discusses the various electro-analytical methods of which several hundred are described in the text, for many of these methods were devised and apparently nearly all have been tested in the author's laboratory.

The book is quite frankly a collection of receipts which if followed to the letter will lead to successful analyses. When a deviation from the prescribed rule will lead to disaster, or why this method succeeds and that method fails, the reader is not told. Nor is this altogether the fault of the author. Most of the methods here given are like cook-book receipts, based on pure empiricism. We do not know why the investigator tried a given method. We only know that he tried it and it "worked." In general the practise of quantitative analysis has so far outstripped the theory that at present it may be considered more an art than a science. This state of things the author accepts without protest. A chapter entitled "Theoretical Considerations" is devoted to Freudenberg's work on the separation of metals at constant E.M.F. Aside from this no mention of theory is made except occasionally when one of the old-fashioned theories is treated as an experimental fact, for example, on page 111 it is stated as if it were well established that in the electrolysis of potassium oxalate, potassium deposits on the cathode and later reacts with the water to produce hydrogen and alkali.

The directions given in the book are as a rule clear and explicit, but not always. Thus on page 109 we read, "add 4 c.c. of a solution of ammonium acetate, 20 c.c. of citric acid, and dilute to 200 c.c. with water." It would be convenient to know the strength of the ammonium acetate and citric acid solutions which are to be added. However, such omissions are infrequent. A more serious criticism may be made which applies to every process described in the book, and it is not that the author gives too few directions, but too many to be mutually compatible. On nearly every page we are told to electrolyze with, say, a current density of 5 amperes per 100 sq. cm. and an E.M.F. of 5.5 volts. Now when a cell is constructed of given dimensions, and filled with a solution at a certain concentration and temperature, the voltage required to produce a given current density is fixed by the conditions. It is true that the potential fall at the electrode is a very important factor in metal separations but this fall is determined directly by the current density. The voltage at the cell terminals is of no consequence in the analysis. From the directions for each process the prescribed voltage given by the author may be entirely omitted and must be in order to make the directions self-consistent.

In discussing the various processes the probable experimental error is not discussed, but fortunately figures are often given showing the results of actual analyses and from these the probable accuracy of the different methods under favorable conditions may be estimated.

Especial attention is given to the deposition of metals on a mercury cathode and to the use of rotating electrodes. The latter device, which permits an analysis formerly requiring several hours to be carried on now in a few minutes, was invented by v. Klobukow in 1886 but has only been generally adopted within the last few years. Its efficiency is apparently due merely to the relative motion of electrode and electrolyte which prevents the depletion of the electrolyte in the neighborhood of the electrode and also perhaps by mild attrition produces a more coherent film of metal. It is therefore possible to use a very high current density without the formation of loose or poorly adhesive films.

In the chapter on the history of electroanalysis it is interesting to learn that even in 1801 it was proposed to separate the metals by electrolysis, and that in 1860 Lucknow deposited the metals quantitatively and separated them from one another by means of the current, and even determined lead and manganese by depositing them as peroxides at the anode.

Besides chapters on the determination and separation of metals there are others on the determination of halogens and nitric acid, on electrolytic oxidation and on combustion of organic compounds by electrical heating. There is an index, and each chapter is introduced by a short bibliography. The volume is of a convenient size, is bound in flexible covers and is an excellent specimen of bookmaking.

Gilbert N. Lewis
Massachusetts Institute of Technology

SCIENTIFIC JOURNALS AND ARTICLES

The American Museum Journal for April contains a well-illustrated article by Barnum Brown on "The Trachodon Group" of two mounted skeletons of these strange dinosaurs. There is a plate of the large African elephant head, obtained by the Tader expedition and mounted by Mr. Lang. Under "Ethnological Loan Collections" is a description of the exhibit illustrating the life of the Ojibwa Indians deposited in a branch of the public library where it is seen by children to whom the story of Hiawatha is told during the "story hour." Recent museum publications are noticed and announcements made of the various lecture courses.

The Bulletin of the Charleston Museum for March under "Museum Records" notes the progress in caring for the collections and tracing the history and records of material that has been accumulating for more than a century and includes "the fossil man of Guadeloupe," the Elliott Herbarium and specimens noted by Holbrook, and Audubon and Bachman.

The Evolution of the Elephant, by Richard S. Lull, forming Guide No. 2 of the Yale University Museum comprises 44 pages, with many illustrations and four maps of distribution of fossil and living forms. It includes a general discussion of the characters and affinities of the Proboscidea, the evolutionary sequence of the genera and species and the indicated migrations of the Proboscidea which led to their present distribution.

The Museums Journal of Great Britain for March has an article on "Museums of Elementary and Higher Grade Schools," by

Herbert Bolton, pointing out their usual mixed character and lack of relation to the school curriculum and suggesting how they may be made of real value. G. A. Dunlop describes "Drying Plants without Pressure" by the use of fine sand or boxwood sawdust, the latter material preserving many of the natural colors and much of the texture of flowers and leaves. It is pointed out that care should be taken in using sawdust owing to its irritating effect on the mucous membrane of the eyes and air passages. There is an account of the exhibit of "British Grown Trees in the Natural History Museum." Among the many "Notes" is one to the effect that the London and North-Western Railway is gathering material to be ultimately displayed in a railway museum.

The Museum News of the Brooklyn Institute for April contains articles on "The Giant Stork, or Jabiru," "Zuñi Silver Working," and "Lizards in Human Stomachs." The section devoted to the Children's Museum discusses "Elementary Physics as a Subject for Children's Museum Instruction" and notes the various living animals at the museum.

A new psychological journal, *Le revue psychologique,* has been established at Brussels under the editorship of Mlle. I. Ioteyko, M.D.

SOCIETIES AND ACADEMIES

THE NATIONAL ACADEMY OF SCIENCES

The scientific program of the meeting of the National Academy of Sciences held in Washington on April 21, 22 and 23 was as follows:

"A Proposed International Atlas of Land Forms," by W. M. Davis.

"The Geological Age of the Santa Cruz Beds of Patagonia with Restorations of Santa Cruz Mammals" (with lantern illustrations), by W. B. Scott.

"The Biological Station for Research, at Agar's Island, Bermuda" (with lantern illustrations), by E. L. Mark.

"The Cytological Basis of Heredity and the Determination of Sex" (with lantern illustrations), by E. B. Wilson.

"On the Functions of the Parathyroid Glands in their Relation to Calcium Metabolism and to Tetany," by W. G. MacCallum and C. Voegtlin (introduced by W. H. Welch).

"Supplementary Atmospheres," by T. C. Chamberlin.

"Great Tangential Movements of the Earth's Crust," by Bailey Willis (introduced by Ira Remsen).

"Some Results of the Magnetic Survey of the United States," by L. A. Bauer (introduced by R. S. Woodward).

"The Metasilicates of Lime and Magnesia—An Application of Physical Chemistry to Minerals," by E. T. Allen (introduced by R. S. Woodward).

"The Exact Measurements of Quantities of Heat, up to 1,500° Centigrade," by W. P. White (introduced by R. S. Woodward).

"Spermatogenesis in the Bee and in the Wasp," by E. L. Mark and Manton Copeland.

"Biographical Memoir of Alpheus Hyatt," by W. K. Brooks.

"Perceptions, Ideas and Hallucinations," by J. McK. Cattell.

"Application of Periodic Solutions of the Problem of Three Bodies to the Motion of the Moon," by F. R. Moulton (introduced by E. H. Moore).

"Biographical Memoir of Asaph Hall," by G. W. Hill.

"The Elevated Reefs of Mombasa and Adjacent Coast," by A. Agassiz.

"The Pelagic Fauna of Victoria Nyanza," by A. Agassiz.

"Recent Work of the Smithsonian Astrophysical Observatory," by C. G. Abbot (introduced by Chas. D. Walcott).

"The Hydration of Ions in Solution," by E. W. Washburn (presented by A. A. Noyes).

"Radiant in the Star-group in Taurus" (with lantern illustrations), by Lewis Boss.

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 442d meeting was held on March 21, 1908, with President Stejneger in the chair.

The first paper was by Professor W. J. Spillman, on "Fixation of Breed Characters in Animals and Plants." He first illustrated the manner of behavior of a character pair (non-albinism and albinism). The character of the population from the second to the tenth generation of the descendants of a Mendelian hybrid was illustrated by lantern slides for different methods of selection. First, with no selection, it was shown that with close fertilization the descendants of a hybrid constitute, after a few generations, a population consisting of 2, 4, 8 and so on, fixed types, each constituting half, a fourth, an eighth and so on, of the population, depending on the number of character pairs considered, the number of the fixed types resulting being equal to two with an exponent equal to the number of character pairs. Along with these fixed types is found a decreasing proportion of hybrids between the fixed types. With promiscuous cross fertilization and with no selection to type the proportion of the various types occurring in the second generation of the hybrid remains the same in later generations.

By that method of selection in which extracted recessives are discarded it was shown that both with cross fertilization and close fertilization the population gradually approaches the type selected. In close-fertilized plants the approach is rapid, making in ten generations a nearly pure population. With promiscuous cross fertilization this method of selection tends to produce a pure population, but at a much slower rate than with close fertilization. For instance, with two character pairs, when cross fertilization occurs, in the tenth generation the type selected becomes approximately 65 per cent. of the population, while under similar conditions, with close fertilization, the type selected becomes approximately 99 per cent.

With animals another type of selection is practicable, viz., that in which one of the sexes is tested for gametic purity and only homozygotes of the type desired used. When this method is used the selected type increases even more rapidly than with close fertilization and elimination of extracted recessives.

In plants still a different process is practicable, viz., that of testing each second generation individual by saving its seed and planting them separately. When the next crop matures the character of the progeny of the various individuals enables the breeder to select those which are homozygote and those thus establish at once a pure breed.

The speaker also referred to the so-called elementary species secured by Nilsson, of Sweden, and Shull, of this country, explaining them as the descendant of a completely homozygote individual. It is claimed that in these completely homozygous forms all hereditary variation is completely eliminated and that only such variation occurs as is due to environment.

Dr. C. O. Townsend asked whether the speaker considered variation caused by environment to be hereditary. In answer it was stated that that question had not been sufficiently investigated to permit of a categorical answer. When plants are moved to an entirely new environment, important variations frequently occur. Some of these variations are hereditary, at least under the new environment. Whether they would be permanent should the descendants of the plant be returned to the original environment has not been sufficiently investigated.

Mr. M. C. Marsh read the second paper, describing "A New Method of Marking Salmon Fry." Distinctive marks on young salmon, provided they do not interfere with the life and movements of the fish and are recognizable in the adult, are very useful in acquiring information concerning the age and migrations of salmon and the efficiency of artificial propagation. The Bureau of Fisheries has obtained definite returns from salmon fry marked in Alaska by the amputation of certain fins with scissors. These marks were placed upon fry about three months old. The operation of marking is rather slow and tedious. The possibility of rapidly marking salmon fry in the sac stage or at the time of planting, by cauterizing the fins with a thermo-cautery needle was shown. Either the adipose, dorsal or anal may be removed in this way and probably other fins. The shock of the operation causes a moderate loss which ceases after two or three days and the remaining fry recover. Evidence thus far gives reasonable assurance that regeneration will not interfere with the recognition of the marked fish which return as adults. Combination marks on the same fish may to some extent be made and in this way the number of distinctive marks may be increased. A given mark should, of course, be confined to one locality and one season, unless an interval of years has elapsed.

A character shaped like the letter s may be branded upon the skin of salmon fry by the aid of a thermo-cautery with small mortality. The subsequent obliteration of the wound by healing and regeneration, and failure of the scar to grow sufficiently with the growth of the fish, are possibilities which may interfere with recognition of the adults. Salmon fry, however, are to be marked by these methods on a considerable scale in Alaska, and the outcome awaited.

By partly stupefying the salmon fry with chloroform the marking and branding is greatly facilitated and the loss reduced.

A method for marking the fry of the great commercial species, such as the cod, shad and whitefish, is greatly desired. Such fry are too small and delicate to withstand the shock and handling incident to a mechanical mark.

The last paper was by Dr. M. W. Lyon, Jr., consisting of "Remarks on the Horns and the Systematic Position of the American Antelope." The history of the literature on the subject of the periodic shedding of the horns of the American antelope was reviewed and an outline of the growth of the horns and the method of shedding presented. Two abnormal cases in which horns were not annually shed were mentioned. Dr. Lyon concluded that in structure and method of growth the horns of the American antelope do not differ essentially from the horns of the cattle, sheep, goats and true antelopes, family Bovidæ, and that the genus *Antilocapra* should not rank as the representative of the family Antilocapridæ of the order Artiodactyla, but as a subfamily, Antilocaprinæ, of the family Bovidæ. Illustrations of the growing horns of males, of female horns, and of an abnormal horn which had not been cast off were shown.

M. C. MARSH,
Recording Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

AT the meeting of March 3, 1908, a necklace, consisting of a human lower jaw suspended from a string of beads and human teeth, and two leather bands ornamented with ends of fingers, all from the Apache and Ute Indians of the southwest United States, were exhibited and commented on by the president and secretary, who referred to the use of parts of the human body for fetichistic purposes. The paper of the evening was by George R. Stetson, "The Industrial Classes as Factors in Racial Development." Mr. Stetson said that the factory began in England under the Romans and that early the evil effects of overcrowding, bad air and lack of sanitation were known, causing attempts to be made to alleviate the troubles. In England, in 1906, 109,068 factories employed four and one fifth million workers, seventy-one per cent. women and children, and in Scotland sixty-eight per cent. were females. Mr. Stetson named various occupations which are dangerous, laundries being the worst. Cotton mills are damp and sometimes have 31–49 volumes of carbonic acid to 1,000 volumes of air, whereas, the law allows only nine volumes to 10,000 volumes of air. In fact few mills are sanitary and the result is to lower the weight, stature and general health among children, and produce rachitis and trade diseases. Much of the terrible deterioration shown among recruits offered is due to the perils of the modern manufactory. Overcrowding, also, is a great evil, which causes pauperism and disease. In Sheffield, for instance, the infant death rate is 236 to 1,000, and in other localities the condition is deplorable. Mr. Stetson said that deterioration is more marked than it was twenty-eight years ago, and it is manifest that the industrial classes must be relieved by some means or the viability of the race will be decreased. The paper was discussed by Professor Holmes, who said that in a small way much has been done to protect the worker, but to secure ideal conditions is difficult and that there would probably always be a certain amount of deterioration; by Dr. Hrdlicka, who said that the employment of children is the chief source of danger, because the seeds of disease are implanted at a period when the body is undeveloped; by Major Clark, who said that child labor is not an unmixed evil, and that it is chiefly a sanitary question; and by Mr. Robinson, who suggested old age pensions as means of avoiding pauperism.

Walter Hough,
General Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 202d meeting of the society, held at the Cosmos Club, on Wednesday evening, March 11, 1908, under informal communications, Mr. W. H. Emmons presented a formula for determining the angle of intersection of a plane with the strike of a vertical section which is drawn oblique to the strike of the plane.

Regular Program

Preliminary Notes on Recent Earth Movements at Butte, Montana, as shown by Precise Levels of the U. S. Geological Survey: R. H. Chapman.

In 1904 precise levels were run at Butte, Montana, and many bench marks established with the purpose that they should be used as a base to compare future changes of surface level.

In 1906 the Coast and Geodetic Survey brought one of its precise lines into Butte and obtained checks on several benches of the 1904 work. These checks show changes which are interesting. Using a bench mark near the Butte Reduction Works as a datum and extending the comparison of benches northward an increasing difference is found.

	Difference
Butte Reduction Works	0.000
Webster School	— .017
Colorado Street School	— .051
Owsley Block	— .436
Court House	— .737
Government Building	— .888

From the Government Building a comparison along another line to the flat southward shows a decreasing difference.

	Difference
Government Building	— .888
Florence Hotel	— .791
Braund House	— .130
South Butte	— .051

Butte Reduction Works again the zero.

The maximum change at the Government Building represents a sinking of .444 foot per annum.

The Owsley Block compared with the Butte Reduction Works shows a sinking of .344 foot between 1899 and 1904, and of .436 foot between 1904 and 1906, the former giving a rate of .069 and the latter of .218 foot per annum. The figures obtained from the earlier work are not so reliable as those depending upon the notes of 1904 and 1906, but comparison shows the rate of change to be increasing.

The bench marks were located in the hope that eventually it would be possible to determine if there is continued movement along the local fault planes, but the 1906 work did not include a sufficient number of checks to be of value for this purpose.

No reliable comparison has yet been had with the benches established on the east side of the continental fault of the Rocky Mountains.

The systematic repetition of check levels at intervals of two years—to bring out the facts of value—was strongly urged.

Pleistocene Phenomena of Central Massachusetts: Wm. C. Alden.

The Worcester County plateau is well glaciated, retaining in but few places residuum of preglacial weathering. There is much drift in the valleys, but on slopes and crests it is very thin, probably not averaging 15 feet over the area.

No undoubted evidence of pre-Wisconsin glaciation was observed. Drumlins are numerous, while in places the bed-rock surface between them is but thinly covered. Consideration of the elevation of the glaciated summits of Mounts Wachusett and Monadnock, their distances from the terminal moraine, and other factors leads to the inference that there may have been 1,500 to 1,900 feet of ice over the central part of the area, and 2,000 to 3,000 feet in the Connecticut Valley.

No moraines of recession are traceable continuously across the area. Terminal moraines, kame and outwash terraces, eskers and delta plains and deposits formed in temporary glacial lakes are numerous, but while they enable one to determine fairly well the positions of the retreating ice front at these particular places, the deposits are almost wholly confined to the valleys, not being traceable across the intervening ridges. However, a consideration of all the factors affords a basis for their correlation as marking thirteen stages of halt in the recession of the ice front across the 30-minute quadrangle. These seem to show a probable gradual development of a broad re-entrant over the Worcester County plateau with lobes lagging behind in the Connecticut Valley and on the lower ground to the eastward, so that in the western part the retreat was from southeast to northwest, and in the eastern part from southwest to northeast.

The phenomena noted above appear to have been formed immediately in connection with the retreating ice front. Nothing was observed indicating that the elevation was lower than at present or that there was an incursion of the sea up the valleys following the deglaciation.

Notes on Recent Changes in the Bogoslof Islands: Philip S. Smith.

In 1900 Merriam summarized the changes that have taken place in the Bogoslof Islands up to the time of the Harriman Expedition of 1899. Since that time two new volcanoes have been formed and one of these later peaks has disappeared. Many of the stages in the rapid changes noted in the islands have been mapped by different observers, especially in the critical years 1906 and 1907. Maps made by Dunn and Stromburg in 1906 were exhibited, but the most interesting series were maps made by Camden, July 4, 1907, Jaggar, August 7, 1907, Camden, August 11, 1907, and October 16, 1907. The two last maps represented the conditions approximately a month before and a month after the disappearance of McCullock Peak, the new volcano which was formed between September, 1906, and July, 1907. Fragments of the ejectementa collected by the Revenue Cutter Service, on examination showed at least two distinct kinds of rock; one an andesite with both hornblende and augite, a rather basic feldspar and an abundance of volcanic glass; the other showed a granular rock similar to a diorite with essentially the same minerals as those of the andesite, but crystallizing with a distinct hypidiomorphic texture. None of the specimens were collected from ledges and it is not known whether or not the diorite is from a fragment riven from the walls of the conduit and thus brought to the surface. The presence of granitoid rocks on the southern margin of the Aleutian chain, however, suggests that the basement on which the recent volcanics have been poured out is in many places a coarsely crystalline granular plutonic rock. No flows of lava were noted in connection with any of the recent eruptions on the Bogoslof islands.

Philip S. Smith,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 649th meeting was held on April 11, 1908, President Bauer presiding. Mr. Bailey Willis, of the U. S. Geological Survey, presented by invitation a very interesting paper on "The Mobility of the Lithosphere."

The address of the last retiring president of the society, Mr. John F. Hayford, was on "The Earth a Failing Structure." In it Mr. Hayford discussed the relations of weight, mass and stability of the earth, and gave physical and geological evidence in favor of the view that the earth yields more or less constantly to the internal stresses due to gravitation. Mr. Willis took up this theme along the lines of geological evidence and presented the conclusion that no considerable mass of the lithosphere has been in a state of rest, that is of static equilibrium, within any period known to geological history.

Referring to the distinction initially made by Powell and Gilbert between epeirogenic and orogenic movements in the earth's crust, the speaker first showed a series of lantern slides illustrating different geographic conditions of North America from late pre-Cambrian to the present time. These charts are necessarily, in the present state of the science of paleogeography, of a provisional nature, and subject to material modification, so far as details of distribution of land and sea at any particular epoch are concerned; but there is no doubt as to the general character of the changes which have occurred from period to period, and these changes are of very notable degree. It was shown that we could distinguish at least four great diastrophic cycles, each one of which consisted of an initial epoch of pronounced continental emergence associated with mountain building, and a later period of planation of lands to a peneplain condition and very wide marine transgression. Of these four cycles, the latest is that in which we live, and we are at the present time in the initial epoch of that cycle which is marked by decided mountain features. If it be assumed that the volume of the oceanic waters has not varied materially throughout the geologic ages which these cycles comprise (and the physical evidence substantiates this assumption) it follows that changes in the superficial extent of seas and lands must be the result of changes in the shape and depth of oceanic basins; but such variations of form can only proceed from movements of the lithosphere, movements which have the character of warping; and as such variations are traced throughout the entire legible period of geologic history, it follows that movement has been an equally persistent factor. From the nature of the effects, which as stated in the early part of the cycle are more vigorous and in the later part more gradual, it follows that there is a pronounced variation and a certain periodicity in the movements; but we are not able to distinguish any time when epeirogenic change has not been in progress in some perceptible degree.

Taking up the other aspect of diastrophism, namely, orogenic or mountain-building movements, the speaker showed a map of the world on which were delineated the axial trends of great folded mountain chains. From a study of their distribution and of their relations to areas of maximum elevation and denudation it appears (*a*) that the Atlantic and Pacific oceanic basins have widened at the expense of the continental margins which have been crushed in; and (*b*) that the whole southern hemisphere (the oceanic hemisphere) has spread northward at the expense of the northern (continental) hemisphere. The very extensive areas about the Arctic Ocean, which have remained undisturbed since an early Paleozoic time, have formed a central mass against which the more southern portions of Eurasia and North America have been folded.

From the detailed consideration of these orogenic movements Mr. Willis concludes that the great tangential displacements are due to an expansion of the suboceanic masses. This conclusion is independent of any particular hypothesis of the causes of such expansion, but in his opinion the effects are so distributed as to be inconsistent with any interpretation on the lines of the contraction theory. Following Dutton, Gilbert and Hayford in the general concept of isostatic adjustment toward an equilibrium among denser and lighter masses of the lithosphere, he holds that the persistent epeirogenic movements as well as the occasional orogenic movements are due to strains set up among the heterogeneous bodies of the earth's crust which differ from one another in density. It appears obvious that were the suboceanic masses enough denser than the subcontinental masses, the former would displace the latter, provided the firmness of rocks be insufficient to maintain their form. In masses of large dimensions, cubes measured by tens of miles on the side, rocks are not firm enough, even under the pressures that exist down to a depth of 100 miles below the surface, to maintain their form if unsupported at the sides; and thus there must exist throughout the lithosphere a tangential strain or tendency to spread which is somewhat greater in the denser than in the lighter masses. This strain is apparently not initially sufficient to cause movement if we may assume that the lithosphere were at any particular instant in a state of equilibrium; but it is a persistent strain of constant direction in any particular locality, and in the event of disturbance through changes of molecular arrangement or temperature, it would serve to direct the effects of any growing strain and ultimately to cause movement in the effective direction, that is from the denser towards the lighter mass.

Mr. Willis thus explains the persistency and periodicity of movement in the lithosphere through the efforts of unstable heterogeneous masses toward equilibrium; efforts which are assisted by variations in molecular arrangement, temperature and pressure, and which are directed by the tendency of the heavier masses to spread at the expense of the lighter masses. The resulting tangential strain grows during a prolonged period and produces more or less incomplete efforts towards equilibrium, which are apparent in epeirogenic warping, but from time to time the increase in strain becomes such that the margins of the lighter areas, continents, are crushed in, and an episode of orogenic movement ensues.

These effects of warping and mountain-building thus result from the mobility of the lithosphere, which is, however, conceived to be highly rigid in relation to sudden stresses or when taken in small masses.

A sufficient mass to account for all the superficial variations of form that are known is found within a depth of 70 to 100 miles below the surface, the geologic results being thus in accord with the determinations by Hayford of the depth of the zones of isostatic compensation. The inner mass of the earth, 3,900 miles radius, is conceived to be held in a state of relatively great stability by the high rigidity induced by pressure of the superincumbent load, and it is thought to graduate into the relatively unstable superficial layer through decrease of rigidity. The great nucleus itself is conceived to be the source of those energies which are expressed in variations of temperature and molecular condition through which the tangential strains gradually develop.

R. L. Faris,
Secretary

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

The seventh regular meeting of the session of 1907–8 was held at the Chemists' Club, 108 West 55th Street, on April 10.

The Wm. H. Nichols medal, awarded annually for the best paper read before the section, was presented to Professor William H. Walker, of the Massachusetts Institute of Technology, for his paper on "The Corrosion of Iron and Steel."

The ceremony of awarding the medal was witnessed by many prominent members of the society. The chairman of the section, Professor Sherman, after reading a letter from the donor of the medal, Dr. Nichols, who expressed his regret at not being present, spoke of the great diversity in the subjects of research for which the authors had received the medal. These included agricultural chemistry, investigation of rare elements, organic synthesis, technical chemistry and finally a physico-chemical investigation of the properties of one of the most important metals.

The president of the society, Professor Bogert, in presenting the medal, gave a short history of the professional career of the recipient. He said, in part, that W. H. Walker graduated from Pennsylvania State College in 1890 and took his doctor's degree at Göttingen about a year later. Since then he has been professor of industrial chemistry at the Massachusetts Institute of Technology and lecturer on that subject at Harvard. Outside of his teaching he has been very successful in technical work, having made improvements in the manufacture of cut glass, in annealing silver, in brewing processes and in the preparation of wood products. He has also contributed much to the chemistry of cellulose.

Professor Walker, in acknowledging the medal, gave a résumé of the paper for which he received the award and outlined further investigations on the same subject which are now in progress.

The remainder of the evening was devoted to papers by Chas. Baskerville on "Courses in Chemistry for Colleges," and Jerome Alexander on "The Effect of Colloids on Crystallization: the Function of Gelatin in Ice Cream"—preliminary paper.

C. M. Joyce,
Secretary

DISCUSSION AND CORRESPONDENCE

THE INTERPRETATION OF THE BEHAVIOR OF THE LOWER ORGANISMS

In my recent volume on the "Behavior of the Lower Organisms" are set forth certain views which have called forth discussion and criticism.[1] In response to many questions which indicate that there is a general interest in the subject, I wish here to reexamine some of the matters raised.

Objections have centered about my discussion of certain general theories of behavior, particularly of the tropism theory, and of certain applications of the theory of selection. Some of the criticisms are clearly just; others seem to me to rest upon misunderstanding, while still others show actual differences of opinion. To set in a clear light these different categories is my present wish.

The only question of importance is: How far is there a real difference of opinion, among workers familiar at first hand with the phenomena, in regard to (1) the actual, experimental facts of behavior, (2) the general and important laws or principles underlying these facts. Divergences due to different lines of interest, different fields of investigation and different understanding of terms merely obscure the essential point and need to be cleared away. To make clear the objects and meaning of different investigators sometimes reveals harmonious diversity in place of conflict; when this result is not reached, it at least shows precisely where opposition lies, and suggests experimentation that shall turn opposition into agreement.

It will greatly facilitate the attainment of these ends if I first set forth briefly certain purposes and principles that guided me in the preparation of my account.

1. My book was designed mainly as a topographic survey of the field of behavior in the lowest organisms. My primary purpose was to give the reader a clear idea of the observable facts, so that he might gain somewhat the same impression that he would from seeing the phenomena themselves. To aid in this, I characterized as typical such phenomena as were fairly representative of the behavior in general, while phenomena that were rare or unique, like the reaction to the electric current, I said were not typical and gave an inadequate idea of the nature of behavior. This, while strictly true, has led to misunderstanding; certain critics have assumed that I considered such phenomena as of no importance *from any point of view*. I believe that there is nothing in my treatment that gives ground for this assumption. Special cases of this form of criticism will come up in later paragraphs.

2. The most important characteristics of behavior have always seemed to me those shown in the biological interrelations of the physiological processes: in the relations of behavior to preserving the organism, to supplying the requirements for metabolism, and in general to keeping the other physiological processes in progress. These adaptive or regulatory characteristics of behavior furnished the problem to the solution of which attention was in my book mainly directed. Therefore I characterized as "important," "significant," and the like, mainly those features of behavior which seemed to lead toward an understanding of its regulatory character. Other investigators, not having this problem in the center of interest, have considered quite other matters as the important ones. Thus Torrey (*l. c.*) holds that we find the most important features of behavior in precisely those features that are not regulatory. Judgments of importance are of course relative; importance *for what?* is the question. I take it that the question in which Torrey is primarily interested is that regarding the nature of the immediate change which occurs in living matter when an external stimulus acts upon it.

3. We now come more directly to the content of the work. Years of investigation had convinced me that the complexity of the problems of behavior had been underestimated; that even in the lower organisms we are compelled to deal with an immense number of

[1] See especially Torrey, in SCIENCE, September 6, 1907; Loeb, *The Journal of Experimental Zoology*, Vol. 4, No. 1, 1907, and *Pflüger's Archiv*, Bd. 115, 1906, p. 580; Parker, SCIENCE, October 25, 1907.

complex and little-understood factors, rather than with a few simple ones.

In my book I therefore attempted, by citation of precise experimental data, to show the great number of factors which play a part in determining behavior; to show that changes in the internal system which makes up the organism are of equal importance for this, with changes in the external system which makes up the environment; and I set forth particularly those remarkable relations of dependence and support between the acts of behavior and the other physiological processes, that are commonly spoken of as adaptation.

4. My positive contention that behavior in the lower organisms is complex, varied and variable, so that it is not easily predictable, led me to a criticism of theories which represented such behavior as simple, uniform over wide fields, and unequivocally determined by single external factors. I found a theory of this character to be widely held; I met it in opposition at every turn as my papers began more and more to present behavior as complex; and I found this view presented regularly under the name of the "tropism theory."

This then was the reason for my attack on the tropism theory. I criticized it, not as a mere statement of one of the factors that make up the complex phenomena of behavior, but as a view of supposed extremely wide applicability, which maintained the simplicity and uniformity of the behavior of the lower organisms. I tried to show that there was no single schema into which most of the behavior of the lower organisms could be forced. How far it was just to identify the view criticized with the tropism theory we shall inquire in a moment; here it is most important, if we wish to get a clear understanding of the grounds of apparent conflict, to grasp the fact that the *simplicity, uniformity* and *general application of a single schema* were the points against which my criticism was directed.

Was this idea of the tropism theory sufficiently general to justify a criticism of it on that basis? The word tropism has been used in many senses and the theory has taken many forms, as we shall see later; but I believe that any one who has followed the literature of behavior must realize that there was such justification, even though he may himself hold to some other definition of the word tropism. The great movement toward extreme simplification in these matters has certainly been generally identified with the tropism theory; "reduction to simple tropisms" has been the ideal. Doubtless not all investigators have held the tropism theory to be so simple and of such wide applicability, but it is true that there has been a general belief that such was the case—a belief not confined to the uninformed, but shared by workers of high standing. Thus, Bohn, in his recent admirable review[2] of this entire question, after setting forth in detail examples of the tropism theory, says, "It is evident that nothing is simpler than this explanation," and again, "For more than ten years certain biologists have thus explained the actions of animals by tropisms. . . . This had become the *necessary* and *sufficient* explanation of all cases. Whenever it was observed that animals accumulated at a point, without even seeking to determine how they reached that point, a tropism was made to intervene." Bohn makes these statements merely as a presentation of well-known facts, and it would be easy to multiply quotations from biologists of the first rank showing that this idea of tropisms was a general one.

In view of certain passages in Professor Loeb's recent paper,[3] a note of historical character is here required. My criticisms have been directed not against any person or school, but against a prevalent view. I have never considered any single person as the sole author or only proper expositor of the tropism theory, but have taken the theory as I found it commonly presented in biological literature. I have not, therefore, considered it necessary to accompany a statement of my results with an exposition of Loeb's work and views; there are other authors whose work and friendship I value highly whose expressed views are more directly in opposition with what I have pointed out than are Loeb's. Certainly many authors besides Loeb have ventured on inde-

[3] *Journal of Experimental Zoology*, 4, 151–156.

[2] "Les Tropismes, les Réflexes et l'Intelligence," *L'Année Psychologique*, T. 12, 1906, pp. 137–156.

pendent contributions to the tropism theory and on expositions of it; if it was an error to take these into consideration, I am guilty of that error. Here we are seeking to discover whether there is divergence of view as to the facts themselves, and nothing would be more gratifying than to find in Professor Loeb an ally instead of an opponent, in this question of the complexity of behavior. We may, if we desire, call the theory which I criticized the popular tropism theory.

Now, how did this popular tropism theory simplify behavior? There is among investigators an extraordinary diversity of opinion as to what a tropism is. Some use the word as a mere name for certain observed facts. In reading, conversation and correspondence I have met the following definitions, each held by well-known investigators: (1) any reaction of a lower organism is a tropism; (2) any reaction to the chemical or physical agents of the environment is a tropism; (3) any movement toward or away from a source of stimulation is a tropism; (4) a tropism is any reaction in which the organism turns as directly as possible toward or away from the source of stimulation; (5) a tropism is any turning produced by stimulation; (6) a tropism is any reaction in which orientation to a steadily acting external force is the main characteristic. It seems clear that there is no tropism "theory" in any of these views; they merely apply a name to certain facts, leaving the nature of the reaction to be determined by experiment, and permitting different explanations in different cases. I myself at first used the term (or its equivalent "taxis") in some such collective sense, till a paper from the laboratory of one of the leading exponents of the tropism theory set forth with some warmth that the phenomena I described had "nothing to do with the tropisms."

Among those who use the word tropism in a precisely defined sense, implying a theory as to the nature of the reaction,[4] there is likewise diversity of view. The theories held by certain investigators give no ground for considering the tropism a simple, elementary phenomenon, nor one of wide application to lower organisms; they involve a highly developed sensory apparatus and a complex activity of the nervous system. Against such theories my criticism was not directed. On the other hand, there *is* a widely prevalent theory of tropisms which if correct really justifies the common view of the elementary simplicity of these phenomena. This is the "local action theory of tropisms," and it was against this that my criticism was directed.

I wish to emphasize this point, as it gives the key to the entire discussion. I found the fountain head of the commonly held belief in the simplicity and uniformity of the behavior of lower organisms in the "local action theory"—representing the stimulus as producing its reaction in that part of the body on which it directly falls, so that the organism reacts as a bundle of independent parts rather than as a unit. I therefore attacked this theory, and no other, in the chapter of my book which deals with this matter. I believe I made it perfectly clear that this was the theory under criticism; in the title of the chapter the "local action theory of tropisms" is specified; I defined precisely what I meant by it; all through the chapter I took pains to specify it, and in my summing up I expressly

[4] I am uncertain whether Professor Loeb, in his recent paper (*Journ. Exp. Zool.*, 4), wishes to range himself with those for whom the word tropism implies nothing as to the nature of the reaction. In his note on page 156, he says that my statement of the tropism theory on page 94 of my original paper is erroneous. The essential point in my characterization of the theory on that page seems to be the statement that "the theory of tropisms says that certain definite things happen in the change of position undergone by organisms under the influence of stimuli; that the organisms perform certain acts in certain ways." If this is the point which Loeb holds to be erroneous, my criticisms of course do not touch his views in the least. Many authors present the tropism theory as a theory of how reactions occur, and it was as such that I criticized it. If I have anywhere wrongly classified Professor Loeb with these, I regret it, and am delighted to discover my mistake. Any one who holds a theory (or would be a *theory?*) of tropisms that says nothing as to how the reaction occurs will hardly find anything in my discussion to oppose his views.

named the local action theory. I believe there is no ground for misunderstanding the theory that I was criticizing, though this seems to have occurred in certain cases.

My discussion has been attacked from two sides. In one recent number of SCIENCE Parker[5] takes the ground that the local action theory is not held, so that it was not worth while to demolish it; while in another recent number, Torrey[6] expressly defends the local action theory. These mutually destructive criticisms naturally relieve me of some embarrassment in replying to both. Torrey's elaborate defense shows that the theory is still very much alive and I can, therefore, only greet with pleasure Parker's ready support of my main contention, even though this takes the form of Sairey Gamp's crushing retort, "Who deniges of it, Betsey? Who deniges of it?" Parker's work has been mainly with more complex animals than those dealt with in my book, and his interests have lain rather in the field of sense physiology than in the development of activity. I can, therefore, readily understand that he should find it inconceivable that such a view should be held; he has doubtless not met it in opposition at every turn, as have those working with the lowest organisms, and as I now meet it in Torrey's paper. In my book I have given precise statements of the theory in the form of quotations from authors of highest standing. Bohn[7] in his recent exposition adds others. None of the authors quoted has, so far as I am aware, repudiated the local action theory. It would appear, therefore, that a statement of the relation of the observed facts to this theory was much needed.

Before turning to the arguments urged in support of the local action theory, another criticism of my discussion, made or implied by most of my critics, must be dealt with. This may be put as follows. Suppose that the simple, local action theory of tropisms is not satisfactory. Nevertheless, there is another, less precise, less simple, theory of tropisms which is of itself important; a theory in support of which Parker and Torrey cite the circus movements of animals when the sense organs of one side have been obstructed. A theory of such importance, it is contended, should have been dealt with in a general work on the behavior of the lower organisms. Further, the chapter criticizing a theory under the name of tropism gives the impression that this other theory is also condemned, though arguments against it are not advanced.

To this criticism my book is justly open. I should have given an exposition of the theory in question, with an attempt to estimate the part it plays in the behavior of the lower organisms. This unpurposed omission was partly due to the fact that the two groups of whose behavior I gave a detailed exposition—the Protozoa and Cœlenterata—have furnished practically none of the evidence cited by my critics; partly to my attempt to focus attention upon the local action theory as of infinitely greater importance than the other form of the theory. But even though I held that action in accordance with the complex form of the theory plays little part in the behavior of the lower animals, the phenomena and theory should have been set forth, and I regret that this was not done.

We may now return to the criticisms and defense of the local action theory. Regarding the nature of my criticisms, one point must be emphasized—a point that has been much misunderstood, though I believe I expressed myself explicitly on the matter. I made no attempt, and had no desire, to deny the existence of the factors on which the local action theory, or any other existing theory of tropisms, was based. So far as local action is concerned, I emphasized in my book such cases as were established, and gave a list of them on page 306. The question which I tried to answer in my discussion of tropisms could be put thus: After some years of study of the behavior of the lower organisms, what is your impression regarding the extent and importance of the part played by tropisms? A well-known investigator, after one of the most thorough and detailed studies of the behavior of a certain group of invertebrates that have ever been made, in which he watched and ex-

[5] SCIENCE, October 25, 1907.

[6] SCIENCE, September 6, 1907 ("the response to stimulation is local," p. 319, etc.).

[7] *Loc. cit.*

perimented with the animals literally day and night for long periods, remarked to me, in discussing this matter, that he never saw any tropisms. Without going so far as this, my answer to the question asked above was that "the theory of tropisms does not go far in helping us to understand the behavior of the lower organisms." I did not deny the existence of the phenomena which the theory takes into consideration, but it seemed to me that there are so many other factors, playing such important parts, that the tropism factor is of relatively small importance in a general consideration of behavior. In my first paper on this subject[8] I included the more complex forms of the tropisms in this judgment. The remark of the investigator above mentioned illustrates the fact that there are certainly other aspects of behavior so striking and important as to quite mask the existence of tropisms.

Let us attempt a brief characterization of tropisms, their history, and the part they play in behavior.

1. The essential point in the tropism, as originally applied by Loeb to reactions to light was, in a word, the idea that the organism in going toward or away from the light is not trying to go somewhere or to reach something, but is merely taking a certain position or *orientation* in the light. This recognition that the *position* is the essential point was a great step in advance, and its application by Loeb to certain features of the behavior of animals was an achievement of the highest importance.

2. This idea of orientation having proved so helpful in the study of reactions to light, the next step was, very properly, to apply it to other features of behavior, to see if it would not prove equally useful elsewhere. The reactions to chemicals, heat and cold, contact with solids, electricity, light, gravity, etc., were all brought under this point of view; attempts to show that the position is the essential point in each of these have for a long time been made with energy and persistence. Our knowledge has grown till we are in a position to estimate the results. In the main it appears that to most of the behavior the orientation idea has little applicability. To that immense province of behavior comprised in the reactions to chemicals of all sorts (including food reactions, respiratory reactions, etc.) it has shown itself quite inapplicable. The case is the same with the reactions to heat and cold. With regard to the reactions to solid bodies nearly the same may be said, though there are some special cases in which the idea of orientation is applicable. The reaction to the electric current furnishes a typical orientation. In some of the reactions to gravity and to water currents the orientation idea is helpful. Yet the recent work of Lyon and others shows that even in these the movement in a certain direction is an essential part of the reactions; they are essentially compensatory movements, and the taking of a certain orientation is by no means the only important point. In certain reactions to light the orientation idea has been most helpful, yet in an immense proportion of the reactions of organisms to this agent it does not show itself the essential point. The orientation theory is of greatest service in such cases as the going of insects toward a bright light, yet even here such work as that of Holmes on Ranatra shows that the orientation is not the only point; the approach to the light seems after all essential, since if a certain orientation does not bring the animal to the light, it learns by experience to take a different orientation which does have this effect. The work of Cole, of Radl and others, shows that in the lower organisms we have the beginnings of reactions to *objects* perceived visually; the animal is not merely oriented by the strongest light, but goes toward such objects, whether bright or dark, as might be said to be "of interest"[9] to it at the given

[8] "Contributions to the Study of the Behavior of the Lower Organisms," Carnegie Institution, Publication 16, pp. 89–107.

[9] The expression "of interest" of course has some objective equivalent, but to try to use it would be to substitute an unintelligible conjecture for an expression which at least conveys an idea

moment. The reactions to light are bound up with almost every possible aspect of behavior, and the orientation principle plays in them but a relatively small part.

3. In Loeb's original theory nothing was said as to the way in which the position of orientation is reached, and I take it that he does not now consider this matter as belonging to the theory proper. But on this matter a tempting idea presented itself, to the effect that the position of orientation was reached in the simplest possible way—by a local reaction of the part on which the stimulating agent impinges. This gave the "local action theory" which made the tropism a thing of such extreme simplicity; it has been applied, in detail or in general, to all sorts of reactions, by many authors. While it holds in a measure for the effect of the continuous electric current, I believe that it has been demonstrated that in the main this idea was not correct; that the element it deals with plays little part in behavior, aside from the effects of electricity. With this we shall deal in later paragraphs.

Attempts have been made to controvert my position on the tropism theory by the performance of crucial experiments or by the citation of specific observations. These are clearly based on misunderstanding. It is obvious that the relative importance of an admitted single factor in producing a set of complex phenomena can not be settled in this manner. Valuable judgment on such a question can be based only on an extended study of the phenomena. My own opinion derives any worth it may have solely from the fact that I had worked for nine years on the behavior of a large number of organisms, attempting to make a careful analysis, with detailed studies of the different factors involved and the part played by each. My conclusions are of the same character as are drawn from a large mass of statistical data. They can be adequately controverted only by showing that the analysis of this mass of data, or of another equally large or larger, will not yield these conclusions. Single observations are of course important, since they are the material from which the large mass is made, but single observations taken by themselves do not help much in taking off the *facies* of a long series of investigations, which is what I tried to do. My conclusion, like all statistical conclusions, is nothing that will enable one to predict for a given individual case; if it were, it would of course be of much greater value than it is. No single observation whatever is inconsistent with my general conclusion.

of the outward facts. The animals go toward visible things that serve for food, protection, etc.

Thus, writers who have flown to the defense of the *existence* of tropisms will find themselves in no conflict with my stand on the matter. It was only the prevalent opinion of the wide generality and importance of the phenomena that I called in question. To hear that the actual existence of the tropism was held to require defense came as a real surprise to me. If put forward as merely one factor out of many, with its relative importance subject to discussion, I shall agree most cordially.

In certain quarters there seems to be an impression that observation of the direct turning of an organism toward a source of stimulation is in some way opposed to my views, and that citation of specific cases of this will come to me as a painful surprise. Yet, of course, this is one of the commonest and most evident facts of behavior, and is discussed in detail in my book (see, for example, pp. 306–308). Its existence is required if the theory I suggested is correct. I pointed out that in consequence of the three factors in behavior whose importance I emphasized, this direct turning toward a localized stimulus would occur; if it did not occur, that would tend to disprove the theory. "Innumerable instances of this class of reactions could be given; they include perhaps the greater number of the directed movements of organisms" (p. 307).

Thus the direct turning of animals is not in dispute. A matter that *is* of interest lies in the answer to the question whether the turning is due to the simple local reaction of the region on which the stimulating agent impinges. My own contention was that this is rarely the case. If authors will state clearly whether they conceive the turning to be due to such simple local reaction, and give the evidence on which this opinion is based, that will be a real contribution on a disputed point.

The reaction to the electric current, in which the effect is local and the behavior is uncoordinated and unadaptive, is the type and pattern of the local action style of behavior. Its importance is thus naturally emphasized by Torrey, in his defense of that theory, as against my own contention that this reaction is not typical of the behavior of lower organisms. The question will be cleared most readily by noticing the different objects which guided us in taking our stands. My own purpose, in my topographical survey of behavior, was to give the reader a correct idea of the facts—of what he would see if he examined the phenomena himself. In doing this, one must inevitably come, I believe, to my conclusion that the "action . . . under the electric current is not typical of the behavior under other stimuli." If the reader examined accurately the reaction to the electric current he would see certain phenomena—local action, lack of unity and coordination, different parts of the body opposing each other, etc. The question is—Is this typical of the behavior? Is this what would be seen if the reactions to heat, light, gravity, chemicals, etc., were examined in the same way? Certainly it is not. If the reader should get the impression that the extraordinary series of phenomena seen when an electric current is passed through a collection of infusoria is likewise what is seen when they are subjected to other stimuli, his idea of behavior in the lower organisms would be a ridiculous caricature of the reality. There appears to be no reason for concealing this fact, and I set it forth as clearly as I could.

On the other hand, Torrey holds that in the reaction to the electric current we may have exhibited in a very direct way some of the fundamental changes that occur in living matter when subjected to the action of a stimulus; hence its great importance. Nothing that I have said militates against this opinion. The statements and implications that I hold that "the uniqueness of the electric stimulus . . . vitiates its claim to consideration"; that "the interesting phenomena of galvanic stimulation are to be so lightly put aside," etc., emanate from Torrey, not from myself. So far have I been from "neglecting" it, that I devoted in my book more space to this reaction than to any other. But the importance of the reaction to electricity is of the same sort in the behavior of lower as in that of higher animals; though of the utmost importance, no one would consider the reaction of a muscle to electricity "an adequate type of the behavior of mankind." I believe that it was made plain in my book that this was the point which I was setting forth.

Torrey takes up my account of the reactions of *Euglena* to light, and attempts to show that it agrees with what would be expected from the local action theory of tropisms. It is not possible to take up the details of this matter here. But I may point out the following: In accordance with my general practise, my account in this case was based, not on an attempt to explain an isolated reaction by a preferred theory, but on an extensive analytical investigation of the reactions of the organism, attempting to isolate experimentally the various elements of which the behavior is made up. In this investigation I was not able to find experimentally that element which the tropism theory calls for, while those I did find accounted for the entire behavior. I, therefore, had no ground for asserting the existence of the tropism element. I do not see that Torrey has adduced any additional ground for such assertion; at best he has merely tried to show that interpretation along the line he prefers is not inconsistent with the facts.

One of my figures of the reaction (Fig. 93 in my book) Torrey thinks "perfectly in harmony with the tropic schema," he says: "it is hard for me to conceive how an organism swimming of necessity in a spiral course could react more definitely to a moderate directive stimulus than *Euglena* does here"; and he "can only wonder at my running so boldly and far into the enemy's camp." Surely this last remark does not mean that Dr. Torrey considers it a reputable scientific procedure to manufacture or alter a figure claiming to represent the facts, in order to make it agree with a theory. My figures were made from as precise a study of the facts as I could make, before I had attempted by analysis of all the facts to see what they mean, so that the figures form part of the data for my later conclusions. In my preface I said that my ideal was "to present an account that would include the facts required for a refutation of my own general views, if such refutation is possible," and I should not be without the gratification of having fulfilled that ideal if Torrey should be adjudged to have made out his case. But the reason why I held that the organism does not react as directly as possible is as follows: The oriented organism is swimming toward the light in a spiral course, thus swerving first to the right, then to the left (omitting from consideration the movement in other planes). Now the light is changed, so as to come, say, from the right, as in my Fig. 95. The most direct way in which the organism, swimming in a spiral, could become oriented to the light would be by an increase in the swerving to the right and a decrease in the swerving to the left, and this is what the tropism theory would lead us to expect. But the fact is that there is an *increase* in the swerving both to the left and to the right, the spiral becoming a wider one; the increase to the right being, however, greater than that to the left, the organism becomes gradually pointed to the right. The increased swerving to the left is not accounted for by the tropism theory, and is indeed squarely opposed to it, while it is to be expected if the analysis I gave is correct.

The point becomes quite clear when we compare this reaction with that to the electric current, which with its undoubted local action Torrey considers a typical tropism. Since *Euglena* itself has not been shown to react to electricity, we can not make the comparison here, but Torrey does not maintain his views for *Euglena* alone, and the facts in the reactions of ciliates to light, gravity and water currents are parallel to those in the reactions of *Euglena* to light. In all these reactions the organism swerves, in becoming oriented, only toward a certain side *x*, never toward the opposite side *y*, just as in the reaction of *Euglena* to light. But in the reaction to the electric current the organism may be caused by the local action to swerve directly toward the side *y*, and to become oriented in that way. Local action would cause swerving toward the side *y* in the reactions to light, gravity, etc., exactly as in the electric current, and the fact that this does not occur seems to be a demonstration that local action is not the explanation in these cases.

It will then be clear, I hope, that my analysis was based on a thorough consideration of the available experimental data, and not on prejudice for or against any given theory. Torrey indeed admits, if I understand him, the existence of all the factors which I set forth, and the correctness of my analysis so far as it deals with positive factors, but believes that there is an additional factor, in virtue of which *Euglena* may turn *directly* toward a light. Thus the behavior of *Euglena* is more complex, according to Torrey's view, than I represented it. There is no doubt but that increase of knowledge tends to reveal increased complexity in the behavior of the lower organisms; of this many recent examples could be given. My own work has had decidedly this tendency, but, as in the present case, I tried to keep the theory as simple as the facts would permit. But my experiments on *Euglena,* while not revealing the power of direct turning, do not disprove its existence. It has always seemed as extraordinary to me as to any one else that the direct turning should not occur. There is little profit in discussing matters which only experiment can settle. At the time my work was done, I had no opportunity to study the reactions of *Euglena* in the stage when it has no flagellum and moves by contractions. Such a study is much needed, and it may reveal the additional factor which Torrey looks for. Many higher organisms show a power of direct localization, in connection with complex activities of other sorts; there is no antecedent improbability of this in *Euglena*.

Related to this matter is Torrey's discussion of the question whether the organism is or is not stimulated after it is oriented, which leads him finally to the extraordinary conclusion that I "insist on an interpretation of organic behavior by means of general changes in internal states that are psychical rather than physical," and to a general condemnation of my analysis on this account. Most of the points made in Dr. Torrey's interesting paper I can appreciate, but at the discussion which leads to this conclusion regarding psychic factors I must confess my astonishment. The conclusion is reached only by the aid of the somewhat desperate assertion that to say that an oriented organism is subjected to no general stimulation "is no more than saying it then possesses no feeling of discomfort." Had I made such a statement, I should have expected much just and severe criticism for "psychologizing"; for "crude anthropomorphism."

The root of the difficulty lies in a misunderstanding of certain of my attempts to avoid the use of indefinite terms not having a precise experimental meaning; it comes finally to a simple matter of definition. Experimentally, it has seemed to me that the study of behavior reduces mainly to a study of two things: (1) the causes of changes in behavior; (2) the nature of the changes themselves. Now these two things correspond nearly to what are commonly called *stimuli* and *reactions,* though the common usage is a little less precise, not always representing experimental concepts. I, therefore, adopted for experimental discussions the word reaction as signifying a *change in behavior;* the word stimulus as meaning the *cause* of a change in behavior, though so far as I could I used the plain phrases in place of the two terms. Unless some such definitions are used there is no experimental method of telling whether an organism is reacting or not; whether it is stimulated or not. On page 283 of my book I took the greatest pains to emphasize the fact that my discussion would not be intelligible unless this meaning of the word reaction were kept in mind. With this, a stimulus, as the cause of a reaction, is likewise clearly defined; this definition I had already given on page 6.

Stimulation and reaction are evidently, as thus used, correlative terms; if there is no reaction, there is no stimulation. I have no desire to insist that these are the only possible definitions; I merely wish to point out that this was my explicitly declared usage. Now, if we apply these definitions, the whole structure of difficulties raised by Torrey falls to the ground. From the definitions it follows that when the movements of an organism are uniform, it is not stimulated. After the infusorian has become oriented to light, it does not change its movements, but swims in the same way it did before; there is then no external evidence that it is stimulated, and if my purely empirical definition is accepted, it is not stimulated.

If it be maintained, as Torrey does, that the organism is nevertheless stimulated at such a time, then evidently some internal condition is taken as a criterion of stimulation. This is precisely the criterion which Torrey incorrectly attributed to me, and on the ground of which he charged me with making "feelings of discomfort" and other psychical phenomena the basis of my analysis. If there were any sound foundation for his argument, I could retort that it is his view that calls for the psychical factors. But, of course, there is no reason for dragging in psychic factors at all; it is perfectly easy to suppose that the organism when oriented is in a differing physico-chemical state, and this assumed state might be considered stimulation, unless the empirical definition of stimulation as correlative with reaction is preferred. To be unable to conceive a change in physiological state otherwise than as psychical would seem to unfit one completely for the objective analysis of behavior; such changes demonstrably occur even in unicellular organisms.

It is evident that the highly objectionable propositions which Torrey deduces from my discussion, to the effect that there can not be "a constant stimulus that does not induce a differential movement," or that I deny the "possibility of symmetrical stimulation for an oriented organism," depend simply on the definition of stimulus and reaction as correlative terms of purely experimental meaning. I certainly believe that many animals, after they have "fixed" a source of light and are swimming toward it, are in a different physiological state from before. If we define stimulation somewhat indefinitely as meaning any such changed physiological state, then we may of course hold that they are then stimulated. There seems to be no real difference of opinion on this matter; but the method of formulation of course depends on the definition of the terms employed.

A further point discussed by Torrey has to do with the relation between selection and adaptation. As an aid to understanding the existence of adaptations in behavior, I accepted certain forms of the selection theory. Torrey emphasizes the existence of unadaptive reactions, like that to the electric current; he points out that there is no ground for supposing that selection has played a part in their production. To this I agree fully. But since Torrey draws therefrom the conclusion that "the hypothesis advanced by Jennings is not sufficiently broad to encompass all the phenomena it is devised to explain," it needs to be pointed out that my view was not "devised to explain" such phenomena. A theory of selection, while directed primarily to the explanation of adaptiveness, requires the existence of raw material from which selection may occur, and this raw material must of course be largely unadaptive, or there would be no ground for selection. Selection can never account for the existence of that from which selection is made. This, I believe, was made plain in my book. "It is clear that natural selection can not account for the origin of anything; only that can be selected which already exists" (p. 326). I stated explicitly that the hypothesis set forth was a theory *of regulation;* my exposition of the matter opens on page 315 as follows: "The question in which we are interested is then the following: How can behavior develop? That is, how can it change so as to become more effective—more regulatory?" The existence of unadaptive reactions not coming under this theory was recognized. "The organism is composed of matter that is subject to the usual laws of physics and chemistry. External agents may of course act on this matter directly, causing changes in movement that are not regulatory" (page 345). The origin of these unadaptive reactions I did not discuss, because I had no light to throw on the matter. But I emphasized my conviction that the study of the laws of matter and energy furnish the main field for investigation, as compared with questions of selection. "Whatever the part assigned to natural selection, the superlative importance of these laws remains; they must continue the chief field for scientific investigation" (p. 326). I might have said "the only field," since of course the study of selection is merely the study of how these laws work under certain complicated conditions.

Torrey evidently overlooked my explicit statements of the object and limitations of the theory in question.

This discussion of theories of development tends to give the impression that these form the important part of my treatment of behavior. It is, therefore, only just to point out that this matter was a side issue from the main purpose of my work, and was explicitly put forward merely as a suggestion as to what may have occurred. The short chapter on this subject begins as follows: "It is not the primary purpose of the present work to treat the problems of development, but rather to give an analysis of behavior as we now find it. But the results of this analysis furnish a certain amount of evidence as to how development may have occurred; this it will be well to set forth briefly." The book is primarily a treatment of behavior as a branch of experimental physiology.

But I believe it to be short-sighted and unfortunate for a physiologist to attempt to set in opposition physiological interpretation, on the one hand, with so-called "historical" interpretation, dealing with selection and evolution, on the other. Selection is not something outside of physiological or physico-chemical action; it is merely a characterization of certain ways in which such action occurs. Some of the relations brought about in such action are lasting, while others are fleeting; those which last are said to be "selected." The study of selection is an examination of the relative permanency of different physico-chemical and physiological relations, and it is eminently a matter for experimentation.

Again, in addition to the rapid processes occurring mainly in the lifetime of individuals, there are slow processes requiring more than a generation to produce evident effects; various aspects of these we call "heredity," "evolution," "genetics," etc. These slow processes belong as much to physiology as do the rapid ones. The existing condition of living things is known to be largely a product of these processes, so that to attempt to exclude them from consideration and to act as if their effects did not exist, when we are trying to understand living things, is a most futile proceeding. These matters are coming rapidly under experimental study, so that attempts to exclude them from consideration in physiology, as "historical," can not endure much longer.

We now come to the matter which seems to underlie most of the criticisms of my discussion. Certain authors seem to identify the "tropism theory" with the view that the behavior of organisms is to be explained by objective, experimentally determinable factors. They feel that an attack on the "tropism theory" is an attack on this view; this comes forth notably in the criticisms made by Loeb and Torrey, and it is evident in the attitude of some other writers.

There is, so far as I can see, nothing in the facts and relations which I have brought out that in any way opposes the principle that behavior is to be explained by objective, experimentally determinable factors—or indeed that bears in any way on the question. I have simply assumed throughout that it *is* to be explained in that way, and I do not see how experimental investigations can proceed on any other basis. Beginning my work in 1896, when the movement led by Loeb against the use of psychic concepts in explaining objective phenomena was in full swing, I considered that battle as fought and won; I have, therefore, ever since proceeded, without discussion or ado of any sort, on that basis. Every one must recognize the tremendous service done by Loeb in championing through thick and thin the necessity for the use of objective, experimental factors in the analysis of behavior. No convinced experimentalist, knowing the previous history of the subject, can reread, as I have just done, Loeb's early work on behavior without being filled with admiration for the clear-cut enunciation, defense and application of the principles on which valuable experimental work has rested since that time, and on which it must continue to rest.

Any differences of opinion between Loeb and myself are then matters of detail; they concern merely the results of the application of the agreed principles of investigation. It has seemed to me that some of the experimentalists have rested content with superficial explanations; that they did not realize the complexity of the problems with which they were dealing. This has been the history of most applications of experiment to biology; the more thorough the work, the deeper are the problems seen to be.

Thus I have not hesitated to bring forth facts tending to show the inadequacy of the physico-chemical factors thus far set forth, and doubtless some have suspected that this was done with the concealed purpose of discrediting the general adequacy of such factors. This is a complete mistake; I did not till lately realize even the existence of such a suspicion. Complete confidence in the experimental method removes anxiety as to the effect of criticizing the details of its application. My objections are only to the adequacy of particular factors; they are based on experimental grounds, and the difficulties they raise are to be resolved only by experimental study. There is a vast difference between holding that behavior is fundamentally explicable on experimental grounds, and holding that we have already so explained it.

In a recent paper Loeb[9] has intimated that even if the behavior of the organisms under consideration were as complex as that of man, the same objective and experimental methods must be used in analyzing it. To this I fully agree, and the behavior of man is of course no more to be excepted from this treatment than is that of any other organism. In some recent writings one finds indications of a curious dualism, as if the behavior of lower organisms were to be analyzed in the objective, experimental way, but the behavior of higher animals and man were not. This takes most often the form of objection to any comparison between the objective features of the behavior of higher and lower animals, or to the use of the same terms in speaking of them, with a tendency toward accusations of vitalism or "psychologizing," against those making such comparisons. Such accusations evidently depend on the premise that the behavior of higher animals is to be explained only by vitalism or by "psychologizing." When one is tempted to accuse an opponent in such ways, it is worth while to first examine whether the tendency to read psychic or vital factors into the phenomena does not lie in the mind of the accuser, rather than in that of the accused. When one has consciously and consistently taken the ground that the behavior of all organisms, including man, is to be analyzed in the objective, experimental way, and that there is no ground for expecting a failure of this method at any point, there is less occasion for anxiety at the use of similar terms for similar objective phenomena throughout the series.

For example, the "method of trial and error" is as much an objective phenomenon, to be explained by experimentally determinable factors, in the dog or man, as in the infusorian. The undoubted great differences between the exemplifications of the "method" at the two extremes are matters for experimental analysis and demonstration, if the experimental method is not to fail. They do not necessarily show that the fundamental principle involved is different, and it is this common fundamental principle to which the common name calls attention. How far we should avoid words that have ever had any psychic connotation whatever is a matter on which there may be divergence of opinion; but it is most important to realize that this is totally distinct from the question whether the psychic connotation is of any use in objective experimental analysis. If this distinction is lost sight of, a divergence in practical details is taken for a conflict in fundamental principles, to the detriment of experimental science. That it is impossible to avoid such words completely is seen when we find in the writings of such men as Loeb the frequent use of such terms as "associative memory." Of course it is to only the objective phenomena that Loeb refers; but this is precisely the case also with other experimentalists accused of similar practises!

[9] *Pflüger's Archiv*, 1906, **115**, p. 581.

To sum up the discussion with the defenders of the tropism theory: We all stand on the same foundation, and the differences of opinion are in matters of detail. In attempting to demonstrate the complexity of the problems of behavior, I have focused attention on a certain precise and narrow form of the tropism theory which seemed to me to have gained undue prominence—in order to show that such narrow schemata are inadequate. In so doing other forms of the theory, more flexible in character, and setting forth the tropism as but one factor out of many, have been thrown into the background; of this the supporters of the theory have justly complained. With my main contention that behavior in the lower organisms is complex, involving many factors, so that no one schema gives an adequate account of it, there seems to be little disagreement. As to the value of the "local action" theory there is still divergence of opinion.

And now a word as to my own positive contributions to the analysis of the matter. It is obvious that conclusions of the "statistical" character that I have attributed to my own, are, from their relative inapplicability to specific cases, of much less value than precise chemico-physical or physiological ones. It is also obvious that to demonstrate the complexity and difficulty of a field of work is not an achievement to be compared in value with the demonstration that this field is simple and easily explicable on a few known principles. I am under no illusion in regard to this. The clear-cut, narrow tropism theory would be of infinitely greater value for predicting and controlling the behavior of animals than anything I have offered, if only it were true. I am sure I regret that I can make no attempt to put an equally simple schema in place of the one I criticized; if the phenomena of behavior were of elemental simplicity, that would certainly be much more convenient, though perhaps they would then be less interesting. Many of the concepts used in my analysis—"physiological states," "selection," "trial and error," and the like—are collective ones, characterizing varied phenomena of a high degree of complexity. They all require much further analysis; they are programs for future work, not final solutions of the problems. My analysis was mainly an attempt to lay out the field, to point out the principal phenomena with which we have to deal, and to define some of the main problems. If any one attempts to explain all behavior on any one basis, to unlock all its secrets by any catchword whatever, be it "trial and error," "selection," "tropisms" or what not, he lacks a realization of the complexity of his field of investigation. Like other complex fields, that of behavior, even in lower organisms, must be divided up; the various factors must be subjected to long and intense special investigation, with a realization that we have here material for the work of many generations of investigators.

H. S. Jennings
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Baltimore, Md.,
November 26, 1907

SPECIAL ARTICLES

INTERPRETATION OF THE CHEMICAL COMPOSITION OF THE MINERAL BENITOITE

In July, 1907, Professor G. D. Louderback published an interesting paper on the new mineral benitoite. For a description of the physical properties of the mineral the reader is referred to the original article.[1] The analysis of the mineral, made by W. C. Blasdale, showed the following:

	A	B	Average	Mol. Ratios
SiO_2	43.56	43.79	43.68	0.723
TiO_2	20.18	20.00	20.09	0.250
BaO	36.34	36.31	36.33	0.237
	100.08	100.10		

This yields the empirical formula $BaTiSi_3O_9$. From this Louderback concludes: "Benitoite is then a very acid titano-silicate of barium and stands in a class by itself, both as regards acid silicates and titano-silicates."

Upon reading the paper, immediately after its publication last year, I noticed that there was a very striking similarity to be observed between the composition of benitoite and beryl, for, if benitoite be interpreted as a metasilicate, we have:

Beryl .... $\overset{II}{Be_3}\overset{III}{Al_2}(SiO_3)_6$

Benitoite .... $\overset{II}{Ba_2}\overset{IV}{Ti_2}(SiO_3)_6$.

This similarity in the chemical composition is sufficient to consider the two compounds as isomorphous, for, although titanium with a valency of four replaces aluminium with one of three, the total valences in both compounds are the same. There is, however, a difference of one with respect to the number of atoms. A few examples of well-known isomorphous series will show that the above is not unusual.

In the marcasite group we have:

Marcasite .... $Fe\overset{II}{S}\overset{II}{S}$

Arsenopyrite .... $Fe\overset{III}{As}\overset{II}{S}$

Löllingite .... $Fe\overset{III}{As}\overset{III}{As}$.

Here the number of atoms is constant in all three compounds, but the valences vary. The albite-anorthite group furnishes another illustration.

Albite .... $\overset{I}{Na}\overset{III}{Al}\overset{IV}{Si}Si_2O_8$

[1] "Benitoite, a New California Gem Mineral," University of California Publications, Bulletin of the Department of Geology, Vol. 5, 149–153, 1907.

Anorthite .... $\overset{II}{Ca}\overset{III}{Al}\overset{III}{Al}Si_2O_8$.

In this series the valences of some of the individual elements vary, but their total and also the number of atoms in each compound are the same.

The galena group illustrates an isomorphous series in which the individual valences and the total number of atoms may both vary.

Galena .... $\overset{II}{Pb}S$

Argentite .... $\overset{I}{Ag_2}S$.

(For other examples of isomorphous series see Brauns's "Chemische Mineralogie," Arzruni's "Physikalische Chemie der Krystalle," and Groth's "Tabellarische Uebersicht der Mineralien," preferably the French edition of 1904.)

The similarity of beryl and benitoite is also to be noted by observing their axial ratios. Both minerals crystallize in the hexagonal system.

	a : c
Beryl	1 : 0.4989
Benitoite	1 : 0.4230.

The value for benitoite is one half of one of those suggested by Louderback and is, no doubt, to be considered only as approximate, since no data concerning the reliability of the readings are given.

It is well known that TiO_2 has either acidic or basic properties. In the case under consideration, the quantitative analysis simply reveals the presence of TiO_2 as such. As to whether it is acid or basic, depends upon which of these assumptions will allow of the simplest explanation and yet be in strict accord with the observed facts.

The similarity of the composition of beryl and benitoite indicates a metasilicate and that TiO_2 is to be considered basic in this instance. The metasilicates are very common in nature, which is not the case with the salts of $H_2Si_4O_9$, a derivative of the tetrasilicic acid $H_4Si_4O_{10}$, to which Louderback would refer benitoite. Up to the present time only one mineral, lorenzenite with the composition $Na_2(Ti, Zr)_2$-Si_2O_9, has been observed which can be referred to $H_2Si_4O_9$. In lorenzenite, Ti and Zr replace two atoms of silicon, but in benitoite, according to Louderback's interpretation, one atom of silicon would be replaced by titanium. Thus, in both cases, $H_2Si_4O_9$ is to be considered the basis. Hence, even though Louderback's interpretation be correct his statement, page 152, "Benitoite . . . stands in a class by itself, both as regards acid silicates and titanosilicates," needs to be modified.

In a very recent paper by Ralph Arnold,[2] it is pointed out that benitoite occurs in an area of basic rocks, such as serpentine and glaucophane schists. In fact, benitoite is found in cracks and cavities in the latter and is always associated with the hydrated basic metasilicate natrolite, $Na_2Al(AlO)$-$(SiO_3)_3.2H_2O$. According to Arnold, benitoite may have crystallized before the natrolite, but some occurrences seem to indicate that probably the crystallization of these minerals was practically contemporaneous.

Therefore, the interpretation suggested above, which is based (1) upon the similarity of the chemical composition and axial ratios of beryl and benitoite; (2) upon the fact that TiO_2 may act as a base; (3) that benitoite occurs in an area of basic rocks, and (4) is always associated with the hydrated basic metasilicate, natrolite, seems amply justified. Accordingly, from what has been published, benitoite is not to be considered "a very acid titanosilicate of barium," but rather a metasilicate of barium and titanium.

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SOME PHYSICAL CHARACTERISTICS OF COLLEGE STUDENTS[1]

A PHYSICAL examination is required of all freshmen in Columbia College and the Schools of Applied Science during the first month of the academic year. The examination includes

[2] "Notes on the Occurrence of the Recently Described Gem Mineral, Benitoite," by Ralph Arnold, SCIENCE, N. S., Vol. XXVII., pp. 312–314, 1908.

[1] Read before the New York Academy of Sciences, Section of Anthropology and Psychology, on October 28, 1907.

a record of personal and family history, 31 measurements, 7 strength tests, vision and hearing tests, condition of skin, heart, lungs, nose, throat, teeth and of any abnormalities of spine, shoulders, chest, feet, etc.

The main purpose of these examinations is to help the medical director in guiding and advising each student in matters of physical exercise and hygienic living. The data collected are of interest to the physician and the anthropologist by showing the occurrence of various abnormalities and physical characteristics in healthy young men.

AVERAGE MEASUREMENTS OF 790 COLUMBIA STUDENTS 17, 18 AND 19 YEARS OLD

	First Exam.	Averages			Second Exam.
		206 Students	317 Students	267 Students	
Date	....	....	....	....	....
Age	....	17.5	18.1	19	....
Weight	....	58.29	58.36	60.32	....
Stretch of Arms	....	177.86	178.13	178.36	....
Height Standing	....	171	171.31	171.61	....
Height Sitting	....	88.84	89.24	90.1	....
Length of Trunk	....	63.67	63.9	64.63	....
Girth of Neck	....	33.5	33.79	34.27	....
Girth of Upper Chest—Repose	....	84.44	85.08	86.17	....
Girth of Upper Chest—After Expiration	....	81	81.07	82.23	....
Girth of Upper Chest—After Inspiration	....	89.53	90.06	91.2	....
Girth of Lower Chest—Repose	....	78.2	79	79.7	....
Girth of Lower Chest—After Expiration	....	76.17	76.94	77.52	....
Girth of Lower Chest—After Inspiration	....	84.52	84.96	85.94	....
Girth of Waist	....	69.5	69.86	71.00	....
Girth of Right Upper Arm	....	24.54	25.14	25.4	....
Girth of Right Upper Arm—Flexed	....	27.75	28.24	28.8	....
Girth of Right Forearm—Contracted	....	25.7	26	26.5	....
Girth of Left Upper Arm	....	24.14	24.5	25.1	....
Girth of Left Upper Arm—Flexed	....	27.15	27.65	28.2	....
Girth of Left Forearm—Contracted	....	24.97	25.32	25.67	....
Girth of Right Thigh	....	49.76	50	50.77	....
Girth of Right Calf	....	33.2	33.35	33.76	....
Girth of Left Thigh	....	49.54	49.78	50.48	....
Girth of Left Calf	....	33.14	33.33	33.7	....
Depth of Chest—Repose	....	18.41	18.57	18.64	....
Depth of Abdomen	....	17.3	17.32	17.4	....
Depth of Head	....	19.35	19.33	19.42	....
Breadth of Head	....	15.35	15.39	15.43	....
Breadth of Shoulders	....	39.38	39.55	40.04	....
Breadth of Chest—Repose	....	25.57	25.58	25.9	....
Breadth of Waist	....	24.74	24.75	25.15	....
Breadth of Hips	....	31.88	31.98	32.3	....
Capacity of Lungs	....	395	401.2	406.4	....
Strength of Right Forearm	....	45.4	47.54	50.84	....
Strength of Left Forearm	....	40.85	43.22	45.2	....
Strength of Back	....	131.75	138.95	144.0	....
Strength of Legs	....	211.8	231.1	238.8	....
Strength of Upper Arms (Push Up)	....	4.39	5.43	5.9	....
Strength of Upper Arms (Pull Up)	....	5.46	6.22	7.0	....
Total Strength	....	508.68	549.22	577.5	....

The occurrence of flat foot and weak foot appears to be increasing from year to year, as shown in the following table.

ABNORMALITIES OF THE FEET

	Class of 1910, 364 Students Per Cent.	Class of 1911, 305 Students Per Cent.
Normal feet	61.2	48.2
Both feet flat	15.4	16.9
Both feet weak	20.4	29.5
One foot weak	1.8	3.6
One foot weak and one flat	0.9	1.7

The following table shows the occurrence of abnormalities of the spine. More than 95 per cent. of the abnormalities recorded in this table were postural and not pathological.

ABNORMALITIES OF THE SPINE

	Class of 1910, 365 Students Per Cent.	Class of 1911, 305 Students Per Cent.
Normal spine	18.3	15.4
Kyphosis (round back)	17.3	18.0
Lordosis (hollow back)	12.6	12.1
Scoliosis (lateral curvature)	6.6	4.0
All three abnormalities combined	15.6	13.7
Kyphosis and lordosis	20.5	29.0
Kyphosis and scoliosis	4.6	3.6
Lordosis and scoliosis	4.4	4.2
Scoliosis alone or combined	31.2	25.5

The nationality of the students is of interest in connection with the above data.

BIRTHPLACE OF 283 STUDENTS IN THE CLASS OF 1911

		Per Cent
United States	240	84.8
Russia	14	4.9
Canada	5	1.8
Austria	4	1.4
Roumania	3	1.0
West Indies	3	1.0
Italy	3	1.0
Hungary	3	1.0
England	2	
Scotland	1	
India	1	
China	1	
Germany	1	
South America	1	
Japan	1	

NATIONALITY OF PARENTS OF 288 STUDENTS

		Per Cent
American (both parents)	100	34.7
German (both parents)	57	20.0
British (both parents)	33	11.5
Hebrew (both parents)	20	6.9
Russian and Pole (both parents)	16	5.5
Hungarian (both parents)	4	1.4
Italian (both parents)	3	1.0
Latin-American (both parents)	3	1.0
French (both parents)	2	
Scandinavian (both parents)	2	
Chinese (both parents)	1	
Japanese (both parents)	1	
Roumanian (both parents)	1	
Bohemian (both parents)	1	
American and foreign	12	4.1
Mixed foreign	19	6.6
Three or more nationalities represented in parents and grandparents	13	4.5

G. L. MEYLAN

THE AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES

GENERAL STATEMENT OF THE POLICY

THE officers of the federation deem it advisable to make the following brief statement of plans and policy, for the information of associations which may be interested in joining the organization.

The general purpose of the federation is to increase the efficiency of the federated (local) associations by bringing each of them into helpful cooperative relations with others that are working along similar lines in other parts of the country, and with the new Section L on Education of the American Association for the Advancement of Science.

The work of the federation through its officers and committees is expected in the near future to be developed along the following principal lines:

As a clearing house for the federated societies the federation will undertake to collect and to keep up-to-date information in regard to the work and the publications of these societies, and to aid as opportunity offers in the formation of new societies when needed.

As a publishing agency the federation will systematically print such of this information as may be of general interest in simple bulletins or in reports in scientific periodicals. Each federated society will be furnished with a list of the principal papers published in its field, and available to its members by purchase or exchange.

As a cooperative organization the federation will from time to time, of its own initiative or at the instance of a particular society, propose questions of general interest for the consideration of the federated societies, or appoint committees on questions of national scope in the teaching of science.

In relations with national societies, such as, for example, the American Association for the Advancement of Science, the National Educational Association, the National Society for the Promotion of Industrial Education, etc., the federation will endeavor to secure due recognition of the interests of the associations composing it, and of the great body of teachers of science.

At its Chicago meeting the American Association for the Advancement of Science showed its interest in and approval of the movement by affiliating the new federation with itself, and then extending to members of the federated associations the opportunity of joining the association without the usual initiation fee.

In general, the federation is expected in the future development of its policy to promote the advancement and improvement of science teaching in whatever manner may seem wise under the restrictions fundamental to its organization, which leave entire freedom of action to the federated associations, and which contemplate the transaction of federation business mainly by correspondence, and with limited funds.

In spite of these limitations, it is the opinion of the officers of the federation that it will fill an important need and render a valuable service. They confidently appeal on this basis, too, for the support of associations which have not yet already joined the federation, with the hope of beginning the work outlined at an early date.

H. W. Tyler, *Chairman*,
Association of Mathematics Teachers in New England.

R. E. Dodge,
New York State Science Teachers' Association.

F. N. Peters,
Missouri Society of Teachers of Mathematics and Science.

J. T. Rorer,
Association of Teachers of Mathematics in the Middle States and Maryland.

C. R. Mann, *Secretary*,
Central Association of Science and Mathematics Teachers.

NEW ENGLAND FEDERATION OF NATURAL HISTORY SOCIETIES

The annual meeting of the New England Federation of Natural History Societies was held in Boston on Friday and Saturday, April 17 and 18. The result of the election was the following board of officers for the coming year: president, John Ritchie, Jr., Boston Scientific Society; vice-presidents, Arthur H. Norton, Portland (N. H.) Society, Norman S. Eaton, Fall River (N. H.) Society; secretary, J. H. Emerton, Cambridge Entomological Club, and treasurer, Miss Delia I. Griffin, Fairbanks Museum, St. Johnsbury, Vt. Two councillors for each of the New England states were named. The principal business of the federation was the arrangement of the details of the Mount Washington field meeting, July 1–8 of the present year. The federation will assemble at the Summit House on Wednesday evening, July 1, for its own meeting. The other evenings will be devoted to the meetings of the states, Friday being preempted by Vermont, at which time the regular summer joint-meeting of the Vermont Botanical Club and the Vermont Bird Club will be held. Features of the field-meeting will be rambles to the stations of the alpine flora and the geological exposures, trips into the ravines and along the ridges and evening meetings where papers illustrated by the lantern will be presented. It promises to be an important meeting, about twenty-five of the New England societies promising representatives. Members of the Appalachian Mountain Club which is to hold its regular field-meeting at the Profile House at the same time will be in attendance and it is proposed to make the summit the objective point for an excursion of Section E of the American Association for the Advancement of Science, which will begin its sessions on Monday, June 29, at Hanover. Mount Washington, therefore, promises to be the scene of active scientific gatherings during the early summer.

In connection with the annual meeting in Boston there was a two-days' exhibition of material and methods. Much of this had relation to the help given by local societies to the public systems of education. The Barton Chapter of the Agassiz Association, represented by Misses Cherrington and Clapp showed many specimens of mosses, Miss Cora H. Clarke, many specimens of galls, Mr. Emerton, his portable comparison collection of spiders and the Lawrence Society, of New Hampshire, a collection of local birds' nests. The Worcester Society, of New Hampshire, exhibited its bird sets for public school teachers, its moss specimens for its free classes in botany and some local collections. It showed also photographs of the Dodge collection of birds, a splendid special one of Worcester County, valued at ten thousand dollars, given to it by Mrs. E. H. Dodge, a gift that was supplemented by the works of Audubon, presented to the society by Thomas H. Dodge, one of the foremost of Worcester's wealthy citizens. Architects' drawings were also shown by the society of the new home that the society hopes to have, a building that will place the natural history interests of the city on the same high plane as those made possible for art by the recent Salisbury bequests.

GEOGRAPHICAL FIELD STUDY IN ITALY AND THE ALPS

IN connection with a summer trip abroad, Professor W. M. Davis, of Harvard University, proposes to spend June and the greater part of July in northern Italy and the Alps, studying certain geographical problems. He would be pleased to have associated with him a number of advanced students, already somewhat practised in field study. The districts proposed for examination and the general itinerary (subject to change) are as follows: The foothills of the Apennines near Ancona (about June 1); the non-glaciated valleys of the Apennines in the neighborhood of Faenza (about June 5); the basin of Florence (about June 10); the Mediterranean coast, between Pisa and Spezia, between Spezia and Genoa, west of Genoa (about June 15–20); the divide between Mediterranean streams and the headwaters of the Po, north of Genoa (about June 22); changes in river courses in the headwaters of the Po (about June 24); glaciated valleys and lake basins in the Alps (Como, Lugano, Maggiore) (about June 25–30); the non-lacustrine valleys of the Dora Baltea and Dora Riparia (about July 2–6); glaciated valleys of the French Alps near Grenoble (about July 8–15).

It is desired to treat the problems above outlined, and such other problems as members of the party may desire to take up, in accordance with the methods of systematic physiography. The method preferred involves the consideration of *structure, process and stage;* that is, each district is to be regarded as a solid mass, made up of certain geological structures (composition and attitude of rocks), standing at a certain altitude with respect to baselevel, and advanced by certain erosional processes to a certain stage of physiographic development. The possibilities and the limitations of verbal description are to be carefully considered.

It is not intended that the members of the party should travel continuously together. The party may be joined and left at any time, as agreed upon. It is requested that any person who desires to take part in these studies should send to address given below, at Cambridge or in Italy, a statement of his qualifications and (in case he does not hold a university appointment) a letter of introduction from the professor of geography with whom he has recently studied.

If his qualifications appear sufficient, word will be sent giving place and date of *rendezvous.* On meeting, some local problem such as above indicated will be taken up, its general nature will be set forth, the methods of treating it will be discussed, and two or three days will be spent in the field with such members of the party as are there gathered. Professor Davis will then go on to some other locality, leaving the party to continue local study of their problem for several days. At the end of that time they will overtake him at a new locality, where a report will be made on their first piece of work and (with such new members as there join the party) a plan for a second piece of work will be developed; and so on as long as desired, but not later than July 20.

Professor Davis does not desire to assume any responsibility as to arrangements of travel, hotels, trains, etc. Each member of the party is to make his own traveling arrangements and to pay his own traveling expenses. At the same time, while members of the party are together, it is expected that plans of travel will be made in common. A general reunion is proposed about July 18, in or near Grenoble, for the presentation and discussion of the various studies. The languages of the Geographical Congresses (French, German, Italian, Spanish or English) may be used. Professor Davis may be addressed as follows: care of W. J. Turner and Co., Naples, until May 10; care of Sebasti e Reali, Rome, until May 20; care of Kuster and Co., Turin, until June 30.

SCIENTIFIC POSITIONS IN THE PHILIPPINES

THE Bureau of Science of the Government of the Philippine Islands at Manila announces two vacancies in the chemical laboratory: one at a salary of $2,000 per year for candidates with the doctor's degree, the other at $1,600 a year open to those with a bachelor's degree. The bureau desires candidates from the leading American universities where chemistry is well taught. The training should be the usual thorough one in the preparatory studies such as physics and mathematics, and in general inorganic, analytical and organic chemistry, together with a course in organic preparations. The research work for the doctor's degree may be either in inorganic or organic chemistry.

Candidates who are thoroughly equipped, who are accurate and painstaking in their work, who have the proper technique and capability for individual investigation, will have opportunities for promotion to vacancies occurring in positions above them. The salaries in the division of chemistry range from $1,600 United States currency per year, through intervals of $200 and $250, to $3,000 per year.

The laboratory is fully equipped with all modern apparatus and with a complete scientific library.

All information in regard to these positions can be obtained from the Bureau of Insular Affairs, Washington, D. C.

Two positions in the biological laboratory for men thoroughly trained in bacteriology and pathology are vacant in the Bureau of Science, Manila. One of these is at a salary of $2,500 United States currency per year. and it is desired if possible that the candidates should have had training in the principles and technique of serum preparation and therapy, and it is hoped that the successful one shall acquaint himself with the serum work carried on in the Bureau of Science and become capable of operating the serum section of the biological laboratory. The other position is for an assistant in bacteriology and pathology, and candidates must be capable of doing original work and must have the degree of doctor of medicine.

The opportunity for the study of tropical diseases is unsurpassed, and the candidates, through the diagnostic work in the hospital and in the government prison, will have every opportunity to study a great variety of tropical infections and parasites.

The outlook for promotion is good, as vacancies occur in upper positions in the laboratory. The salaries range from $1,600 to $5,000 United States currency. The bureau publishes the medical section of the *Philippine Journal of Science,* so that all research work can be promptly edited.

All information in regard to the positions can be furnished from the Bureau of Insular Affairs, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

At the meeting of the National Academy of Science held in Washington on April 23, members were elected as follows: Edwin Brant Frost, director of the Yerkes Observatory, University of Chicago; William E. Storey, professor of mathematics, Clark University; Edward F. Nichols, professor of physics, Columbia University; W. F. Hillebrand, chemist in the U. S. Geological Survey; Wm. B. Clark, professor of geology, the Johns Hopkins University; Whitman Cross, geologist, U. S. Geological Survey; E. G. Conklin, professor of zoology, University of Pennsylvania, professor-elect of biology, Princeton University; Theobald Smith, professor of comparative pathology, Harvard Medical School; Simon Flexner, director of the Laboratories of the Rockefeller Institute for Medical Research. Foreign associates were elected as follows: Svante A. Arrhenius, director of the Division of Physical Chemistry of the Nobel Institute of the Academy of Sciences, Stockholm; Joseph Larmor, Lucasian Professor of Mathematics at Cambridge University; Ivan Petrovic Pavlov, Imperial Institute for Experimental Medicine, St. Petersburg; Hugo Ritter van Seeliger, professor of astronomy in the University of Munich, and Th. Barrois, professor of parasitology in the University of Lille.

At a meeting of the council of the Boston Society of Natural History, held on April 15, it was unanimously voted that the Walker grand honorary prize of one thousand dollars be awarded to Dr. Grove Karl Gilbert, of the United States Geological Survey. This award is made once in five years under the terms of the will of the late William Johnson Walker, a benefactor of the society, "for such scientific investigation or discovery in natural history as the council may think deserving thereof; provided such investigation or discovery shall have first been made known and published in the United States of America." The previous recipients of the Walker grand prize have been: Alexander Agassiz, Joseph Leidy, James Hall, James D. Dana, Samuel H. Scudder and Joel A. Allen.

THE bill providing a pension of $125 monthly each to the widows of Drs. James Carroll and Jesse W. Lazear has passed the senate by a unanimous vote.

PROFESSOR E. A. SCHÄFER, of Edinburgh University, is giving this week the Herter lectures at the Johns Hopkins University, the subject being "The Pituitary Body." On April 23 he lectured on "Internal Secretions" at the George Washington University. The lecture was followed by a smoker given by the Medical Society of the University.

DR. M. P. RAVENEL, professor of bacteriology in the University of Wisconsin, has been appointed director of the State Hygienic Laboratory.

PROFESSOR BASHFORD DEAN, of Columbia University, has been elected a corresponding member of the Paris Museum of Natural History.

THE Right Hon. A. J. Balfour, F.R.S., has been elected a corresponding member of the French Academy of Moral and Political Sciences in succession to Lord Reay, who has been elected an associate.

M. MAURICE HAMY, of the Paris Observatory, succeeds the late Dr. Janssen as a member of the Paris Academy of Sciences.

DR. J. N. LANGLEY, professor of physiology at Cambridge, has been elected a foreign member of the Royal Danish Scientific Society.

THE Back bequest for 1908 has been awarded by the Royal Geographical Society to Lieutenant George Mulock, R. N., on account of the survey work which he did on the National Antarctic Expedition.

PROFESSOR A. L. KROEBER, of the University of California, has returned from an ethnological visit to the Mohave Indians of Arizona and California. His investigations continued previous studies of the mythology, rituals and music of the tribe. A survey of nearly three hundred shellmounds on the northern shores of San Francisco Bay has recently been completed by the department of anthropology of the university.

AT the request of the Smithsonian Institution, the Department of State has appointed Dr. George Grant MacCurdy, of Yale University, a delegate on the part of the United States to the sixteenth International Congress of Americanists, to be held at Vienna, September 9 to 14, 1908.

MR. HARLAN I. SMITH, of the department of anthropology of the American Museum of Natural History, will continue his archeological reconnoissance of Wyoming, begun in 1907. A trip across the northeastern part of the state, possibly reaching western Dakota and southern Montana, is planned for the coming field season. The work is to begin to locate fields for future detailed cooperative explorations in this portion of the country which lies near the center of a very great area, regarding the archeology of which there is scarcely any literature and from which there are very few specimens in museums or elsewhere readily available for study.

THE Swedish government has proposed a grant for a scientific expedition to Spitzbergen this coming summer for geological and geographical research. Professor Gerard de Geer, the rector of the University of Stockholm, will be the leader of the expedition.

DR. CHARLES R. VAN HISE, president of the University of Wisconsin, will give the address to the graduates of the Michigan College of Mines on May 1.

THE Hon. James Bryce, British ambassador to the United States, will give the baccalaureate address to the graduating class of the University of Wisconsin on June 14.

DR. EDGAR F. SMITH, vice-provost of the University of Pennsylvania and professor of chemistry, will deliver the annual address at the one hundred and fifty-second commencement on June 17.

By the will of Lord Kelvin, Lady Kelvin is appointed sole executrix, and all his property is bequeathed to her. According to the inventory, the value of the property is over $800,000.

Professor K. G. Abel, head of the industrial chemical laboratory at Stuttgart, died on March 9, at the age of fifty-eight years.

Professor Franz von Leydig, the zoologist, died at Rothenburg on Monday, in his eighty-seventh year. Dr. von Leydig studied at the Universities of Würzburg and Munich, and after holding a professorship at Tübingen for eighteen years, he was appointed to a chair at Bonn University in 1875. He is well known for his researches in comparative histology and anatomy.

The U. S. Civil Service Commission announces an examination on May 14, 1908, to fill a vacancy in the position of physical chemist, in the laboratory of the United States Geological Survey, at $2,160 per annum. No merely scholastic or clerical tests will be given, and competitors will not be assembled for examination. On May 20, there will be an examination for preparator of fossils in the Geological Survey, at a salary of $25 a month.

Prince Roland Bonaparte has given the Paris Academy of Sciences 100,000 francs for scientific research.

An expedition is being equipped, under the auspices of the Russian ministry of marine, with the object of discovering a northeast passage between the Atlantic and Pacific Oceans.

The thirteenth general meeting of the American Electro-Chemical Society is being held this week in Albany, N. Y.

The Bridgeport Medical Association has joined the Bridgeport Scientific and Historical Society this season in a series of nine popular lectures, which have been well received.

The Lake Laboratory maintained by the Ohio State University announces the usual program for the coming summer, including courses in general zoology and botany, entomology, ornithology, experimental zoology, comparative anatomy, ecology, embryology, invertebrate morphology and ichthyology; also opportunities for research work and accommodations for investigators as in previous years. The staff will include beside the director, Professor E. L. Rice, of Ohio Wesleyan University, Professor Lynds Jones, of Oberlin College; Professor Charles Brookover, of Buchtel College; Professor M. E. Stickney, of Denison University, and W. B. Herms, at present fellow in zoology at Harvard University. The opportunities offered are excellent for fresh water, and special attention is given to the aquatic life of the locality. Opportunities for research work in this line are very favorable. Independent investigators are given the use of tables free of charge, but are expected to furnish their own microscopes and other apparatus. The locality is an excellent one for summer work, the laboratory being situated on the point separating Sandusky Bay and Lake Erie, with its frontage on a fine beach. For circulars or detailed information letters may be addressed to the director, Professor Herbert Osborn, Ohio State University, Columbus, Ohio.

The spring lectures to be delivered in the lecture hall of the museum building of the New York Botanical Garden, Bronx Park, on Saturday afternoons, at four o'clock, are as follows:

May 2—"A Botanical Expedition to Jamaica," by Dr. Arthur Hollick.

May 9—"Early-flowering Trees and Shrubs," by Dr. N. L. Britton.

May 16—"Plant Life of the Sea," by Dr. M. A. Howe.

May 23—"Ornamental Shrubs: their Selection and Arrangement," by Mr. George V. Nash.

May 30—"Plants that Feed on Insects," by Dr. C. Stuart Gager.

June 6—"Adulterants in Foods and Drugs and their Detection," by Dr. H. H. Rusby.

From the annual report of the Nantucket Maria Mitchell Association we learn that a fire-proof observatory is in process of construction on the memorial grounds on the Island of Nantucket, a few feet from the house (the birthplace of Maria Mitchell) which the association has owned and cared for since 1902, having brought together there certain scientific collections, as well as books and other material formerly the property of Professor Mitchell. Her five-inch telescope (Alvan Clark, maker), donated to the association, is in the hands of Alvan Clark & Sons Corporation, Cambridge, Mass.; they are providing a new mount and will themselves place it in the memorial observatory in good order when the building is ready to receive it, about the first of June.

We learn from the *Electrical World* that the Niagara Scenic Commission has reported to the Secretary of War that the Niagara, Lockport and Ontario Power Company should be made to restore the beauty of the river bank at the point where its transmission cables cross the Niagara gorge. The point is about four miles from the falls, and the trees and shrubs were cut, broken and injured by the work necessary in the erection of the towers and lines. The scar left on the face of the cliff is not so bad on the New York as on the Canadian side, where the scenic commission has no authority, but the commissioners of Victoria Park may cause the restoration of the bank on that side.

The central committee of the International Congress on Tuberculosis has, as reported in the *Journal* of the American Medical Association, announced the offer of prizes of $1,000, besides gold and silver medals, each prize to be accompanied by diplomas or certificates of award, for each of the following: (1) For the best evidence of effective work in the prevention or relief of tuberculosis by any voluntary association since the last International Congress, in 1905. (2) For the best exhibit of an existing sanatorium for the treatment of curable cases of tuberculosis among the working classes. (3) For the best exhibit of a furnished house, for a family or group of families of the working class, designed in the interest of the crusade against tuberculosis. (4) For the best exhibit of a dispensary or kindred institution for the treatment of the tuberculous poor. (5) For the best exhibit of a hospital for the treatment of advanced pulmonary tuberculosis. Other prizes offered are following: (1) The Hodgkins Fund Prize of $1,500 is offered by the Smithsonian Institution for the best treatise that may be submitted on "The Relation of Atmospheric Air to Tuberculosis." (2) A gold medal and two silver medals for the best exhibits sent in by any states of the United States, illustrating effective organization for the restriction of tuberculosis. (3) A gold medal and two silver medals for the best exhibits sent in by any state or country (the United States excluded), illustrating effective organization for the restriction of tuberculosis. (4) A gold medal and two silver medals for each of the following exhibits: (*a*) For the best contribution to the pathologic exhibit. (*b*) For the best exhibit of laws and ordinances in force June 1, 1908, for the prevention of tuberculosis by any state of the United States. (*c*) For the best exhibit of laws and ordinances in force June 1, 1908, for the prevention of tuberculosis by any state or country (the United States excluded). (*d*) For the best exhibit of laws and ordinances in force June 1, 1908, for the prevention of tuberculosis by any municipality in the world. (*e*) For the society engaged in the crusade against tuberculosis having the largest membership in relation to population. (*f*) For the plans which have been proved best for raising money for the crusade against tuberculosis. (*g*) For the best exhibit of a passenger railway car in the interest of the crusade against tuberculosis. (*h*) For the best plans for employment of arrested cases of tuberculosis. (5) Prizes of two gold medals and three silver medals for the best exhibit of a workshop or factory in the interest of the crusade against tuberculosis. (6) Prizes for educational leaflets: A prize of $100, a gold medal, and two silver medals in each class, for the best educational leaflet submitted in each of the seven classes defined below: (*a*) for adults generally (not to exceed 1,000 words). (*b*) For teachers (not to exceed 2,000 words). (*c*) For mothers (not to exceed 1,000 words). (*d*) For indoor workers (not to exceed 1,000 words). (*e*) For dairy farmers (not to exceed 1,000 words). (*f*) For school children in grammar school grades (not to exceed 500 words). (*g*) Pictorial booklet for school children in primary grades and for the nursery. Dr. Charles J. Hatfield, Philadelphia, is the chairman of the committee, and Dr. Thomas G. Ashton, Philadelphia, is the secretary.

The Friday evening lecture at the Royal Institution on March 27 was given by the Hon. R. J. Strutt, whose subject was "Radioactive Change in the Earth." Lord Rayleigh was in the chair. According to the report in the London *Times,* Mr. Strutt remarked that the mineral pitch-blende, the source of radium and other radioactive materials, was in England only found in Cornwall, in veins in the granite and slate. The question arose, How did it get there? The answer he proposed to adopt was that it was derived from the surrounding granite which refined examination showed to contain radium to the extent of one part in a million million. Minute though this proportion was, the total quantity of radium contained at this rate in the external crust of the earth, to a depth of 40 or 50 miles, was more than sufficient to account for the internal heat of the earth. Of the constituents of granite zircon was found to contain quite a large quantity of radium, and in microphotographs of granite discolorations could often be perceived round a zircon crystal. Radium being present in granite, it was natural to expect the presence of helium also; and in fact that gas could be found if looked for with sufficient care. It could also be found in other minerals, the radioactivity of which was not very conspicuous, and he showed a sparking tube filled with helium which had been obtained from about 2 pounds of quartz. Radium also was to be found in numbers of other minerals he had examined, and generally in sufficient quantities to explain the amount of helium they contained. One exception he had discovered was beryl, which contained no radium worth mentioning, but a very large quantity of helium. After discussing a possible explanation of this exception, the lecturer concluded by saying that as the production of helium was a question of time, the quantity found in rocks of different geological strata might provide us with a means of estimating how much time had lapsed since their deposition.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. Henry Wilde, D.C.L., F.R.S., already a liberal benefactor of Oxford University, has given £4,000 to found a Lectureship in natural and comparative religion.

Mrs. Gordon and Miss Peters have given £4,000 to University College, Dundee, for the erection of a laboratory of electrical engineering, in memory of their late brother, Lord Dean of Guild Peters.

An agreement has been reached in the matter of affiliation of Cooper Medical College with Stanford University. The study of medicine must be pursued in San Francisco and the trusts left by Dr. Levi C. Lane are to be fulfilled.

The regents of the University of Wisconsin at their meeting on April 22 considered the question as to whether the efficiency of instruction might be increased by providing separate classes in subjects generally neglected by men and by women, respectively; but as the matter was one of general educational policy, the regents deferred action until the faculty has an opportunity to consider the question and to report the results of its investigation to the board. A committee of nine professors in the college of letters and science, with Dean E. A. Birge as chairman, is now considering the matter, but owing to the complexity of the subject will probably not be able to report for some time.

At the University of Wisconsin Professor Carl C. Thomas, now head of the department of marine engineering of Cornell University, has been chosen to the professorship of steam engineering made vacant by the death of Storm Bull.

Professor Fred'k F. Jones, dean of the College of Engineering and Mechanical Arts in the University of Minnesota, has been elected dean of the academic faculty of Yale University. Professor Jones graduated from Yale College in 1884 and has been connected with the University of Minnesota since 1885.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MAY 8, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

IN spite of the fact that Section E held a summer field meeting[1] at Plattsburg, N. Y., during the week of July 3 last, the interest of its members in the winter meeting showed no abatement. A large number of its geological members attended the meeting of the Geological Society of America at Albuquerque, and consequently there was not a large attendance of those whose special interest is geology. But, on the other hand, the Association of American Geographers met in Chicago at the same time as Section E, and this attracted a large number of geographers, many of whom are members of the section.

Immediately after the general session of the association, the Association of American Geographers and Section E held a joint meeting for the purpose of arranging the program, after which the two organizations separated. The geological members of the section held six sessions in the Walker Museum, University of Chicago, during Tuesday, Wednesday and Thursday, with the vice-president of the section presiding, and the geographical members met with the American Geographers, except during the early portion of Wednesday afternoon, when the entire section met to listen to Professor Chamberlin's paper on the influence of the tides.

At the first meeting of the section Pro-

[1] An account of the summer meeting is printed in SCIENCE, No. 665, pp. 397–404, Sept. 27, 1907.

fessor W. S. Bayley was elected secretary of the section for the meeting in the absence of the regular secretary, Professor W. H. Hobbs was elected member of the general committee, Professor U. S. Grant, member of the council, and Mr. F. B. Taylor, member of the sectional committee for five years.

At the business meeting of the sectional committee held on Wednesday, January 1, Mr. Bailey Willis, of Washington, was nominated for vice-president of the association and chairman of the section, and Dr. F. P. Gulliver was named for secretary. At this same meeting also the names of about fifteen members were presented to the council with the recommendation that they be elected as fellows. Professor Charles R. Dryer was nominated as delegate from Section E to the Ninth International Geographic Congress, to be held at Geneva in July next.

Since the address of Vice-president Lane had already been read at the summer meeting of the section (SCIENCE, August 2, 1907, pp. 129–143) all of the sessions at Chicago were devoted to the presentation and discussion of papers, of which 31 were read in full. The abstracts of these follow:

The Red Sandstone Series of Southeastern Minnesota: C. W. HALL, Minneapolis, Minn.

Records of deep and artesian wells drilled in southeastern Minnesota for twenty years past have shown the existence of an apparently widely distributed sandstone beneath the overlying and non-aquiferous beds. Drillings to the granite rocks in several localities indicate a thickness of from 100 feet to 300 feet for this formation, and place it directly upon the basal granite rocks of this region. The paper correlated the scattered data with the view to establishing the existence of a well-defined sandstone series at this horizon.

Preliminary Account of the Geology of the Highlands of New Jersey: W. S. BAYLEY, Urbana, Ill.[2]

The Highlands of New Jersey are a part of the series of ridges of pre-Cambrian rocks that extend southwestward from the Hudson River to Reading in Pennsylvania. They have long been described as being composed of parallel layers of limestone and gneiss, and, principally, because of their association all of the rocks have been regarded as metamorphosed sediments. Recent observations have shown that the limestone is one member of a well-defined series of fragmental rocks of pre-Cambrian age, and that the gneisses are igneous rocks that have intruded these. The parallel arrangement of the rocks is due to the fact that the intrusive rocks invaded the old sedimentary series along their bedding planes. The structure of the gneiss is thought to be the result of flowage, by which some of their components have been strung out in line.

The complex gneisses and sedimentary rocks have been broken into blocks by great longitudinal faults, which almost invariably occur in the southeast sides of the gneiss ridges, separating them from the northwest sides of narrow longitudinal valleys underlain by Paleozoic rocks. One of the largest of these faults limits the Highland area on the south and separates it from the Piedmont plateau. Cross faults of comparatively small magnitude run nearly perpendicularly to the structure of the region and cause slight displacements in the interlaminated gneisses. They are of especial importance in connection with the magnetite mines, since they cause displacements of the ore bodies.

These generally consist of rich magnetic phases of the gneisses and like them are

[2] By permission of the director of the U. S. Geological Survey.

distributed in layers that generally strike and dip with the surrounding rocks.

The sedimentary rocks are correlated with the Grenville series of East Ontario and the Adirondacks.

Petroleum Fields of Illinois in 1907: H. Foster Bain, director of the Illinois Geological Survey, Urbana, Ill.

The author declared that in 1907 Illinois will produce more than 24,000,000 barrels of crude petroleum. This is more than any state in the union, save California, produced in 1906 and in fact more than any country, save Russia and the United States. Production began here in June, 1905, with 5,489 barrels. The oil is of good grade, running about 32° Baume. It occurs in Carboniferous strata in Clark, Cumberland, Crawford and Lawrence counties. A number of different producing horizons have been recognized ranging from Upper Coal Measures down to the Chester group of the Mississippian. There is marked irregularity in pressure, in productivity and in relations to gas and salt water in the different pools, and it seems likely that final studies will lead to important conclusions regarding the genesis and accumulation of the oil.

General Petrology of Wisconsin Igneous Rocks: S. Weidman, Madison, Wis.

This paper described the general chemical features of a large area of intrusive igneous rocks in central and northern Wisconsin. These were intruded as three separate or distinct magmas, as rhyolite, diorite-gabbro and granite-syenite. Phases of the granite-syenite magma are the highly interesting and rare rocks, nepheline-syenites and associated pegmatites. The several intrusive magmas are each characterized by relatively high alumina and low magnesia. The nepheline-syenites and associated quartz-syenites are especially characterized by high alumina and low magnesia and in them are developed such rare minerals as fayalite and hedenbergite as important rock constituents. Several unusual rock phases are developed. All the igneous rocks of the region show a close chemical relationship, and this close relationship is especially well illustrated in the chemical character of the minerals developed in the syenites and pegmatites.

Geology and Mining Industry of Chihuahua, Mexico: Rufus M. Bagg, Jr., Urbana, Ill.

The author described briefly the main topographic features of the state of Chihuahua and explained their bearing upon the mineralization of the region.

The geologic formations were also discussed and the main types of ore deposits classified. Many examples of mines were cited to illustrate these types. The history of mine development and the future outlook of the mining industry in Chihuahua were discussed in conclusion.

Niagaran and Oriskanian in the Western Part of Virginia: E. B. Branson, Oberlin, Ohio. (Read by title.)

The Earthquake of 1872 in the Owens Valley, California: Willard D. Johnson, D. C., and W. H. Hobbs, Ann Arbor, Mich. (Read by W. H. Hobbs.)

This paper consisted principally of the description of a series of photographs and specially detailed maps of the country affected by the Owens Valley earthquake. The maps exhibited in an unusually fine manner the courses of recent faults in the valley and their general characteristics.

A Design for a Universal Seismograph with Duplex Recorders for Horizontal Motion: C. F. Marvin, U. S. Weather Bureau, Washington, D. C.

The author described the construction of a single seismograph that will give every detail of the horizontal components of earthquake motion.

The instrument is capable of producing no less than three distinct records of each component of horizontal motion, making six records in all; that is to say, two components of horizontal motion under high magnification (100 to 200, or more, if necessary); two other records of low magnification (1 to 10, if desired); and finally, during destructive or strongly-felt earthquakes, a low magnification record which will be inscribed on a rapidly-moving drum—thus realizing practically six separate records.

The construction of the instrument was shown by lantern slides.

Report of Seismological Committee of the International Seismological Association: H. F. Reid, Baltimore, Md., chairman. (Read by Dr. Otto Klotz, Ottawa, Canada.)

In the absence of Professor H. F. Reid, chairman of the seismological committee, Dr. Otto Klotz, of Canada, who with Dr. Reid attended the meeting of the International Seismological Association at The Hague in September last, read the chairman's report, of which the following is an abstract:

Twenty-two states are now members of the association, England, Austria and Canada having joined since last year. There were about fifty persons present either as delegates or as invited guests, and these included a majority of the leading seismologists of the world. Signor Palazzo, of Italy, was the retiring president. Professor A. Schuster, of Manchester, England, was elected president for the next four years. Professor Forel, of Switzerland, was elected vice-president for two years; and the next meeting of the permanent commission was fixed to take place in Switzerland two years hence; Strassburg was continued as the central bureau of the association for the next four years.

The report of the central bureau showed that it had made careful studies of seismological instruments at Strassburg during the last year, and that it had published the catalog of earthquakes for the year 1904.

In the competition for a cheap seismograph costing 300 Marks, and giving 40 to 50 magnification, instruments were exhibited by Professors Agemennone, Spindler and Boyer, of Göttingen, and Smitt, of Utrecht. They are to be sent to Strassburg and their relative efficiency carefully tested before the prize is awarded.

Many scientific papers were presented at the meeting of the association. Professor Weichert gave his conclusions regarding the character of the interior of the earth based on the result of seismological observations. They confirm his earlier idea of a central core of iron or steel surrounded by a stony layer, and establish the radius of the core at 4,500 kilometers, and the thickness of the stony layer at 1,500 kilometers. The existence of long vibrations of periods of eighteen seconds or more reveals, he thinks, the existence of a layer of liquid or plastic material at a depth of about 30 kilometers from the surface.

Prince Galitzin advocated the use of strong electro-magnetic damping and electro-magnetic recording appliances for seismographs.

A Reconstruction of the Water Planes of the Extinct Glacial Great Lakes in the Lake Michigan Basin: J. W. Goldthwait, Evanston, Ill.

In 1905 the writer made numerous measurements of altitude of the raised beaches on the west side of Lake Michigan by the aid of the Wye level. The definite correlation of several shore-lines below the "highest Algonquin" was thus made possible. Last summer similar data were secured, under the direction of F. B. Taylor, on the east side of Lake Michigan, from the Straits of Mackinac southward and on the Upper Peninsula southward to Holland, Mich. From these data several distinct water planes of the extinct lakes, Algonquin and Nipissing, were recognized. They were shown in detail on a plotted profile. The inclined planes converge southward, and appear to coincide near Onekama, Mich., and Green Bay, Wis., to form a single horizontal water plane at the height of 596 feet A. T. or 15 feet above Lake Michigan.

The correspondence of this series of raised beaches with those studied and described by J. W. Spencer east of Lake Huron and Georgian Bay was discussed. The extension of the profile northward to the Sault Ste. Marie indicated a probable correlation between the raised beaches bordering Lake Michigan and those of the Superior Basin.

Earth Movements in the Laurentian Basin Since its Occupation by the Ice: William Herbert Hobbs, Ann Arbor, Mich.

The introduction of precise leveling to determine the present positions and altitudes of the abandoned shore lines within the Laurentian Basin, as indicated in the last paper, has opened a new era of study of the earth movements which have taken place within this province since the Pleistocene glaciation. Professor Hobbs's paper was a discussion of problems the solution of which was sought in field work undertaken for the Michigan Geological Survey during the season of 1907.

A Review of the Great Lakes History, with Special Reference to the Deformation of the Ancient Water Planes: Frank B. Taylor, Fort Wayne, Ind.

South of the line passing through Lake St. Clair and Ashtabula, Ohio, the ancient beaches are substantially horizontal, and they are the same around the southern third of Lake Michigan, as shown by Professor Goldthwait. North of this, in the Lake Michigan Basin, the beaches above the Algonquin beach are all tilted upward towards the north; in the Lake Huron Basin they are tilted upwards towards the north-northeast, the rate being a foot to the mile or less.

The Algonquin beach keeps horizontal for about 100 miles farther north than the others in both basins. Then it begins to rise towards the north; for the first fifty miles at a rate of nearly one foot per mile; then for about thirty miles at a rate of a little more than two feet per mile; and then for at least fifty miles and perhaps farther at a rate of more than three and a half feet per mile. The rate of uplift east of Lake Huron seems slightly greater than in the Lakes Michigan and Superior basins. The direction of maximum rise is about north-northeast east of Lake Huron and nearly north in the Lake Michigan Basin.

The Kirkfield outlet of the Algonquin to the Trent Valley in Ontario was discussed and it was shown that the opening of this outlet lowered the level of Lake Algonquin at least 40 or 50 feet, and that at this time the ice sheet had withdrawn from all of the Lake Michigan Basin, from nearly all of the Lake Huron Basin, and probably from much of the Lake Superior Basin. Lake Algonquin was at first confined to the Lake Huron Basin with its outlet at Port Huron. Whether its mergence with Lake Chicago occurred before or after the opening of the Kirkfield outlet is not known. The Kirkfield outlet was in the area of great uplift and was soon carried up to a higher altitude than the old outlet at Port Huron, to which place the discharge was then returned. The uplift then continued, at first slowly, but later with relative rapidity, producing before its close the remarkable series of northward splitting beaches which are associated with Lake Algonquin.

Following the discussion of the beaches of Lake Algonquin, the Nipissing Great Lakes were described with their outlet eastward through Lake Nipissing to the Ottawa River. Continuing uplift raised this outlet and turned the discharge of the upper lakes back once more to Port Huron, where it has remained to the present time.

The character of the causes of the deformation of the old water planes was discussed very briefly (*a*) with reference to the effects produced on the water planes within the Great Lake area, (*b*) in the light of Pleistocene deformations affecting wider areas, and (*c*) in the light of the leading theories concerning the conditions of matter in the interior of the earth.

The Mississippian Section in Illinois: Stuart Weller, Chicago, Ill.

No detailed studies of the Mississippian rocks of Illinois have been reported for over a generation. In the meantime much progress has been made in the study of the equivalent formations in neighboring states, and much information regarding them has accumulated. In view of these conditions it has seemed desirable to conduct a series of investigations upon these formations in Illinois where the typical sections occur, using the more modern methods of stratigraphy and paleontology. The present paper is a report of progress of these studies which have been carried on during the last two years.

Devonic Elements in the Late Siluric Fauna of Southern Michigan:[3] A. W. Grabau, New York, and W. H. Sherzer, Ypsilanti, Mich. (Read by W. H. Sherzer.)

[3] By permission of Dr. A. C. Lane, state geologist of Michigan.

In southern Michigan the Monroe formation forms the upper part of the Siluric. In the upper part of this formation and about 200 feet below its summit is an intercalated coral-reef limestone 40 to 50 feet thick, made up of Siluric and Devonic stromatoporoids and corals, and containing, besides, a number of other fossils related to species elsewhere in this country known only from the lower Middle Devonic. The highest beds of the region contain an upper Siluric fauna of European affinity. The bearing of these facts on the paleogeography of the Upper Siluric and on faunal development and migration was discussed.

Notes on the Traverse Group of Michigan:[4] A. W. Grabau, New York City. (Read by W. H. Sherzer, Ypsilanti, Mich.)

During the progress of the study of the stratigraphy and faunas of the Traverse Group of northern lower Michigan—a number of distinct faunal divisions have appeared. The subdivisions of the group and the migrations of the successive faunas were considered, and the progressive evolution of some of the characteristic species was traced.

The Evolution and Distribution of the Plesiosaurs: S. W. Williston, Chicago, Ill.

The known range of the Plesiosauria of North America is from the Upper Jura (Baptanodon beds) to the middle or upper part of the Fort Pierre Cretaceous. A comparison of nearly all the known material from North America with much of that from Europe gives assurance that no known genus is certainly common to the two continents. The genus *Plesiosaurus*, especially, the most generalized of the known plesiosaurs, is certainly not represented by any known species in America.

[4] By permission of Dr. A. C. Lane, state geologist of Michigan.

The American forms, moreover, present a higher degree of specialization than is known among the European. As stated by the author in an earlier paper, the plesiosaurs as a group, which at least is of subordinal rank, present sufficiently wide and distinct divergences of structure to warrant their separation into a number of well-marked families, families distinguished by structural characters fully the equivalent of those used in the classification of modern reptiles. Of these families, the author is prepared to define at least three from North America: the Elasmosauridæ, characterized by the greatly elongated neck, absence of interclavicle and interclavicular foramen, and the broad separation of the coracoids posteriorly, especially; the Polycotylidæ, by the presence of a large interpterygoidal foramen anterior to the parasphenoid, large interclavicle and interclavicular foramen, three or four epipodial bones, etc.; the Brachaucheniidæ, by the broad union of the pterygoids anteriorly, the absence of interpterygoidal foramen, very short neck, etc. He believes that at least two other families will have to be erected for the reception of known forms.

On the Discovery of Vertebrate Fossils in the Pennsylvanian, near Pittsburgh, Pa.: Percy E. Raymond, Pittsburgh, Pa.

In the clay which underlies the Ames limestone the writer has found remains of vertebrate fossils. These fossils have been identified by Dr. W. D. Matthew and Professor E. C. Case as belonging to amphibians, theromorph reptiles and pelycosaurian reptiles. As the horizon from which these bones were obtained is in the Conemaugh series about midway between the top of the Mississippian and the base of the Dunkard series (Permian), it seems probable that these are the oldest reptiles yet discovered. It has been suggested that the beds which contain these fossils are of Permian age, but in spite of the affinity of these forms with the Permian species, the preponderance of evidence at the present time is in favor of retaining the Conemaugh series in the Pennsylvanian.

On the Discovery of Pelycosaurian Remains in Rocks of Pennsylvanian Age near Pittsburgh, Pa.: E. C. Case, Ann Arbor, Mich. (Read by title.)

The Lignite of Mississippi: Calvin S. Brown, University Post Office, Mississippi.

This paper described the situation and topography of those portions of Mississippi that are known to be underlain by lignite. The mode of occurrence and geological relationship of the lignite beds were outlined and the character of the material in composition and its value as a combustible were briefly sketched.

The Influence of the Tides on the Earth's Rotation: T. C. Chamberlin, Chicago, Ill.

The ultimate purpose of the study was to determine whether changes in the rate of the earth's rotation have been serious factors in its deformation. The problem may be approached from the astronomic and from the geologic points of view. The former are largely cosmogonic and tidal, and the tidal involve the cosmogonic. The inferences from the older cosmogonies involve gaseous and molten states, as well as the separation of the moon from the earth; and are thus radically different from the inferences drawn from a cosmogonic hypothesis which permits a rigid elastic state of the earth from its beginning. The subject is, therefore, open to reconsideration in the light of alternative hypotheses.

The necessity for treating the tides as the phenomena of essentially independent bodies of water lying in irregular basins on the surface of the lithosphere was shown by citations from the co-tidal charts recently issued by the U. S. Coast and Geodetic Survey. Attention was called to certain anomalies in the relative heights and peculiar behavior of the tides which render difficult any explanation on the usual lines, and Harris's theory of their essential origin in special segments of the oceans was briefly sketched. In addition to this, an inertia tide, assigned to the tilting of the basins by the tidal deformation of the lithosphere, was suggested as a supplementary possibility, but its quantitative value was not estimated or urged.

The normal oscillations of the earth as a spheroid were briefly discussed in the light of mathematical deductions and of certain seismic, nutational and tidal phenomena, with the general conclusion that the lithospheric pulsations, whether tidal or otherwise, have a short period and, in the case of the tides, act directly with the forcing agency.

An attempt to analyze and estimate the influence of the water tides as a retarding agency by the usual method based on the positions of the tidal protuberances, was found not only impracticable because of its intricacies and theoretical uncertainties, but because it involved an unrecognized factor that renders the method misleading. Moulton has found that all energy which is converted into heat by the friction or impact of the lunar tides and lost by dissipation, must in the present configuration of the earth-moon system be taken from the rotation of the earth and the revolution of the earth-moon system in the proportion of 27:1, and that the rotation of the earth must be reduced and the moon must retire, and that *this is independent of the kind or phase of the tide.* It is, therefore, only necessary to estimate the total loss of energy by the tides and subtract the appropriate portion of this from the rotational energy of the earth to ascertain its retarding effects.

The data for such an estimate were put into a tractable form, with large assumptions of tidal height and frictional zones, and submitted to W. D. MacMillan for computation by the formulas used by engineers. The result gave an increase in the day of one second in 460,000 years, or less than four minutes in 100,000,000 years.

The geological evidences were discussed on the basis of a series of spheroidal deformations corresponding to a series of rates of revolution computed by Slichter. It was found that changes of rotation would cause distinctive kinds of deformation of which no distinct traces could be detected. The distributions of the hydrosphere through the geological ages were also found incompatible with the theory of appreciable change of rotation. These negative evidences of the geological record are in close harmony with the computed effects on the revised basis.

Glacial Erosion in Wales: W. M. Davis, Cambridge, Mass.

The mountains of north Wales are peculiarly significant in the problem of glacial erosion, because they retain in part forms little changed from those which are not producible by normal erosion, but which are eminently characteristic of the forms that glaciers would produce if they acted as eroding agents. In order to appreciate the meaning of these contrasted forms, it is essential that the observer should have in mind a clear picture of the forms appropriate to subdued mountains that have been acted on only by normal agencies. The general absence of such mountains in western Europe has delayed the recognition of the glacial origin of a number of abnormal features.

Beginning and Recession of Saint Anthony's Falls: F. W. Sardeson, Minneapolis, Minn.

The character of the Mississippi gorge from Fort Snelling to St. Anthony's Falls was outlined and a description was given of the terraces and abandoned gorges, to show that the falls have increased in height during their recession. The early history of St. Anthony's Falls was described in detail and the formerly estimated rate of recession of the falls was revised.

Arched Structure in Lockport Limestone: H. L. Fairchild, Rochester, N. Y.

The author exhibited a few lantern views showing arching layers in the Lockport (Niagara) limestone at Niagara Falls. This peculiar structure has been known for seventy years and was figured in Hall's report on the fourth (New York) district, 1843, but no satisfactory explanation of the phenomenon has been found.

Correlation of Distribution of Copper and Diamonds in the Glacial Drift of the Great Lakes Region: Oliver C. Farrington, Chicago, Ill.

The distribution of copper in the glacial drift south of the Great Lakes resembles closely that of the diamonds which have been discovered in the same region. As the source of the copper is known to be the rocks bordering the shores of Lake Superior, it seems probable that the source of the diamonds was in the same region.

The Alteration of Glacial Deposits by Later Ice-invasions: Frank Carney, Granville, Ohio.

The readvance of an ice-sheet subjects the drift already accumulated to gradation which probably removes much of it, and to differential stresses which presumably alter the portion not removed. The extent of this alteration is influenced (1) by the length of the interval of deglaciation, a control that is further conditioned (*a*) by cementation of the early drift, whether till or modified deposits, and (*b*) by topography; (2) by the thickness or weight of the over-riding ice; (3) by the activity of the ice, especially if at different times the predominant motion varied somewhat in direction. The change brought about in over-ridden drift differs with the nature of the drift: if till, the changes produced are disturbance or distortion, foliation, induration, jointing, faulting, and apparently color-alteration; if modified deposits, distortion, jointing, faulting, but only slight foliation and induration.

The presence of such alteration in drift in proximity to drift bearing no such evidence suggests that the two represent distinct ice-epochs.

A Demonstration of the Curvature of the Earth's Surface: Robert M. Brown, Worcester, Mass.

The paper recorded an observation by the writer on the curvature of the earth at Lake Quinsigamond, near Worcester, Mass. A board two feet square, divided vertically into a black upper surface and a white lower one, was set up with the union of the two surfaces at a certain height above water level. On an island about 4,000 feet away a white bar was erected, parallel to the water and at the height of the horizontal line of the first piece of apparatus. In line with these two and about 4,000 feet beyond the second piece, a telescope was set at the given height above the water. On sighting through the instrument the bar was projected against the top of the board. A scale suspended from the bar showed the amount of deviation from a straight line. From this reading the size of the earth was deduced.[5]

[5] Printed in full in the *National Geographic Magazine*, Vol. XVIII., 1907, 771–774.

Working Hypothesis on the Physiography of Alaska: Wallace W. Atwood, Chicago, Ill.

Associated with the study of the Cretaceous and Tertiary formations in the district of Alaska, it has been necessary to consider with some care the physiographic history of the district. In the coastal provinces there has long been recognized a great peneplain which is now represented by the summits of the Coast ranges. This is shown in southeastern Alaska, along the gulf of Alaska and on the Kenai Peninsula.

In the Controller Bay region and in the Cook Inlet region, distinct peneplains were recognized below the summits of the Coast ranges. In the Cook Inlet region the lower peneplain is post-Kenai (Oligocene) and the upper or summit peneplain, there represented by the crest of the Kenai Peninsula, is certainly pre-Kenai. Through the Kenai Peninsula there are certain passes which correspond in elevation with the general level of the lower peneplain, and which are the valleys developed during the period when the second peneplain was being developed.

In crossing the Coast range at White Pass, the uppermost or summit peneplain is readily recognized, but below this level there is a system of broad open valleys in which White Pass, Chilcoot and Chilcat Pass belong. Passing to the northward and down the head waters of the Yukon system, the uppermost, or summit peneplain, was traceable, but the remnants which reached that level became less and less in extent and in number. At Cariboo, in the Yukon territory, an intermediate bench appears and to the northward many more extensive benches and ridges reach that intermediate level. Before reaching Dawson the intermediate horizon is seen to represent the summit of the Yukon plateau. This plateau has been recognized by many as a great peneplain, and its correlation with the summit peneplain has been suggested. The studies during the past season would indicate that these two great Peneplains are distinct, and suggest, at least, that the broad passes through the Coast ranges are of the same age as the Yukon plateau peneplain.

In the central portion of the great Yukon plateau area between Eagle and Fairbanks, the Yukon plateau is well shown, and rising above it there are many monadnock forms which belong to the earlier or summit peneplain of the Coast ranges. There are also distinct benches below the Yukon plateau, and from 1,200 to 1,400 feet above sea-level, which attract attention. They are represented at Eagle by a low ridge just south of town, and in the valley of Seventy Mile and Mission Creek, by broad open valleys above the present gorges.

Continuing the studies farther down stream, the upper peneplains became less and less conspicuous, and the lower one grew in importance and then took a lesser place, as the modern peneplain, represented by the broad alluvial flats of the lower Yukon, Koyukuk and Kuskokwim rivers became more conspicuous.

The hypothesis stated briefly is that the great summit peneplain of the coastal province is distinct from certain lower peneplains bordering the Pacific and from the Yukon plateau peneplain of the interior; that in the Yukon basin there have been several peneplains developed and that each process of peneplaination has moved as a wave up that basin from the westward, just as the modern peneplain is today moving up that valley; that the extent and number of remnants of each peneplain decrease from the headwaters of the Yukon toward the mouth, just as terrace remnants in a single valley may decrease from their up-stream termini to the lower portion of the valley; that the lower peneplains of the Pacific coast provinces may possibly be correlated with the Yukon plateau peneplain, or with still lower erosion surfaces in the interior; that Schrader's Koyukuk plateau, just south of the Endicott Mountains, is to be correlated with the 1,200–1,400 foot peneplain recognized in remnants along the Yukon and its tributaries near Eagle, and by more extensive areas farther down the valley; that the summit peneplain of the Rocky Mountains described by Schrader may be of the same age as the summit peneplain of the Coast ranges.

The Honeoye-Irondequoit Kame-Moraine: Charles R. Dryer, Terre Haute, Indiana.

The range of drift hills described extends about fourteen miles in the counties of Livingston, Monroe, and Ontario, N. Y. It is divided by transverse valleys into three principal portions. (1) The Irondequoit-Turk Hill portion consists of heavy Kame deposits in the Irondequoit Valley, which, extending eastward over the Turk Hills, appear to be a group of large drumloids, partly buried and masked by sands and gravel. (2) The Gahyandock Hills consist of massive Kame deposits, superposed upon a basal terminal moraine, the surface of which is exposed in the bordering plateaus. These hills rise to 1,100 feet A. T. (3) The Bloomfield-Lima Kame-moraine adjoins (2) on the south, and consists of a gravel outwash plain on the north, changing to a typical terminal moraine at the southern end.

The range is cut through by the present valley of Honeoye Creek at its southern end, where well borings show the presence of a deeply drift filled preglacial valley. (1) and (2) are separated by the Rush-Victor glacial river valley which was a line of eastward drainage for melting ice and subsequent lake waters. The filled valley of the lower Irondequoit has a rock bottom below the level of Lake Ontario and is thought to have been the preglacial outlet of the Honeoye Valley. The whole range was a continuous marginal deposit during the retreat of the Wisconsin ice sheet and marks the position of the debouchment of a powerful subglacial stream.

Glacial Lake Bloomfield: Charles R. Dryer, Terre Haute, Indiana.

Numerous deltas in the Honeoye and Hemlock Valleys in Ontario and Livingston Counties, N. Y., at the 1,000-foot level A. T., indicate the existence of an ice-dammed lake which succeeded the glacial Honeoye and Hemlock Lakes described by Fairchild, and immediately preceding Lake Warren. Its principal outlet was across the divide eastward to the Bristol Valley. A later and lesser outlet was opened to the northeast near the village of East Bloomfield. Two smaller spillways to the west may have been briefly active. The northern border of Lake Bloomfield was formed by the margin of the ice, when it stretched from the Gahyandock Hills to the north end of a ridge three miles west of Lima Village.

The Loesses of the Mississippi Valley: B. Shimek, Iowa City, Iowa.

Evidence was presented to the effect that a loess deposit followed each drift sheet, and that the loesses are inter- and post-glacial. This conclusion is supported by the vertical position of the loesses with reference to the drift-sheets; by geographical position, the best illustrations occurring near the borders of drift-sheets; by root-tubes; by fossils; by differences in texture and composition.

The Gases in Rocks: R. T. Chamberlin, Chicago, Ill. (Read by T. C. Chamberlin.)

Some of the results of 112 analyses of the gases derived from a wide range of rocks, and a part of the generalizations based upon these were presented. A classification of the analyses according to the types of igneous rocks brought out the fact that, while the rocks of each group may vary considerably among themselves, the group as a whole fits into a logical place in relation to the other groups. Arranged in the order of the total volumes of gas evolved per unit volume of rock, the types of rock rank thus: (1) Basic schists, (2) diabases and basalts, (3) gabbros and diorites, (4) granites and gneisses, (5) andesites, (6) syenites, (7) rhyolites.

A classification on the basis of the age of the rocks showed a rapid and steady decline in the quantity of every gas in passing up the columns from Archean to Recent lavas. Fine-grained rocks were found to give off more gas than those of coarser granularity.

A series of special experiments showed that the gases obtained from heating rock material in vacuo come from three sources: (1) Gas held mechanically in minute cavities and pores, (2) gas occluded within the substance of the rock, and (3) gas produced by chemical interaction between the nongaseous constituents of the rocks at the high temperatures used.

An average of 51 analyses of the gas from igneous rocks, expressed in volumes of each gas per unit volume of rock, gives the following figures: H_2S, .01; CO_2, 2.16; CO, .18; CH_4, .05; H_2, 1.36; N_2, .09; and total, 3.85.

It was found that rock powders which had ceased to give off gas in combustion tube, and were apparently exhausted of their gas content, were able, when re-heated after an interval of several months, to produce a considerable quantity of additional gas amounting, in some cases, to as much as half the volume originally obtained. Test experiments showed that this was not the result of a selective absorption of gases from the atmosphere during the interval, but was due to some kind of diffusion or molecular rearrangement going on slowly within the rock material.

The significance of these gases, existing in a threefold state so generally and in so large a variety of rocks, and their bearings on some of the problems of vulcanism and of the atmosphere were indicated.

In the discussion that followed the reading of this paper reference was made to the bearing of the results upon the explanation of causes of gas explosions in mines. Dr. A. J. Holmes, chief of the technical branch of the U. S. Geological Survey, in the course of his remarks on the subject, gave a report of progress of the investigations undertaken by the survey to establish the cause of the recent disastrous explosions in coal mines.

Work of the United States Reclamation Service: E. T. Perkins, Chicago, Illinois.

This paper was a summary of the results obtained by irrigation in the United States and other countries, and a statement of the work being done by the U. S. Reclamation Service.

Fjords of Puget Sound and the Saguenay: Warren Upham, St. Paul, Minn.

This paper presented the results of the study of the Puget Sound and the Saguenay regions.

Puget Sound and its many long and narrow arms, called canals, from 100 to 600 feet in depth beneath the sea level, are admirable examples of fjords opening northward, running thus toward the interior of the ice-sheet which during the glacial period covered this district, being the southern part of the continental ice-sheet west of the Rocky Mountains. It is impossible to ascribe the depth of these fjords to glacial erosion because they run in courses opposed to the courses of glacial erosion and transportation of material eroded.

The Saguenay Fjord, sixty miles long, river-like in its nearly uniform width and its somewhat winding course, with a depth from nearly 500 to 900 feet beneath the sea level, continuously enclosed on each side by steep or precipitous bluffs and cliffs 500 to 1,500 feet high, is regarded as a very typical fjord of the Norwegian type.

Both the fjords of Puget Sound and of the Saguenay have been eroded alike by river channeling before the Ice Age, showing, with the other fjords farther north, that this continent was greatly uplifted during a considerable time preceding the continental glaciation. Such high land elevation the author believes to have caused the cold climate and the accumulation of snow and ice which characterized the Glacial Period.

W. S. Bayley,
Secretary pro tem.

THE HANOVER MEETING

Section E, Geology and Geography, proposes to give a series of excursions to various points in Vermont and New Hampshire in connection with the meeting of the American Association for the Advancement of Science at Hanover this summer.

A tentative plan is the following:

1. The first excursion to be under Dr. Wolff, of Harvard University, starting from Bellows Falls, Vt., Friday, June 26. This will be a trip across the Green Mountains, arriving at Rutland, Vt., some time on Saturday.

2. An excursion with Professor G. H. Perkins, state geologist of Vermont, to some of the marble quarries.

3. An excursion to Ascutney Mountain, Vermont, under Dr. R. A. Daly.

4. A trip to the Quechee River local glacier under Professor Hitchcock, of Dartmouth.

5. A study of the terraces of the Connecticut River.

6. A day in the Corbin Park to see the buffaloes, etc.

7. A trip of one to three days around Littleton, N. H.

8. A trip to Mt. Monadnock, if enough care to go.

9. A trip to one of the points of interest for economic geology.

10. The final excursion will be made to the Summit House on Mt. Washington, where greatly reduced rates have been secured for a stay of from a day to a week.

It will greatly assist in making arrangements for the meeting if all those who have any thought of taking part in these excursions will send word as soon as possible to

F. P. Gulliver,
Secretary Section E

30 Huntington Lane,
Norwich, Conn.

A PLAN FOR AN EXCHANGE OF TEACHERS BETWEEN PRUSSIA AND THE UNITED STATES[1]

On behalf of the Department of Ecclesiastical Affairs, Instruction and Medical Affairs of Prussia, Geheimer Ober-Regierungsrat, Dr. Karl Reinhardt, addressed the Carnegie Foundation for the Advancement of Teaching in the summer of 1907 and laid before it a plan for an exchange of teachers between Prussia and the United States. An exchange similar to the one proposed is now in effect between Prussia on the one side, and France and England on the other; and in view of the usefulness of this work, not only in the school systems of the respective countries, but also in the better feeling and understanding of the countries, Dr. Reinhardt urged the exten-

[1] Bulletin issued by the Carnegie Foundation for the Advancement of Teaching. The committee of arrangements consists of Dr. Henry S. Pritchett, president of the foundation, Professors Julius Sachs and Calvin Thomas, Columbia University, and Headmaster James G. Croswell, Brearley School, New York.

sion of the plan to America. He requested that the foundation act in an official capacity with the royal government of Prussia and that it arrange all details of the exchange for this side of the ocean.

Upon receipt of the communication from the Prussian minister, the president of the Carnegie Foundation brought the matter to the attention of the trustees, and at the meeting of the trustees in November, 1907, it was voted that the president of the foundation should undertake the supervision, on the American side, of the exchange with Prussia. This bulletin is prepared, therefore, in order, first, to suggest the general nature and value of the system, and, second, to give the details by which it is to be put into operation. It is addressed especially to presidents of colleges, universities and normal schools, to superintendents of schools and members of school boards, and to teachers who may wish to consider spending a year or a half year in Prussia under the conditions offered by the Prussian government.

GENERAL NATURE OF THE SYSTEM

The plan for this exchange of teachers is to effect a permanent arrangement by which teachers of the United States shall be assigned for a year or half year to schools in Prussia, and *vice versa*. The instruction to be given in Prussia will be the teaching of English in a conversational way. It is not, however, necessary that the teacher should be a teacher of language in this country, but that he should be a cultured man able to conduct such exercises in an interesting manner.

The significance of the interchange of teachers between countries in Europe has greatly increased during the last two years. The immediate end gained by the exchange of teachers of language is the vitalizing of the instruction in foreign languages and the correction of defects in the system of instruction in one country or the other. But the indirect products of the exchange are far more important. A teacher transplanted for a year to a school in a foreign country has the opportunity to improve his whole view of educational methods. He returns to his regular work with increased efficiency and with freshened ability to teach.

By such an exchange students at an impressionable age learn of the social customs and gain the point of view of the people of the other country, and this under an arrangement which is stimulating and interesting in comparison with the formal language study.

The exchange is, therefore, one that ministers not only to the improvement of the teaching of modern languages, but to general educational efficiency, to a broader understanding of other countries and a betterment of international relations.

From the point of view of the young, ambitious American teacher, the opportunity to spend a year in Prussia is an attractive one and should be considered in about the same way as a fellowship in a good American university. In either case the remuneration is slight. The American teacher who goes to Prussia for a year will receive from the Prussian government from one hundred to one hundred and ten marks a month ($25 to $27.50). It is estimated that this is equivalent to about $40 to $45 a month in a small town in the United States, and that it will meet the actual living expenses of the teacher during the year.

The remuneration is a secondary consideration. Teachers, especially those who are now serving their apprenticeships as scholars or fellows in colleges and universities, preparing themselves for the profession of teaching, will recognize the benefit which a year of study and conversational teaching in Prussia would bring them. The opportunity is virtually that of a traveling fellowship. The teachers have the right to attend instruction in all classes of the institution so far as it is beneficial to their work. Many teachers in the United States who consider the plan may not welcome the idea that they are to remain at one particular institution during their official connection with the school system in Prussia; and that, further, they are under the direct guidance of the director of the institution to which they are assigned. These restrictions, however, have their advantages. The privilege of becoming acquainted with the school system of Germany in all its working details and the fact that this privilege is accorded the visiting teachers under most dignified and agreeable circumstances are worthy of emphasis. The director of an institution to which a teacher is assigned will, with his colleagues, take a personal interest in introducing the teacher into the social life of the community. Good-fellowship is extended to him, and with this the opportunity to gain an intimate knowledge of German ideals in teaching and to observe German methods in practise. In the United States such an opportunity is usually accorded a visitor who gives evidence of sincerity in his desire for the privilege, but in Prussia the privilege is rarely granted to any one except through formal application to the Royal Minister of Instruction.

In no case are teachers to take part in the formal instruction of the institution which they visit. They do not do the work, or even part of the work, of a regular teacher. This would impose too heavy a burden upon the visitors and would render their relationship with the students too didactic. The plan is for the visiting teacher to teach conversation in his own language in an informal manner for not more that two hours each day, his classes being small groups of upper classmen who wish to perfect themselves in the language of the teacher. The students and the teacher discuss the manners and customs of the teacher's home, the school arrangements, the family life, the conditions of public life, the social usages, etc. Work of this nature will not interfere with the teacher's leisure for study and observation, and for short trips to communities other than his own.

DETAILS OF THE SYSTEM

All matters of business connected with the exchange of teachers are transacted either through the Prussian Minister, whose address is Berlin W, 64, Wilhelmstrasse 68, or through the Carnegie Foundation for the Advancement of Teaching, 576 Fifth Avenue, New York City. All communications from those interested in the matter in the United States should be addressed to the president of the Carnegie Foundation for the Advancement of Teaching.

All applications from institutions for teachers from Prussia and for appointments of individuals to go to Prussia should be filed at the office of the foundation not later than June 15, to go into effect in October. In making application a teacher should give his full name, address, date and place of birth, citizenship, religious faith, academic preparation for teaching and information concerning his fitness for the work, and preference in regard to situation in Prussia. Formal application blanks for this purpose may be had upon request from the offices of the foundation.

The candidate for appointment to a position in Prussia should be a graduate of a college which requires for admission the usual four-year high school course. He must have been for at least one year a teacher, though not necessarily a teacher of languages, and must have reasonable facility in the German language. The teacher who goes to Prussia will enter a *gymnasium* or a *real-gymnasium*. His work will be the informal teaching of the English language by means of conversation. As stated in the general discussion, the remuneration is one hundred to one hundred and ten marks a month paid by the Prussian government in monthly instalments.

A teacher coming to the United States from Prussia may enter a college or a high school of good standing. His work, similar to that of the American teacher assigned to a post in Prussia, will be the teaching of the German language by means of conversation. The Prussian teacher for appointment in the United States must be a graduate of a German university and must have served for at least a year as a probationary teacher under the director of a *gymnasium*.

Any educational institution or city school board which makes application for a Prussian teacher must agree to pay the visiting teacher a sufficient sum to meet modest living expenses such as board, room, laundry, etc. In no case should this amount be less than the monthly allowance which the Prussian government pays to an American teacher in Prussia. An amount of approximately fifty dollars a month for a period of eight months will usually meet the requirement. The amount will vary according to location.

Many colleges, universities and normal schools which have departments of German will probably be glad not only to select a representative to go to Prussia, but also to receive in return a Prussian teacher who would doubtless stimulate a new interest in the work of the department. It is not necessary, however, that an institution which receives a Prussian teacher should also nominate a teacher to go to Prussia; nor that if an institution sends a teacher to Prussia it receive a foreign teacher in return.

The Prussian government pays all the necessary traveling expenses of the teachers selected to come to America. While many of the American teachers will probably be willing to pay their own traveling expenses to Prussia, it is hoped that institutions which nominate the individual teacher will also pay the transportation to Prussia, thus making the appointment one of distinction and honor as well as an educational opportunity.

All appointments are made either for one academic year or for one half of the academic year. The year begins at Easter and is divided into two terms, the second term beginning about October 1. There are generally two weeks vacation at Easter, two weeks at Christmas, one week at Whitsuntide, and about four weeks in June or August, according to the arrangement of the ministry.

In accepting an appointment from either country, teachers pledge themselves not to publish anything concerning the institutions with which they are connected except with the permission of the proper authorities. This restriction is a nominal one. It is understood that there will be no objection to any serious and well-informed publication on the part of the visiting teacher.

At the present time women are not eligible to appointments as exchange teachers with Prussia.

American teachers who take these appointments are expected to render a report at the end of their service to the president of the Carnegie Foundation concerning such matters as seem to them important or to have educational value.

The Carnegie Foundation assumes no

financial responsibility in acting as an agent in this exchange of teachers.

SCIENTIFIC BOOKS

Comparative Anatomy of Vertebrates. Adapted from the German of Dr. Robert Wiedersheim, Professor of Anatomy in Freiburg, by W. N. PARKER, Professor of Zoology in the University of Wales. Royal octavo, pp. 576, 372 figures. Macmillan and Co., 1907. Third edition, founded on the sixth German edition (pp. 800, 416 figures).

As indicated in the preface and upon the title-page, this is not a literal translation, but a reduced "adaptation," a more difficult task which also throws a greater responsibility upon the adapter. Although former editions have been—and this will doubtless be—consulted by investigators and teachers, that it was prepared chiefly for students is stated upon the title-page of the original and in the preface of the adaptation; its substance and form, therefore, may fairly be judged from the standpoint of those who seek information and who expect a text-book or reference-book to be not merely correct, but well arranged, clear, consistent and approximately complete. Furthermore, while the fact that a technical work of this size has reached a sixth edition in one language and a third in another constitutes a presumption of its general acceptability, it is likewise warrant for what, under other conditions, might seem hypercriticism. The reviewer takes the ground that there is no excuse whatever for lack of clearness or coordination, and that for inaccuracy the only valid excuse is the advance of knowledge since the volume went to press. He holds, also, that rigid and unsparing criticism of works like the present is required if biology is to compete educationally with the more exact sciences and with the languages. Recognizing his own limitations, the reviewer hopes that others may contribute, to the end that future editions in both languages may be beyond criticism in all respects.[1]

Like its predecessors in both languages, this volume excludes the Tunicates and the other lower Chordata; students would welcome some account of these comparatively recent recruits from the "invertebrate mob," or at least references to their treatment elsewhere.

The preface states that "this edition has been almost entirely rewritten." That the changes have not always been for the better is exemplified in the omission of the essential qualification mentioned later in connection with the brain of *Amphioxus*. Careful revision would have averted the need of the following comment. The discussion of the nature and origin of the limbs opens with a paragraph in which the problem is said in the original to have been "seit einer Reihe von Jahren im Vordergrund." In the second English edition this was rendered "attacked vigorously during the last thirty years." In the present edition the entire paragraph is reproduced, *verbatim;* its literal interpretation would eliminate the first third of the period named in its predecessor. The paper and press-work are creditable to the publishers; many of the cuts are original and most of them, whether pictures (Fig. 134), schemas (Fig. 339) or colored diagrams (Fig. 306), are artistic, clear and correct. The least commendable purports to represent the "placoid scales" (Fig. 30). Admittedly "semi-diagrammatic," it need not so nearly resemble a segment of a rather roughly constructed harrow. Among figures in the original that are omitted from the adaptation are the skeletons of the pterodactyl (Fig. 37), *Archæopteryx* (Fig. 19) and *Stegosaurus* (Fig. 30). Among those added to the original are the meroblastic ovum (Fig. 4) and the "diagrammatic longitudinal section of a vertebrate" (Fig. 11).

Respecting this last, criticism is mainly from the pedagogic standpoint, bearing in mind that it occurs at the threshold of a work intended primarily for students. It faces the original's "diagrammatic transverse section." This is very simple and purely schematic,

[1] Some suggestions as to the improvement of the previous edition were made by the reviewer in *The Nation* for October 28, 1886, and an indication of his disappointment may be found in the same periodical for February 13, 1908.

omitting even the heart or a ventral venous trunk representing it. The other is comprehensive and complicated, yet omits the great veins, dorsal and ventral, and even the aorta, the only viscus in the transection besides the enteron; in brief, the two sections are not correlated. Finally, the spleen and the pancreas are so represented as to give the distinct impression of a single continuous organ with a hole at the smaller end. As in most works of the kind, comparable figures are often reversed in direction. Without insisting unduly upon conformity with the practise of the elder Agassiz,[2] for students such reversals are often confusing, especially where different sets of abbreviations are used for the same parts, as in Figs. 149 and 150, 160 and 161, 172 and 173.

In the introduction of sixteen pages, after definitions and general considerations, vertebrate ontogeny is outlined, all too briefly for the student; indeed, only one already familiar with the facts would comprehend either the conversion of the blastula into the gastrula, or the formation of the notochord and neural tube. And what impression would be made upon the average reader as to the dependability of biologic science by the statement (p. 5) that "In all vertebrates the blastophere passes—or did so in earlier times—into," etc., with no "probably" or corresponding German word to indicate that, however well founded, our belief is pure hypothesis, unproven and unprovable? The "general classification of the principal vertebrate groups," although occupying more space than in the original, and with two thirds of page 15 left blank, absolutely ignores extinct forms, even some that are discussed in the text, *e. g., Archæopteryx* (p. 60), *Hesperornis* and *Ichthyornis* (123, 318), *Stegocephali* (142, 148), *Pleuracanthus* (145), *Ichthyosaurus* and *Plesiosaurus* (163). The introduction closes with a full-page "Table Showing the Gradual Development of the Vertebrata in Time." Like the original, it is said to be "modified from H. Credner," but there is no explanation of the further changes, especially the inclusion of the Amphibia and Reptilia in a single column.

[2] See American Association for the Advancement of Science, *Proceedings*, 1873, p. 274.

The statement on page 63 as to the persistence of the human tail up to a certain embryonic size is undesirably condensed from the original (p. 65); it lacks the two instructive figures there given, and—like the original—it fails to note the presence of a perfectly distinct caudal appendage at a considerably later stage, even though it may not contain the original prolongations of the neural and enteric cavities. The several kinds of tails among fishes might well have received fuller treatment. The figure of *Protopterus* in the original is omitted from the adaptation, and neither portrays a typical heterocercal tail (sturgeons and most sharks), nor the very instructive developmental stages of the gar and some teleosts so fully made known by the younger Agassiz thirty years ago. The account of the relations of the ovaries to the oviducts in teleosts is not clear in the original (p. 559), and still less so in the adaptation (p. 466).

Some of the following features may not commend themselves to all, but they afford the reviewer considerable gratification: The distinct recognition of the importance of the olfactory portion of the brain (pp. 200 and 220); the omission of the "Isthmus rhombencephali" from the encephalic segments; the retention of the correct spelling, *Lepidosteus;* the use of coele and its compounds for the cavities of the brain, and of postcaval and precaval; and the avoidance of "*Anlage*."

The following statements as to the brain are more or less defective, misleading or erroneous.

Page 201—"The middle commissure is present in mammals only." It exists in the alligator and in all turtles so far as the reviewer is aware. The succeeding paragraph as to the corrugations of the cerebral surface is worded even more loosely than the original; it implies that only the lateral aspect is so modified and that *pallium* and *cortex* are synonymous; fails to distinguish between total and partial fissures, and omits the concluding phrase of the original as to the concomitant increase of the conducting fibrous constituent.

Page 203—The original of the following sentence is characteristically German, but it might have been rendered into more straightforward English: "A series of unpaired ventricles lying in the longitudinal axis of the brain, as well as paired ventricles, can be distinguished."

Page 204—Without the figure that surely should have accompanied this very brief account of the brain of the lowest vertebrate an imperfect idea would be conveyed by the phrase, "kegelförmigen Auftreibung," rendered "conical and enlarged." The presence of an olfactory bulb, mesal at its base, but deflected to the left, never would be inferred from the statement that "the brain cavity opens freely to the exterior dorsally by a neuropore." In the previous English edition this free rendering of the original is properly qualified by the phrase, "in the larva," the omission of which from the present volume conveys an error as radical as would be embodied in the declaration, "man has a short triangular tail," without the qualification, "at a certain stage of development."

Page 210—The account of the selachian forebrain is not clear as to either the developmental stages or the various adult conditions; see also the commentary upon Figs. 157 and 158.

Page 213—As to the olfactory bulbs of teleosts, the original merely remarks (p. 249) in effect that they may be either sessile or pedunculate. The adaptation says "they are either closely applied to the telencephalon [forebrain] and contain a small ventricle, or they become differentiated into tract and bulb, as in elasmobranchs [selachians]." In the absence of any representation of the alleged olfactory ventricles the reviewer, recalling the artifact figured by him in the perch (A. A. A. S., *Proceedings*, 1875, Pl. 3, Fig. 14), apprehends that they may be as insignificant as those discussed the following year (p. 258), and scarcely deserving of the title; certainly, in neither form is there a patent cavity as in sharks and rays.

Page 214—The teleostean cerebellum is by no means always "extremely large"; and while in some, as the salmon (Fig. 160), it is "bent upon itself and overlies the medulla oblongata," in others, *e. g.*, perch, it is erect, and in still others, *e. g.*, catfish, it tilts forward upon the midbrain.

Page 227—The midcommissure may be "large" in most mammals, but in man it is notably small.

Page 228—In both the original and the adaptation it is assumed that the carnivoral cruciate fissure is homologous with the primatial central or Rolandic, but their comparable relation to the chief motor areas of the cortex by no means proves their morphologic identity.

Page 236.—In connection with the ordinary cranial nerves the original devotes two figures and the larger portion of pages 276 and 277 to the new "Nervus terminalis" of Locy (Science, Aug. 11, 1905, and earlier papers there cited). This was none too much in the opinion of the reviewer, whose appreciation of what he regards as an "epoch-making" series of observations has been briefly expressed in Science, May 26, 1905, p. 813. Yet the subject is disposed of in the present volume in a foot-note of six lines; the words "in the region of" are superfluous and misleading in respect to both the origin of the nerve in the terma ("lamina terminalis") and its distribution to the olfactory mucosa; worse yet, through a misprint for *Amia* (*Amiatus*) which does not occur in the original, the adaptation credits the nerve to the Anura, notwithstanding Locy's declaration that he searched for it in vain in the frog and toad.

Fig. 145—The uniform line between the two halves of the frog's brain fails to indicate the exceptional coalescence of the olfactory lobes, and there is no reference to the later figure, 164, *B*. In some respects Ecker's figure (145) is less satisfactory than those published in 1853 by Jeffries Wyman, apparently unknown to both author and adapter.

Fig. 148—Without challenging the usefulness of this schema of the three primary "cerebral vesicles" (*encephalic* is the natural equivalent of "Hirnbläschen" as well as more

correct in itself), surely in this connection should at least be mentioned the suggestive observations of Charles Hill as to the eleven neuromeres in teleosts and birds.

Fig. 149—Unless otherwise stated, a "longitudinal" section is assumed to be mesal, or sagittal and parallel with the meson, or at least in one and the same plane. Here the cerebral and olfactory regions are not in the same plane with the rest. No one would be more pleased than the reviewer to find a brain with a single olfactory tract and bulb on the middle line as—in the absence of qualification—is the case in this figure, the "ideal" key to the "real" brains that follow it. The dotted ellipse marked *Tho* ("optic thalamus") might fairly represent the midcommissure connecting the two thalami, but hardly those bodies themselves; see also under Fig. 152.

Fig. 150—In neither the original nor the adaptation is it stated what brain serves as the basis of this diagram.

Fig. 151—Here are five diagrams "illustrating the structure of the hypophysis" (pituitary body). They are not adequately explained in either the general text or the description, and the latter contains words, "chromophilous" and "chromophobic," which, like "chromaffin" (pp. 495–6) are neither defined nor included in the index. Even orientation of these diagrams is difficult since more complete figures with which they might be compared (150, 154, 161, 165, 172) head in the opposite direction.

Fig. 152—This diagram of the "ventricles," as if their roofs were removed, should be coordinated with Fig. 149. Here the side walls of the "third ventricle" might properly be designated *thalami*.

Fig. 153—In a diagram to illustrate the several flexures of the brain there is perhaps no great harm in representing the midbrain as if it were a flattened "lump" suggesting no organic relation with the adjoining segments. This figure, or some other, should exhibit the definite topographic relation of the principal (mesencephalic or cranial) flexure to the cephalic end of the notochord.

Figs. 157 and 158—To these representations of the dorsum, venter, left, and exposed cavities of a shark brain should have been added a midsection. The foramen so conspicuous on the venter is not named or even accounted for in the description or text; yet, as figured and described by the reviewer in 1876 (*Amer. Jour. Science,* Vol. 12, pp. 103–5) it is very significant in connection with the embryonic condition with most sharks and the permanent condition of the more primitive forms.

Fig. 159—From this brain of the gar, as usual with ganoids and teleosts, the telas are omitted, and their absence is hardly accounted for with sufficient clearness in the text. More serious is the lack of qualification respecting the interpretation of the cephalic portion. It is probable that the conditions are essentially the same as in the Teleosts with sessile olfactory bulbs, viz., the wider pair of solid lobes marked *prs.* are the striata, the smaller ones beyond (hollow in ganoids but practically solid in teleosts), the olfactory bulbs, and the so-called olfactory lobes merely the slightly enlarged beginning of the nerves. It is a reproach to the comparative anatomists of this country that the brain of this exclusively American form should not have been fully elucidated. The reviewer frankly accepts his share and admits the erroneousness of certain interpretations of 1875 (A. A. A. S., *Proceedings,* p. 179 and pl. 2); but in respect to the then prevailing non-recognition of the "morphological importance of the membranous or other thin portions of the parietes of the encephalic cavities" he made a general confession and promise of reform in a paper under the title quoted above, read before the Association of American Anatomists and published in the *Journal of Comparative Neurology,* October, 1891, pp. 201–3.

Fig. 163 represents the dorsum of the brain of *Ceratodus* (*Neoceratodus*), taken by the adapter (unaccountably the author gives no dipnoan brain) from Parker and Haswell's "Zoology." In that work it is said to be "chiefly from Sanders"; it is defective in several unspecified respects and bears no close resemblance to the only figure by that anatomist known to the reviewer, viz., in the

Annals and Magazine of Natural History, March, 1889, Pl. VIII.; a more satisfactory figure was published by Bing and Burckhardt in 1905 (*Jenaische Denkschrift*, Vol. IV., p. 518).

Fig. 164, *A, B, C, D*—From the originals these four views of the frog's brain are reduced somewhat, darker and less clear, especially as to the intercerebral fissure. The midsection (*D*) was taken by the author from the paper in the *Morphol. Jahrbuch*, Vol. XII., p. 239, by H. F. Osborn, who was careful to delimit the cut surface resulting from the division of the secondarily coalesced olfactory lobes; the dorsal part of this boundary is omitted in both the original and the adaptation.

Figs. 166 and 167—In all six of the figures of the brains of *Hatteria* and the turtle the slender tracts connecting the cerebral hemispheres with the olfactory bulbs are designated by I, the first of the cranial nerves, as if in the obsolete and misleading anthropotomic sense. The original has a midsection of the *Hatteria* brain, omitted from the adaptation. Both should have included midsections of the bird's and of the rabbit's or other simple eutherian mammal.

Fig. 170—On the ventral and lateral aspects of the rabbit's brain the primary fissure (*r. f.*) demarcating the olfactory tract and hippocampal lobe from the pallium ceases much sooner than in nature.

Fig. 171—In the dorsum of the dog's brain the olfactory bulbs are represented as if coalescent, as in frogs and toads. In the side view the bulb is inadequately demarcated from the tract. On the venter the trapezium is indistinguishable. On both sides the cruciate fissure is made continuous with another; if such a junction really existed in the specimen from which these pictures were made the exceptional feature should have been specified.

Fig. 172—This midsection of a marsupial brain is not in the original, the author of which dismisses with a brief foot-note the vexed question as to the representation of the callosum in implacental mammals. The adapter accepts the negative view of Elliot Smith, but is apparently so impressed by the resemblance of the "hippocampal or dorsal commissure" to the true callosum as to apply the title "splenium" to the rounded junction of the two component laminæ. Neither the original nor the adaptation represents the entire brain of any marsupial or monotreme.

Fig. 173, *A*—In both works this is the only representation of the mesal aspect of a eutherian brain. It is designated simply "human" and "Gehirn des Menschen." In the absence of qualification it would naturally be regarded as of natural size and adult.[3] It is, however (in the adaptation, not the original), said to be "mainly after Reichert." In that anatomist's "Der Bau des menschlichen Gehirns," 1859–61, as to dimensions and certain features it coincides with Fig. 38, a fetal brain estimated at 24–26 weeks; but there are omitted the occipital and calcarine fissures, always deep at that and even earlier stages; the shading is misleading as to the difference between ectal and ental areas, and whereas the cut surfaces of the fibrous pons and callosum are left blank the nearly fiberless midcommissure is conspicuously dotted.

Fig. 173, *B*—This lateral aspect of the adult human cerebrum reproduces Ecker's imperfect fissural schema of forty years ago upon a scale too small for usefulness; the faculty of articulate speech is, by implication, located in the orbital region rather than in the subfrontal ("Broca's") gyrus; there is no glimpse of the insula or hint of its existence under that name, now almost universally employed to the exclusion of the ambiguous "central lobe."

The climax of pictorial misrepresentation is reached in connection with the pons. This is rightly stated to be characteristic of mammals. As such, one would naturally expect it to be fully and clearly described and accurately portrayed. "In mammals the floor [of the oblongata] gives rise anteriorly to a transverse

[3] Compare, in the original of the "B. N. A." (*Archiv für Anat. u. Physiol.*, Anat. Abth., Suppl. Band, 1895), the designation by His of Fig. 20 as "fötales . . . aus dem dritten Monat." It might possibly be at term, but is more probably adult.

band of fibers (pons Varolii)" (p. 203). "The two lateral lobes of the cerebellum are connected by a large commissure, the pons Varolii; this extends round the medulla oblongata ventrally and is more largely developed the higher we pass in the mammalian series" (p. 229). From this and from the subjoined "diagram of the chief systems of fibers of the human brain" there would be gained the impression that the pontile[4] fibers all cross from one cerebellar hemisphere to the other, whereas at least an equal number decussate and either end in pontile cinerea or become deflected to a sagittal direction. In further diminishment of the usefulness of this figure to the uninformed, the fibrous connections of the cerebellum are called "crura" in the description but "peduncles" in the text. Granting, however, that histology is subordinate in a work of this kind, are macroscropic features of the part in question more satisfactorily dealt with? In Fig. 171, the dog's brain, the area corresponding with the pons is fairly well defined, but the line shading gives the impression of a longitudinal direction of the fibers. On the preceding page the figure of the rabbit's brain embodies not only a *suppressio veri,* but a *suggestio falsi.* There is not the least indication of a pons; on the contrary, the mesal furrow is even more marked than in the pons-less bird on the opposite page, and at either side is a longitudinal line as if the lateral margin of an "anterior pyramid." This same figure occurs in former German and English editions, and in the author's "The Structure of Man," with no intimation of its defects; it is also reproduced in both the "Text-book" and the "Manual" of T. J. Parker and Haswell, although correct —if less artistic—pictures of the rabbit's brain are given in T. J. Parker's "Zootomy" and other elementary treatises. The repetition of such a travesty is susceptible of three explanations, viz., either (*a*) the author and the adapter are unaware of the existence of the pons in the rabbit, or (*b*) they have overlooked its omission by the artist, or (*c*) they are indifferent to the just claims of the student for reliable information upon a feature that distinguishes the mammals from all other vertebrates.

[4] This is the regular English form (Angloparonym) of the Latin *pontilis,* the only correct adjective from *pons;* yet certain medical and scientific writers persist in using *pontal, pontial, pontic, pontine* and *pontinal.*

The extensive and well-arranged bibliography of the previous edition has evidently been augmented and probably embraces the six hundred additional titles of the last German edition; but there are signs of carelessness in, *e. g.,* the inclusion in the literature of the brain of mammals (p. 528, fifth from foot) of a title referring exclusively to the amphibian brain.

An inserted slip disposes of twenty-six errata. As indexes go, perhaps this volume is not conspicuously deficient; yet probably the following are not all the omissions that might be found: appendix (vermiformis), 311; bends (flexures) of the brain, 204; callosal fissure, 225; central lobe, 227; central sulcus, 228; chromophilous and chromophobic, Fig. 151; chromaffin, 495, 496 and 247; cirri, 312; cortex and olfactory cortex, 220; cruciate sulcus, 228; crura cerebelli, 229; diacœle, 210; flexures of the brain, 204; hippocampal fissure, 225; insula (central lobe), 227; mantle, 200; mesocœle, metacœle and myelocœle, 210; ossa mentalia, 135; paracœle, 210; peduncles of cerebellum, 229; pineal cushion, 201; piriform lobe, 228; postcaval and precaval, 426; rhinal fissure, 225; telocœle, 210; thorax, form of, 70; Zirbelpolster, Fig. 150; about thirty, far too many for either a text-book or a work of reference.

Notwithstanding the deficiencies above enumerated, the present is the best English treatise upon vertebrate anatomy, as the original is the best German. The reviewer sincerely hopes to greet a later faultless edition.

Burt G. Wilder

SCIENTIFIC JOURNALS AND ARTICLES

The April number (volume 9, number 2) of the *Transactions of the American Mathematical Society* contains the following papers:

L. E. DICKSON: "Representations of the general symmetric group as linear groups in finite and infinite fields."

L. P. EISENHART: "Surfaces with isothermal representation of their lines of curvature and their transformations."

J. L. COOLIDGE: "The equilong transformations of space."

A. RANUM: "Concerning linear substitutions of finite period with rational coefficients."

R. B. ALLEN: "On hypercomplex number systems belonging to an arbitrary domain of rationality."

G. D. BIRKHOFF: "On the asymptotic character of the solutions of certain linear differential equations containing a parameter."

G. A. MILLER: "On the holomorph of the cyclic group of order p^m."

E. B. VAN VLECK: "On non-measurable sets of points, with an example."

THE April number (volume 14, number 7) of the *Bulletin of the American Mathematical Society* contains the following papers: "Subjective Geometry," by G. W. Hill; "On Higher Congruences and Modular Invariants," by L. E. Dickson; "Note on Jacobi's Equation in the Calculus of Variations," by Max Mason; "On the Distance from a Point to a Surface," by E. R. Hedrick; "A Geometric Representation of the Galois Field," by L. I. Neikirk; "Concerning the Degree of an Irreducible Linear Homogeneous Group," by W. B. Fite; "On the Lorentzian Transformation and the Radiation from a Moving Electron," by F. R. Sharpe; "Shorter Notices" (Walker's On the Resolution of Higher Singularities of Algebraic Curves into Ordinary Nodes, by H. S. White; K. Bopp's Die Kegelschnitte des Gregorius a St. Vincentio in vergleichender Bearbeitung, by F. Cajori; Annuaire du Bureau des Longitudes pour L'An 1908, by E. W. Brown; Kuenen's Die Zustandsgleichung der Gase und Flüssigkeiten und die Kontinuitätstheorie, by E. B. Wilson); "Notes"; "New Publications."

The May number of the *Bulletin* contains: Report of the February Meeting of the American Mathematical Society, by F. N. Cole; Report of the February meeting of the San Francisco Section, by W. A. Manning; "A Fundamental Invariant of the Discontinuous ζ-Groups Defined by the Normal Curves of Order n in a Space of n Dimensions," by J. W. Young; "On Certain Constants Analogous to Fourier's Constants," by C. N. Moore; "Note on the Second Variation in an Isoperimetric Problem," by E. Swift; "Note on a Certain Equation Involving the Function $E(x)$," by R. D. Carmichael; "The Inner Force of a Moving Electron," by F. R. Sharpe; "The Recently Discovered Manuscript of Archimedes," by C. S. Slichter; "Shorter Notices" (P. H. Schoute's Mehrdimensionale Geometrie, II. Teil, Die Polytope, by W. B. Carver; Field's Theory of the Algebraic Functions of a Complex Variable, by J. I. Hutchinson); "Notes"; "New Publications."

SOCIETIES AND ACADEMIES

BOSTON SOCIETY OF MEDICAL SCIENCES

A MEETING was held at the Harvard Medical School on March 17, Professor H. C. Ernst presiding. The following papers were presented:

A Note on a New Thermochemical Method: Dr. L. J. HENDERSON and C. T. RYDER.

By introducing a reaction mixture into a Dewar flask which is immersed in a very accurately regulated water thermostat, it is possible to obtain very accurate measurements of heats of reaction of slowly progressing reactions. It has been found that in such a system Newton's law holds very accurately, and that the correction thus involved, with proper manipulation, is very small.

A Series of Ninety-one Blood-cultures: Dr. LAWRENCE J. RHEA.

An Intracanalicular Papillary Adeno-fibroma from the Groin, with lantern illustrations: Mr. E. L. YOUNG.

The Theory of Neutrality Regulation in the Animal Organism: Dr. L. J. HENDERSON.

By analysis of the equilibrium between the four substances carbonic acid, sodium bicarbonate, mono-sodium phosphate and di-sodium phosphate, with the aid of the concentration law, it may be shown that previous findings concerning the constitution of such systems are in accord with the theory. Curves have been constructed which define the equilibrium at 18°, and very accurately at 38°. These studies prove that such systems possess nearly the highest efficiency which can occur in isolated aqueous solutions for the preservation of neutrality. By the intervention of vehicles of escape for some of the above substances, the efficiency of these systems in the body is so far magnified that they far surpass the efficiency of any possible closed aqueous solutions of like concentration in preserving a hydrogen ion concentration near 0.3×10^{-7}N. It is shown theoretically and experimentally that the alkalinity of blood probably varies materially with the temperature, so that the alkalinity of blood in the body is probably three times as great as it has been believed to be. Moreover the increase in alkalinity in high fever is probably not insignificant.

C. L. Alsberg,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 443d meeting was held April 4, 1908, with Vice-President Hay in the chair. Dr. L. O. Howard exhibited a photograph showing a greatly enlarged female of *Diaspis pentagona* containing a forming imago of *Prospalta berlesei* How., and stated that he had just received this photograph from Professor Berlese. The Diaspis is a dangerous enemy to mulberry in south Europe, and the *Prospalta* was imported from America in the hope that it would establish itself in Italy. The photograph indicates that the parasite is breeding in Italy and encourages hope.

Dr. Barton W. Evermann commented briefly on the successful outcome of the attempt made by the Bureau of Fisheries to inoculate fishes with the glochidia of fresh-water mussels, as a stage in the propagation of the latter. The experiments, conducted by Doctors Lefevre and Curtis, of the University of Missouri, were made last fall at La Crosse, Wis., with more than 25,000 fish of various species, and gravid mussels, furnished by Professor U. O. Cox from the Wabash River at Terre Haute, Ind. The young, when ready to be set free from the mussels, were placed in the same water with the fish, which were soon found to have many of the young attached to their gills, fins or other parts, some of the fish bearing several hundred. They remained attached until March, when, as they began to release themselves, the fish were planted in the Mississippi River.

Doctors Lefevre and Curtis have been experimenting for some time under the auspices of the Bureau of Fisheries for the purpose of developing a method of artificially propagating fresh-water mussels on a commercial scale and in the interests of the pearl-bottom industry which has recently grown to enormous importance in this country. They are greatly pleased with the results.

The first paper, by Mr. C. L. Marlatt, was on the subject of "The White Fly Problem in Florida." It was illustrated by numerous lantern slides representing the life history of the insect and means of control, particularly by fumigation.

The systematic position and general characteristics of the white fly (*Aleyrodes citri*) were discussed in connection with a general account of the family Aleyrodidæ. The white fly first appeared in this country in the orange section of Manatee County, Florida, and was present there a great many years before it was scientifically studied and named. It is supposed to be of Chinese origin, but this origin has not been fully established. From the point of its first appearance in Manatee County it has spread throughout Florida and along the Gulf coast into Texas. It may occur in any northern greenhouse, principally on citrus plants, and seems to be able to maintain itself out of doors as far north as Georgia and perhaps South Carolina. The orange growers of California have long feared it and have made a strong effort to keep it out of the state. These efforts were long successful, but in May of 1907 it was found to be well established in north-central California at Marysville, and a little later at Oroville, and still farther south and much closer to the main orange section at a single point near Bakersfield. The strenuous efforts undertaken by the state of California to stamp out these points of infestation were described.

In Florida it is the principal orange pest, and puts a very heavy tax on all citrus products in that state. Its damage comes not only from its direct effect on the tree, but also from the sooty mold which follows its presence and spreads over the upper surface of the leaves and discolors the fruit. An account was given of the work done against this insect, beginning with its first description by Riley and Howard in 1893, the subsequent investigation of it in Florida from the standpoint of the sooty mold by Webber and Swingle in the early 90's, and the later work under the auspices of the Bureau of Entomology now in progress. The characteristics and action of the sooty mold (*Meliola camelliæ*) which lives in the honeydew secreted by this and other allied insects, were described. A snail was illustrated which, during the last few years, has, in a few groves in Manatee County, been apparently a very efficient aid in removing the sooty mold, on which it feeds.

The natural enemies and means of control of the white fly were discussed. No true insect parasites of the white fly are known. Other species of white flies have many parasites, but so far none of these have paid any attention to *Aleyrodes citri.* The principal natural means of control are some four parasitic fungi, comprising two species of *Aschersonia,* known respectively as the yellow white-fly fungus and the red white-fly fungus; one species of *Microcera,* and an undescribed fungus known as the brown fungus. Under favorable conditions these fungi give the groves one clean year in three, with some protection during the other two years. An account of these fungi was given, together with an account of the action of secondary or hyperparasitic fungi. The means of artificially encouraging and disseminating the parasitic fungi were also described.

By means of lantern slides the process of fumigation of orange trees for the white fly during the hibernating period in winter was fully illustrated.

The next paper was by Dr. W. C. Kendall in the form of "Notes on Sebago Lake, Maine." He said that there are nearly 2,000 lakes in the state of Maine, each over 20 acres in extent, of which Sebago Lake is the next to the largest, having an area of approximately 50 square miles, with a greatest depth of 310 feet at the normal level of the lake above the sea.

Biologically the lake is of particular interest, since it is one of the four bodies of water in the state in which the land-locked salmon was indigenous and in which this fish attains the largest size. He stated that two salmon were taken in the State Fish Commission weirs last fall weighing respectively 31¼ and 35½ pounds.

The various views of the past and present regarding the place of this fish in classification were mentioned; also the various theories regarding the reason of its occurrence in fresh water, the speaker favoring the view that it was derived from the migratory or sea salmon and that it is a distinct species.

About fifty pictures were shown on the screen, illustrating the conditions about the lake and its outlet, the Presumpscot River, and some of natural history objects. Of particular interest was one showing honeycomb, but without any contents whatever, attached to a bush with no protection from the weather. It was attached to the twigs of the bush about four feet from the ground. When first found, late in October, there were 50 or 75 living bees on the comb, but before it could be photographed a heavy cold rain destroyed the bees.

In the discussion of this honeycomb, members differed as to whether the pieces had been thrown into the bushes by bee hunters, and afterward attached to the twigs by bees which later took out the honey, or whether it had been originally built in the position in which it was found.

M. C. Marsh,
Recording Secretary

THE TORREY BOTANICAL CLUB

The meeting for February 11, 1908, was held at the American Museum of Natural History and was called to order by President Rusby at 8:10 P.M. Sixty-five persons were present.

The scientific program of the evening consisted of an illustrated lecture by Dr. A. J.

Grout under the title "A Botanist's Vacation in North Carolina." The lecture was of a semi-popular character and the numerous lantern-slides from photographs taken by the speaker illustrated the scenery and fauna as well as the flora of the mountains of western North Carolina. The speaker's abstract follows:

Seven weeks of last summer's vacation were passed in the "Pink Beds" on the estate of Geo. W. Vanderbilt about forty miles west of Asheville and twelve miles from Brevard. Our visit was made possible and profitable through the assistant director of the Biltmore Forest School, Dr. Clifton D. Howe. The Pink Beds is a mountain valley over 3,000 feet above sea-level and derives its name from the color given to the whole valley in spring by the innumerable blossoms of *Azalea, Rhododendron* and *Kalmia*. The climate is cool, like that of Vermont and New Hampshire, but the almost daily thunderstorms, often almost torrential in character, are an inconvenience to the botanist. The fauna as well as the flora is an interesting mixture of northern and southern forms. Many of the forms which at first seem identical with northern species on closer examination are found to have good varietal or even specific differences. The chipmunk, for instance, is undoubtedly a chipmunk but so dark in color as to be scarcely recognizable when first seen. Of our familiar northern flowers, the daisy, evening-primrose, trailing arbutus, Indian pipe, *Clintonia borealis,* two species of *Trillium,* bluets, Indian turnip and many others are common; of the shrubs, witch-hazel, *Kalmia, Rhododendron maximum,* the pink, and the white, azalea are noticeable; of the trees, the chestnut, several species of oak, hickory, a few sugar maples, a few white and pitch pines, some ash, and the sassafras, all seem to give the country a familiar look. But on the other hand two additional species of *Rhododendron,* the flame-colored *Azalea,* chinquapin, the great number of tulip-trees and magnolias, the *Nyssa, Oxydendron,* Carolina hemlock and other unfamiliar trees, the open forest filled with innumerable unfamiliar flowers or unfamiliar species of familiar genera, such as *Phlox, Lilium, Listera, Habenaria,* etc., emphasizes the difference in one's latitude and keep one's interest awake.

Miss Gertrude S. Burlingham found about the same number of species of *Lactaria* in Vermont and in North Carolina, *i. e.,* 30–35, and about half of this number were common to both.

About 130 species of mosses were collected; of these about 100 are found in Vermont, but many of these 100 differ appreciably from northern forms.

Hookeria Sullivantii, Entodon Sullivantii, Raphidostigium Novæ-Cesareæ, Pylaisia subdenticulata, Campylopus introflexus, Campylostelium saxicola, and three species of *Zygodon* were some of the interesting species collected. The moss flora was found to be essentially like that recorded by Mrs. Britton from southwest Virginia, but fifteen to twenty species that she did not find were collected and several common northern forms which she recorded were not met with. The absence of *Polytrichum commune* and *Harpidium* and the abundance of *Entodon, Thuidium* and *Fissidens subbasilans* were very notable.

The open pasture-like mountain summits covered with herbs and some low trees contrasted strongly with the rocky barren ridges of the northern Appalachians, and spruces and firs (*Abies Fraseri*) hardly appear under 5,000 feet altitude.

Marshall A. Howe,
Secretary pro tem.

DISCUSSION AND CORRESPONDENCE

THE STATUS OF THE JAPANESE SOFT-SHELLED TURTLE

In my "Herpetology of Japan"[1] I raised the question whether the Japanese soft-shelled turtle had been properly united with *Amyda sinensis.* The question had not previously been discussed in any detail by competent authority and based upon adequate material. As the specimens at my command seemed to indicate that these turtles in China and Japan have split up into forms corresponding to the

[1] Bull. 58, U. S. Nat. Mus., 1907, pp. 515–519.

different zoogeographical areas, I considered it the wisest course for the present to keep the synonymies and descriptions of these forms separate, and not being able to make up my mind as to their exact status I left them the usual binominal names by which previous writers have designated them.

My friend, Professor F. Siebenrock, curator in the Naturhistorische Hofmuseum in Vienna, and foremost among students of the Testudinata, has recently, in an article, "Ueber einige, zum Theil seltene Schildkröten aus Südchina,"[2] attempted to show that I did so erroneously ("irrigerweise"). To those unfamiliar with the literature it would appear that I am the first to subdivide the species in question, while, as a matter of fact, I have only doubted the wisdom of some recent authors to lump the forms previously recognized without giving sufficient reasons for so doing. From the way Siebenrock emphasizes that I have separated them into "four distinct species [vier selbständige Arten]," while in his opinion they can not be distinguished even as subspecies, it might be supposed, moreover, that I had been very dogmatic and insistent upon their *specific* distinctness, and it is against this misconception that I pen this protest.

Here is what I said:[3]

> The status of the soft-shelled turtles inhabiting China and Formosa (*A. sinensis* and *schlegelii*), Japan (*A. japonica*) and Amurland (*A. maackii*) has not been worked out for lack of material.

Hereby I indicated that I had not taken any stand as to their specific or subspecific rank, and also that my material was inconclusive and consequently my opinion undecided. I stated, also, further on (p. 516):

> The absence of specimens from the drainage of the Yangtse River, which may be supposed to represent the true *Amyda sinensis*, is particularly to be regretted, as it prevents me from arriving at any but the most inconclusive and preliminary results. That my specimens represent three [not four] separable forms, however, I have but little doubt.

[2] *Sitz. Ber. Akad. Wiss. Wien, Math. Naturw. Kl.*, CXVI., Pt. I., December, 1907, pp. 1741–1776.

[3] "Herpet. Japan," p. 515 seq.

As for the fourth *"form"*[4] I had no personal opinion to offer, never having seen a specimen, and I took great pains to state this plainly (p. 527):

> It is *quite likely* that eventually *A. maackii* may turn out to be the same thing as the Peking form [*A. schlegelii*], in which case that name will take precedence.

Altogether Siebenrock in his rendering of my treatment of these forms makes me use expressions much more positive than the very careful and hesitating words really employed by me. Thus he says: "Stejneger, *l. c.*, p. 518, thinks it is impossible [meint es sei *unmöglich*] " that the two figures quoted "can belong to individuals of the same species [Individuen derselben Art angehören können]," while what I said was simply that "it is not easy to believe that Gray's and Siebenrock's figures represent the same species." Now that Siebenrock has explained the matter by stating that the apparent difference is due to an error of the artist, it is of course "easy to believe."

Siebenrock also states that I "placed the chief weight in distinguishing between my three species [legt das Hauptgewicht bei der Untersuchung seiner drei Arten]" on certain characters, which he then proceeds to contrast in a table of three parallel columns. One who has not seen my book would naturally think that these characters are such as were particularly selected by me to represent constant differences. This is far from being the case. The characters contrasted in the table are culled from my detailed descriptions of three *individuals,* one a four-year-old *male* from Japan, No. 21,179, U. S. N. M.; the other a four-year-old *female* from Formosa, No. 34,055, U. S. N. M.; the third a male in the third year from Tientsin, No. 29,700, U. S. N. M. Siebenrock has evidently taken these descriptions of mine for *diagnoses,* a mistake he could hardly have made if he had studied my book carefully. He would then have seen that they are merely minute descriptions of

[4] I took particular pains in my treatment of these turtles to avoid the terms "species" and "subspecies" as far as possible, and instead used the word "form" in order to particularly emphasize the preliminary character of the whole proceeding.

individuals, and that the weight attributable to the differences shown is discussed elsewhere, viz., pp. 516–519. The "Hauptgewicht," it will then be seen, is placed in my table of comparative measurements on page 516, and even in this case with considerable diffidence, as shown by the following qualification: "Although the series is small, the figures probably deserve some confidence, because of their remarkable uniformity and harmony."

As said above, my material was scant and my conclusions, therefore, preliminary and inconclusive. I have received no *authentic* material since and I am at present as undecided about the real status of these *forms* as I was when I wrote my book. Unfortunately, Siebenrock's treatment has not helped much to clear the matter up. True, he is very positive that there is only one *species* and not even another subspecies ("Selbständige Unterarten," p. 1742, whatever that may mean), and with the great respect I have for him as an authority on the Testudinata and my own inferiority in this field, I would gladly have accepted his dictum, were it not that apparently his and my views as to what constitutes "species and subspecies" are so radically at variance that a discussion would be fruitless.[5]

That Siebenrock completely fails to understand my point of view is plainly shown in the last two paragraphs of his article in which he contrasts *A. sinensis* with *A. cartilaginea* and *A. steindachneri* by the young of the former having symmetrical black marks on the plastron which are lacking in the latter, concluding that inasmuch as there are symmetrical black marks in all of my "four species" ("die vier Arten im Sinne Stejneger's") these can only be individuals of the same original form ("nur Individuen der selben Stammform sein können"). As if I ever had denied that the "forms" I preliminarily recognized by name belong to the same "Stammform"! Of course they do. The question is only, has this "Stammform" in its various geographical areas split up into "separable forms," and this I claim Dr. Siebenrock has failed to disprove. I have shown clearly that the black plastral pattern in the Japanese specimens differs essentially from that described by Dr. Siebenrock himself in Annamese specimens, and yet he maintains that these juvenile markings prove ("beweist") the *identity* of these forms.

That I have used a binominal designation for these, in my opinion, "separable forms" does not mean that I regard them as "selbständige" species. Were I to employ for them trinominals I would thereby have indicated that I knew them to intergrade, but that I did not and do not yet know. Maybe they do. Maybe only 75 per cent. of the specimens from each geographical area can be told apart. But if 75 per cent. of the Japanese specimens can be shown to be different from 75 per cent. of the Chinese specimens I shall be satisfied for my zoogeographical purposes to regard them as "separable forms" and to recognize them nomenclatorially. Whether that be binominally or trinominally is at present immaterial.

Leonhard Stejneger
U. S. National Museum,
Washington, D. C.,
April 2, 1908

[5] This is pretty well illustrated by the way in which he takes me to task for not recognizing *Geoclemys reevesii unicolor* (*l. c.*, p. 1760), as a subspecies ("Unterart"), claiming that I regard the "more or less uniform black specimens" as "individuelle Aberrationen." I have not committed myself on that point. To me these specimens represent either a color phase of a dichromatic species, or they are simply more or less melanistic individuals, but I do not know which, and for my purpose it matters little whichever they are. It is admitted that these specimens are found wherever the typically colored *G. reevesii* is found, and color varieties not geographically separated I do not recognize *nomenclatorially*. At any rate, they are not *subspecies* in the modern and commonly accepted meaning of the word.

AN OLD STORY

We are still struggling with variations of the old discussion with which some of our teachers tormented our boyhood days. Did Niagara Falls roar before the country near it was inhabited? We still hear it asserted that space would not exist if we were so situated that we were ignorant of its properties. Space is a relation between points. If we had no fixed or relatively fixed datum points, to serve as origins, and to enable us to establish direction lines, we are assured that there would be no space. We should not be able to move if there were nothing for us to bump against. We discover a certain tree in a pathless forest which no foot had trodden before. It has rings of growth and a magnitude which indicate that it must have had a history before it ever came into the thought of man. But its existence dates from its first discovery. It was pure nothingness before.

Let us imagine some unfortunate floater to have spent his life in solitude on a raft in mid-ocean. The water is smooth, the winds are at rest and the sky is continually overcast with a uniform layer of clouds. This we are to assume will involve the conclusion that latitudes and longitudes and compass directions do not exist. The fact that there are other philosophers in Paris who have enjoyed advantages which the floater has not enjoyed must not be considered.

If some of our philosophically inclined brothers would spend a little more time in defining the sense in which they are using words, and a little less time in the futile attempt to define things, the atmosphere would seem clearer. The youthful floater would be somewhat less at sea.

Francis E. Nipher

THE SATELLITES OF MARS

To the Editor of Science: The letter of Professor Eastman in Science, No. 695, is my only excuse for taking your valuable space. In consequence of Professor Eastman's letter to the editor of the *Transcript*, there was printed in the paper this explanation: "In the account of the work of Professor Hall presented in the *Transcript* at the time of his death, reference was made to the discovery of the satellites of Mars as 'accidental.' Although the discovery did belong to the class of the accidental because it was unpredictable, still the hastily-chosen word does not describe the conditions upon which the discovery was based. The exact term is a little difficult to catch, speculative and tentative describing in a way the methods by which the observations were carried forward to success."

This note prefaced half-a-column of extract from Professor Newcomb's "Reminiscences" on the same discovery, and together they formed an article that one would not be expected to overlook. Being no longer "live" news, the article was not published till December 21.

With reference to the companions of Procyon seen at the observatory, it was simply the current gossip of the astronomers of the time, fifteen or twenty years ago, lingering in my memory. It illustrated the splendid, sterling qualities of Professor Hall better than any other story that recurred to me during the hurried preparation of the article. It is very good of Professor Eastman to set the world right in the matter, to place the discovery of the fictitious companions where it belongs and to assure us that this bit of gossip has, what most gossip lacks, a foundation.

John Ritchie, Jr.

SPECIAL ARTICLES

COINCIDENT EVOLUTION THROUGH RECTIGRADATIONS AND FLUCTUATIONS (THIRD PAPER[1])

I published recently the statement of a law which I believe to be fundamental in the evolution of organisms, namely, "The Law of the Four Inseparable Factors."[1] It is expressed as follows:

The life and evolution of organisms continuously center around the processes which we term heredity, ontogeny, environment and selection; these have been inseparable and interacting from the beginning; a change introduced or initiated through any one of these factors causes a change in all.

[1] "Evolution as it Appears to the Paleontologist," Science, N. S., Vol. XXVI., No. 674, November 29, 1907, pp. 744–749. (First paper.)

"The Four Inseparable Factors of Evolution: Theory of their Distinct and Combined Action in the Transformation of the Titanotheres, an Extinct Family of Hoofed Animals in the Order Perissodactyla," Science, N. S., Vol. XXVII., No. 682, January 24, 1908, pp. 148–150. (Second paper.)

I have added two corollaries from my studies on the titanotheres, in which it appears to be highly probable that in different parts of the body of highly complex vertebrated animals, different evolution factors may be operating coincidently to produce a coordinated adaptive result, namely:

First, that while inseparable from the others, each process may in certain conditions become an initiative or leading factor; second, that in complex organisms one factor may be initiative in one group of characters while another factor may at the same time be initiative in another group of characters, the inseparable action bringing about a continuously harmonious result.

(Fig. 1, *A, Palæosyops*) and *dolichocephalic* forms (Fig. 1, *C, Dolichorhinus*); the former become increasingly brachycephalic, the latter become increasingly dolichocephalic. This change of proportion is brought about as follows: (1) there is a redistribution of materials, (2) this effects a change in the entire proportions of the skull, (3) the different component bones are affected differently, because there are *distinct percentages of increment,* in breadth or in length, in the bones of each region.

First Experiment, Redistribution (Fig. 1). This proves that a general redistribution of materials will convert a brachycephalic into a dolichocephalic type. I outline the broad

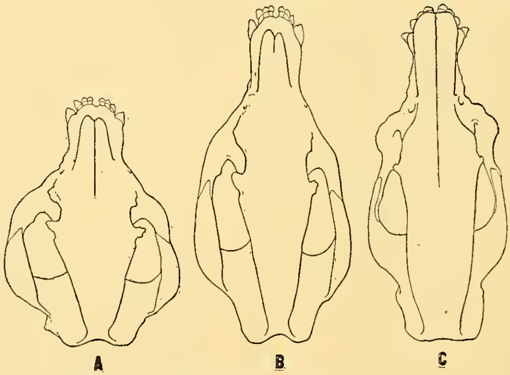

Fig. 1. Artificial Dolichocephaly.

A, Palæosyops, extreme brachycephalic type.

B, outline produced artificially by stretching *A* to length of *C.*

C, extreme dolichocephalic type, *Dolichorhinus.*

In a recent paper before the Zoological Society at New Haven these corollaries were illustrated in the evolution of the titanotheres, as shown in the accompanying Figs. 1, 2 and 3.

1. *Selection of Fluctuations*

It is observed that in four or five contemporaneous phyla of Middle Eocene titanotheres, unquestionably derived from a common lower Eocene ancestor, there is a tendency to diverge into *brachycephalic* forms

skull of *Palæosyops* on a sheet of India rubber and stretching the sheet lengthwise, produce the Fig 1, *B,* thus artificially creating a skull of dolichocephalic type which approximately resembles Fig. 1, *C.* This experiment illustrates what may be done by a mere redistribution of materials.

Second Experiment, Redistribution (Fig. 2). This illustrates progressive dolichocephaly. Here are represented the outlines derived by stretching and slightly expanding the skull of a dolichocephalic animal into that of its still more long-skulled descendant. Fig. 2, *A*, represents the palatal view of a skull which is ancestral to the second skull represented in Fig. 2, *C*. An outline of the skull represented in Fig. 1, *A*, is traced on India rubber and stretched into the outline represented in Fig. 2, *B*, which it is seen gives us an approximate approach to Fig. 3, *C*.

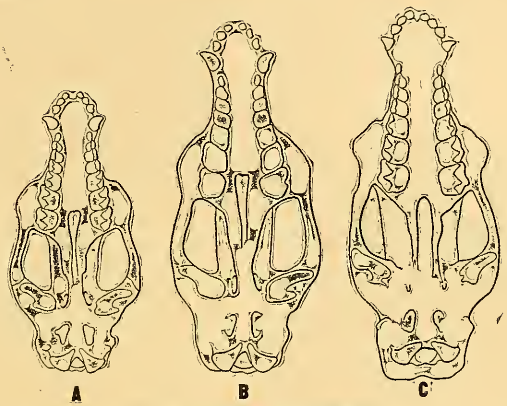

Fig. 2. Artificial Dolichocephaly.

A, a skull ancestral to *C*.

B, outline produced artificially by stretching *A* to length and width of *C*.

C, extreme long-skulled type, *Dolichorhinus*.

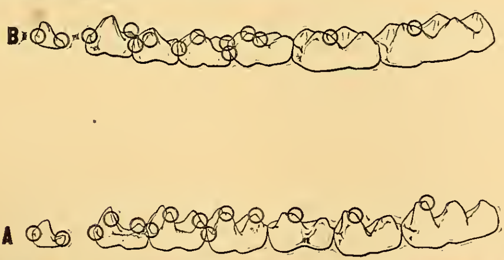

Fig. 3. Rectigradations. *A*, *Orchippus*, Middle Eocene horse; *B*, *Palæosyops*, Middle Eocene titanothere. The circles indicate new cuspules rising independently in these two phyla.

The above two experiments prove that transition from brachycephaly to dolichocephaly or from dolichocephaly to an intensified dolichocephaly may be interpreted partly as a mere redistribution of materials, all parts being stretched in the same proportion. *But this does not describe all that actually occurs in nature, because in skull lengthening or shortening each bone is affected somewhat differently.*

I am inclined to regard dolichocephaly and brachycephaly in the vertebrates generally as caused by the natural selection of fluctuations in a broad-skulled or long-skulled direction, respectively.

The important point to note is that the descendants of a single ancestral titanothere or of any other vertebrate may become either brachycephalic, mesaticephalic or dolichocephalic; in other words, *the primitive mesaticephalic ancestral form of skull does not control the form of skull which may be derived from it, yet an evolution tendency once established is pursued to its limits.*

2. *Tooth Evolution through Rectigradations or Orthogenesis*

Here, in contrast to the foregoing cases of brachycephaly and dolichocephaly a law of hereditary ancestral control appears to be in operation. The diagrams in Fig. 3, *A, B,* represent the origin of cuspules in two independent families of Perissodactyla which also have sprung from a very remote common ancestor.

The types selected are (*A*) *Orohippus,* a Middle Eocene horse, and (*B*) *Palæosyops,* a Middle Eocene titanothere. The teeth represent the seven grinders of the lower jaw viewed from the internal aspect. Circles surround the new cuspules, which are appearing on the inner sides of these teeth. We observe that cusp for cusp exactly the same cuspules are arising in the jaw of *Orohippus* as in the jaw of *Palæosyops,* but that, although an animal of the same geological age, *Orohippus* is acquiring its new cusps a little more rapidly than *Palæosyops,* as shown in the following table:

	Palæosyops No. of Cuspules	Orohippus No. of Cuspules
First premolar	2	2
Second premolar	2	3
Third premolar	3	4
Fourth premolar	4	4
First molar	3	3
Second molar	1	1
Third molar	1	1
Total	16	18

This comparison proves that while there is apparently a law of ancestral or hereditary control operating in the genesis of these new cusps, and that while the new cusps are orthogenetic and hence may be termed "rectigradations" (because developing in fixed lines) *such law of ancestral control does not determine the rate of evolution of the cusps in these two types.* The *rate* of evolution is more rapid in *Orohippus* than in *Palæosyops.*

This observation appears to bar the hypothesis that the appearance of these cusps is due to an internal perfecting tendency which operates independently of external conditions and to favor the hypothesis that in some unknown manner external conditions control the rate of evolution, again illustrating the law of the four inseparable factors.

Conclusion

The contrast between the origin of changes of proportion illustrated in brachycephaly and dolichocephaly and the origin of new cuspules is, apparently, that the former is independent of hereditary control and not predetermined, while the latter is predetermined or under hereditary control. Both phenomena are controlled alike as to *rate of evolution* by adaptation to external conditions, namely, by the kind of food on which the animal subsists.

These considerations appear to me to sustain my hypothesis of the independent operation of two primary factors at least to produce an harmonious adaptive result.

Henry F. Osborn

THE FILLING OF EMERALD LAKE BY AN ALLUVIAL FAN

About four miles northwest of the town of Field, in British Columbia, and separated from it by Mount Burgess, lies the beautiful sheet of water known as Emerald Lake. Situated near the head of a broad glacial valley, this lake has been formed probably by the damming of the original channel by a heap of glacial débris, perhaps supported by a resistant outstanding ledge of bed rock at this place. Across this barrier the water has its exit.

The present interest in Emerald Lake, however, rests not so much upon its mode of formation as upon the fact that it is slowly being filled in at its northern end by a large alluvial fan. Since the streams which feed the lake have their source in the snow and ice fields high up on the adjacent mountains, they are loaded with a considerable supply of rock waste, which, by reason of their swift descent down the steep mountain slopes, they can easily wash into the valley. But as soon as the water reaches the much gentler grade of the valley floor, a great deal of the material, which is too heavy to be borne farther, is dropped, the coarser near the foot of the cascades, the lighter at some distance. In spring, when the volume of the rivers is much increased, coarse fragments are swept farther down the valley than they are in the summer season. Furthermore, after the stream has raised its bed in one place, a freshet may cause it to break through its low walls and begin building in a new direction. Evidence of this swinging of the stream is abundant on the surface of the Emerald Lake fan, in the numerous forsaken channels that radiate from its feeding point, or origin.

The construction of the fan is carried on by *two* streams which unite near the head of the lake. That the west branch is the more efficient is proved by the fact that the east branch flows through a narrow marshy tract bounded on the east by the steep valley walls and on the west by the edge of the fan of the west branch. In other words, the latter has shoved the east branch against the eastern valley walls. Furthermore, the east stream has, near the base of its cascades, a small fan of its own.

There is no doubt, then, that the main fan is growing. At what rate this development is going on is not certain; but it must be relatively rapid, for, although trees of twenty or thirty years are found on many parts of the deposit, especially in the older portions, these are generally rather thinly scattered. Vegetation is scarce because there has been little or no rock decay.

Emerald Lake was described above as occupying a depression near the head of a glacial valley. We may add that the fan is in the northern half of this depression; that is, the lake and the fan together are situated in a single basin. This is very evident in the field, where the continuity of the bounding walls of both fan and lake is most conspicuous.

The northern border of the lake is marshy because the finer sediments of the fan are laid down here. Farther back these are being covered by coarser sand and pebbles. Hence a vertical section through the fan would be that of a typical lake basin, for in vertical succession the strata run from fine below to coarse above.

There are five facts, therefore, which indicate that the lake is being filled in by the fan. They are as follows: (1) the surface of the fan is dissected by channels of *recent* formation; (2) the weaker stream has been pushed against the valley wall; (3) the deposits are fresh, and the vegetation is consequently sparse; (4) the lake and the fan are in the same depression; and (5) the structural relation between the lake and the fan is that of a filling lake basin. The first three statements denote recent change, while the last two refer to the close connection between the sites of the water and of the sediments. To-day Emerald Lake appears to be about half its original size. How soon it will be crowded out of existence it is impossible to determine; but that it must eventually disappear, unless some unforeseen event occurs, seems inevitable.

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BOTANICAL NOTES

SEASIDE LABORATORY WORK

THE combination of recreation with study is so difficult in many places that it often seems an act of cruelty to urge tired teachers to engage in study during summer vacations. We work too hard for eight or nine months, so that rest of some kind is often absolutely necessary in order to avoid brain fag. No doubt it would be a wiser plan in schools and colleges for both students and teachers to work at a more leisurely rate, and to keep it up the whole year, as is done in other occupations, but as schools are conducted at the present time teachers and students are pretty well fagged out by the beginning of the summer vacation, and there is imperative need of rest. In spite of this, many teachers find it necessary to add to their stock of knowledge during the vacation, and so they flock to the summer schools, and add six or eight weeks of strenuous work to their school year of teaching. No wonder that so many teachers, especially in the high schools, so soon acquire the look that we recognize as the "teacher's face." The wonder is that more of them do not break down mentally and physically.

When Agassiz thirty-five years ago started the Penikese summer school he did more than any one then thought for the tired teachers of the country, for he showed them how they might rest and study at the same time. He showed them that "better way" of finding out about nature and all the world of living things. His secret was the simple one of learning of nature by being in it, of learning about the world of living things by becoming a part of that world of life. And this was the beginning of the out-of-doors schools in America. In these new schools, instead of trying to bring mutilated fragments of nature into the laboratory the student lives in the forests, fields and meadows, with the birds, insects and plants. He lives much in the open, wandering through the fields and woodlands, searching the brooks, rowing over the ponds and bays, always with nature, because always in nature. And at the end of his vacation school he returns to his teaching refreshed and strengthened in body and mind, and with a satisfying store of knowledge about the woodsy things, and the creatures of the swamps and ponds.

Such a vacation school is that at Cold Spring Harbor, on the north shore of Long Island, thirty miles eastward from New York City. For eighteen years it has annually welcomed those who came to it for rest and study, and this year it invites such again to come (during July and August) to its shady woodlands, its bogs, its fresh ponds, and its salt-water basins and bays, all full of the life that thrives in such environment. Here one may study birds, comparative anatomy of animals, embryology, bionomics and evolution. Here too, the student may acquaint himself with the world of lower plants, from the tiny water forms to the fungi, the lichens, the mosses and the ferns, up to the flowering plants. For these living things are all about him, and he has but to observe them where they grow, or take them to the near-by laboratory where with microscopes and books he may study them more critically.

For twenty years the Marine Biological Laboratory at Woods Holl, on Buzzard's Bay, Mass., has afforded facilities for seaside study. In the waters of the bay and its varied shore line, including points and flats of many kinds, extending out to Vineyard Sound and across to the shores of Marthas Vineyard, added to the fresh-water ponds and lakes on the mainland, the student may find a world of aquatic life, while in the woodlands, which in many places still linger from the time when the region was covered with forests, terrestrial life of all kinds may be found in abundance. In the laboratory are provided botanical courses of instruction in algae, fungi and the higher plants, and zoological courses in lower animals, embryology and comparative physiology. The fact that it is only fifteen miles from the laboratory to Penikese Island where Agassiz started the first seaside summer school should add interest to this place for vacation study.

Much like the preceding is the Lake Laboratory at Cedar Point, near Sandusky City on Lake Erie, which for the past few years has offered similar facilities for those living so far away from the ocean as to practically prohibit so long a journey. Here also are offered facilities for studying animals and plants in the forests, in the open or in the ponds and bays, while in the laboratory are more formal studies of the embryology, morphology and comparative anatomy of animals, and the more technical lines of general botany.

If you are tired out at the end of the school year, and yet feel that you must study, go to Cold Spring Harbor, or Woods Holl, or Cedar Point, and rest while you imbibe something of what nature can teach you when you come closely in contact with her.

PHILIPPINE TIMBERS

Not long since a notice was made in Science (March 13, 1908) of F. W. Foxworthy's paper on Philippine Woods published in the *Philippine Journal of Science.* Now we have another paper on the same subject published as Bulletin No. 7 by the Bureau of Forestry of the islands, and entitled "A Preliminary Check-list of the Principal Commercial Timbers of the Philippine Islands" prepared by Dr. H. N. Whitford, the chief of the Division of Forest Investigation. This list differs from the former in giving more attention to the systematic arrangement of the species and their distribution as indicated by actual specimens in the herbarium of the Bureau of Science in Manila, while it gives much less attention to the structural and physical properties, and uses of their wood. The purpose of the list is to show what is actually known as to the timber trees of the islands, so that additions and corrections may be made more easily. As in the former list the common names used in different parts of the archipelago are recorded, and one of these is selected for each species as the one most widely used, and therefore the approved name for general use.

The twenty-six families which are represented by somewhat more than eighty species are arranged according to Engler and Prantl's system in the Natürlichen Pflanzenfamilien. The families Leguminosae, Dipterocarpaceae, Combretaceae and Sapotaceae contain the larger numbers of species; in fact these four families include nearly one half of the known species. There is but one species of Pinaceae, viz.: *Pinus insularis.* A good index completes the pamphlet.

ANOTHER TREE BOOK

The Philadelphia publishing house of Lippincott Company has just brought out a book which must prove very useful for students and tree-lovers everywhere. It bears the title of "Our Trees: How to know Them," and is the joint work of Arthur I. Emerson and Dr. Clarence M. Weed. The book consists of large photographs which have been very well reproduced in the full-page plates, and in each case a page of non-technical text. Each photographic plate includes the flowers, fruits, twigs and leaves on a larger scale, and at the side a view of the tree on a much smaller scale. The text includes a popular but accurate description of the tree, its bark, foliage, fruit and something of its uses. Its range of natural distribution is usually given, and in some cases suggestions are made as to its ornamental value. In the sequence of families and the generic and specific nomenclature the authors follow Sargent's "Manual of the Trees of North America." The book must prove to be a valuable addition to the library of every man who is interested in trees.

A SECOND ORCHID BOOK

Three years ago the present writer had the pleasure of reviewing favorably in this journal (Science, May 19, 1905) the first volume of Oakes Ames's "Orchidaceae," and now the second volume, which has just been received, calls for a notice. This one opens with a five-page introduction in which the author discusses the part of Engler's "Das Pflanzenreich," which deals with *Orchidaceae,* protesting vigorously against the treatment which his writings and drawings received at the hands of the editors of that work. Then follow half a dozen short articles before reaching the principal paper of the volume, "Studies in the Orchid Flora of the Philippines," covering 242 pages. Following this are fifteen pages devoted to new species and names of American orchids, and the volume closes with a generic and specific index to volumes I. and II. Nine full-page plates and many text illustrations, all very good and satisfactory, are scattered through the book. As in the preceding volume, all original descriptions (and many others) of species are in Latin, as is quite proper in a work of this kind, although the general discussions as well as the keys are in English. In many cases the Latin description is followed by an English translation. The paper used in the book is of fine quality, and the typography and presswork of the best. The author is to be congratulated upon bringing out a second volume so soon after the first, and it is to be hoped that he may be encouraged to continue this admirable series. It is particularly creditable to American botany.

SHORT NOTES ON BOTANICAL PAPERS

Dr. P. A. Rydberg's "Scandinavians who have contributed to the Knowledge of the Flora of North America" (Augustana College Library Publications, No. VI.) is a valuable contribution to the history of botany in this country. This comes quite opportunely at this time when there is a distinct revival of interest in everything pertaining to the history of botany, due no doubt to the celebration last year of the two-hundredth anniversary of the birth of Linné. In treating the subject Dr. Rydberg recognizes eight historical periods, viz.: the Medican (A.D. 1478–1601) in which there were no Scandinavian contributors to the flora of North America; the Bauhinian (1601–1694) again with no contributors; the Tournefortian (1694–1735) with two contributors; the Linnean (1735–1789) with eleven Scandinavian contributors; the Jussieuan (1789–1819) with eight; the Candollean (1819–1840) with twelve; the Hookerian (1840–1889) with forty-three; the Englerian (1889–) with thirty-two. These botanists, of whom there were one hundred and eight, are divided by nationality as follows: Danes, 51; Swedes, 43; Norwegians, 9; Finns, 5. Short biographies are given of each, with lists of their principal works bearing on the flora of North America.

The Annual Report of the Director of Botanical Research in the Carnegie Institution (Dr. D. T. MacDougal) for 1907 contains brief accounts of the lines of work carried on during the year. Among the titles are "The Advance and Recession of Vegetation in the depressed Basins of the Colorado Delta," "Acclimatization," "Distribution and Movements of Desert Plants," "The Topography of Chlorophyll Apparatus," "Physiology of Stomata," "Evaporation and Plant Distribution," "The Relation of Evaporation to Plant Activity." An automatic rainmeter is described, and mention is made of the explorations and field work undertaken, the studies of desert conditions, bibliographical and cooperative work, equipment, etc., and the report closes with a list of the laboratory publications of the year, including thirteen titles. This work was provided for by a grant of $25,000, and was practically all done at the Desert Laboratory at Tucson, Arizona. The report includes a map of the Colorado River delta, a half-tone view of the laboratory, and two views of portions of the Salton Sea. Every botanist will be glad to note that the work undertaken is of the highest scientific value, and the trustees of the institution are to be congratulated upon their selection of so able a director of the botanical work.

The United States National Herbarium has begun the publication of a series of papers by Mr. William R. Maxon under the title of "Studies of Tropical American Ferns," the first of which has just appeared as part 7 of volume X. of the "Contributions" from the Herbarium. This part is pretty largely taken up with attempts of the author to bring order out of the confusion into which many of the species have fallen. One new genus, a new name for another genus and several new species are the additions proposed in this part. Two good plates illustrate some of these additions. The continuation of this series will be watched with interest by fern students everywhere.

The closing number (December, 1907) of the *Philippine Journal of Science* (Botany) contains notes on an early collection of ferns, a revision of *Tectaria* (by E. B. Copeland), descriptions of two new grasses (by E. Hackel), some additions to the flora, further identifications of some of Blanco's species, and further titles for the index of Philippine botanical literature (by E. D. Merrill).

Another part (vol. 9, part 2) of the North American Flora has come to hand, completing the Family *Polyporaceae* (by M. A. Murrill). Part 1, which appeared in December, 1907, covered the first half of this family, and included the key to the tribes and genera, and descriptions of the genera and species from *Hydnoporia* (No. 13) to *Laetiporia* (No. 46), while this part begins with *Phaeolopsis* (No. 47) and closes with *Cycloporus* (No. 78). An examination of these pages shows one who has known something of the pore fungi that he will have many new names to learn, since the old genera, as *Polyporus, Daedalea, Lenzites, Trametes,* etc., have been split up into new ones.

If there are any plants about whose nomenclature there has been no doubt, the common alfalfa of the fields is one of them. We all felt that we were on solid ground when we wrote its name *Medicago sativa* of Linné, but now comes C. S. Scofield, of the United States Department of Agriculture, who offers strong reasons for abandoning this name. It appears that Tournefort in 1700 figured "luserne" quite correctly under the name of *Medica,* and also a very different plant on the same plate under the name of *Medicago.* Linne made use of Tournefort's plate and descriptions, at first (in the "Systema Naturae," 1735) accepting his names, but later (in the "Species Plantarum," 1753) applying the name *Medicago* to both plants in the plate. It appears from this that *Medicago* must be retained for the second plant on the plate (*M. radiata*), and that the proper name of the alfalfa ("luserne") is *Medica sativa* (L.) Mill.

G. H. Powell, of the Bureau of Plant Industry of the United States Department of Agriculture, has published (in Bulletin 123) the results of his studies of the decay of oranges while in transit from California. He finds that it is principally due to a blue mold (*Penicillium digitatum*), although a part of it is caused by *P. glaucum.* He finds, further, that the fungus is incapable of penetrating unless the skin has been injured in some manner. Cooling the fruit before shipment and the maintenance of a cool temperature in transit tend to reduce the amount of decay. The report is illustrated by nine full-page plates, two of which are colored.

Experiments by Dr. G. G. Hedgcock extending through five years seem (Bulletin 131, Bureau of Plant Industry, U. S. Department of Agriculture) to prove that the disease of the roots of the almond, apricot, blackberry, cherry, peach, plum, prune and raspberry known as "crown gall" is essentially identical, and due to the same organism. Furthermore, it has been found possible to produce ("with great difficulty") a crown gall on the apple, chestnut, walnut and rose by transfer of the organisms from the galls on the first named plants. The author says, further, "these results show quite conclusively that apple crown gall in its soft form is contagious, but that in the hard form it is either slightly or not at all contagious."

CHARLES E. BESSEY
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HARVARD ANTHROPOLOGICAL SOCIETY

THE Harvard Anthropological Society celebrates its tenth anniversary in May of this year. The club was founded in 1898 mainly through the initiative of the late Dr. Frank Russell and Mr. Walter S. Andrews. Its object "is the promotion of interest in the study of the natural history of man and of the history of human culture with special reference to its origins and primitive forms and to the general laws of its development."

The society is composed of undergraduates and graduates of Harvard University who are taking or have taken courses offered by the department of anthropology. The officers, with the exception of the permanent secretary, are elected from the student body. Meetings open only to members of the club are held every month during the college year, at which time papers are presented and discussed. The society thus furnishes a means of intercourse between the older and younger men which is not possible in any other way.

During the first seven years of the history of the organization two or more public lectures were given under the auspices of the society each year. A different policy has been carried out during the last three years. Two dinners have been held annually with a special guest of honor who has delivered an address. These occasions have proved most profitable as well as enjoyable as many former members of the club have returned.

The society numbers among its honorary members Professor F. W. Putnam, Miss Alice Fletcher, Mr. C. P. Bowditch, Professor Franz

Boas and Professor A. C. Haddon. Among the speakers at the meetings of the club have been, in addition to the honorary members, Professor A. M. Lythgoe, Professor George F. Moore, Professor Leo Wiener, Professor A. L. Kroeber, Professor Marshall H. Saville, Mr. Stewart Culin, Professor E. H. Nichols, Dr. J. M. Bell, Professor John Murdock, Professor G. H. Chase and Mr. E. B. Drew.

ALFRED M. TOZZER

SCIENTIFIC NOTES AND NEWS

On the death of W. S. Yeates, the late state geologist of Georgia, Professor S. W. McCallie, for a number of years the senior assistant geologist of the survey, was appointed state geologist. S. P. Jones, some years back assistant state geologist, who has recently been doing special work in petrography at the University of Wisconsin and at the Sheffield Scientific School, at Yale University, has been appointed assistant state geologist. The staff of the survey now consists of S. W. McCallie, state geologist; Otto Veatch, assistant state geologist; S. P. Jones, assistant state geologist, and Edgar Everhart, chemist.

The British home secretary has appointed R. A. S. Redmayne, M.Sc., professor of mining in Birmingham University, to the newly-created post of chief inspector of mines.

Dr. Fridjof Nansen has retired as Norwegian Ambassador to Great Britain.

The fiftieth anniversary of Dr. S. E. Chaillé as teacher in the medical department of Tulane University will be celebrated by the alumni on May 19. It is the intention to establish a memorial fund for the endowment of a chair of physiology or hygiene to be named after Dr. Chaillé.

Professor A. Lawrence Rotch, founder and director of the Blue Hill Meteorological Observatory, has been elected an honorary member of the Royal Meteorological Society of London.

At the annual general meeting of the American Philosophical Society, Philadelphia, held on April 23, 24 and 25, new members were elected as follows: Martin Grove Brumbaugh, Philadelphia, superintendent of public schools; Walter Bradford Cannon, Boston, Mass., professor of physiology in Harvard University; James Christy, Philadelphia, consulting engineer; William Hallock, New York City, professor of physics in Columbia University; Edward Washburn Hopkins, New Haven, Conn., professor of Sanskrit and comparative philology at Yale University. Leonard Pearson, Philadelphia, dean of the faculty of veterinary medicine in the University of Pennsylvania; Josiah Royce, Cambridge, Mass., professor of the history of philosophy in Harvard University; Jacob G. Schurman, Ithaca, N. Y., president of Cornell University; Charles Henry Smyth, Princeton, N. J., professor of geology at Princeton University; Herbert Weir Smyth, Cambridge, Mass., Eliot professor of Greek literature in Harvard University; Henry Wilson Spangler, Philadelphia, professor of mechanical engineering in the University of Pennsylvania; Edward Anthony Spitzka, professor of general anatomy at Jefferson Medical College, Philadelphia; John Robert Eitlington Sterrett, Ithaca, N. Y., professor of Greek language and literature, Cornell University; Richard Hawley Tucker, Mount Hamilton, Cal., astronomer in the Lick Observatory; Robert Williams Wood, Baltimore, professor of experimental physics in Johns Hopkins University. As foreign members were elected: Ernest Nys, Brussels, judge of the Court of Appeals and professor of law in the University of Brussels; Albert F. K. Penck, Berlin, professor of geography in the University of Berlin.

A solution of the difficulty caused by the interference of summer teaching with professional investigation is suggested by the instructors in the department of geology and geography at Harvard, who announce in the pamphlet lately issued by the Harvard Summer School of Arts and Sciences that they will receive properly qualified students in connection with the various studies that they propose to undertake themselves. Field work in historical and structural geology in Montana is offered by Dr. G. R. Mansfield; geological or petrographical studies in Montana or New England, by Professor J. E. Wolff; physiographic studies in central France, by Professor D. W. Johnson; physiographic field work in northern Italy or southern Switzerland, by Professor W. M. Davis; and geological field work in Brazil, by Professor J. B. Woodworth. The several instructors named may be addressed regarding their plans of work.

Dr. Charles A. Kofoid, associate professor of histology and embryology in the University of California and assistant director of the San Diego Marine Biological Laboratory, has been granted leave of absence and will spend the coming academic year in Europe, principally at Munich and Naples. He will deliver a course of lectures in June at the University of Liverpool on "The Plankton" and an address at London before the Challenger Society of Great Britain on "Oceanography in America."

Professor John M. Macfarlane, professor of botany in the University of Pennsylvania, has returned from a collecting trip in the Gulf states.

Professor David G. Lyon, curator of the Semitic Museum of Harvard University, has left Cambridge for Samaria, where he will take charge of the excavations to be carried on under the auspices of the museum.

Six members of the department of geology at the Oklahoma State University are doing field work this summer. Professor Gould, with S. S. Hutchinson and R. R. Severn, is studying air and gas problems in the eastern part of the new state. He will prepare a report on the subject to be published by the Oklahoma Geological Survey. Professor E. G. Woodruff, accompanied by J. W. Montgomery and E. S. De Galyer, is with N. H. Darton in Wyoming, working for the U. S. Geological Survey.

The tenth and last lecture in the Harvey Society course will be delivered at the New York Academy of Medicine building on Saturday, May 9, at 8:30 p.m., by Professor A. E. Schäfer, of the University of Edinburgh. Subject: "Artificial Respiration in Man." Professor Schäfer, who has come to the United States for the purpose of giving the Herter lectures at the Johns Hopkins Medical School, was chairman of a committee appointed by the Royal Medical and Chirurgical Society to investigate the phenomena attending death by drowning and the means of promoting resuscitation in the apparently drowned. His lecture will embody the results of much practical work on the subject of artificial respiration.

Professor Charles H. Judd, of Yale University, will be one of the lecturers in the new department of psychology and pedagogy which is to be given at Chautauqua this summer. Among other special courses in the summer school is one in physical education by Dr. J. W. Seaver.

Sir William Ramsay delivered on April 11, at the Electro-Technical Institute, Vienna, a lecture on radio-active gases. After tracing the history of the discovery of argon, krypton, neon and xenon, the lecturer demonstrated the scientific importance of the emanation of radium, and expressed once more his gratitude for the gift of radium which he received some time since from the Austrian Academy of Sciences. The lecture was followed by a reception in honor of Sir William and Lady Ramsay.

UNIVERSITY AND EDUCATIONAL NEWS

The new buildings of the College of the City of New York will be formally dedicated on May 14, when addresses will be made by Mayor McClellan, of New York City, and President Eliot, of Harvard University. In the afternoon the didication of the Chemistry and Mechanical Arts Buildings takes place. Professor Charles Baskerville, director of the department, will preside at the dedication of the building for chemistry, the program of which is as follows:

"A Pioneer of Chemistry," by Edgar F. Smith, vice-provost of the University of Pennsylvania.

Unveiling of portrait of Wolcott Gibbs, Ph.D., the first professor of chemistry, 1848–64.

"Some Changes in Chemistry in Fifty Years," Ira Remsen, '65, president Johns Hopkins University.

Unveiling the portrait of R. Ogden Doremus, LL.D., second professor of chemistry, 1864–1903.

"The Future in Chemistry," by Wilder D. Bancroft, professor of physical chemistry, Cornell University.

"The College Course and Practical Affairs," H. Nichols, president of the General Chemical Company.

"Chemistry and the Municipality," by Herman A. Metz, comptroller of New York.

Formal opening of the building by Edward M. Shepard, chairman board of trustees.

At its recent session the legislature of New Jersey appropriated $20,000 for furnishing and equipping the new engineering building which is being erected for Rutgers College.

All but $5,000 had been contributed toward a fund of $100,000 for Sewanee University required by Mr. Andrew Carnegie as a condition of his gift of $60,000.

At their last monthly meeting the regents of the University of Michigan resolved to apply for admission to the benefits of the Carnegie Foundation for the Advancement of Teaching.

The *Electrical World* says: "A meeting of alumni of the Brooklyn Polytechnic was held last week to protest against what has been charged as mismanagement of the institute. Since 1899, when Henry Sanger Snow, the missing ex-treasurer of the New York and New Jersey Telephone Company, became president and radical changes were introduced, some alumni say that the school has run up a deficit of $268,989, while before it had been self-sustaining. The borrowing capacity of the institution has now been reached, as its indebtedness is $400,000. Abandonment of the arts course, first suggested by Snow, is particularly opposed by the alumni."

Dr. Frank K. Sanders, of Boston, formerly dean of the Divinity School at Yale, and now executive head of the Congregational Publication Society of the United States, has been elected president of Washburn College, Topeka, Kansas.

Dr. William H. Warren, professor of chemistry in the Medical Department of Washington University, St. Louis, Missouri, has been appointed dean of that institution.

Dr. John W. Bradshaw has resigned as registrar of the literary department of the University of Michigan. He will continue in the department of mathematics. The position of registrar will be filled by Professor Arthur G. Hall, of Miami University, who will be an instructor in mathematics and editor of the *Bulletin*.

At the recent meeting of the regents of the University of Nebraska, Professor F. D. Heald presented his resignation in order to accept the professorship of botany in the University of Texas tendered to him some months ago. This leaves vacant also the position of botanist to the Agricultural Experiment Station, which Professor Heald held at the time of his resignation. It is probable that in electing a successor the regents will continue the present arrangement which combines the professorship of botany in the School of Agriculture with the position of botanist to the Experiment Station. This involves also some instruction of advanced university students in plant pathology. The election will probably not be made before the middle of June.

Walter H. French, deputy-superintendent of public schools at Michigan, has been appointed professor in the Michigan State Agricultural College, in charge of the department of agricultural education.

Robert H. C. Heck, of Lehigh University, has accepted the chair of mechanical engineering at Rutgers College.

Henry B. Drowne, at present an assistant engineer with the State Board of Public Roads, of Rhode Island, has been appointed instructor in civil engineering at Brown University.

Mr. H. F. Hart will retire from an instructorship in mathematics at Syracuse University at the end of the present academic year, in order to take charge of the department of mathematics in the Montclair, N. J. High School.

SCIENCE

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THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY, APRIL 23–25, 1908

THE general meeting of the American Philosophical Society was held at Philadelphia on April 23, 24 and 25. The opening session was on April 23 at 2:30 P.M., and morning and afternoon sessions were held on the following days; with an evening lecture by Professor Henry F. Osborn on April 24, at the hall of the Historical Society of Pennsylvania, which was followed by a reception to the visiting members and friends of the society. The sessions were largely attended. The meeting closed with a dinner at the Bellevue-Stratford on the evening of April 25.

Forty-two papers were presented, covering a wide range of subjects. Among those relating to science were the following:

Cytomorphosis, a Study of the Law of Cellular Change: CHARLES SEDGWICK MINOT, of Harvard University.

Cellular change is in the direction of the differentiation of the protoplasm of the cell. As more and more of the undifferentiated protoplasm becomes specialized, the cell loses its plasticity to respond to exterior influences, and the power of the cell to reproduce depends upon the amount of undifferentiated protoplasm remaining. A blood corpuscle, for instance, which contains no undifferentiated protoplasm can not reproduce and must die. In muscle, on the other hand, the small amount of undifferentiated protoplasm remaining in the cell enables it to grow, and repair injuries.

Differentiation is the rule, and its end is the death of the cell.

Inheritance in Protozoa: HERBERT SPENCER JENNINGS, of the Johns Hopkins University.

Heredity has never been thoroughly studied among the Protozoa. This paper gives the results of an extensive experimental and statistical investigation of a number of generations of *Paramœcium,* raised from cultures and from "wild" forms. It has been assumed that the inheritance of acquired characters is normal among protozoa, though uncommon among higher forms. The author does not find that inheritance of acquired characters is more common in Protozoa than in Metazoa. "Wild" races of large or small size breed true to type, and in these the larger mate with the larger and the smaller with the smaller as a rule; when different sizes mate they produce different sized offspring, in the few cases where the mating is fertile. The production of new races does not readily occur by either inheritance of acquired characters, by selection or by mating.

Determination of Dominance in Mendelian Inheritance: CHARLES B. DAVENPORT, of Cold Spring Harbor, N. Y.

In studying heredity, where a single character is considered which one parent possesses and the other lacks, or a character that is contrasted in the parents, it is generally found that the offspring are alike, and like one parent only. From examples of poultry, of insects, of certain mammals, including man, and certain plants in regard to inheritance that may be described as Mendelian, it is concluded that where a stronger determiner meets a weaker determiner in the germ, dominance is the result. When the character is present in one parent only, we have the extreme case and typical Mendelian inheritance, but when the determiners are of nearly equal potency the Mendelian law is obscured.

A Preliminary Report upon a Crystallographic Study of Hemoglobins: A Contribution to the Specificity of Vital Substances in Different Vertebrates: EDWARD T. REICHERT and AMOS P. BROWN, of the University of Pennsylvania.

The primary object of this research was to determine whether or not corresponding albuminous substances are identical in different species. The results of the investigation, which has covered more than one hundred species of vertebrates, show: (*a*) the crystals of oxyhemoglobin obtained from any single genus are isomorphous, but unlike those obtained from other genera, unless these genera are closely related or in the same family; (*b*) specific differences in angle and habit are observed between crystals obtained from species of the same genus, so that it is generally possible to recognize the species by the crystals; (*c*) the occurrence of several types of crystals of oxyhemoglobin occur in the same species; (*d*) indications are found in the crystal angles of a substance in the molecule common to all hemoglobins, no matter what the system of crystallization. The application of this method of research to problems in zoological classification and in heredity was pointed out.

The Excretory Organs of the Metazoa, a Critical Review: THOMAS H. MONTGOMERY, of the University of Texas. (Read by title.)

The Effect of Certain Preservatives upon Metabolism: HARVEY W. WILEY, of the U. S. Department of Agriculture.

Details were given of the work that Dr. Wiley is carrying on, in the study of the effect upon the human organism of a number of preservatives commonly used in the preparation of foods, such as borax, boric acid, salicylic acid and salicylates, sulphurous acid, sulphites, benzoic acid and benzoates, formaldehyde, copper sulphate and potassium nitrate. Experiments with the first five of these preservatives show conclusively that their continued use, in quantities such as are used in food preservation, hinders or prevents metabolism, and may seriously derange the functions of the organism. The other substances enumerated are still under investigation, but the results thus far obtained seem to indicate that they are equally injurious.

Observations Regarding the Infliction of the Death Penalty by Electricity: E. A. Spitzka, of Jefferson Medical College.

This paper sets forth the history of "electrocution," the methods employed and the phenomena observed in this mode of death, together with the post-morten findings; detailing the observations of the author, based upon 31 electrocutions at Sing Sing, Auburn, Dannemora and Trenton prisons. Compared with other methods, "electrocution" is the most humane method of inflicting the death penalty, because of its efficiency, quickness and painlessness, and it should be adopted in every state in the union.

Recent Discoveries in the Pathology of Rabies: Mazÿck P. Ravenel, of Madison, Wis. (Read by title.)

The Brain of Rhinochimæra: Burt G. Wilder, of Ithaca, N. Y.

Four years ago Garman described a new species of chimæroid from Japanese waters, under the name of *Rhinochimæra pacifica,* giving a brief description of the brain, with figures showing the general form from the dorsum, venter and side. This paper gives a detailed description of the brain of this species, confirming Garman's findings and giving much additional data derived from dissection of the brain.

Preliminary Report on the Brains of the Natives of the Andaman and Nicobar Islands: E. A. Spitzka, of Jefferson Medical College.

There is urgent need for research upon the anatomy of the brains of the exotic races, so rapidly becoming impure or extinct. Through the efforts of Dr. W. W. Keen, president of the society, enlisting the aid of Lord Curzon, Viceroy of India, Mr. Risley, ethnographer for India, and Dr. A. R. S. Anderson, senior medical officer at Port Blair, Andamans, the author was enabled to secure a brain of an Andamanese and one of a Nicobarese. The ethnic characters of these aborigines were discussed, and their brains compared as to size and structure with those of whites, Eskimos, Japanese, Chinese, negroes and Papuans, previously studied.

A Comparison of the Albino Rat with Man in Respect to the Growth of the Brain and the Spinal Cord: Henry H. Donaldson, of Philadelphia.

A statistical study of the growth of the brain and the spinal cord in the white rat, in which the weight of the brain and of the spinal cord is recorded and compared with the body weight at various stages of the development of the animal. The results are plotted, and from these records the logarithmic curves are drawn. When compared with the curves derived from the same data in the case of man and plotted to a corresponding scale, a close similarity in the curves is noted.

The Classification of the Cetacea: F. W. True, of the Smithsonian Institution.

The paper deals with the classification of the toothed whales (sperm whale, beaked whale, porpoises, etc.) and has special reference to the fossil forms. The recent work of Dr. Abel, of Vienna, on fossil cetacea is reviewed and criticized. The opinion is expressed that the *Cetacea* are not directly derived from Zeuglodonts, and that their origin is not at present known; also that the white whale and the narwhal should not be removed from the family Delphinidæ, and that the river dolphin, *stenodelphis,* should, for the present at least, be placed in that family.

Results of the American Museum Exploration in the Fayûm Desert of Northern Egypt: Henry F. Osborn, president of the American Museum of Natural History.

Professor Osborn gave an account of the American Museum expedition into the Fayûm Desert in search of the ancestors of the elephant. The formations explored were Middle and Upper Eocene. Bradnell and Andrews, between 1901 and 1905, had explored the region, finding ancestral forms of the Proboscidea and of the Hyracoidea, as well as primitive Sirenia and Zeuglodonts. The camp of the American Museum expedition was located to the west of Qasr el Sagra, near the bone quarries opened by Bradnell. Remains of *Arsinoïtherium, Palæomastodon* and *Mœritherium* were obtained from these quarries. A reconnoissance into the Zeuglodon Valley, near Gar el Gehannem, was described. The restorations of *Mœritherium* and *Palæomastodon,* made by Mr. Charles R. Knight, under the direction of Professor Osborn, were exhibited. From northern Africa the elephant stock migrated south through Africa, north into Europe, and northeast and east through Asia into the Americas. From a comparison of the ancestral elephant *Mœritherium,* with the Sirenian *Eotherium,* it is believed that the sea cows and the elephants are derived from the same stock.

Additional Notes on the Santa Cruz Typotheria: W. J. Sinclair, of Princeton University.

A presentation of the general conclusions reached, as a result of two years' study of the Typotheria from the Santa Cruz formation of Patagonia. They appear first in the *Notostylops* beds (uppermost Cretaceous or basal Eocene) and become extinct in the Pampean (Pleistocene). It is generally assumed that the rodents and conies are related to *Typotheria,* but this does not appear to be the case, the resemblances are probably due to convergence. The *Toxodontia* and the *Typotheria* probably had a common origin. The *Typotheria* do not lend much support to the idea of a former land connection with Africa, showing no relationship with the recently discovered Eocene mammals from the Fayûm province of Egypt.

Stratigraphic Observations in the Vicinity of Susquehanna Gap, north of Harrisburg, Pa.: Gilbert van Ingen, of Princeton University.

Details the results of field work that Professor Van Ingen has been carrying on along the Susquehanna River, above Harrisburg. The formations are found to contain well-preserved fossils and several typical faunas, as, for instance, the Hamilton, Ithaca, etc., are well developed. The findings of the author do not always agree with those of the Second Geological Survey of Pennsylvania, even in regard to structure, a great thrust fault recognized by the author, for example, has rendered the section incomplete, a fact not noted by the survey.

Further Researches on the Physics of the Earth, and especially on the Folding of Mountain Ranges and the Uplift of Plateaus and Continents, produced by Movements of Lava beneath the Crust, arising from Secular Leakage of the Ocean Bottom: T. J. J. See, U. S. Naval Observatory, Mare Island, Cal. (Read by title.)

Progress in the Demarcation of the Boundary between Alaska and Canada: O. H.

Tittmann, Superintendent of the U. S. Coast and Geodetic Survey.

Details the methods employed in determining and marking the Alaskan boundary. The length of the boundary is about twelve hundred miles, extending from the Arctic Ocean south along the 141st meridian to near Mt. St. Elias, and thence along the coast strip of southeastern Alaska. In southeastern Alaska, aluminum bronze monuments are placed wherever it is practicable to do so, but, as most of the turning points in the line are inaccessible snow-clad peaks, they will be defined by triangulation, connecting with the work of the Coast and Geodetic Survey. The initial point on the 141st meridian, which is also being marked by monuments, was determined by a telegraphic longitude circuit, extending overland from Vancouver through Canadian territory, and by way of Seattle and the United States government cables, to Valdez and thence overland to the boundary.

A Living Representative of the Most Primitive Ancestors of the Plant Kingdom: George T. Moore, Marine Biological Laboratory, Woods Hole, Mass.

Chodat has derived the green algæ from the Palmellaceæ. In this family he points out that there exist three principal stages or conditions: (1) the *Zoospore* condition, (2) the *Sporangium* condition, and (3) the *Tetraspora* condition. The author thinks that a better starting point is found in *Chlamydomonas,* which also shows three corresponding conditions, in addition to the Zoospore type, namely the *Volvox* type, the *Tetraspora* type and the *Endosphæra* type. The *Tetraspora* type of *Chlamydomonas* has developed into the *Palmellaceæ* and thence into the algæ and higher green plants. Even as high as the mosses and ferns a *Chlamydomonas* stage is to be seen in the male gametes.

The Influence of Heat and Chemicals on the Starch Grain: Henry Kraemer, of Philadelphia.

From a study of "reserve starches" and their behavior in relation to heat and chemicals, Professor Kraemer concludes: (*a*) The starch grain consists of two nearly related substances, the one a colloid, which takes up aniline stains, and the other a crystalloid, which becomes blue with iodine (*b*) The starch grain is made up of concentric layers, one series of which contains a large proportion of crystalloids, while the other alternate layers are composed mostly of colloids. (*c*) The polarization effects produced by the starch are attributed to the crystalloidal substance. (*d*) The starch grains retain their polarizing properties up to 180° C. (*e*) At the higher temperatures, in the case of the potato starch, the double refraction becomes stronger. (*f*) While heating the starch grains in water rapidly changes the structure of the grain, it is upon the addition of chemicals or ferments that denaturization is brought about.

A Contribution to the Knowledge of the Fungi of Pennsylvania; Gasteromycetes: D. R. Sumstine, Wilkinsburg, Pa.

This is the initial paper by the author giving a list of the fungi growing in Pennsylvania, and deals with the *Gasteromycetes.* Keys for the determination of orders, families, genera and species are given; about sixty species of *Gasteromycetes* are enumerated and their distribution is given by counties. The paper includes a bibliography of Pennsylvania mycology and a short sketch of the mycologists who have worked in this field.

Leaf Structures of the Bermuda Sand Strand Plants: John W. Harshburger, of the University of Pennsylvania.

The paper describes the adaptation of the leaf structures of the Bermuda sand strand plants to the environment, as shown by a histological study of the leaves. The epidermal structures developed in the leaves to prevent transpiration and desiccation, brought about by the intense light and heat of the sun and the reflection of the white sand, are described and illustrated. Thickening of the cuticle, the development of water-storage tissue, and a hairy covering and the depression of the stomata are the principal changes brought about by the exterior conditions.

The Explosion of the Saratoga Septic Tank: William Pitt Mason, of Troy, N. Y.

The explosion of a tank used for the storage of sewage, and supposed to be due to the ignition of an explosive mixture of marsh gas and air, is discussed. The marsh gas is derived from the fermentation of the sewage, and the ignition is assigned to the generation of phosphine, which is supposed to have ignited spontaneously.

Some Chilean Copper Minerals: Harry F. Keller, of Philadelphia.

The author describes a number of raw minerals containing copper, from the mines in the Province of Tarapaca, Chile. Among these, the most interesting are peloconite, a manganese ore containing a considerable proportion of copper; a new double sulphate of copper and magnesium, isomorphous with chalcanthite; and a beautifully crystallized sulphate and arsenate of copper, which could not be identified with any known species. The author expects to follow this communication with others on minerals from Copaquira, Huiguintipa and other Chilean localities.

Absorption Spectra of Solutions: H. C. Jones, of Johns Hopkins University.

The object of the present investigation was to ascertain whether combination between the solvent and dissolved substances had any effect upon its power to absorb light. Certain salts in the anhydrous state have very different absorption than when combined with water. A solution of anhydrous neodymium chloride in absolute alcohol gives absorption bands differing from those obtained when a few per cent. of water is added. The application of this observation to the author's theory of hydration is discussed.

Effect of an Angle in a Wire Conductor on Spark Discharge: Francis E. Nipher, of St. Louis.

The problem to be solved is to determine the real current direction in a wire, through which a spark discharge is passing. The spark discharge was that of a long eight-plate machine. One terminal was grounded on a water pipe, the other was grounded in the air. A small wire bent at a sharp right angle was placed vertically in the lines of the earth's magnetic field, and so connected that the negative discharge could be sent either up or down around the angle and its effect recorded on a photographic plate placed under the angle. Very interesting photographic results were obtained, but the author does not consider that the main question was conclusively answered. The work is to be continued, using a platinum wire of .002 inch diameter. The electrometer will probably be a means for examining the two sides of the angle, and it can be used with a continuous current running through the fine platinum wire.

Some Results of the Ocean Magnetic Work of the Carnegie Institution of Washington: L. A. Bauer, of Washington.

Dr. Bauer described the work of the *Galilee* expedition in the Pacific since August, 1905. The work accomplished, briefly stated, is as follows: (*a*) magnetic observations have been made on the ocean areas which closely approach land observations in accuracy; (*b*) errors found in magnetic charts of the Pacific Ocean amount to from 1° to 5° in declination (or variation of the compass) and in dip, and about .04 in the horizontal magnetic force. The correction of such errors, especially the error in declination, is of great importance for the safe and rapid navigation of vessels.

The Investigation of the Personal Error in Double Star Measures which depend on the Position of the Angle: Mr. Eric Doolittle, of Philadelphia.

This paper gives the result of the determination of the constant personal errors, and also of the probable uncertainty of the measures, of double stars made during the past ten years at the Flower Astronomical Observatory of the University of Pennsylvania. Some eighty thousand single measures are available for the investigation. The double stars observed are divided into four classes and the law of occurrence of error deduced for each class. It is shown that for each class the personal error is well determined, so that from measures actually made the true value can be quite approximately determined.

Astronomical Photography: John A. Brashear, of Allegheny, Pa.

Dr. Brashear spoke of the advantages of the photographic over the visual method of astronomical observation, and rapidly sketched the history of the development of astronomical photography, from the time of Draper to the present. He also exhibited a number of photographs of celestial objects, such as star clusters, nebulæ, comets, the moon and planets, etc.; a large proportion of which were made with the 10-inch Brashear lens of the Bruce telescope of the Yerkes Observatory.

Relative Advantages of Various Forms of Telescopes for Solar Research: George E. Hale, of Solar Observatory, Pasadena, Cal.

Professor Hale discussed different types of telescopes for solar research, describing particularly the equipment at the Solar Observatory of the Carnegie Institution at Mount Wilson, California. The advantages of the fixed horizontal telescope with heliostat were pointed out. The author also described the large spectroheliograph of this observatory and exhibited a number of examples of photographs taken by means of this instrument, including solar prominences, faculæ, and sunspots.

Photographs of Daniel's Comet: E. E. Barnard, of the Yerkes Observatory.

The comet was photographed on thirty-eight nights with the Bruce photographic telescope of the Yerkes Observatory. This is one of the brightest comets that have been visible since the great comet of 1882. It was visible to the naked eye for about two months during the summer. The photographs showed that the most active period in the comet's history occurred nearly a month before perihelion, at which time changes occurred so rapidly that the appearance of the comet changed from night to night. Indeed, on comparing the Yerkes Observatory photographs with photographs made at M. Flammarion's observatory in France, and at the Lick Observatory on the same night, marked differences in the photographs could be seen.

The Solution of Algebraic Equations in Infinite Series: Preston A. Lambert, of Lehigh University.

The object of this investigation is to develop a general method for determining all the roots of any algebraic equation, by means of infinite series. The method consists in forming algebraic functions of x from the given equation $f(y)=0$ by introducing a factor x into all the terms but two of the given equation. These algebraic functions are expanded into power series in x by the multinomial theorem, by Maclaurin's series, or by La Grange's series. If, in these power series, x is made unity, the resulting series, if convergent, determine the roots of the given equation. The convergency conditions determine in advance in which two terms of the given equation the factor x is to be omitted.

It is shown that all roots of the given equation can be determined by means of infinite series, derived by that method.

The Completion of the Lunar Theory and the Tables of the Moon's Motions to be made therefrom: Ernest W. Brown, of Yale University. (Read by title.)

Problems of Three Bodies on Surfaces: Edgar Odell Lovett, of Princeton University. (Read by title.)

Other papers of a general nature read at this meeting were the following:

The Law of Oresme, Copernicus and Gresham: Thomas Willing Balch, of Philadelphia.

The Dramatic Function of Cassandre in the Oresteia of Æschylus: William A. Lamberton, of the University of Pennsylvania.

Goethe's Private Library as an Index of his Literary Interests: Waterman T. Hewett, of Cornell University, Ithaca, N. Y.

Art and Ethnology: Edwin Swift Balch, of Philadelphia.

A Vedic Concordance: Professor Maurice Bloomfield, of Johns Hopkins University.

On the Lost Tribes of Israel and the Aryan Ancestry of Jesus and His First Disciples: Paul Haupt, of Johns Hopkins University.

The Sign and Name for Planet in Babylonian: Morris Jastrow, Jr., of the University of Pennsylvania.

Medieval German Sculpture in the Germanic Museum of Harvard University: Kuno Francke, of Harvard University.

Notes on Greek Vases in the Museum of Science and Art of the University of Pennsylvania: Professor William N. Bates, of the University of Pennsylvania.

The balloting for new members took place on Saturday morning, April 25, and those were elected whose names were printed in the last issue of Science.

The meeting concluded with a dinner at the Bellevue-Stratford, at which Vice-president William B. Scott, of Princeton, presided, and toasts were responded to by His Excellency, Mr. Wu Ting-fang, Dr. Horace Howard Furness, Professor William Gilson Farlow, Dr. Harvey W. Wiley and Hon. Hampton L. Carson.

THE APPLICATIONS OF PHYSICAL CHEMISTRY TO ORGANIC CHEMISTRY[1]

To do justice to the subject, the "Applications of Physical Chemistry to Organic Chemistry," one would have to touch on all the chapters of organic chemistry: there is no branch of it that can not be put into more precise and therefore clearer terms with the aid of physico-chemical ideas. In the time at our disposal to-day it will be necessary for me to limit myself to a few illustrations.

We might begin with the simple device which we owe to physical chemistry of identifying a solid substance most positively by taking a melting-point not only of the substance itself, but also of a mixture of it and the compound it is suspected of being: this device was hardly known or used fifteen years ago and is now considered a more reliable and, certainly, a more rapid identification test than an exact ultimate analysis: I recall that in an investigation

[1] Address before the American Chemical Society, December, 1907.

carried out a dozen years ago, two compounds were obtained, each of which melted at 245° to 247°; both had the same composition and they were at first supposed to be identical; but mixtures of the two melted 30° to 40° lower than either substance alone, and this gave us our very first warning that we were dealing with *isomers*. Again, in a more recent investigation on a new class of nitrogen *stereoisomers*, the syn and anti chlorimido compounds,

$$\begin{array}{c} R—C—R' \\ \| \\ ClN \end{array} \quad \text{and} \quad \begin{array}{c} R—C—R' \\ \| \\ NCl \end{array},$$

we were on the point of abandoning the search for nitrogen stereoisomers other than the long-known oximes and hydrazones, when the simple observation was made that a crude chlorimido ester, melting at 65°, gave analytical data representing a perfectly pure substance and yet could be resolved into two distinct compounds, each giving the same analytical results, but each of which melted some twenty degrees higher than the original substance, a mixture of which, however, melted again at 65°. Then we knew that we had at last stumbled on the long-sought stereoisomers, the simplest representatives of the whole type. Structural identity being proved, the rigorous proof of stereoisomerism *versus* physical or crystal isomerism was brought in part with the aid of the low melting point of the mixture of the two substances.

The physico-chemical theory of the separation of *stereoisomers* of the asymmetric carbon type, for instance, of the separation of *d* and *l* tartaric acids, by the crystallization of their salts with optically active bases, has led to extremely important and useful developments in recent years; the theory is, in brief, that whereas two opposite forms, + A and — A, must have the same physical and chemical properties, except in the rotation of the plane of polarized light, the compounds

$$\left\{ \begin{array}{c} +A \\ +B \end{array} \right\} \quad \text{and} \quad \left\{ \begin{array}{c} -A \\ +B \end{array} \right\}$$

obtained when the two forms are combined with a single active component, say + B, are no longer optical images and will have different physical and *chemical* properties. The recognition of this simple fact has led to the extension of the method of separation to other substances than acids and bases, namely to esters, amides, hydrazones and so forth. Most important, though, is the fact recognized first by Marckwald that for the same reason the chemical activity of two asymmetric substances, + A and —A towards an asymmetric compound +B may be different and that consequently, for reactions that are not instantaneous like salt formation, but involve time, like esterification, the velocity of formation of the compound, + A + B, say an ester, may be quite different from the velocity of formation of — A + B. This must make possible a separation by chemical means, rather than by physical. But, *vice versa*, the velocity of decomposition of such esters when once formed may likewise be different. All these conclusions were confirmed by experiment and the result is of greatest importance to science, for it gives us a direct explanation of the long-known fact that enzymes will attack only one of a pair of stereoisomers and not the other, will cause, for instance, *d*-glucose to ferment, but not *l*-glucose; for in the enzymes we have asymmetrical substances (Fischer) corresponding in every way to what we have symbolized as + B.

Again, the much-discussed, once hotly fought question of the true structure of so-called *tautomeric* compounds has found its rational solution with the aid of physical chemistry. Whether acid amides have the structure, $RCO.NH_2$ or $RC(OH):NH$, whether a 1,3 dicarbonyl derivative, like acetoacetic ether, is a ketone, $CH_3CO.$-CH_2COOR, or an alcohol, $CH_3C(OH)$:-$CH.COOR$, are questions which could not really find their final answer by the older methods of the study of derivatives, although at the time that was the best we could do. According to the present views, which J. Traube first presented, we have in solutions of the tautomeric compounds both forms in equilibrium with each other; for instance, we have

$$C_6H_5CO.NH_2 \rightleftarrows C_6H_5C(OH):NH$$

and

$$CH_3CO.CH_2COOR \rightleftarrows CH_3C(OH):CHCOOR.$$

According to the laws of equilibrium and kinetics, if a given reagent, for instance an alkali, uses up the one form, say by neutralization, the whole material can be changed in the same way; the other form, inert in regard to a particular reagent, regenerates the active form continuously by a one-sided reaction. Thus, even if the unstable form existed in only minimal quantity, it could be the source of the actual product of the reaction, and that is why the old method of proof by the study of derivatives must be considered faulty. The isolation of the two closely related forms has not only confirmed this modern view by the qualitative observation that the forms are mutually convertible into each other, but Wislicenus, Claisen, Kuester and others have measured quantitatively the velocities of transformation of tautomers and have determined a number of the equilibrium constants. With the proof by Knorr, showing that in the solid phase only one tautomer can exist in stable form, the whole matter has received a definite, sharp setting. That the subject is one of interest not only to organic chemists, but to all of us, is evident from the fact that our indicators, phenolphthalein, methyl orange and others, seem to owe their valuable property of changing their tint, in passing through the neutral point, to conditions of *tautomerism* affecting the *chromophoric* groups in these compounds.

And so we find physico-chemical methods of investigation of the greatest advantage in the treatment of the three important classes of organic compounds which have the same molecular weight and composition but different character and identity—namely, *isomers, tautomers* and *stereoisomers.*

But the organic compounds themselves, their structure and the arrangement of their atoms in space, represent in a way the least important side of organic chemistry—far more important are their reactions, the changes to which we can subject them, the things we can do with them. For on these changes all the scientific and technical applications and our very life depends. It is in particular to the study of some phases of this question of organic reactions that I wish to call your attention this morning. To take a concrete case, the reversible reaction of esterification and saponification

$$CH_3COOCH_3 + HOH \rightleftarrows CH_3COOH + CH_3OH$$

has been an important one ever since its study helped establish our fundamental law of chemical equilibrium. But the reaction has been important in other directions as well, for early investigations showed that either action is greatly accelerated by the addition of an acid like hydrochloric acid; since the acid did not seem to change or to take part in the reaction, it was said to act by its mere presence as a catalytic agent; and this is a typical reaction from which important laws regarding catalysis were laid down. There are hosts of reactions in organic as in inorganic chemistry in which we use one ingredient or the other to accelerate the action, or rather to make it go at all. It has always been a subject for speculation and investigation as to how and why a catalytic agent like hydrochloric acid does its work in actions like the saponification of methyl acetate or the inversion of cane-sugar or the digestion of food. Many chemists have believed that more reactive addition products are formed as intermediate products; but of what nature would they be to be more reactive? We know that addition products, representing more saturated compounds, very often are really less reactive than the unsaturated compounds from which they are obtained. There are, however, important exceptions to this rule: in trying to imagine just how an acid can affect the speed of the action

$$CH_3COOCH_3 + HOH + HCl \rightarrow CH_3COOH + CH_3OH + HCl$$

we must recall the most fundamental fact concerning acids, the fact that they have the power to form salts with bases and basic oxides. Here we have the acid and the oxide and the idea is at once suggested that *salt* formation of the ester with the acid is the cause of the acceleration or catalysis. Baeyer has shown, in fact, that acid esters in common with other oxygen compounds do form well-defined salts with acids, oxonium salts, derived from quadrivalent oxygen, salts of exceedingly weak bases, but still true salts, as shown by the electrolytic experiments of Coehn. Now, one of the most important differences between a very weak base and its salts is that almost all salts, no matter how weak the base, ionize much more readily than the weak base itself—this is a general case when the addition product, the salt, is more reactive than the unsaturated compound, the base, and it is so through the power of ionization.[2] So it was thought that the accelerating or catalytic action of the acid could be readily understood as due to such salt formation, if the water reacts, not with the ester itself, but only with its positive ion, as expressed in:

$$CH_3CO.\overset{+}{\underset{\substack{|\\H}}{O}}.CH_3 + HOH \rightarrow CH_3COOH + CH_3\overset{+}{\underset{\substack{|\\H}}{O}}H.$$

The velocity of the reaction would then be simply expressed in the fundamental equation:

$$\text{Velocity} = \frac{dx}{dt} = K_{\text{velocity}} \times \text{Conc.}_{\text{Pos. Ions}} \times \text{Conc.}_{\text{HOH}}.$$

As a matter of fact, *with this single assumption* that only the positive ions are active, it is possible to deduce mathematically by the rigorous application of our simple laws of chemical equilibrium and dynamics, as applied to the salts of very weak bases, every fundamental fact that has long been known about the processes of saponification and esterification: In the first place, by the application of these laws, we find this equation resolving itself, mathematically, into the equation:

$$\text{Velocity} = \frac{dx}{dt} = K'_{\text{velocity}} \times \text{Conc.}_{\text{Ester}} \times \text{Conc.}_{\text{HOH}} \times \text{Conc.}_{\text{H ions}},$$

the fundamental empirical equation which tells us that at a given temperature the velocity of saponification is proportional to the concentrations of the ester, the water and the hydrogen ions; the innumerable measurements which have established the correctness of this empirical equation agree, therefore, obviously also with the fundamental equation of our theory. The latter is also found to be in perfect agreement with the two other characteristic features of this catalysis—namely, that the ultimate condition of equilibrium of the reversible reaction of saponification and esterification is not sensibly modified by the addition of the acid, but is only reached more rapidly; and finally, the catalyzing acid does not appear to combine with any of the sub-

[2] Addition products often have a decomposition tension producing an action as the result of an increased potential of a component.

stances involved in the reaction—hence the name catalytic agent. The acid does not appear to combine with the ester simply because the salt is almost completely hydrolyzed under the conditions of equilibrium between such a weak base and a strong acid—and only very small quantities of the salt and its positive ion exist at any moment. But still, if the concentration of a component is increased, say, a thousandfold by the addition of an acid, its reactivity is increased proportionately according to the law of mass action, no matter whether a minute quantity has thus been increased a thousandfold or a larger mass.

Thus far the development of the subject was purely mathematical and theoretical, although no assumption was made which was not based on established facts of organic chemistry. An experimental test of the correctness of this theory necessarily was a main object. The ordinary esters were not considered suitable for the purpose; they are such weak and unstable bases that it was not considered wise to attempt to measure exactly the actual concentration of their positive ions in given cases—although this will now be attempted. Recourse was first taken to a very closely related class of compounds, the imido esters, $RC(:NH)OCH_3$, in which the stronger basic group $(:NH)$ has replaced an oxygen atom of the ordinary esters. The imido esters are pronounced bases, although weak ones, and form well-defined salts. They are decomposed by water into ammonia and an acid ester according to

$$RC(:NH)OCH_3 + HOH \rightarrow RCOOCH_3 + NH_3.$$

This action is enormously accelerated by the addition of acids, just as is the decomposition of an ordinary ester. On the basis of the above theory, it was thought that the acceleration of the decomposition of the imido ester would also be due wholly to the formation of the salt, and, through it, of its positive ion in larger masses; in other words, the real decomposition must be

$$RC(:\overset{+}{N}H_2)OCH_3 + HOH \rightarrow RCOOCH_3 + \overset{+}{N}H_4,$$

and the isothermal equation giving the velocity of the action must be

$$\text{Velocity} = \frac{dx}{dt} = K_{\text{velocity}} \times \text{Conc.}_{\text{Pos.Ions}} \times \text{Conc.}_{\text{HOH}},$$

the same as for the acid esters.

In this case the theory could be put to the test of experiment, for all the factors could be determined—the velocity of the reaction, the exact proportion of free ester, its salt and its positive ion at any moment were ascertained without difficulty. Not to weary you with experimental details, it may be said that the substance undergoing decomposition was found, as a matter of fact, to be the positive imido ester ion; the free base, the non-ionized salt do not decompose with water in this way. The deeper the investigation was carried, the more marked, too, was found the parallel between the acid esters and the imido esters, which have served for the experimental verification of the theory; there is an alkaline catalysis of imido esters, as there is of esters, and the alkaline catalysis in both cases is very much the faster one and subject to the same law; there is a salt effect or salt catalysis for the imido esters as there is for acid esters and for cane-sugar, and our measurements help to explain, we believe, the nature of salt catalysis in both cases.

The proof of the soundness of a theory is shown by the experimental verifications of predictions which can be made on the basis of it, and I would like to report two such cases. Imido esters react also with ammonia, as do ordinary esters, and the products are quite analogous; we have:

$$C_6H_5COOCH_3 + NH_3 \rightarrow C_6H_5CONH_2 + CH_3OH$$

and

$$C_6H_5C(:NH)OCH_3 + NH_3 \rightarrow C_6H_5C(:NH)NH_2 + CH_3OH.$$

The latter reaction proceeds very slowly but is accelerated again enormously by the addition of an acid. On the basis of the general theory we supposed at once that the real action does not involve the imido ester itself at all, but only its positive ion, so that we must have

$$\text{Velocity} = \frac{dx}{dt} = K_{\text{velocity}} \times \text{Conc.}_{\text{Pos. Ion}} \times \text{Conc.}_{NH_3}.$$

This action is interesting because almost all of the added acid is taken by the stronger base, the ammonia, to form an ammonium salt, the weaker base, the imido ester, taking only a very small share of it. The same catalytic effect can, therefore, be produced also by adding an ammonium salt to the mixture; the weaker base will also take a small part of the acid; but this small share, however minute, can be rigorously ascertained with the aid of the equilibrium law and of the experimentally ascertained affinity constants of the two bases. The mathematical development led to the rather startling prediction that the reaction velocity would be found to be independent of the concentration of free ammonia—one of the reacting components—a result which no one would anticipate from the old view as expressed in the first equation. That is, while accelerating the action proportionately to its mass, the ammonia, according to our view, should also retard it to a like degree by driving the imido ester proportionately out of its combination with the acid and thus its concentration would not affect the reaction. As a matter of experiment, the velocity of the reaction was found, as predicted, to be practically independent of the concentration of free ammonia. In the second place the degree of ionization α of the ammonium salt figures in the final mathematical equation—the velocity constant referred to the positive imido ester ions being K_v/α. Now, ammonium sulphate is ionized considerably less than ammonium chloride in equivalent solutions. When we determined the velocity of the action for methyl imido benzoate, first using ammonium chloride as the catalyzer, we found that it is 281 if α is left out of consideration, and for the sulphate solution it is 212. The respective degrees of ionization of the salts in the concentrations used are 80 per cent. and 61 per cent., respectively, and for K_v/α we have $281/0.80 = 351$ and $212/0.61 = 351$. The third point of especial interest is that in this reaction the actual concentration of the reacting substance, the positive ester ion, is exceedingly small; for instance, only 0.000,018 gram molecules at the beginning of our first series, and still smaller as the reaction proceeds, but it is rigorously calculable and it is noteworthy that the velocity is really found proportionate to this small but vital component. This, I believe, also justifies completely the conception that the catalysis of ordinary esters is also due to a very small but vital component, which has hitherto escaped measurement, but the assumption of whose presence enables us to give a rational explanation of catalytic action of acids which is in complete agreement with all experimental facts and with the laws of dynamics.

Another fact discovered as a result of applying the theory is this: in all our determinations we have found the rule to hold that in the presence of an acid catalyzer the tendency for action is for the ion of a weaker base to change into the ion of a stronger one—that is true for the amidine reaction, for the action of water on imido esters and on ordinary esters, and even for the formation of esters from an acid and alcohol; the rule is probably dependent on the law of maximum work and should lead to the recognition of what may be called the driving force of the actions—I have not time to discuss it here. In our experience there was only one notable exception to the rule: years ago we found that urea esters would not react with amines to give guanidines, a reaction which would correspond entirely to the formation of amidines from imido esters:

$$NH_2C(NH)OCH_3 + NH_3 \rightarrow NH_2C(NH)NH_2 + CH_3OH.$$

And, yet, the guanidines are much stronger bases than are the urea esters. Now it happened that in our older work we had almost invariably used the free esters and amines, no salts. In a reinvestigation of the action from the new point of view, hydrochloric acid was added to help the ionization of the urea ester. With this simple modification, the method works beautifully, excellent yields of guanidines are obtained and the action falls into line with the others. Quantitative measurements showed too that the reaction proceeds with a velocity proportionate to the concentration of the positive urea ester ion. The result was interesting not only because it represents a successful synthesis predicted by the theory, but also because in this case the stronger base is the urea ester and it takes the major part of the catalyzing acid—for the imido esters and ammonia the conditions were reversed. And so the theory is found to work, whether the reacting positive ions are present in very minute or in larger masses, whether the catalyzer combines in minimal or in larger proportion with the substance undergoing catalysis!

We thus find that it is possible by physico-chemical methods to determine the mode of action of reagents, so-called catalyzers, which we add to mixtures in organic chemistry to make the actions "go." By entirely analogous methods and properly chosen conditions the active component may be ascertained by velocity determinations in a large variety of organic reactions, methods which are applicable not only in chemistry proper, but also particularly in the domain of biochemistry, where catalytic action by acids, alkalies and enzymes is of foremost importance.

In conclusion, I should like to call attention to one other important method of physical chemistry which has been extensively applied in inorganic fields and is now being used in organic work with the largest promise of valuable results. It is the method of studying chemical reactions with the aid of potential differences produced by a logical arrangement of reacting substances—a method which Ostwald seems to have originated and which he has developed into a chemometric method. One of the most valuable applications is in the study of oxidation and reduction, and it was, in fact, first used by Ostwald in such reactions in an investigation carried out with Bancroft. Such potential differences, according to the theory of Nernst, amply confirmed by experience, are a function, in the first place, of characteristic constants of the reacting substances and, in the second place, also, of the concentrations of the reacting substances, the ions, around the electrodes. The application to an organic problem will become clear by the consideration of a specific case. We remember that the oxidation of a great many organic compounds like aldehydes and sugars is most vigorous in alkaline solutions. We use ammoniacal silver solution and even sodium hydroxide with it as a most delicate test for such aldehydes, and alkaline Fehling solution for sugars. Is the alkali necessary to liberate silver oxide or copper oxide as the true oxidizing agent, as is often supposed? The physico-chemical method of investigation shown here easily leads to a correct analysis of the action; as a matter of fact, we find silver nitrate a far more powerful oxidizing agent than is ammoniacal silver oxide, and it is so because in both cases the oxidation is due to the tendency of the silver ions to discharge their positive electricity and that positive electricity is the real oxidizing agent here just as it is at the positive pole in every case where a current is passed through any solution whatever. In the silver-nitrate solution there is a far greater concentration of these discharging silver ions than in the ammoniacal solution, in which most of the silver is present in the rather stable complex ion, $[Ag(NH_3)_2]$. But the alkali is used to increase the concentration of the active reducing component of the aldehyde—which probably is a methylene salt $\pm$ CH(ONa) or its ion[3]—the alkali added to the silver nitrate is positively detrimental to the latter's oxidizing power. (Illustrated by an experiment with silver nitrate against formaldehyde and sodium nitrate; then alkali is added to the aldehyde, and finally ammonia to the silver nitrate.) It could be shown in the same way that the alkali used with Fehling's solution in the oxidation of glucose is used wholly for its action on glucose, and is rather a disadvantage than helpful as far as the copper is concerned. This method of investigation enables us, therefore, to analyze the action of our oxidizing and reducing agents, and it promises to lead us ultimately to a mathematical solution of the problem.

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[3] The oxidation of an aldehyde is best interpreted as being due to the oxidation of sodium oxymethylene (NaO)CH $\pm$, the two free valences of which may justly be considered to consist of a positive and a negative electric charge. Any oxidizing agent, *e. g.*, the positive current of electricity resulting from the discharge of the silver ions, would oxidize this as follows:

$$(NaOCH)\pm \text{ and 2 positive charges} \longrightarrow (NaO)CH\,{}^{+}_{+}$$

and the hydroxyl ions of the alkaline solution would by uniting with this residue give sodium formate:

$$(NaO)HC\,{}^{+}_{+} + 2\overline{OH} \longrightarrow NaO(HCO) + H_2O.$$

The two sodium ions belonging to the two hydroxyl ions used migrate to the silver nitrate cell in the chemometer, replacing the two silver ions which have been discharged—all of which corresponds to actual observation. (Views developed by Nef, W. A. Noyes and others are in part applied in this interpretation.)

SCIENTIFIC BOOKS

Psychology: General Introduction, pp. 389. *Laboratory Manual of Psychology,* pp. 127. *Laboratory Equipment for Psychological Experiments,* pp. 257. By CHARLES HUBBARD JUDD, Professor of Psychology at Yale University. New York, Charles Scribner's Sons. 1907.

Professor Judd's contribution to the available facilities for the teaching of psychology is a notable one. The plan is consistent, the execution capable, the result distinctive. The text becomes part one of the series of three volumes; a brief laboratory manual makes possible the performance of a considerable range of demonstrations and individual experiments, all reduced to as simple a material basis as is compatible with convenience; while the third volume furnishes the instructor with a *vade mecum* for management and equipment of his modest instrumental plant. The general plan thus provides for the "object lesson" conduct of an introductory course in psychology, suitable at once to colleges and universities and to normal schools that are ready to give psychology a prominent place in their schedules. The text becomes available alike with such illustrative experimentation and without it, or with such portion of it as meager facilities make possible.

In distinction from the more conventional text which implies and as a rule receives the supplementary exposition of demonstration, there have appeared at least four distinctive procedures for the rendering of first aid to the psychology inquisitive. Professor Sanford's volume was early in the field and adopted the orthodox laboratory-manual method of furnishing a large range of small experiments, each for the most part devoted to the illustration of a principle or minor factor in a carefully presented and elaborated scheme. Professor Titchener's apparatus is the most elaborate and the most advanced. He introduced the twofold division of a manual for the student and another for the instructor, and again divided the procedures into the qualitative and the quantitative type. Four sturdy volumes thus compose the basis for a course in experimental psychology. Moreover, the principle of the Titchener series is to select relatively few problems in the several fields and give to each a thorough and painstaking treatment, sufficient in many cases to yield a definite result in quantitative form. What is thus gained is a considerable training in the research methods of psychology—the procedures by which the standard results have been reached—or at least a worthy prolegomena thereto; what is sacrificed is the demonstration of a large range of phenomena almost equally important and certainly equally valid as illustrations of psychological principles with which the psychologist, amateur or professional, will have to deal. A third type of manual is that by Professor Witmer, which though a single volume of text, yet carries with it an experimental flavor by including a collection of all manner of devices by which paper and print may serve the experimentalist's purposes, and by an insistent use of questions and set exercises which the student may (if sufficiently urged) carry on to his own benefit. The fourth member is that now added by Professor Judd.

There is much to be said for each of these procedures; and the variety of pedagogical principles and practical experiences will determine the preference or expediency of each. Professor Sanford's idea was in the main that of letting each instructor choose his own text (or furnish it by lectures) and find in the manual a large enough range of illustrative material so that by choosing, omitting, intruding and transposing, he may build up an experimental course. Such a plan is of permanent value, is more nearly that which has found favor in other laboratory sciences and will always be preferred by a considerable proportion of the teaching psychologists. It is greatly to be regretted that Professor Sanford has not completed his scheme by writing the second part of his manual, which at this stage (with a revision of the first part) would serve the purposes of quite a number of courses now given in colleges. The great emphasis on illustrations of principles, the covering of a large range of observations, the furtherance of direct speaking relations between the student and the common mass of psychological data: these are the points that commend such a method, as well as the adaptability of the course to the perspective or even the prejudices of the instructor. Professor Titchener's plan, equally distinctive, equally legitimate as an ideal, and more suitable to the graduate student, yet inevitably is limited to a smaller and more professionally interested clientele. The work is authoritative in its own field and indispensable to any one engaged in the experimental enlightenment of students. Yet the attitude and the interest fostered by the Titchener volumes will fail to appeal to a considerable number of worthy students, whose ambition to become familiar with the spirit of the experimental inquiry in psychology deserves recognition. Professor Witmer's volume has the largest popular appeal; it aims to satisfy a less persistent type of interest and does so with skill and success; it is wholly free from the unfortunate type of popularization characterizing Professor Scripture's volume (in construction a very able book), while yet it pretends to be nothing other than what it is. It may be characterized without disparagement as a good summer-school course in psychology. Professor Judd's series occupies the middle ground in the group. It forms a system of text and experimentation, though with a possible independent use of each; like the Titchener series, it gives practical laboratory guidance to the instructor; like that, too, though not for like reasons, it limits its practical exercises to a rather few problems; yet it shares with Sanford the emphasis of principles and takes for granted about the same level of maturity and earnestness of interest as does the use of the Sanford volume. Yet Judd's book is compatible with the very minimum of hours devoted to practise work, and in that emulates the Witmer volume. It thus becomes clear that the Judd series should find a place amid the sorts and conditions that affect the instruction in psychology in our colleges, and with a favorable environment and able handling, the volumes will do good service. They will also serve the cause of psychology by making available and thus comprehensible to a larger body the close relation of views on life and mind and the scientific attitude towards their examination.

Without risking further so much of the odium of comparison as seemed necessary to place Professor Judd's volume among its fellows, one may proceed to some account of the text. Professor Judd favors an indirect and objective attack upon the problems of mental experience. An introductory setting forth of psychology, what it aims to do and how it proceeds, a survey of the nervous system in its evolutionary phases, a more minute survey of the nervous system of man and of its action, precede the general unfoldment of conscious experience from which the rest of the volume takes its order and unfoldment. For the systematic groupings and analyses of mental experience prove to be those connected with sensations and their functional issue in relations to the outer world with its setting in space and time, and then most naturally the culmination and motivation of these in the expression of action and behavior. The conduct thus resulting presents gradations and complications, and in turn involves subjective attitudes and analyses of various degrees of complexity. Instinct, memory, imagination, the self feelings, impulse and choice, further engage the psychologist's attention, while two concluding chapters, the one upon dissociation and the other upon applications of psychology, widen the outlook to include certain corners of the abnormal field and the embodiment of psychological results in educational practise.

Every one having to do with texts in his teaching specialty comes to regard a new applicant for favor under apperceptive criteria of his own. The present writer considers first the content, the material presented, the perspective of topics and the enlightenment available: what kind of a table has the psychological caterer set? He considers next—though really concomitantly—the spirit of the presentation, the tone, the attitude of the craftsman. This is more than the palatability of the viands; it involves the underlying chemistry of food preparation, the esthetics of the art culinary and a knowledge of appetites and their vagaries and shortcomings. He asks thirdly how will the student react when the feast is spread before him, remembering that the diet is to be adhered to for a semester or longer. The notable success of Professor Judd's text is in the first respect. It sets a substantial and admirably selected diet. The emphasis upon the genetic side of things is real and instructive, not forced, superficial and distorted, as appears in so many attempts in "psychology for teachers." The contact with realities of experience is close; and the student should feel the realism of his study. Again the tone is thoroughly psychological; while thoroughly sympathetic with physiological results, it insists upon psychological interpretations. It equally avoids undue absorption in controversial issues and philosophical speculations. On the second count, except as already involved, commendation must give way to criticism. The author fails to bear in mind that he is teaching, presenting, expounding, not justifying the details of his presentation, or disclosing how he or his brother psychologists have come to hold as they do. This fault of Professor Judd's pages both unduly expands and detracts from their merit, and such digressions are an obstacle to the student and wholly foreign to the underlying purpose of the text. It is an error of judgment rarely found in a text-book in physics, but seems to be a temptation for the majority of writers of "psychologies." Equally must it be pointed out that the forest does not appear very plainly or very attractively among the trees. There is a little too much detail, a little too little contouring of the larger topography. The map is serviceable, but not illuminating. On the third count the writer must frankly express his doubts. The genus student is a difficult guest and his reactions uncertain. Doubtless he likes not that which is good for him, and partakes in large quantities of what is pernicious. Yet, after all, he has a rather versatile appetite which responds to judicious encouragement. Plainly, the diet must be made attractive. Professor Judd's book is not emphatically unattractive from the student's point of view; yet in this respect, it does not compare in success of achievement with several of its rivals for collegiate favor—notably with Professor Angell's text.

Writing texts is like much else, a matter of temperament. The good text-writer is largely born and not made—at least not by the publisher's solicitation. Nor have the best teachers always proved themselves the best writers of texts. The conditions are not unlike those attaching to the construction of ocean steamships, requiring one model for speed and another for cargo. Each result is a compromise; though some are plainly freighters; and others lightly burdened greyhounds. Solidity of content and attractiveness of exposition are not incompatible; but when they are found in marked degree, the possessor thereof should feel within him the call to write a text. In the meantime we shall be content with what there is, and welcome Professor Judd's volumes to a place among their fellows.

JOSEPH JASTROW

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for February has an article on "The Law of Geminate Species," by David Starr Jordan, geminate species, being two closely related species, found on opposite sides of some natural barrier. Henri Hus discusses "Fasciations of Known Causation," noting that these abnormalities may be transmitted by seeds or cuttings. Charles A. White treats of "The Aggregate Origination of Parasitic Plants" and Charles Depéret of "The Evolution of the Tertiary Mammals and the Importance of their Migrations," considering the changes in the fauna of certain European beds as brought about by local evolution and by immigrations from North America and other regions. G. H. Parker considers "Zoological Progress" or the increase in our knowledge of the animal kingdom. Under "Notes and Literature" variation in *Amblystoma tigrinum* finds itself under *In*vertebrate Morphology.

Bird-Lore for March–April has articles on "The Home Life of the American Egret," by Frank M. Chapman; "The Background of Ornithology," by Spencer Trotter; "The Nest in the Gutter," by Gilbert H. Trafton, and the third paper on "The Migration of Flycatchers," by W. W. Cooke. Under "The Common Names of North American Birds" Edward H. Perkins proposes changes in some inapplicable names. The Audubon leaflet is by Mabel Osgood Wright and is devoted to the song sparrow. A new bird reservation in Florida, known as the Mosquito Inlet Reservation, is announced.

The Zoological Society Bulletin for April is an "Aquarium Number" and deals with all manner of aquatic animals. There are articles on "The Natural Foods of Freshwater Fishes," "Porpoises, Long-lived Fishes"—some of which have lived in the Aquarium for fourteen years—"The Sturgeons, Electrical Fishes and Luminous Fishes." "The Largest Marine Animals" gives much information on the size and weight of many species and "A Large Lobster" records a specimen twenty-three and three quarter inches from tail to rostrum and weighing thirty-four pounds. It is announced that an effort will be made to capture some porpoises by means of a heavy seine and bring them alive to the aquarium.

SOCIETIES AND ACADEMIES

THE BOSTON SOCIETY OF MEDICAL SCIENCES

COMPARATIVE ANATOMY AT THE HARVARD MEDICAL SCHOOL

A SPECIAL meeting of the Boston Society of Medical Sciences, devoted entirely to the current work of the Department of Comparative Anatomy, was held at the Harvard Medical School on the evening of April 7. A brief paper was presented by every member of the department, and by Dr. Meigs, who has used the laboratory for the histological portion of his studies concerning the physiology of muscle. After the meeting there was an extensive demonstration of preparations illustrating the papers presented, and the laboratories were open for inspection. Serial sections of the eggs of the Mexican axolotl were exhibited, showing all the important stages of maturation and fertilization; eighty of these series have recently been added to the embryological collection. They were specially prepared by Dr. J. W. Jenkinson. From the following abstracts it will be seen that a considerable variety of scientific topics was discussed, all of which are of medical interest.

Dr. E. B. Meigs described the histological differences between relaxed and contracted smooth muscle fibers.

A number of physiologists have supposed that muscular contraction might be the result of the passage of fluid from one part of the muscular tissue to another, and recent comparisons between histological preparations of relaxed and contracted striated muscle indicate that, during the contraction of this form of muscle, fluid passes from the sarcoplasmic spaces into the fibrillæ or sarcostyles.

The present investigation consists in a comparison between preparations of uncontracted and contracted smooth muscle. The results indicate that in smooth muscle also there is a passage of fluid from one part of the tissue to another during contraction, but that the movement in this case is opposite in direction to that which takes place in the case of striated muscle; the contraction of smooth muscle seems to be accompanied by a passage of fluid from the contractile cells to the intercellular spaces.

The histological results in the case of both striated and smooth muscle are in harmony with the reactions of the two tissues to swelling reagents and their opposites. Striated muscle immersed in distilled water, or in various other reagents which are absorbed by it, slowly goes into contraction; and pieces of muscle which have been caused to contract in this manner may be made to lengthen slowly by immersion in reagents which abstract water from them. Both kinds of reagents have exactly the opposite effects on smooth muscle.

Dr. L. W. Williams discussed the notochordal origin and the histogenesis of the nucleus pulposus. The notochord of the young mammalian embryo is a continuous rod of uniform diameter. It is composed of clearly defined cells surrounded by a thin outer, and a thick mucin-containing inner sheath. The deposition of inter-cellular substance in the embryonic vertebral cartilage squeezes the notochord into the intervertebral discs, where it forms the nuclei pulposi. Within the vertebræ, the notochordal tissue degenerates. The sheaths after becoming calcified are finally destroyed by bone-forming tissue. Within the nucleus pulposus, the loss of cell-walls converts the notochordal tissue into a syncytium with mucin in its meshes. It closely resembles embryonic connective tissue. The notochordal nuclei multiply rapidly by mitotic division. The intercellular substance increases in volume and finally separates the syncytium into small vacuolated masses of protoplasm, similar to fat cells. Each cell is spherical and usually has two nuclei, which lie in a small amount of cytoplasm separating two or more large vacuoles. It was shown that the notochord in man normally has a sinuous course in the base of the skull, and that chordoma usually occurs at the points where the notochord comes nearest to the upper surface of the bone.

Dr. V. E. Emmel presented some results of his studies in regeneration and growth. According to Conklin's hypothesis inverse symmetry in mollusca and perhaps also situs inversus in man are due to an inverse organization of the egg, corresponding with maturation at opposite poles. It does not accord with this theory that until the fourth molt the large crusher claw of the lobster may be made to develop on either the right or the left side. In the larval lobster the first pair of claws or chelæ are alike and symmetrical, but at about the fifth molt a transition from symmetrical to asymmetrical differentiation of the chelæ normally occurs. The experiments were planned to show to what extent asymmetrical differentiation can be controlled by the amputation of one chela, thus giving the remaining chela the greater advantage in growth. The results show (1) that up to the fourth molt right or left asymmetry of the chelæ may be produced at the will of the experimenter; (2) that during the fifth stage (*i. e.*, between the fourth and fifth molts) experimental control ceases; and (3) that in later stages of development, when the asymmetry of the chelæ has become established, the amputation of one or both chelæ does not reverse the original asymmetry. It appears, therefore, that the factors controlling asymmetry become operative after hatching and are correlated with conditions of growth. The histological changes which occur at these stages of growth and regeneration are being studied.

Mr. R. E. Scammon discussed the accessory chromosome as a determinant of sex. He showed original preparations of the male germ cells of insects, similar to those which led McClung to formulate his theory of the accessory chromosome as a sex-determinant. There were also exhibited several preparations of orthopteran germ cells in which the accessory forms part of a huge multiple chromosome. The behavior of the accessory in these forms was discussed in the light of the recent work of Wilson and others, and the relation between the condition of the accessory chromosome in the Orthoptera and other insect types was shown.

Dr. F. W. Thyng described several models of the pancreas in embryos of the cat, rabbit, pig and man. In the embryos studied no reason was found for subdividing the ventral pancreas into independent right and left parts. Attention was called to the marked differences between the human pancreas and that of the other animals studied. The pancreas of the rabbit and pig usually encircles the portal vein; frequently it does so in the cat, but, apparently, no such occurrence has been recorded in man. The probable manner of development of the rare human anomaly in which the pancreas surrounds the intestine, was explained. In addition to the two human embryos modeled, eighteen others were studied. In all of these the dorsal pancreas joined the intestine nearer the stomach than the common bile duct, but in the other mammals this condition was reversed.

Professor F. T. Lewis, in describing the intestinal diverticula of mammalian embryos, cited Osler's tribute in 1881, to Meckel, who wrote of diverticula in 1812. "In the Handbuch der pathologischen Anatomie the subject is treated at great length and we have an admirable example of the thoroughness with which the older anatomists did their work. No detail has escaped him, and I doubt if any new point in structure or mode of development has since been determined." Until recently, however, the regular occurrence of epithelial diverticula along the small intestine of mammalian embryos has apparently been overlooked. There may be as many as forty-eight of these in a human embryo of 22 mm. Usually they degenerate, but it is possible that they may persist to form anomalous diverticula in the adult. There is reason to believe that elongated forms may become detached, thus giving rise to mesenteric cysts. The embryonic diverticula are discussed at length in the current number of the *American Journal of Anatomy* (Vol. 7, pp. 505–519).

Dr. John L. Bremer described aberrant roots and branches of the abducent and hypoglossal nerves. In the interval along the ventral portion of the medulla between the roots of the abducent and hypoglossal nerves, nerve roots are found in certain human embryos from the fifth to the tenth week. Of these roots there are two classes: one running ventrally, as though to join the hypoglossal or abducent nerves, or to join the glossopharyngeal nerve, to which no ventral branch has been recognized heretofore; and the other class running laterally, to pass just posterior to the accessory nerve, or, if arising further forward, to pass just posterior to the glossopharyngeal nerve. Roots of this latter class, from their distribution, seem to represent the fibers which, in a spinal nerve, form the ramus dorsalis. The fibers of both sorts which pass anterior to the vagus seem to indicate the remnants of a ventral root to the glossopharyngeal nerve.

Professor Minot in conclusion spoke of the relations of the new department of comparative anatomy to the general work of the school. The department was organized through the interest of President Eliot, with the intention of broadening the scope of the scientific work in the new buildings, and of cooperating with investigators in anatomy, physiology and pathology. It is expected that it will contribute an essential part to the advanced teaching and research for which the new laboratories are specially designed and endowed. The old department of histology and embryology has been merged with comparative anatomy, to the financial advantage of the school. The chief energy of the new department is devoted to the first-year teaching. The instruction is designed, not to produce specialists in anatomy, but to meet the needs of practitioners in medicine, and to prepare students for their later work in the school. In the fourth year there are courses for specialists both in clinical subjects and in anatomy. The papers read at this meeting indicate the scope and variety of the research work going on in the department.

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and thirty-eighth regular meeting of the society was held at Columbia University on Saturday, April 25, extending through the usual morning and afternoon sessions. The attendance included thirty-five members. President H. S. White occupied the chair, being relieved at the afternoon session by Professor C. J. Keyser. The following new members were elected: Professor H. E. Buchanan, Lincoln College, Lincoln, Ill.; Mr. E. F. A. Carey, University of California; Professor F. E. Chapman, Southern University, Greensboro, Ala.; Professor R. C. Maclaurin, Columbia University; Mr. E. J. Miles, University of Chicago; Mr. C. A. Stiles, University Preparatory School, Ithaca, N. Y.; Mr. J. S. Thompson, Mutual Life Insurance Company, New York; Mr. O. A. Turney, Phoenix, Ariz.; Mr. C. B. Walsh, Ethical Culture School, New York; Professor R. T. Wilbur, Christian Brothers College, St. Louis; Miss E. R. Worthington, Yale University. Ten applications for membership were received.

Professor E. B. Van Vleck was reelected a member of the editorial committee of the *Transactions*, to serve until 1911. It was decided to hold the summer meeting and colloquium of the society in 1909 at Princeton University, and Professors Fine, Osgood, Holgate and the secretary were appointed a committee to make appropriate arrangements. A committee consisting of Professors P. F. Smith, Keyser and Bliss was appointed to consider the advisability of holding the annual meeting of the society at Baltimore in affiliation with the American Association for the Advancement of Science.

The following papers were read at this meeting:

S. E. Slocum: "The collapse of tubes under external pressure."

E. B. Wilson: "On the differential equations of the equilibrium of an inextensible string."

E. B. Wilson: "On the principle of relativity."

E. Swift: "Note on the second variation in an isoperimetric problem."

J. I. Hutchinson: "The hypergeometric functions of n variables."

E. Kasner: "Note on Meusnier's theorem."

B. F. Finkel: "Determination of the groups of order 2^m which contain self-conjugate cyclic subgroups of order 2^{m-4} and whose generating operations correspond to the partitions $[m-4, 4]$, $[m-4, 3, 1]$."

J. W. Young: "Two-dimensional chains and the classification of complex collineations in a plane."

C. N. Moore: "On certain constants analogous to Fourier's constants."

P. Saurel: "On the distance from a point to a surface."

E. B. Lytle: "Multiple integrals over iterable fields."

P. A. Lambert: "The fundamental theorem of algebra."

E. V. Huntington: "On the fluctuations in the speed of a flywheel."

E. V. Huntington: "On the theory of the gyroscope, with special reference to the Brennan monorail car."

O. E. Glenn: "Studies in the theory of degenerate algebraic curves."

The Chicago Section of the society met at Chicago on April 17–18. The summer meeting of the society will be held at the University of Illinois on September 10–11.

F. N. Cole,
Secretary

THE TORREY BOTANICAL CLUB

The meeting for March 10, 1908, was called to order at the American Museum of Natural History at 8:30 P.M. by the chairman of the program committee. There were twenty-five persons present. The scientific program consisted of an illustrated lecture entitled "On Horseback through Hayti," by Mr. George V. Nash, and was listened to with great interest by all present.

Tracy E. Hazen,
Secretary pro tem.

The meeting of March 25, 1908, was held at the museum of the New York Botanical Garden, with Dr. John Hendley Barnhart in the chair. The minutes of the meetings of February 26 and March 10 were read and approved. A special committee of the club, appointed on February 11, reported as follows:

"At a regular meeting of the Torrey Botanical Club held at the American Museum of Natural History, February 11, 1908, a committee was appointed to draft resolutions concerning the death of the late Morris K. Jesup.

"Be it therefore *Resolved,* That the secretary be instructed to enter in the proceedings of the Torrey Botanical Club, and transmit to the board of trustees of the American Museum of Natural History, this record of our sincere regret at the loss of one who always manifested such a broad and deep interest in all matters pertaining to natural science."

The report of this special committee was unanimously accepted and adopted. The scientific program was then taken up and two papers were read, of which the following abstracts have been furnished by the authors:

Botanical Experiences in Western South Carolina: Homer D. House.

The richness of the flora of the southern Allegheny Mountains was commented upon, special attention being called to the beauty of the mountains in early June, when several species of *Azalea* and *Rhododendron* are in bloom. Two trips into the mountains were described, one to Jocassee Valley for *Sherwoodia* (commonly known as *Shortia*) and to Tomassee Knob and Tomassee Falls. At the latter place several northern plants were collected, among others *Viola canadensis, Trillium grandiflorum, Filix bulbifera* and *Dryopteris Goldiana.* The second trip was to Rabun Bald in Georgia during early June. The top of this mountain is covered with *Rhododendron catawbiense,* which was at that time in full bloom. In the thickets around the coves on the eastern slope of the mountain a new species of bindweed, *Convolvulus sericatus,* was found. *Viola rotundifolia* also was found here, as well as in adjacent South Carolina, thus considerably extending its known range. The speaker exhibited a large number of specimens, several of them new to South Carolina, and commented upon their distribution.

Observations on the Nutrition of Sarracenia: Winifred J. Robinson.

Plants of *Sarracenia purpurea,* the common northern pitcher-plant, were exhibited and several colored illustrations of the plant in flower were shown.

The present series of experiments was undertaken under the direction of Professor William J. Gies at the New York Botanical Garden in the summer and autumn of 1907 to determine the digestive power of *Sarracenia purpurea* on carbohydrates, fats and proteids. Solutions of great difference in concentration were introduced into the pitchers and it was found that they resisted distilled water and 33⅓ per cent. sugar solution equally well. Acid and alkaline solutions of a very low concentration had no apparent effect upon the pitchers, but a 0.5 per cent. solution of acetic acid and a 1 per cent. solution of potassium nitrate both proved injurious. Sachs's nutrient solution caused the pitchers to decay within a few days. Liebig's meat extract was used as a test of the effect of a stimulant.

Bacteria and infusoria developed in great numbers and decay began in a few days. Solutions of milk in distilled water of different proportions were used, from the results of which it was inferred that the pitcher produced an alkaline substance which reacted with the acid produced in a very dilute solution of milk but was not sufficient to neutralize solutions of greater strength. There was nothing to indicate that the milk fat or protein was digested. Solutions of grape-sugar and cane-sugar of different proportions were placed in the pitchers and there were no indications of a detrimental effect upon them. With Fehling's solution the contents of the pitcher, after the sugar solution had been allowed to remain in them several days, gave a reddish precipitate of copper-oxide, indicating the presence of invert sugar. The reduction was most marked in a 10 per cent. solution of cane-sugar. Starch paste was allowed to remain in the pitchers from three to seven days, when it was removed and tested by boiling with Fehling's solution. The reddish precipitate indicated that a reduction had taken place, though it was not so marked as in the case of the cane-sugar. The addition of an antiseptic did not hinder the reduction of the cane-sugar or starch. Olive-oil and ethyl-butyrate were used to test the fat-digesting power of *Sarracenia,* but the results indicated no digestion. Fibrin was used to determine the digestive power upon protein, but the results were negative. These results as to protein correspond with those obtained by Schimper in 1882 (*Bot. Zeit.* 40: 225) and by Goebel in 1893 (*Pflanz. Biol. Schild.* 2: 186).

Marshall A. Howe,
Secretary pro tem.

DISCUSSION AND CORRESPONDENCE

VERY HIGH CUMULUS CLOUDS

To the Editor of Science: The conflagration in the city of Chelsea on April 12 caused cumulus clouds to form at a great altitude. At Blue Hill Observatory, situated 14 miles south and 630 feet higher, in the afternoon the temperature was 45° and the relative humidity 14 per cent., with a gale from the west-northwest. The sky was cloudless, except for a succession of flat, white cumulus which formed at the top of an immense inclined column of smoke that was highest over Boston harbor and about twelve miles from Chelsea. After drifting further to leeward these clouds slowly dissolved as they sank into a warmer stratum, because no longer supported by the rising smoke. Approximate angular measurements made at Blue Hill by Mr. L. A. Wells and in Boston by the writer, when combined with the direction of the smoke, gave the minimum height of these clouds between four and five miles. Their relative velocity as compared with the surface wind also indicated that they were much higher than the ordinary cumulus clouds which float at the level of about a mile.

Artificial conditions gave rise to these clouds, since the air was too dry for the convectional currents at their normal height to cool to the dew-point, even if they had not been broken up by the strong wind. The air, which was intensely heated by the fire, however, maintained its potential excess of temperature over the surrounding air long enough to ascend to so great a height that its small vapor content was condensed into cloud, when it formed not, as is usual, "the visible capital of an invisible column," but the white crown of a brown mountain.

Mr. S. P. Fergusson described in Science, Vol. X., p. 86, the formation over a fire of similar clouds whose height was also measured from two stations, but in this case the clouds had only half the altitude of those recently observed. In thunder-storms, however, the cumulo-nimbus rise into the cirrus level and their tops have been measured at Blue Hill above eight miles, or nearly twice as high as the cumulus caused by the Chelsea fire.

A. Lawrence Rotch
Blue Hill Meteorological Observatory,
April 22, 1908

CLOUDS OVER A FIRE

The great fire in Chelsea, Mass., on Sunday, April 12, 1908, which burned more than two square miles of city blocks, began under conditions of clear sky and high west to northwest winds. Between two and three o'clock in the afternoon, about three hours after the fire started, the updraft was sufficiently strong to overcome the high wind and occasionally to carry water vapor to the level of cloud formation. Cumulus clouds resulted, capping the smoke, and appearing or disappearing according as the latter rose or failed to rise to the necessary altitude. So near to this altitude was the average summit of the smoke that it was possible for the writer, on seeing an especially vigorous puff from the fire, to predict the formation of a cloud some seconds in advance of its appearance. The clouds did not, as far as could be seen from a position directly to windward of the fire, attain to well-rounded, typical cumulus forms. They varied from mere flecks of white to moderately large but flattish masses and were usually dissipated within five minutes from the time they became visible. Their bases were more or less mingled with and hardly distinguishable from the summit of the smoke-cloud; it was therefore impossible to tell whether or not they were typically flat-based. The clouds appeared to be formed not directly over the fire, but a very considerable distance to leeward, where the high wind first permitted the rising air to reach its dew-point altitude.

The occurrence of these cumuli recalls a similar phenomenon over the burning coal pockets of the Boston & Maine Railroad close by at Charlestown in December, 1896, and noted by Professor R. DeC. Ward in Science for January 8, 1897. In this instance the greater concentration of the fire and the consequent greater proportion of water-vapor carried aloft, caused the development of a far more perfect cumulus cloud than that formed over the widely scattered Chelsea fire.

B. M. Varney

Harvard University,
April 30, 1908

THE INFALLIBILITY OF NEWTON'S LAW OF RADIATION AT KNOWN TEMPERATURES

Although there is no direct reference to "the absolute temperature of space" (on which hinges the whole question of the sun's *effective* surface temperature) in Professor Very's paper published in the last number of Science, it is clear that he is still inclined to favor the claim that the temperature of space is in the neighborhood of 300° C., notwithstanding the demonstration I have given, showing that the temperature is probably less that 2° C.

The title of the present article gives evidence that I wholly disagree with Professor Very when he claims that Stefan's law is in better agreement with actual observation than is Newton's law.

Just why I regard Stefan's law as wholly wrong will appear from the theoretical results given below. How such erroneous laws similar to that of Stefan's ever came to be deduced can be largely inferred from the contents of a paper on "The Earth as a Heat-radiating Planet," sent to the editor of Science on December 25, 1907, but not yet published at the time of this writing.[1] In that paper (where, for obtaining the terrestrial radiation into space, the *effective* surface-temperature of the earth is provisionally placed at 200° C.) it is made evident that according to my results "serious changes in the constants of radiation in the formulæ accepted to-day" (to quote part of a sentence from Professor Very's article) must actually be made.

I shall now demonstrate that both theoretically and experimentally *Newton's law gives uniformly consistent results when the observations are properly interpreted,* and that Stefan's law leads to absurd and unintelligible results at known temperatures.

Let us first conceive that the observations were made in free space, the two totally different expressions for the absolute temperature of space will then read

For Newton's law $t = T(d/D)^2 = 0°.7$
For Stefan's law $t = T\sqrt{d/D} = 300°$.

Since the temperature of space must be taken as constant in each case we obtain for comparison the two sets of values of T, for different values of D, given in the second and third columns of the following table:

[1] Published in Science for March 6, 1908.

$\frac{D}{d}$	T Absolute		Newton $T_0 = 300°$
	Newton	Stefan	
1	0°.7	300°	300°.7
2	2.8	424	302.8
3	6.3	520	306.3
4	11.2	600	311.2
10	70	949	370
20	280	1,342	580
30	630	1,643	930
40	1,120	1,897	1,420
53.4	2,000	2,192	2,300

Considering now, for example, the temperatures corresponding to the values 1 and 2 for D/d, the total failure of Stefan's law is at once apparent, for while the increase of temperature corresponding to an increase in the aperture from $D = 0.337$ in. to $D' = 0.674$ in. is consistently 2°.1 C. according to Newton's law, the increase according to Stefan's laws is 124°.0 C., an absurd result! Again, as the other waves direct from the sun enter and reach the bottom of the earth's atmosphere the focal temperature due to these *direct* waves must evidently be measured from a totally different starting-point. If the absolute temperature of air at the place of observation is T_0, then T_0 must be taken as the origin from which the temperatures, properly belonging to the *direct* solar radiations alone, must be measured. If for the present case we have $T_0 = 300°$ C., the theoretical values given in the fourth column will result from Newton's law. Now when we come to apply this same line of reasoning to Stefan's law, the data given in the third column become both absurd and unintelligible for ordinary temperatures (corresponding to small values of D)!

Much of the confusion heretofore existing regarding the temperature of space can, in my opinion, also be traced to the largely prevalent but mistaken idea that the ordinary mercurial thermometer is a suitable instrument for measuring *direct* radiations, when in fact this thermometer then simply measures the stored-up energy trapped in the "hot-house"-like form of this particular instrument. The ideal thermometer will be one which gives instantaneous results, since the intensity of the ether vibration is independent of the time. For this reason the platinum plate in my observations was hammered so thin that the evidence of melting was secured from practically instantaneous exposures in the solar focus. It will be noticed that for the value 53.4, corresponding to $D = 18$ inches, I have assumed the actually measured focal temperature to be 2,300° C.; the excess over the accepted value for the temperature of melting platinum I have roughly estimated to be equal to the losses resulting from causes similar to those which Professor Very mentions in the second paragraph of his paper.

In any case, I hold that however great the possible error of my measured value for the focal temperature may be, this error can not affect the validity of my theoretical formulas.

J. M. Schaeberle

Ann Arbor, Mich.,
February 17, 1908

SPECIAL ARTICLES

THE HEREDITY OF SEX

In *Proceedings of the Zoological Society*, 1906, I., p. 125, Doncaster and Raynor described certain remarkable experiments respecting the inheritance of the moth *Abraxas grossulariata* and its variety *lacticolor*. This variety was originally known in the female form only. Experimental crossings showed the following results:

1. *Lact.* ♀ × *gross.* ♂ gave F_1 ♂s and ♀s all *gross.*

2. F_1 *gross.* ♀ × F_1 *gross.* ♂ gave *gross.* ♂s, *gross.* ♀s and *lact.* ♀s; no *lact.* ♂ being formed.

3. *Lact.* ♀ × F_1 *gross.* ♂ gave all four possible forms, *gross.* ♂s, *gross.* ♀s, *lact.* ♂s, *lact.* ♀s. The ♂ lacticolor thus raised were the first that had ever been seen.

4. F_1 *gross.* ♀ × *lact.* ♂ gave *all* ♂s *gross.* and *all* ♀s *lact.*

In discussing this curious series of facts Doncaster adopted Castle's view that each sex was heterozygous in sex, and that each gives off male-bearing and female-bearing gametes. He then shows that if it be assumed (1) that in the F_1 ♀ there is coupling such that the male ova all bear the *grossulariata* factor and the female ova all bear *lacticolor;* (2) that in the gametes of the male there is no coupling; (3) that in fertilization union can only take place between gametes bearing opposite sexes; (4) that dominance attaches to the sex brought in by the ovum; the observed results would be produced.

On reexamination of the case we have found a much simpler and, as we think, more probable account of the phenomena. Two assumptions only are needed: (1) that one female is heterozygous for sex, femaleness being dominant, and the male a homozygous recessive; (2) that when in F_1 the two dominants, femaleness and the *grossulariata* factor coexist, there is a repulsion between them, such that each gamete takes one or other of these two factors, not both. Such mutual repulsion of two dominants has already been shown to occur in the sweet pea when a plant is heterozygous for the upright standard and for the blue factor, constituting what must be regarded as a spurious allelomorphism between them.[1]

The whole series of facts is then consistently represented as follows, D and R representing the presence and absence of the *grossulariata* factor:

1. *lact.* ♀ × *gross.* ♂

	RR ♀♂	DD ♂♂
F_1	*gross.* ♂ DR ♂♂	*gross.* ♀ DR ♀♂

2. F_1 *gross.* ♀ × F_1 *gross.* ♂

composition	DR ♀♂	DR ♂♂
gametes	{D ♂ {R ♀	{D ♂ {R ♂

F_2	2 *gross.* ♂ DR ♂♂ DD ♂♂	1 *gross.* ♀ DR ♀♂	1 *lact.* ♀ RR ♀♂

3. *lact.* ♀ × F_1 *gross.* ♂

RR ♀♂	DR ♂♂

1 *gross.* ♂	1 *gross.* ♀	1 *lact.* ♂	1 *lact.* ♀
DR ♂♂	DR ♀♂	RR ♂♂	RR ♀♂

[1] Science, N. S., XXVI., p. 655.

4. F_1 *gross.* ♀ × *lact.* ♂

DR ♀♂	RR ♂♂
gross. ♂ DR ♂♂	*lact.* ♀ RR ♀♂

The numbers originally obtained were very wild and irregular, but on repeating the experiments Doncaster got results which are numerically very close to expectation.[2]

Attention is drawn to this case as illustrating the great value of evidence respecting dissimilarity in reciprocal crosses for the elucidation of the problem of sex-heredity. We have long been engaged on a more complex case of this kind, the heredity of the black pigmentation of the Silky fowl, in its crosses with brown Leghorns and other fowls with light shanks. The facts there also point very clearly to a similar solution, but it may be some years before the evidence is complete.

On general grounds it seems to us probable that one and not both sexes of the same organism will be shown to be heterozygous for sex, and that the approximately equal output of the two sexes in ordinary cases is a consequence of this. Correns[3] has lately shown that his experiments with *Bryonia* suggest that in that plant it is the male which is heterozygous. Russo[4] from his experiments

[2] *Nature*, 1907, LXXVI., p. 248.

[3] *Bestimmung und Vererbung des Geschlechtes*, Borntraeger, 1907.

[4] *Atti Ac. Lincei*, 1907. Heape (*Proc. Roy. Soc.*, Vol. 76, B, 1905) described in the rabbit processes by which ovarian ova frequently degenerate, apparently as a normal occurrence. Mr. Heape very kindly gave us an opportunity of examining his preparations, and it was impossible to avoid being impressed with the general resemblance which such degenerating ova bore to those which Russo regards as destined to become males. Consequently before that view of their nature is adopted, the relation of the so-called "male" ova to the degenerating ova will need very careful study; for it seems as yet not unlikely that those differences which Russo has taken to indicate maleness may prove to be due to incipient degeneration. Also as regards the important question of the alleged effect of lecithin in increasing

on rabbits concludes that sex is determined by the ova, which he regards as male and female, respectively, or in Mendelian terminology, that it is the female which is heterozygous.

There is, we think, no reason *a priori* why in nature generally dominance should be the special property of one sex alone. We rather anticipate that dissimilarity will be found between the great groups in this respect.

Consistently with the view that in Vertebrata the female is heterozygous, the production of male secondary sexual characters ensues in the female consequent on ovarian disease, while castration of the male produces effects which may perhaps all be regarded as arrests of development. In the Crustacea, however, the work of Geoffrey Smith and of Potts on parasitic castration points to the converse conclusion, namely, that the male is there heterozygous for sex, assuming definite female characters when castrated, while in the female castration merely arrests development.

Correns refers to E. B. Wilson's facts respecting the accessory chromosome as supporting the view that the male is the heterozygous sex, and we have lately done the same.[5] Doncaster, however, has pointed out to us what must be a serious difficulty in the application of this argument; for if the male sex be dominant, it has then to be supposed that dominance attaches not to the presence of the accessory chromosome, but to its absence, since it is in the female that the accessory chromosome is paired. Great weight we think must be given to this criticism. Dominance, as we now suppose, is due to the *presence* of something which is *absent* from the recessive, and we are almost precluded from imagining that the absence of a chromosome can be a cause of the dominant quality.

In order to bring the facts of sex inheritance in the parthenogenetic forms (bee, aphis) into line with our view, it would perhaps have to be supposed that sex segregation in these types takes place not between gametes, but between the primitive soma and the germ plasm, so that the ova would all bear the recessive male character and the spermatozoa the dominant female factor. To discuss this suggestion in detail would, however, carry us beyond the scope of this note.

R. C. Punnett
W. Bateson

Cambridge, England,
March 19, 1908

the output of females, an opinion can scarcely be formed on the cases published by Russo, for these are declared to have been selected. It is to be hoped that the full statistics will soon be published.

[5] Science, XXVI., 1907, p. 658.

PRE-CAMBRIAN ROCKS IN SOUTHEASTERN WYOMING[1]

During the past summer the ancient rocks of the Laramie and Sherman quadrangles in southeastern Wyoming were studied in some detail. The maps cover a portion of the Laramie Mountains and the easternmost spurs of the Medicine Bow range. It appears that most of the region is underlain by a coarse-grained red granite, but there are scattered patches of older rocks which show various degrees of metamorphism and bear complex relations to one another.

The oldest rocks recognized in the district are a series of schists and gneisses, which are largely metamorphosed volcanics, although they contain some rocks clearly of sedimentary origin, and others which are doubtful. The supposed volcanics include hornblendic schists and schistose rhyolites. Some occur in the form of dikes, while breccias indicative of surface extrusives were recognized in several places. Certain highly quartzose rocks and tremolite-schist are interpreted as altered sediments. The rocks are so highly folded, metamorphosed and cut by later intrusions that the relations of the different members to each other are very obscure and have not yet been elaborated.

Next in age follows a group of granitic gneisses, which are evidently metamorphosed granites. They are clearly intruded into the schists just mentioned. There are at least two distinct varieties of these gneisses: one

[1] Published by permission of the Director of the U. S. Geological Survey.

a coarse-grained gray-to-pink biotite-gneiss and the other a highly acid pink muscovite-gneiss of finer texture. The latter was found intruded into the former.

A variant group of semi-metamorphosed basic intrusives is somewhat younger than the gneisses. These include syenites, gabroid and dioritic rocks. In some of these rocks a gneissic structure has been induced, while others are not notably altered. It is evident that they are of different ages relatively to each other, although belonging to the same general interval of time in the section.

In the northern part of the Sherman quadrangle gray anorthosite, or labradorite rock (with or without hornblende), is exposed over wide areas. It is intruded into the schists, granite-gneiss and dioritic rocks, but is itself essentially unaltered.

On the east side of the district the gneisses are further intruded by a quartz-porphyry, which is so little altered that it is believed to be younger than the basic intrusions, although it may be older than the anorthosite.

All of the foregoing formations are surrounded and probably underlain by the great mass of coarse red granite, to which the name "Sherman granite" has been given. The contact surface is in many places so nearly horizontal that bodies of gneiss and schist form outliers on hill-tops, while the valleys have been trenched through into the younger granite. Dikes of all sizes emanate from this foundation and traverse gneisses, schists, porphyries and gabbros indiscriminately. The granite itself is essentially unaltered, except that it is deeply weathered at the surface. It is crossed by a moderate number of small dikes, consisting of fine-grained granite, pegmatite and diabase. The diabases are apparently the youngest rocks of the pre-Cambrian complex.

Since there are no well-defined sedimentary rocks in the pre-Cambrian mass, it is not possible to assign the rocks to any particular age. They are covered unconformably by the Carboniferous, but they are so nearly identical with granites and older rocks, which to the north in the Big Horn Mountains and to the south in Colorado lie beneath the Cambrian, that the writer has no hesitation in considering them all to be of pre-Cambrian age. It is probable that the schistose complex of volcanics and intrusives, with traces of sedimentary rocks, belongs to the Archean; it is equally probable that the unaltered granites and diabase are not older than the Algonkian. The position of the intermediate formations is entirely problematical.

Eliot Blackwelder
University of Wisconsin

A STATISTICAL STUDY OF BROWN SCALE PARASITISM

Parasitic and predatory enemies are important factors that should be taken into consideration in the control of injurious insects; but the effectiveness of such agencies is very often overestimated, since their efficiency is usually based on estimates made instead of upon accurate and sufficient data. It very frequently happens that a notable decrease in numbers of insects occurs coincidently with the introduction of a parasite, but this reduction should not be attributed to the parasite alone, as is often the case, since there are many other factors entering into the problem.

The brown scale (*Eulecanium aremniacum* Craw) is one of the most important pests of prune trees occurring in this state, and according to statements frequently made and published here, this scale is kept in very complete subjection by its parasite (*Comys fusca*). This control for the whole state is usually estimated at 95 per cent. During the past winter the writer visited sixty-six different orchards, covering all the important prune sections in the state, and has made an examination of a total of 63,700 scales. From this count the actual percentage of parasitized scales is 12.02 per cent. The counts were made in units of 100 and covered various parts of the tree and various trees in the orchard. The location of each orchard and the name of its owner were taken, and the abundance of scales, both young and adult, in relation to the amount of parasitism, was noted. A summary of a part of these data is given in the table below:

No. Orchards	Scales Examined	Parasitized	Not Parasitized	Per Cent. Parasitized	Per Cent. Not Parasitized	Highest Per Cent. in Any Orchard	Lowest Per Cent. in Any Orchard	Greatest Number Parasitized in 100	Least Number Parasitized in 100
			San Joaquin Valley						
27	31,200	1,918	29,282	6.15	93.85	32.25	1.9	45	0
			Sacramento Valley						
11	14,500	1,916	12,584	13.21	86.79	23.15	2.38	60	0
			Santa Clara Valley						
10	4,800	644	4,156	13.42	86.58	20.5	4.5	23	3
			Napa Valley						
9	7,200	971	6,229	13.49	85.51	17	11	22	7
			Sonoma Valley						
9	6,000	2,210	3,790	36.83	63.17	47.6	20.33	55	15
			Grand Total California						
66	68,700	7,659	56,041	12.02	87.98	47.6	1.9	60	0

H. J. Quayle

University of California,
Berkeley

EXPERIMENTS ON EARTH CURVATURE

After reading my article on earth curvature[1] Mr. H. F. Dunham, of New York, called my attention to similar experiments reported

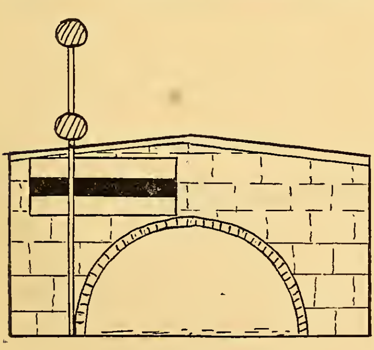

Fig. 1

by Mr. Alfred Russel Wallace.[2] A brief sketch of Wallace's experiment and its results may possibly be of interest to the readers of Science.

In 1870, through the medium of the public press, a Mr. John Hampden wagered £500 that the convexity of the surface of any inland water could not be proved. Mr. Wallace accepted the challenge. The old Bedford Canal was chosen for the experiment and a six-mile stretch between two bridges selected as the site. On the higher of the two bridges a white sheet, six feet long and three feet wide, was fastened. Along the center of the sheet parallel to the water was a six-inch black band, the lower edge of which was at the same height above the water as the parapet of the second bridge. At the half-way point a pole with two red discs, four feet apart, was erected in such a way that the center of the upper disc was at the same height as the center of the black band. A six-inch telescope, resting on the parapet of the second bridge, was used for sighting. The result, as seen through the telescope, is shown in the accompanying figure. A second experiment was performed with a spirit-level.

The sequel of the experiment is almost as interesting as the experiment. The referee for Mr. Hampden, a devotee of the flat earth school, insisted, on looking through the telescope, that the three points were in a straight line. Hampden, who refused to look through the instrument, accepted the statement, although Wallace's referee declared that the curvature was shown. An umpire, chosen to settle the difficulty, awarded the money to Wallace. Then followed a remarkable series of libels, persecutions and recriminations. As late as 1885 Hampden published, among other things, the statement that "no one but a degraded swindler has dared to make a fraudulent attempt to support the globular theory." Wallace sums up his experience in this matter thus: ". . . two law suits, the four prosecutions for libel, the payments and costs of the settlements amounting to considerably more than the £500 pounds I received from Hampden, besides which I bore all the costs of the week's experiments, and between fifteen and twenty years of continued persecution."

The whole story as presented by Wallace is

[1] "A Simple Method of Proving that the Earth is Round," *Nat. Geog. Mag.*, XVIII., 771.

[2] "My Life," Alfred Russel Wallace, Vol. II., 381–393.

a most astounding series of libels, against which he seemed to have been utterly powerless.

Robert M. Brown
State Normal School,
Worcester, Mass.

A SIMPLE CONTINUOUS ELECTRIC CALORIMETER FOR STUDENTS' USE

For several years we have been using, with considerable success, a simple form of the continuous-flow calorimeter for measuring Joule's equivalent in the electrical laboratory work of our elementary students. I venture to describe the apparatus here in the hope that it may commend itself to those engaged in practical work, as being simpler of operation than the older electrical methods of measuring this important constant.

A glass tube, about 50 cm. long and 2 to 3 mm. internal diameter, is cemented at both ends to brass collars carrying washers and nuts, which screw into brass castings drilled out to receive suitable thermometers. A heating wire, of about 10 ohms, coiled in a long helix, passes through the tube and is soldered to the brass collars. The helix serves to break up the stream-lines, and thoroughly mix the water as it flows through. A copper or tin vessel with overflow maintains a constant head of water from the city mains at any desired elevation, and a tube conveys the water to the inflow end of the calorimeter. An air trap, made from an inverted thistle tube, serves to catch any air bubbles liberated or carried down by the water. The temperature of the inflowing water is measured on the thermometer. After passing through the flow tube, the water passes out at the outflow end to a suitable measuring vessel. The temperature of the outflowing water is recorded at regular intervals on the second thermometer. The upper end of the brass T, to which the outflow pipe is attached, is open to the air and establishes the head independent of the exact level of the end of the outflow pipe. Having obtained a reading on the two thermometers before any heating current is turned on, the electrical circuit is completed, and after four or five minutes, during which the temperature of the outflow water becomes steady, readings are commenced. These consist in measuring the current at regular intervals on a tangent galvanometer or a Weston ammeter and reading the inflow and outflow temperatures during the time taken to obtain a suitable amount of water to weigh,

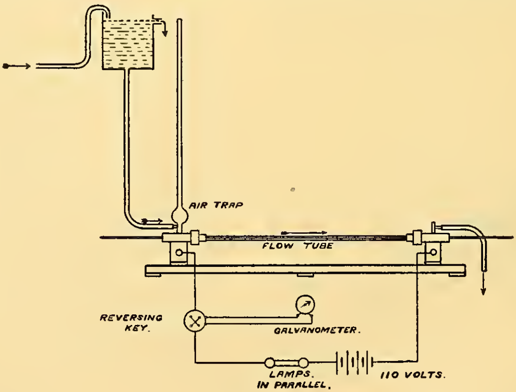

Fig. 1

or during the time necessary to fill a vessel of known capacity. From these readings the average flow per second and the difference in temperature can be determined and hence the number of calories of heat carried off by the water per second calculated. Knowing the electric current and the resistance of the heating wire, the electrical energy in Watt seconds can be calculated and the ratio of this to the heat produced gives the value of J. In place of knowing the resistance of the heating wire, the drop across the calorimeter may be obtained on a voltmeter. In our work the ordinary 110-volt direct-current circuit is used through a number of lamps, which may be connected either alone or in parallel. Various experiments may be performed with different flows and different heating currents. An alternating heating current may be equally well employed when a suitable A.C. ammeter or dynamometer is introduced.

The value of the method lies in its directness and great simplicity. No corrections are necessary for heat loss, provided the mean temperature of the flow water does not differ more than about 5 degrees from the temperature of the room, and even for larger differences the correction is very small. The object of the experiment, which is the measurement of J, is not lost sight of by the elementary student in determining troublesome corrections. A few values, taken at random from the students' results, are as follows: 4.16, 4.20, 4.12, 4.25, 4.18 joules per calorie. These were obtained with heating currents from 2 to 4 amperes. The rise of temperature ranged from 6 to 12 degrees, and the water flow was varied from 2 to 4 grams per second.

Professor Ervin S. Ferry, of Purdue University, LaFayette, Ind., writes me of the success attending the use of the calorimeter in his elementary classes. He has included an account of the apparatus and method in his recent text-book of "Practical Physics," Vol. 1. The accompanying diagram shows the general plan of the apparatus and connections.

H. T. Barnes

McGill University

EVOLUTION IN RHYME

A little book has recently come into my hands that may be as new to most of the readers of Science as it is to me. It is called "Das Neue Laienbrevier des Haeckelismus," is in two parts, was published in 1878 in Berne and Leipzig, and evidently enjoyed a considerable popularity in its day, as the first part is marked, "3te Auflage." The first part is called "Genesis, oder die Entwicklung des Menschengeschlechts, nach Haeckel's Anthropogenie in zierliche Reimlein gebracht," while the second is "Exodus, oder der Auszug des Menschengeschlechts aus Lemurien, eine kritisch-analytische Komödie." The author is one Herr Reymond, and the very effective comic illustrations are by Steub, a one-time popular contributor to *Fliegende Blätter.*

The book is a burlesque in rhyme of the descent of man, and is introduced by a short statement of the history and status of the theory of organic evolution and an abstract and general table of contents of Haeckel's "Anthropogenie." The parts of the Laienbrevier are arranged exactly according to the chapters and titles of the "Anthropogenie," and the whole extremely clever *tour de force* must have been received with great glee by the anti-evolutionists, especially the anti-Haeckelians.

The contents of the book are arranged in the general form of a play with the *dramatis personæ* speaking rhymed dialogue and introducing many songs in solo or chorus, the melodies for these songs being mostly well known folk, soldier, and especially student songs. There are so many clever verses and the whole performance is so well sustained throughout the two volumes (the second was only written in response to the popular acclamation of the first) that in selecting a couple of sets of verses to illustrate the character of the Laienbrevier I have made no attempt at particular choice but have taken practically the first to attract my attention. Dissociated, however, from the well-organized total performance they give but little more than a suggestion of the entertaining character of this delightful bit of evolution literature. I tender profuse apologies for my awkwardness in translating Herr Reymond's verses. Rhyme and rhythm are very much out of my line.

On page 119 of the first volume in the section "Vom Moner bis zur Gastraëa," Moner sings, to the melody of "Ich bin der alte Ahasver;

I am an ancient Moneron,
Derived by chance from carbon;
Dredged up from darkest of deep seas
To pose with science' garb on.

I am an ancient Moneron,
All organs sadly lacking;
No eyes or ears nor limber tongue
To keep forever clacking.

I am an ancient Moneron
Given o'er to multiplying.
O, would I had some power beside,
E'en were it that of dying!

And then Amœba comes forward and sings, to the tune of "'S ist kein schöner Leben als Studentenleben."

O, what a happy family
Are we minute Amœbæ!
In stagnant pools and slimy wells
We lay our courses creepy.

When we divide, we must endure
A protoplasmic spasm,
For unlike Moneron we have
A nucleus; quite a chasm!
Yet still we lack what we should like,
Our lowly life to aid in,
For each a kindly-hearted, fair
And true Amœba-maiden!

And so on for a score more of lines, ending with "Das Amoebenthum, es lebe hoch!"

At the end of the second volume a picture is given of the old theater *Diener* sweeping out the broken and used up properties of the play, and soliloquizing thus, as epilogue:

Completed is the comedy;
The actors pass, to no one's sorrow;
The old world stands in its same place,
And other prophets come to-morrow.

Vernon L. Kellogg
Stanford University, Cal.

A CORAL ISLAND MODEL

It is announced in the Harvard University *Gazette* that a large naturalistic model of Bora Bora, one of the Society Islands in the South Pacific Ocean, has recently been added to the exhibits in the coral room of the Museum of Comparative Zoology. The model is the gift of Mr. Alexander Agassiz and the work of Mr. George C. Curtis, whose model of the metropolitan district around Boston, in another room, is already well known to visitors to the museum. Mr. Curtis visited Bora Bora in 1904, at the suggestion of Mr. Agassiz, and spent several months there making surveys, soundings, photographs, and sketches, the results of which are now shown in the model. It is on a scale of about one and a half feet to a mile, horizontal and vertical alike, and is painted in natural colors. The central island, peopled by about 2,000 native Polynesians, is about five by three miles in diameter. It is the dissected upper portion of a great volcanic cone that here rises from the deep sea floor; a steep-walled central knob standing about 2,500 feet over sea level, and surmounting a group of radiating spurs. The foot of the heavily wooded lower slopes is lapped by the quiet waters of the lagoon, where the blue water is some fifty fathoms deep. Communication with the sea is maintained by a passage through the outlying shoals and the narrow barrier reef which forms the exterior border of the concentric island system. A little farther out the sea bottom deepens rapidly at an angle of nearly 45 degrees, and thus soon descends to a depth of 2,000 fathoms or more. The deep ocean floor would, on the scale of the model, be reached near the level of the floor of the coral room. The ocean depths immediately surrounding the reef are well suggested by the dark blue color of the outer submarine slope and by the device of placing models of vessels at sea level on fine wire supports which are hardly visible a few feet away. The use of natural colors and true proportions throughout the model makes it highly effective. By placing the eye at sea level a most realistic view of the island may be gained; the line of breakers on the outer barrier reef; the sails of boats in the lagoon, their hulls hidden by groves of palm trees; the villages at the foot of the inner mountainous island; the lower wooded slopes; and, dominating all, the central, gray-white peak.

WORK OF THE COAST AND GEODETIC SURVEY

The report itself must be consulted for the details of the extensive cartographic work of the Bureau in the United States proper, Alaska, Porto Rico and the Philippines, as well as for the account of the progress of the primary triangulation and leveling of precision. In all these branches of the work great activity prevailed and notable results were achieved during the year.

Certain important work of the survey receives bare mention, as for instance the results of the investigation of the earth's figure based on geodetic operations in the United States. This is owing to the fact that these results were communicated to the International Geodetic Association in a preliminary report which has been published.

Appendix 1 gives the details of field operations, and Appendix 2, the details of office work. Five other appendixes form valuable discussions of interesting subjects.

Soon after the California earthquake of April 18, 1906, it became evident that the permanent horizontal displacements of large areas covered by triangulation in California had so changed the lengths and directions of the lines joining the triangulation stations as greatly to diminish the value of the triangulation for its primary purposes as a framework for future surveys. During the year, therefore, new triangulation extending from Point Arena to stations south of Monterey Bay was done, which serves to restore the value of the old triangulation by determining the new positions of 61 of the old triangulation stations. The triangulation included the Farallen Light House, 22 miles to the westward of the great fault accompanying the earthquake, and the stations Mocho and Mount Diablo, 33 miles to the eastward of the fault. The new triangulation serves to trace the permanent distortions and displacements of the earth's crust for many miles back from the fault in each direction and to show that they follow certain regular laws. This is the most extensive and accurate determination by triangulation of the effects of an earthquake which has yet been made anywhere in the world. Appendix 3 is a full report upon this investigation.

A full report on the measurement of six primary bases with steel and invar tapes in 1906 is printed as Appendix 4. The invar (nickel steel) tapes have a coefficient of expansion about one twenty-eighth that of steel tapes, hence it is much less difficult to keep the temperature errors within the required limit with invar tapes than with steel tapes. Invar tapes had not been used in the United States until 1906 in primary base measurements. The thorough tests of these tapes, made by using them on six bases in conjunction with the steel tapes formerly used, showed that measurements may be made more conveniently, accurately, and at smaller cost per mile than with the steel tapes, and that the invar tapes are sufficiently durable and stable for safe field use. This demonstration is believed to be a distinct step in advance in base measurement.

The steady progress in the magnetic survey of the United States and accumulation of magnetic observational data, as mentioned in Appendix 5 of the report, should be of special interest to the surveyor and the navigator, as well as to those pursuing the study of the science of terrestrial magnetism. Throughout the year the measurements of the earth's magnetism were made at places distributed over a majority of the states and territories of the United States and at numerous places at sea along the Atlantic and Pacific coasts of North and South America, and in Porto Rico and the Philippines. Important information was secured in the equatorial regions. Numerous "repeat" observations were made throughout the country in order to follow as closely as possible the secular change in the magnetic elements. Five magnetic observatories were maintained in continuous operation and important seismological data were also obtained. The facilities of the observatories were afforded to all investigators who desired to make standardization comparisons of their instruments; and in response to numerous requests information, or observational data, was furnished for practical application or for use in special investigations of terrestrial magnetism and allied phenomena.

Appendix No. 6, constituting the concluding portion of a manual of tides, treats of the flow of water, of river tides, tidal currents, permanent currents, annual inequality, lake tides, seiches, and miscellaneous tidal matters.

Charts of concurrent lines are given for the principal marginal waters along the Atlantic Coast of the United States. The numbers upon these lines show the times of the maximum flood current.

The dependence of the permanent ocean currents and the annual height in equality upon the prevailing winds is briefly pointed out. Seiches are shown to exist in harbors and other tongues of water, as well as in lakes; but their character is fundamentally different in some respects.

The analyses of observations upon the tides of Lake Superior show that they follow closely the equilibrium theory although the range is only 1½ inches at Duluth and one third inch at Marquette.

In Appendix No. 7 is given a detailed description with appropriate illustrations of the Long Wire Drag, a device for detecting erratic obstructions of small extent in navigable waters. The method of operating can be understood from the simple statement that the drag is a wire varying in length from 480 to 1,400 feet, supported at suitable intervals and maintained at any desired depth below the surface of the water. This drag is towed over any given area by launches, and in the area so searched no elevation of the bottom above the depth at which the wire is suspended can escape detection. Buoys floating at regular intervals above the drag indicate to observers in the launches when and where an obstruction is touched, and the spot so indicated is then accurately determined.

This method of sweeping has proved a sure means of detecting pinnacle rocks and similar erratic obstructions which heretofore have eluded the hydrographic surveyor, since it is almost impossible to discover them by lines of soundings with the lead. Only the navigator in whose hands rest many lives and much property can realize the relief from mental strain that comes from knowing that the water in which he is sailing is absolutely free from hidden dangers or that every menace is charted. The device has proved very satisfactory under widely varying conditions and marks a decided advance in marine surveying.

This report, or any one of the Appendices, numbered 3 to 7, may be obtained by interested persons, free of charge, upon application to the Superintendent of the Coast and Geodetic Survey, Washington, D. C.

BERMUDA BIOLOGICAL STATION FOR RESEARCH

By arrangement with the Bermuda Natural History Society, the Station for Research at Agar's Island will be open for about seven weeks this summer. There are accommodations for a limited number of instructors or research students in either zoology or botany.

Members of the expedition will sail from New York on the steamer *Bermudian* (Quebec Steamship Co.) at 11 A.M., on Tuesday, June 16, arriving in Bermuda, June 18, and will return on August 5, reaching New York August 7. Those who can not sail on June 16, may do so two weeks later, June 30.

The expense will be $110 for first-class passage from New York to Bermuda and return, and for board and lodging at the islands six weeks and six days. For the shorter time—four weeks and six days—the expense will be $90. Payments are to be made to the undersigned, fifty dollars on or before June 1, the balance on arriving in Bermuda.

For further information apply to

E. L. Mark

109 Irving Street,
Cambridge, Mass.

CONFERENCE ON THE CONSERVATION OF NATURAL RESOURCES

In a sense the federal and state scientific work to date culminates in the Conference on the Conservation of Natural Resources, in the White House, May 13–15. Through the operation of state and federal geological surveys, supplemented by collateral research in higher institutions of learning, the extent of coal, iron ore, and other mineral deposits, in all parts of the United States has been determined or estimated with a fair degree of accuracy; so that it is now possible to say that the original stock of coal of fairly high grade was somewhere in the neighborhood of 2,000,000,000,000 tons, and the original stock of readily workable iron ore approximately 10,000,000,000 tons—while the rates of consumption and waste also are fairly known. Through the operations of the federal forest service, with the aid of antecedent agencies and state bureaus, the rates of forest growth and consumption and destruction have been ascertained with a fair degree of accuracy; so that it is possible to estimate the duration of the timber supply of the country. Through the operations of the U. S. Weather Bureau, with antecedent agencies, the quantity and distribution of rainfall, on which the habitability of the country depends, has been measured approximately; so that the capability for development of different sections of the country is known in at least a general way. Through the operations of the Bureau of Soils, with antecedent and adjunct agencies, the crop producing capacity of the different sections of the country, together with the benefits of improved cultivation and the losses through soil-erosion, have been ascertained in at least a preliminary way; while contemporary bureaus in the federal Department of Agriculture and numerous state instrumentalities have indicated the leading principles involved in that crop production on which national prosperity primarily depends. Thus the state and federal work to date has served to establish the nature, and in some measure the extent of the natural resources of the country.

Through the operations of scientific agencies the habit of definite thought has become fixed; so that experts habitually think and speak or write in quantitative terms. In earlier years a coal deposit, or iron ore body, or pine forest, was vaguely thought inexhaustible; of late the first duty of the expert is to estimate the quantity, the rate of production and the duration of the supply. The habit of definite thought in terms of quantity is now extending to soil, to water-supply, to productivity of the land in forests or other crops, and with this extension there has arisen a realization that none of the natural resources of the country can be considered illimitable or inexhaustible, and that all should be viewed as national assets, to be guarded in the interests of the country.

In connection with the assembling of facts and the development of definite thought (which are among the immediate results of scientific work), the habit and the faculty of prevision have grown up. Prevision has aptly been styled the essential factor of science; and its growth throughout the country as the result first of observation and then of definite arrangement of the facts relating to resources can only be regarded as a typical illustration of the scientific method, notable especially for its magnitude—extending as it does virtually to an entire people.

The natural outcome is the idea of conservation as a public duty, which originated chiefly in the forest service and the geological survey; and it is significant that the idea has taken form more or less independently also in the minds not only of scientific men, including engineering and other experts, but also in the minds of statesmen in every part of the country. President Roosevelt was early impressed; Secretaries Wilson and Garfield were soon in sympathy; and when the president and a score of governors met on the Mississippi last October, it was found that a number of the state executives had fully grasped the same idea. The plan for the Conference, first definitely suggested by the Inland Waterways Commission, was announced by the President at Memphis, October 4; and the interest has steadily increased. The four great engineering associations have contributed effectively by separate and joint meetings; and commercial and civic organizations have been active, as have been a number of scientific bodies, beginning with the American Association for the Advancement of Science, which appointed a strong committee at the Chicago meeting, and whose president is a leading speaker at the conference.

The conferees with the president include the governors of the states and territories, each with three advisors; the justices of the Supreme Court; the members of the Cabinet; the senators and representatives in the Sixtieth Congress; the Inland Waterways Commission; the presidents of leading national and interstate scientific, technical and industrial organizations dealing with natural resources; together with a limited number of special guests, representatives of the press, etc.

While no formal program was framed in advance, the preliminary calendar was as follows:

CALENDAR

May 12, 7:30 P.M.—Meeting of the Governors and special guests with the President at dinner in the White House.

May 13, 10:00 A.M.—Assembling of Governors and their advisors with otner conferees in the East Room.

11:00 A.M.—Address by the President: "Conservation as a National Duty."

2:30 P.M.—Session on Mineral Resources.

Opening statements:

"The Conservation of Ores and Related Minerals," by Andrew Carnegie.

"The Waste of Our Fuel Resources," by Dr. I. C. White.

General discussion—opened by John Mitchell.

7:30 P.M.—Meeting of the President and Governors as Guests of the Washington Board of Trade at dinner in the New Willard Hotel.

May 14, 10:00 A.M.—Session on Land Resources.

Opening statements:

"The Natural Wealth of the Land and its Conservation," by James J. Hill.

"Soil Wastage," by Professor T. C. Chamberlin.

"Forest Conservation," by R. A. Long.

"Conservation of Life and Health by Improved Water Supply," by Dr. George M. Kober.

General discussion.

2:30 P.M.—Session on Land Resources.

Opening statements:

"Interdependence of Resources, Illustrated by California's Rivers and Forests," by Ex-Governor George C. Pardee.

"Grazing and Stock Raising," by Hon. H. A. Jastro.

General discussion.

9:00 P.M.—Reception to meet the Governors and the Inland Waterways Commission at the residence of Mr. Gifford Pinchot.

May 15, 10:00 A.M.—Session on Water Resources.

Opening statements:

"The Public Lands and Land Tenure," by Ex-Senator Joseph M. Carey.

"Navigation Resources of American Waterways," by Professor Emory R. Johnson.

"The Conservation of Power Resources," by H. S. Putnam.

General discussion.

2:30 P.M.—General Session.

4:30 P.M.—General meeting of the conferees with ladies accompanying them, as guests of Mrs. Roosevelt, in the White House Grounds.

7:30 P.M.—Any session thought desirable by the Governors.

SCIENTIFIC NOTES AND NEWS

In the place of Professor Dr. Max Verworn, professor of physiology at Göttingen, who was unable to accept, Dr. Albrecht F. K. Penck, professor of geography at Berlin, has been appointed by the Prussian Ministry of Education to serve as Kaiser Wilhelm professor for 1908–9 in this country, and has been assigned to a seat in the Columbia University faculties of pure and political science. He will give courses in historical and physical geography.

President Eliot returned from his trip through the middle west on the morning of April 27, after having been absent from Cambridge since March 31. During his absence he delivered, in addition to the six lectures on university organization on the Harris foundation at Northwestern University, no less than twenty-eight other addresses and speeches.

At the annual meeting of the Society of the Sigma Xi of the University of Pennsylvania held at Randal Morgan Laboratory on May 5, Dr. A. W. Goodspeed was elected president; Dr. John W. Harshberger, vice-president; J.

V. Sanford, M.E., treasurer, and Dr. F. H. Safford, recording secretary.

Dr. Oscar Teague has resigned an assistantship in pathological chemistry in the department of experimental pathology of Cornell University to accept an appointment as pathologist in the Philippine Islands. He is now on his way to the islands, where his address will be Bureau of Science, Manila.

In connection with the International Congress on Tuberculosis, to be held in Washington from September 21 to October 12 next, the Smithsonian Institution has offered, as we have already announced, a prize of $1,500, under the Hodgkins fund, for the best treatise "On the Relation of Atmospheric Air to Tuberculosis." This prize will be awarded by a committee appointed by the secretary of the institution in conjunction with the officers of the congress, and consisting of Dr. William H. Welch, Johns Hopkins University, Baltimore, chairman; Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York; Dr. George M. Sternberg, surgeon-general, U. S. A., retired, Washington; Dr. Hermann Biggs, of the New York Department of Health; Dr. George Dock, University of Michigan; Dr. William M. Davis, Harvard University, and Dr. John S. Fulton, secretary-general of the International Congress on Tuberculosis.

On May first Professor W. E. Castle, of Harvard University, lectured at the University of Pennsylvania, under the auspices of the Guernsey Breeders' Association, on "Heredity."

Mrs. Fleming, of the Harvard College Observatory, on the occasion of a reception given to her at the Whitin Observatory of Wellesley College, lectured on the work of the Henry Draper Memorial with which she has been prominently connected since its inception, and in connection with which she has made many discoveries of new stars, variable stars, and stars with peculiar spectra, in addition to the general work of classification in the Draper catalogue of stellar spectra. Mrs. Fleming is an honorary member of the Royal Astronomical Society of London, and, on the occasion of the completion of the Whitin Observatory, was created by the trustees of Wellesley College an honorary fellow of the college in astronomy.

On April 2 Mr. R. Lydekker began a course of two lectures at the Royal Institution on (1) "The Animals of Africa"; (2) "The Animals of South America." The Friday evening discourse on April 3 was delivered by Lord Montagu of Beaulieu on "The Modern Motor-car," and on April 10 by Professor J. J. Thomson on "The Carriers of Positive Electricity."

A course of five free popular lectures was arranged by the Chicago Academy of Sciences for Friday evenings in March and April, at eight o'clock. The lectures, which were given in the lecture hall in Lincoln Park, foot of Center Street, were as follows:

March 27—"Daylight: Its Quantity and Quality," by Dr. Olin B. Basquin, associate professor of physics, Northwestern University.

April 3—"World Building," by Dr. Forest Ray Moulton, assistant professor of astronomy, University of Chicago.

April 10—"The Forests of Eastern America," by Dr. Edgar N. Transeau, professor of botany, Eastern Illinois State Normal School, Charleston, Ill.

April 17—"The Birds of the Washington Coast," by Dr. Lynds Jones, associate professor of zoology, Oberlin College, Ohio.

April 24—"Zoological Collecting in British East Africa," by Mr. C. E. Akeley, Field Museum of Natural History.

The American committee on the Mendel memorial begs to acknowledge the receipt, to April 20, of $322 on account of this fund, received from 150 senders to whom acknowledgment has been personally made. It is proposed to close this account on the first of June. Those desirous of adding their names to the very honorable roll already obtained are requested to make their contributions before that date. Checks or cash may be sent to Dr. C. B. Davenport, Cold Spring Harbor, New York.

The annual celebration of the Blue Hydra Society, composed of biological students at the University of Cincinnati, took place on April

24, an imported hemlock, dedicated to the memory of Cuvier, being planted on the campus. The chief address was delivered by Professor C. A. L. Reed, of the Medical faculty, on "The Lessons of Cuvier's Life."

Robert Chalmers, LL.D., of the Canadian Geological Survey, died at Ottawa, Can., on April 9, at the age of seventy-four years. He joined the survey about twenty-three years ago, and conducted work in Pleistocene geology, especially in his native province of New Brunswick.

Dr. Otto Kuntze, a graduate of the University of Munich, died recently at Iowa City, Iowa. During the past eleven years Dr. Kuntze was a dealer in minerals and rocks, and shortly before his death he placed his entire collection, consisting of thousands of specimens from all parts of the world, at the service of the University of Iowa. Dr. Kuntze was forty-one years of age.

Miss Nina Holton, of Newburyport, a member of the staff of the Bureau of Plant Industry, Department of Agriculture, died of typhoid fever on May 5.

Mr. John Walter Hastings, A.B. (Harvard, 1905), A.M. (1906), ethnologist during the first year of the Peabody Museum Anthropological South American Expedition under Dr. W. C. Farrabee, died on April 26 from injuries received in an accident.

The death is announced of Professor Leopold Schrötter von Kristelli, one of the best known and most influential members of the Vienna medical faculty. Only the week before, as honorary president of the Congress of Laryngologists then sitting in Vienna, Professor von Schrötter delivered an inaugural address, in the course of which he celebrated the achievements of Vienna University in developing the science of laryngology.

The deaths are announced of Dr. Ludwig Schmarde, formerly professor of zoology in the University of Vienna, at the age of eighty-nine years, and of Dr. Wilhelm Scheidner, professor of mathematics at Leipzig, at the age of eighty-two years.

The thirty-eighth general meeting of the American Chemical Society will, as has been already announced, be held in New Haven, Conn., June 30, July 1 and 2. The sections will meet in the lecture rooms of the Sheffield Scientific School, and will be under the chairmanship of the following members: Agricultural and Food Section—A. L. Winton; Biological and Sanitary Section, Thomas B. Osborne; Physical Section, Frank K. Cameron; Organic Section, Wm. McPherson; Inorganic Section, Philip E. Browning; Industrial Section, Wm. D. Richardson. Papers intended for these sections must be sent to the chairman or to the secretary of the society before June 10. The division of industrial chemists and chemical engineers will be organized at this meeting. Programs will be sent members on June 20. Hotel headquarters will be at the New Haven House.

The third International Botanical Congress will be held at Brussels from May 14–22, 1910. All communications relating to the congress should be addressed to Dr. E. De Wildeman, general secretary of the organizing committee, Jardin Botanique de l'Etat, Brussels.

Mr. A. F. Yarrow has offered to give $100,000 for a tank for research purposes to be erected at the National Physical Laboratory.

The late Dr. H. Clifton Sorby, F.R.S., of Sheffield, has bequeathed to the Royal Society of London, a sum of £15,000, for a fellowship or professorship for the carrying on of original scientific research. He leaves to the University of Sheffield £6,500, to which is to be added £3,500 which he gave in 1903, making £10,000, as an endowment for a professorship of geology or such other subject as the university may think more suitable. Dr. Sorby also gives to the university a number of books, optical and scientific instruments, geological, mineralogical and natural history specimens, manuscript books, lantern slides, and microscopical objects of rocks and metals, and architectural and other photographs. To the corporation of Sheffield he bequeaths certain scientific articles, pictures, etc. The Sheffield Literary and Philosophical Society receives a number of books and a sum of £500, and the Geological Society, of London, £1,000.

THE Worcester Art Museum has received under the terms of the will of the late Stephen Salisbury, property valued at $2,738,000. This sum, added to the amount already possessed by the museum, makes its endowment $3,332,000.

A BILL has been introduced in the senate for preventing the manufacture, sale or transportation of adulterated or misbranded fungicides, Paris greens, lead arsenates, and other insecticides, and for regulating traffic therein. This bill has been drafted at the instance of the Committee on Proprietary Insecticides of the Association of Economic Entomologists which includes all the official entomologists of the United States.

THE two hundred and fiftieth anniversary of the founding of the government of Philadelphia will be celebrated from October 4 to 10. The University of Pennsylvania and the other educational institutions of the city will take part. There has been appointed a committee on Medical Day which will arrange special exercises. In this connection there will be prepared a volume of 1,000 pages, including 750 pages of text and 250 pages of illustrations. It will contain an account of all the historical institutions, colleges and hospitals that have existed in the city since its founding. The volume will also contain an account of all the medical and scientific societies and medical journals that have been in existence in Philadelphia from the earliest days.

"A CATALOGUE of the Library of Charles Darwin now in the Botany School, Cambridge," has been compiled by Mr. H. W. Rutherford and published by the Cambridge University Press. *Nature* says of it: "Mr. Francis Darwin has contributed an introduction, in which he gives interesting information, supplementary to the account contained in the 'Life and Letters,' concerning his father's methods of work and treatment of books. The collection of books now bequeathed to the university is not identical with that at Down; thus, the books Darwin wrote and some few others from Down remain in the possession of Mr. Francis Darwin. Darwin's pamphlets are not included in the catalogue, though part of them are on the shelves alongside his books. The introduction points out that Darwin hardly ever had a book bound, and the collection retains to a great degree its original ragged appearance. The general characteristic of the library is incompleteness, hardly any set of periodicals being perfect. The chief interest of the Darwin books lies in the pencil notes scribbled on their pages, or written on scraps of paper and pinned to the last page. Books are also to be found marked with a cypher, as described in 'Life and Letters.' Mr. Francis Darwin provides many facts of interest in connection with some of the more important books included in the library. In a preface, Professor Seward expresses to Mr. Darwin the high appreciation of the botany school and university for rendering the library available to all students."

CONSUL JOHN S. TWELLS, of Carlsbad, furnishes to the *Consular Reports* the following information concerning the discovery that the water in the Austrian uranium mines contains radium of medical value: About eighteen miles from Carlsbad is the small town of St. Joachimstal, where the Austrian government has one of its tobacco factories, and about three miles from that town, up in the hills, at a place which is difficult to reach, are the imperial uranium works, which have become famous during the last few years on account of the radium found in the uranium stone. There is also a government factory at St. Joachimstal where chemical colors are made from the uranium and shipped to all parts of the country. About two years ago the imperial managers of the uranium mines made a report to the government authorities that the water of the mine was found to contain radium, and medical experts have since declared that these waters are of high medical value in certain diseases. During the last fortnight most of the Austrian newspapers have published items according to which the

Austrian government is convinced of the high value of these waters and intends to take charge thereof, construct a proper radium spring, and build hotels, which it will control. The view of the government is, that the beneficial effects of radium in a number of diseases have been admitted by the medical profession, but hitherto the application has been very expensive and treatment difficult. The government believes now that by the discovery of radium in those waters a powerful and at the same time a cheap medium has been found to make the power of radium accessible for bathing purposes.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. Charles Henry Moore, barrister at law and fellow of Gonville and Caius College, Cambridge, has bequeathed £5,000 and the residue of his estate, apparently about £30,000, to the master and fellows of Gonville and Caius College.

The late Dr. Lennander, professor of surgery at Upsala, has bequeathed his entire property to the university to endow scholarships for medical students, for stipends for research work, and for a fund to provide free postgraduate courses in surgery, hygiene and other branches of medicine.

Mr. Andrew Carnegie has given the sum of $200,000 to the Mechanics and Tradesmen's Institute of New York City.

As we have already announced the third session of the National Graduate School of Agriculture held under the auspices of the Association of American Agricultural Colleges and Experiment Stations will open at Cornell University, Ithaca, N. Y., on July 6. The range of instruction will be considerably broader than at previous sessions and includes courses in biochemistry, agronomy, horticulture and plant physiology, dairy husbandry and dairying, poultry, entomology and veterinary medicine. The faculty will include a large number of the leading agricultural scientists of this country. Dr. N. Zuntz, professor of animal physiology of the Royal Agricultural College, Berlin, Germany; Director A. D. Hall, of the Rothamsted Experimental Station, England; Professor L. B. Mendel, of Yale University; Professor S. H. Gage, of Cornell University, and Professor C. B. Davenport, of the Carnegie Institution, will also deliver courses of lectures. Dr. A. C. True, director of the U. S. Office of Experiment Stations is dean of the school, and Professor G. N. Lauman, of Cornell University is registrar.

As the result of the appointment of Edwin C. Holden, of New York, to the professorship of mining engineering at the University of Wisconsin, the present group of electives in mining engineering in the college of engineering of the University of Wisconsin will be developed into a regular four-year course for the training of mining engineers.

At the recent meeting of the regents of the University of Wisconsin Professor Louis Kahlenberg was appointed director of the newly-established course in chemistry.

Mr. Arthur L. Walker has been appointed professor in the department of metallurgy at Columbia University.

Mr. E. L. Potter, a member of the 1908 graduating class in the animal husbandry department of the Iowa State College, has been appointed instructor in animal husbandry (in charge of the department) in the Oregon Agricultural College.

Dr. Victor J. Chambers, now instructor in organic chemistry at Columbia University, will succeed Professor A. Lattimore at the University of Rochester. Dr. Chambers received the degree of bachelor of science at Rochester in the class of 1895. From Johns Hopkins he received the degree of doctor of philosophy in 1901.

Austin teaching fellows at Harvard University have been appointed as follows: Harold Eugene Bigelow, A.B. (chemistry), Edgar Davidson Congdon, A.M. (zoology), George Thomas Hargitt, A.M. (zoology), George Leslie Kelley, S.B. (chemistry), Chester Couch Pope (engineering), Emile Raymond Riegel (chemistry), Edric Brooks Smith (engineering).

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MAY 22, 1908

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THE USEFULNESS OF CHEMISTRY IN THE INDUSTRIES[1]

ONE month ago I had the pleasure of addressing the University of Illinois section on the subject, "Chemistry and Industry." On that occasion I departed somewhat from the orthodox position of loyal chemists, which is that manufacturing industry could not long survive in the absence of chemists and a science of chemistry, and that manufacturing industry owes a large debt of gratitude, if not of worldly goods, to the chemical profession; and I endeavored to show how, long before a science of chemistry developed, a sufficient amount of chemical knowledge and a sufficient number of chemical facts were accumulated by the earliest civilizations of which we have a record, to enable them to establish and conduct chemical manufactures in a rather creditable manner. I felt it was necessary to emphasize this fact, which is frequently lost sight of in the pursuit of laboratory chemistry, in the interest of a fair understanding of the relationship between the science of chemistry, and manufacture, and in the interest of fair play, too, because I should not care to give chemistry more than its due.

There are, broadly considered, but two kinds of manufacture; one of them is concerned with those processes which change the form of matter only, mechanical manufacture, and includes such industries as the founding, metal-working, wood-working

[1] Address delivered before the Indianapolis Section of the American Chemical Society, March 20, 1908.

and weaving industries; the other is concerned with those processes in which the composition of matter is changed, chemical manufacture, and includes metallurgy, clay burning, glass making and the heavy chemical industries. By far the greatest number of industries partake of the nature of both these branches—in other words, are both mechanical and chemical—and in this way chemistry has a greater or less importance in connection with all industries. Students of the development of the human race find that the mechanical arts develop first; but not long afterwards and long before recorded history, are found evidences of a knowledge of metallurgy and of ceramics in the remains of iron and bronze implements and of earthenware utensils. Metallurgy and ceramics are both chemical industries, and they both presume a knowledge of chemical facts, that is, they presume a knowledge of the properties of certain substances, the ores in one case, clay in the other, and of the changes in composition which those substances undergo. If we turn to ancient Egypt, which is unique in having developed a somewhat advanced civilization in an early period and in having preserved by monument, picture, scroll and ornament a record of that civilization, we find that the people of that country, in addition to a knowledge of metallurgy and ceramics, were also informed in the arts of dyeing, pigment manufacture, varnish making, plaster making, paper making and the fermentation industries—all chemical manufacture—and most interesting of all, they were well versed in that distinctly chemical and not altogether simple industry—glass manufacture. Five thousand years ago they made a glass which approximates closely in composition the common glass, so-called soda-lime glass, of to-day. Now glass making is interesting from a number of standpoints. It did not develop as many other chemical industries did, apparently, in a number of localities widely separated, but in one, and that Egypt, and thence it spread throughout the world. So it is comparatively easy to trace the spread and the growth and the historical development of glass-making. On the east the Babylonians, the Assyrians, the Chaldeans, the Phœnicians learned the art; on the north the Greeks and Romans; China probably learned the art from Egypt by way of Ceylon, to which place adventurous merchants journeyed; India learned it later; Byzantium learned the art from Rome, and through Rome, too, the knowledge filtered and spread into Italy, beyond the Alps, and into the Rhine country. In the seventh century the Arabians, in their rise as a conquering nation, overran Egypt, learned her arts and carried the glass industry into Spain, where it flourished. Finally the industry centered in Bohemia, which is preeminent in this industry to-day. And thus the history of glass making can be traced from the most ancient times down to the beginning of modern history. Nor is this all, for in tracing the history of one chemical manufacture, one inevitably comes in contact with others. An industrial people is seldom satisfied with one industry and so where glass making flourished, as a rule other industries flourished also. Nobody knows how glass making was first discovered. Ordinary glass is composed of silica, lime and soda and can be made by melting together sand, limestone and soda in the proper proportions and at a sufficiently high temperature. The Nile valley is cut through limestone rock and this is the common building stone of the region. Soda occurs there, as it does in the arid regions of this country, as an incrustation on the surface of the soil—*alkali,* to use the common expression; and sand is, of course, abundant. It would be hard to find a place better supplied with the raw materials of glass making, and possibly this will account in some degree for the development of the industry there. But not entirely. And so we have various explanations of its origin. The ancient Egyptians were skilled metallurgists and smelted copper, iron, lead and tin and also refined the noble metals. One hypothesis says that the Egyptians first became acquainted with glass owing to the accidental similarity of the slag from one of their furnaces with that product. Another states that the burning of piles of straw frequently results in the production of glass because the potash in the ash combines with the sand and lime of the ash or of the soil beneath, in the heat of the conflagration. And you are all probably familiar with the old story accrediting the discovery to the Phœnicians, those bold seamen and traders of ancient times. This story, which is told by Pliny, that old Roman, than whom I suppose no man ever recorded more truth and untruth, relates how a certain Phœnician ship laden with soda was moored off a sandy shore, and how the merchants came ashore from the ship to cook their evening meal. There were no stones at hand on which to rest their pots and so they brought ashore some lumps of soda from their ship. As their fire grew hotter, the soda and sand fused and they were surprised to behold transparent streams (molten glass) flowing forth and consisting of a liquid previously unknown. The tale is interesting, for any tale is true as long as the telling lasts, but we know that the Phœnicians learned the art of glass making from the Egyptians.

But in whatever manner the ancient peoples learned the art of making glass and other chemical arts, it is certain that as one age succeeded another, the information spread and was handed down from father to son, from generation to generation. The arts were improved and a considerable store of chemical facts were acquired, in a practical way, concerning practical chemical processes. And I endeavored to show, besides the fact that chemical industries were established so long before the science of chemistry, the further fact that the science of chemistry owes a great debt of gratitude to manufacturing industry. In this way: If the chemical knowledge of the ancients could have been transmitted to the middle ages and the modern world only by books, we would know little or nothing of the facts which they slowly and laboriously acquired. Ancient records and books are extremely few in number, and worse than that, the scientific writings, when they are not purely speculative, are quite unreliable. The Greek and Roman poets recorded quite as many facts as did the philosophers and prose writers, and strange to say, the student of ancient knowledge refers as frequently to the ancient poets as to others. I repeat then, that if the world had been dependent upon written books for the transmission of chemical knowledge for, say, from 5000 B.C. to A.D. 1200, it would have fared poorly. There were two methods by which that knowledge was transmitted. The first, the alchemistic writings of the Egyptians and the Arabians; and second, the traditional knowledge of the chemical industries. The laboratory chemistry of the period I have mentioned was, in the early part of it, somewhat alchemistic in its tendency and in the latter part avowedly and emphatically so. Now all alchemistic records must be taken with plenty of seasoning, and are rather poor and unnutritious chemical food at that. And so I say that the principal means by which the chemical knowledge of the ancients was transmitted to the modern world was by means of the traditional method, from the elder to the younger generation working in the chemical industries. So for the old chemical industries we chemists should be thankful.

But some of you may ask: What of the great philosophers of Greece—what did they do for chemistry—Empedocles, Democritus, Aristotle and the rest? There is nothing like going to original sources for information and correct impressions, and therefore in answer I shall ask you to read from one of these philosophers—Empedocles. You all remember what sort of a man Empedocles is reputed to have been. He lived in Agrigentum in the island of Sicily to the south of Italy from 490 to 430 B.C. He was at once statesman, prophet, poet, physicist, physician and reformer. The few remains of his numerous writings are in verse—the classic hexameter. Imagine Sir Wm. Ramsay chronicling the discovery of argon in hexameters! Empedocles came of a proud family, was austere, august, studious, silent, and when he walked abroad in his purple robes bound by a golden girdle, a garland bound around his long hair, with brazen sandals on his feet and his retinue of slaves behind—for Greece and the Grecian colonies were slave-holding countries—he excited the wonder and the admiration of the populace. If you will read Empedocles you will see that he considered that all things are composed of four "elements" so called, earth, water, air and fire, and that the two forces, love and strife, or as we should say, I suppose, attractive and repulsive force, by acting upon these elements, caused changes in the composition of matter.

Another philosopher, Democritus, who lived about 490–390 B.C., in Abdera, in Thrace, made another guess at the secret of chemical composition. His hypothesis concerning the composition of matter considered that there were in all the universe but two entities—vacuum and atoms. Vacuum represented void, interplanetary space. All material things were composed of atoms. All spirit, too, was composed of atoms as well. They were invisible particles, extended, heavy, impenetrable, of various shapes, uncaused, eternally-existent and in ceaseless motion. This hypothesis bears a striking resemblance to the atomic theory of to-day. You see men, like children, have in all ages asked the questions: "What is this made of? What is that made of?" and have endeavored to answer these questions.

You will have guessed already the difficulty with the chemistry of the Greeks. It amounted to nothing more than speculation. The hypotheses were never tested in the workshop of science—the laboratory; they remained at the last what they were in the beginning—unproven products of the imagination. And I think I may safely say that all the Grecian philosophy, as a means of developing and preserving chemical knowledge, was worth less than one factory engaged in chemical manufacture—let us say a factory engaged in the manufacture of glass.

So, on the last occasion on which I spoke of "Chemistry and Industry" I emphasized, and indeed over-emphasized for the sake of the argument, the debt of gratitude owed by the science of chemistry to the manufacturing industries. To-night I wish to take the other view-point and show what the science of chemistry has done and can yet do for manufacture. In truth, manufacture and chemistry must be considered as close partners in the affairs of to-day and neither could well be deprived of the other.

In ancient times and during the middle ages progress in both manufacture and chemistry was slow. That progress goes on in an ever-increasing ratio, and very suggestive of the great progress that has been made is the fact that accuracy, and certainty in application, have increased to as great an extent as rapidity of discovery.

I would like to think of chemistry as an essentially practical science—one which can be directly applied to supplying the wants of mankind. Let us not forget, in our admiration of the brilliant researches of an Ostwald, a Van't Hoff, or a Ramsay, that in the judgment of time even the greatest and most brilliant feats of the mind must be accorded a mediocre place if they are not ultimately practical.

As I have said, there are two classes of manufacture—the mechanical and the chemical. This means that two classes of men have been mainly instrumental in developing manufacture—the mechanical engineer and the chemist. I should not give either class preeminence in industry. I should not say that either one was more necessary to the proper conduct of a manufacturing business than the other; *both* are essential to the highest development of industry. Once in a long time it happens that a man is born with a sufficiently broad conception of science and art, with sufficient industry, and with a sufficiently tireless mind and body that he can pursue both callings. Need I say that such a man is unusual, that he is possessed of unusual talents? Indeed, I might say, if the term genius were ordinarily applied to those who devote their lives not to the fine arts and literature, but to the more lowly calling of fashioning material things with their hands, that he is a genius. Ordinarily we must be content to have the chemical engineer embodied in two individuals—one of them an engineer and the other a chemist, and these men by cooperation and by combination of their separate talents, must develop the manufacture of the future. I can not refrain at this juncture from indulging in just a word of caution to those institutions of learning which offer the degree C.E.—chemical engineer—at the end of a four years' course, possibly with the proviso of one or two years' successful work, after leaving school, in some industrial laboratory. Let me say that a degree in itself means nothing, and the degree of chemical engineer should by all means be a post-graduate degree equivalent to the doctor's degree and should be reserved for exceptional, and not given to ordinary, students. A degree in itself means nothing and may be no more appropriate to the individual than the degree given by some sophomores to the boastful freshman. They painted the letters on his back—A.S.S., which they said stood for astonishing smart scholar.

Let us understand clearly that progress in the manufacturing industries which make use of chemical processes will be uncertain and slow, or altogether impossible, without a well-developed chemical science to furnish new ideas. Let us remember that chemical manufacture has developed more in the period from 1850 to the present time than in all the previous centuries and millenniums of mankind's earth. And while we may well be astonished at the chemical industries which developed when there was no science of chemistry, they were as nothing compared with the chemical industries which have been and are developing in our own time.

To come down to details: As I see it, the chemist may be useful in the manufacturing industries in four different ways:

1. In the buying and selling of materials according to analysis.

2. In the chemical control of manufacturing operations by analyzing raw, intermediate and final products.

3. In a consulting capacity, interpreting chemical process, terms, and operations to the administrative heads of the business.

4. In the improvement of plant and processes, including the working up of by-

products, cheapening of operations, and turning low-grade products into high-grade ones.

I shall take up these four different lines of work, one after another, somewhat in detail.

First—The buying and selling of materials according to analysis. I take it for granted that no modern manufacturing plant can run without power—power is indeed the chief distinguishing characteristic of modern plants as contrasted with ancient ones—and the principal source of power still is steam under pressure, and the heat necessary to generate steam is derived from burning coal. In very recent months plants have been constructed which derive their power from gas engines operating on producer gas, blast furnace gas, etc., and such plants may operate entirely without steam power. The demands made upon the world's coal supply for power have increased greatly in recent years; the coal supply can not last forever; and so, means must be devised for making the coal supply last longer either by utilizing more of the energy or by working out methods for substituting other sources of energy for heat energy. The gas engine is the result of efforts in the first direction and the conversion of the gravitational energy of falling water into electrical energy is the result of the second. In spite of the efforts now being made to conserve the coal supply, the heat from burning coal applied to steam boilers is still the universal way of producing power. To operate a boiler plant a good water supply is necessary. There must not be too large a quantity of incrusting substances in the water, or scale will form in the boiler; the water must not be too alkaline, or it will prime or foam in the boiler. If only a poor water supply is to be had, then the chemist must provide a purification plant or boiler compound which will prevent or minimize the formation of scale. The coal received at all large plants is regularly analyzed and by many the coal is contracted for and bought on analysis. Thus for the very fundamental process of generating power for operating purposes, the manufacturing plant must call in the services of the chemist.

But every plant buys large quantities of supplies besides coal and water. For construction work there is Portland cement, which must be analyzed and tested; and lime and sand are frequently examined by the chemist. The railroad buys its iron and steel, bronze and babbitt, brass and tin according to analysis; the packing-house buys its salt, sugar and vinegar in this way; the soap factory buys oils and tallows, caustic soda and soda ash, essential oils and artificial perfumes entirely according to composition and purity; the sulphuric-acid plant buys its pyrites; the fertilizer plant its potash salts; the glass factory its sand, its lime, its soda; the explosive factory its glycerine and nitric acid, all according to the chemist's certificate. The analytical chemist has come to be a factor of enormous importance in the affairs of the commercial world. The very standard of the basis of exchange is determined by his assay; he analyzes every product from stone and iron to food and spices.

Of course, the thought will occur to you: How was manufacture and exchange conducted at all in the days before chemistry and chemists became so important? How did manufacturers and business men get along at all? Well, they got along fairly well then, but to-day I am afraid their difficulties would be many. The keen competition of to-day and the more elaborate working up of by-products, yes the greater complexity of modern society, have brought about the change. Still, even to-day there are plants of fair size which are operating without chemists. I know of a soap factory, for example, in which the fats are bought on inspection, the alkalies on the seller's analysis, and no control whatever is exercised over the chemical process of soap-making excepting that afforded by the sense of taste which is used in determining when the boiling soap is approximately neutral. The soap lyes are not refined, but are shipped in drums to the refiner.

Somebody may ask: How can a small plant afford to employ a chemist and so increase its pay-roll by a greater or less sum? My reply is that it is not necessary for the small plant to employ a chemist on the spot. At all the large commercial and industrial centers will be found commercial chemists who will make yearly contracts on the basis of the output, to handle all analyses and serve in a consulting capacity as well, in the interest of the plant. I have in mind one such laboratory in Chicago, which serves in an analytical capacity for about four hundred small and large foundries at a moderate compensation for each one. Each day the foundries send in their samples and these are analyzed at night; in the morning the various foundries are notified by telegram or letter as to whether their mixtures are right or wrong, and if wrong they are told how to correct them.

The second way in which I have said the chemist is useful in the modern factory is in following what we call the chemical control work of the factory. In brief, this means the analysis of the raw material, of the intermediate products and of the final products of manufacture. In blast furnace practise, the control work would include the analysis of the ore, of the coke, and of the limestone which go to make up the charge, of the pig iron produced in the operation, and possibly of the slag for cement-making purposes and of the blast-furnace gases. This is an old story to chemists and to those who are familiar with the chemical profession, but I would like to emphasize the fact, that this technical analysis or control work is, so far as the operative side of an industry is concerned, the vital and important thing. There is no doubt that analysis is the backbone of chemistry, and it is well to remember that analytical methods can not be made too exact. The business and commercial and manufacturing world to-day is scrutinizing intently the work of the analytical chemists, both in works and in commercial laboratories, and day by day is demanding more exact and carefully made analyses. I can see signs at the present time of demands in point of accuracy of analytical work which will tax to the utmost the resources of chemical invention. The question of accuracy and rapidity in technical analysis is a most important one and in the near future our great chemical society, through its division of industrial chemists and chemical engineers, must take up this question and by means of committees and cooperative work give the manufacturing world what it is demanding.

There is no factory engaged in the transformation of substances chemically which does not require this control work by chemists. In a soap factory, the raw fats and the alkalies are analyzed; during the process the product is examined for completeness of saponification; the lyes are analyzed for their glycerine content and for excess caustic soda and sodium carbonate; the crude glycerine must be analyzed and the chemically pure and dynamite glycerine after distillation. Finally the finished product must be analyzed from time to time, and the soap of other makers as well, for the sake of comparison.

The Portland cement industry has grown to enormous proportions in this country in recent years and in that industry, again, the turning out of strong and sound cement is a matter depending almost wholly upon the carefulness of the control exercised by the chemist. The limestone or marl and the clay or blast-furnace slag which go to make up the mix, must be analyzed with the greatest care, to insure a uniform product of high quality. I have mentioned the word "uniform." Probably no single thing in manufacture is more important than the turning out of a product which is of the same quality from day to day and from year to year. The public even to-day buys largely according to appearances, and, for example, if one lot of commercial fertilizer is gray and another brown, although of the same grade and composition, the farmer is very apt to have a strong prejudice in favor of one or the other.

The list of industries in which the chemical control work is vitally important might be extended indefinitely. I will only say that in every well-organized pottery works in the country, in every large brewery, in every oil works, gas works, wood distillation plant, varnish works, sugar factory, explosive plant, dye house, tannery, glue factory and fertilizer plant, not to mention those very modern lines of industry which are engaged in the manufacture of acids, alkalies and salts—the so-called heavy chemicals—there is a well-organized laboratory and chemical staff constantly engaged in this work of chemical control. It is hardly necessary, under these circumstances, to answer the question: Does it pay? if the question should be asked. I say unqualifiedly that not only does it pay, but it nets the industry the largest return on the investment of any branch of the establishment. I will go further and say that during the next ten or twenty years, where there is one chemist working at a given industry now, there will be two or three chemists working then. And that this great increase in the chemical forces of this country will mean more to the development of the manufacturing industries here than mere words can express. Germany's preeminence in certain large lines of manufacture to-day is freely acknowledged to be due solely to the contributions which her scientific men, and chiefly her chemists, have made to the cause of manufacture.

The third way in which I stated that the chemist is useful in the manufacturing plant was in the capacity of consulting man, interpreting chemical processes, terms and operations to the administrative heads of the business. In a large plant there is constantly coming up a host of new problems and suggested processes, as well as incidental questions, which can only be properly handled by a technical chemist. To him comes the manager, the president, the superintendent or other members of the executive staff, asking for information: And on these occasions, the chemist is the man of ready reference for everybody. When the questions are coming in thick and fast, his information must be practically all that is recorded in existing and non-existing scientific books and journals and his mind must be as well organized as a card index in a library. There is no question concerning force or matter on this earth, the heavens above or the waters beneath, that the manager or superintendent can not ask, or, I am happy to say, his chemist can not answer with equal facility. What is the difference between salt and sugar? If an iron pipe will rust, why will not a lead pipe? Have you got a good recipe for taking aniline stains out of a table cloth? What is the latest decision on the Board of Food and Drug Inspection? How much salt per day is the proper ration for draft horses? And the list might be carried on to infinity. All these questions, I say, the chemist can answer with as great facility as the layman can ask them.

The fourth sphere of usefulness which I suggested referred to the improvement of plant and processes, including the working up of by-products and cheapening of operations, and turning low-grade products into high-grade ones. Work of this nature is to be viewed in a different light from the other kinds of work which I have described. I should say that while all plants require analytical and control work and also consulting work, there are many plants which can operate, and operate successfully, without any of the research work implied in the present category. This fact is not to be taken as a criticism against the plant, but is to be accepted as a natural feature of industrial operations. Not all plants can lead. There must always be a considerable number which work along the accepted lines of their particular branch with no great desire to take the initiative in developing plant and process. The man who can invent, describe, work out in detail, instal and operate a new industrial process or an improvement on an old one, is an extremely rare person. He must have inventive ability, profound knowledge, keen insight, imagination, initiative, tireless energy and that wonderful faculty of elimination of the non-essential. One of the great mistakes of the present tendency in chemical education is, in my opinion, that every young student of chemistry is taught to believe, or at least is not taught to disbelieve, that on a modest or even a considerable foundation of chemical information he can become a research man in an industrial laboratory and an improver of processes in manufacture. This is a serious mistake. No amount of chemical training can change the nature or the talents of a man, and yet almost every young man who enters an industrial laboratory seems to have the idea that any work but research, or work of an executive nature, is not to be considered worthy. The simple result of this is that the men are failures as research or executive men if given an opportunity, and, further, because they do not regard as sufficiently important for their consideration that foundation of our science, analytical chemistry, they are bad analysts. It is an astonishing thing that the great rarity in an industrial laboratory is a first-class analyst. Most men, instead of looking upon skill in analysis as a desirable thing to attain, consider it as of secondary importance. To them, apparently, the work of Berzelius, of Stas, of Fresenius and of Hillebrand does not appeal, or does not influence them greatly. I believe that every chemist, no matter what line he may be working along, whether a teacher in a high school, a university professor, a consulting chemist or a chemical engineer, should be first of all a capable analyst.

These remarks are somewhat aside from the immediate topic. The chemical engineer—for by this much-abused name I prefer to call those chemists who are able to improve plant and process—has a high calling. Fortunate indeed is the establishment which possesses such a man. In my own limited experience, not more than one chemist in one hundred (and possibly the ratio is lower yet) is entitled to be called by that name. And the greatest of these, the Bessemers, the Solvays, the LeBlancs, the Chances, the Lunges, the Knietsches, stand out as notable landmarks in the course of the history of chemistry. Notice, I have given the names of the men who have *successfully* worked upon new processes. To indicate the difference implied in this statement between the unsuccessful and the successful workers, I shall say that in 1837 Gossage proposed reactions for the recovery of tank waste in the LeBlanc soda process. He worked on the process from 1837 until 1847; nor was he, like many inventors, without funds to carry on his work. He spent a considerable fortune in carrying on his researches, but failed. It was not until 1888 that the Chance-Claus process, simple and cheap, based upon Gossage's reactions, was successfully introduced. There are other examples identical with this one. The reactions in the Solvay process, the Hargreaves-Robinson process, the Deacon process, the contact sulphuric-acid process, were all known before the men were found who could successfully introduce them into manufacture.

I have now dealt at some length with the usefulness of chemistry in the manufacturing industries, but there are other applications of chemistry which I must mention or I shall not have presented my subject to you in the fullest extent. The science of chemistry has permeated every field and phase of modern life. Its growth has been so steady and so silent, and it has been developed on the whole by so few men and in the retirement of laboratories and studies, that the public mind has hardly yet awakened to its full significance. As to its possibilities, no men, not even its enthusiastic disciples and devotees, dare to predict. They only watch its growth and foster it as they would a child. I wonder how long it will take us to catch up with our own times. We live, it seems, half in the past and half in the future. We look back to our boyhood days with delight, and think, to mention only one example, of the good things we used to have to eat, and we look ahead to some future time when those conditions shall have been restored. How often do we seriously stop to consider that engineering and chemical science have made and are making possible better ways of living than were ever possible before? I wonder how long it will take us to realize that better butter can be and is being made in creameries than on the farm, that better hams and bacon can be and are being made in modern packing-houses than in the country butcher shop, that better bread can be and is being made in bakeries than in the home—not to mention the superiority of that distinctly modern invention—the breakfast cereal? Why should it not be true that the larger establishments are able to turn out better and more uniform goods than the smaller ones? In the large institutions formulas can be worked out scientifically by the experts employed there, whereas in the small institutions where the services of the expert are not afforded, that relic of a dark and barbarous age—the so-called rule-of-thumb—still holds sway. In all these developments, modern chemistry has taken a preeminent part. There is no home in this broad land of ours, no home in the whole civilized world, but is better ventilated, better heated, better lighted and supplied with better food and clothing, owing to the applications of the science of chemistry. A broad statement, you will say. Possibly. Take the question of lighting. Glass is a very old invention, but window glass is a modern one—for example; in Roman times, from the beginning of our era to the downfall of the empire, glass was extensively used for tableware (more extensively than it is to-day, in the better Roman families), it was used for ornaments, for mural mosaic work, for pavements in courts, but not for windows. Window glass is a modern invention. And I ask you, how would you like to substitute for the broad clear panes in your dwellings the translucent sea shells, the mica, the oiled paper and the other devices which have been used at various times and by various peoples to let in the light of the sun and shut out the cold of winter? But window glass has to do with natural light—what has chemistry done to improve artificial illumination? In ancient times animal and vegetable oils and fats, waxes and resins, were used for illumination in lamps, candles and torches. The flames must have been extremely smoky, odorous and generally disagreeable. It was in the early eighteen hundreds that the stearic-acid candle was introduced, following Chevreul's pioneer work on the chemistry of the animal and vegetable oils and fats. It was later still when crude petroleum was refined by the chemist and kerosene and gasoline came into general use for lighting and heating. Coal gas, the discovery of Clayton in 1675, was first used for illumination in modern times by Wm. Murdoch in 1792, who lighted his own house with it. Now illuminating gas of one kind or another issues from orifices in the earth in various places and the Chinese at an early day made use of this gas for evaporating salt brine and for lighting salt factories. But no general use was made of either natural or artificial gas until the early eighteen hundreds. In the United States at the present time more than $200,000,000 is invested in gas plants, and the gas industry is, of course, a chemical industry developed by chemists. But with gas flames as with other flames, more of the energy is dissipated as heat than is radiated as light, and for many years the problem of obtaining a larger percentage of the energy of combustibles in the form of light was an unsolved problem. It was known that certain oxides, such as those of calcium and magnesium, emitted a brilliant light when heated, but these oxides were brittle and a mantle made of them would crumble and fall apart. But with the discovery of new elements and the investigations of their properties, oxides were finally found which, when heated, emitted an intense light and at the same time were tough enough to construct a mantle of. Auer von Welsbach took out his first patents for glow lights or gas mantles made of thorium and cerium oxides in 1886. Edison constructed the first successful filament for an incandescent lamp out of a charred bamboo filament, but now the demand is for more light from the incandescent bulb, and the tantalum lamp and the tungsten lamp are already practically successful and others will follow.

So much for the contributions of chemistry to the art of illumination. I might take the matter of food chemistry and show some most interesting developments. How larger and better corn crops are now produced than formerly, due in part to the application of chemistry to corn breeding; how the sugar beet has been raised from 6 per cent. to 8 per cent. of sugar content, to 18 per cent. or 20 per cent.; how the sugar cane and the cereals are being improved; how the scientific application of fertilizers is maintaining soils in a state of fertility; and how the great science of soil chemistry is developing with enormous rapidity. Think what that means. It means the food-supply of future generations and life and health to them. Agriculture is fundamental in human affairs, and chemistry is fundamental in scientific agriculture.

In every branch of human knowledge and activity, the influence of chemistry is making itself felt. Under its influence the people are beginning to note that it is the composition of things, not appearances and not names, that is important. I am as great an admirer as any man of the human imagination in science and in art. I am capable of appreciating keenly the romance in literature and impressionism in painting, and I can enjoy, too, that combination of romance and impressionism which the advertising man places before our vision in vending his wares. I am capable of enjoying these things, I say, as fiction. Imaginative advertising, as advertising, has delighted me from the start. I have read them all from "Sunny Jim" to the "Gold Dust Twins." But, after all, could we not purchase more intelligently if we were better posted on composition and less on catch-phrases and cartoons? Is it too much to hope that chemical composition will one day be the public's guide in matters of this sort? Carnation milk, Violet wafers, Butternut bread, Bullfrog beer, Buttermilk soap and Grapenuts! I can see an opportunity for chemistry here!

In conclusion, there may be some present who will think I have praised chemistry and chemists too highly. Some may say that important matters speak for themselves and need no praising. I am not in the least of the opinion that chemistry needs praising; what it does require in this country is, calling the public's attention to its importance.

W. D. Richardson

SOME RESULTS OF THE MAGNETIC SURVEY OF THE UNITED STATES[1]

The United States of North America, embracing nearly one fifteenth of the entire land area of the globe, or an area about equal to that of Europe, constitutes at present the largest land area for which a general magnetic survey, in sufficient detail and of the requisite accuracy, has been made. The three magnetic elements: the magnetic declination, the inclination and the intensity of the magnetic force, have been determined at about 3,500 fairly uniformly distributed points. Of this number of stations about two thirds were occupied during the seven years the speaker had charge of the magnetic operations of the United States Coast and Geodetic Survey, viz., 1899–1906.

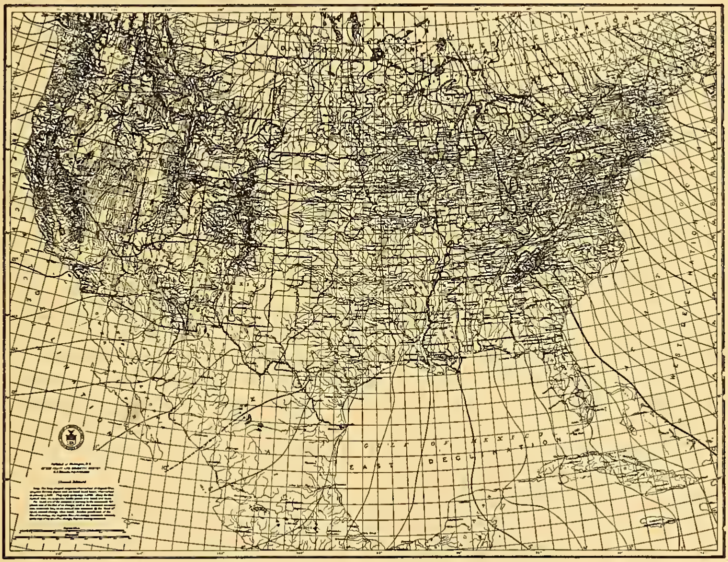
[1] Presented before the National Academy of Sciences, Washington, D. C., April 22, 1908.

The stations are, on the average, thirty to forty miles apart, or we may say there is, on the average, one station for every 900 or 1,000 square miles. Of course, in some states, *e. g.*, in the coast states, the distribution of stations is somewhat denser than in some of the interior western states, because the early magnetic work of the Coast Survey was largely confined to the Atlantic and Pacific coasts. However, before many years the distribution for all the states will be practically the same. When this has been accomplished, the plan is to multiply stations in the regions of manifest irregularities. (Two slides were exhibited, one showing the distribution of the stations up to 1899 and the other up to January 1, 1907.)

Because of this large amount of accurate magnetic data now available for the United States, I was enabled to construct the magnetic maps of the United States, for the first time as based upon strictly reliable and homogeneous data. My predecessor, the late Charles A. Schott, who had been a member of this academy, was obliged to base his isogonic maps or "lines of equal magnetic declination" very largely upon surveyors' data, owing to the paucity of data, whereas his isoclinic and isodynamic maps had to rest upon even more slender material. In the present instance, however, the charts of the various magnetic elements all depend upon practically the same number of observations made at the same points. They are, hence, strictly comparable and we may, therefore, pursue our investigations respecting the irregularities in magnetic distribution much more successfully than hitherto.

Mention should also be made that during the period 1899–1906 special attention was paid to instrumental errors—more frequently inherent in magnetic instruments than generally supposed. All instruments were therefore studied carefully and inter-compared and the necessary corrections on standard instruments frequently obtained. It was also recognized that in magnetic survey work one of the chief aims must be to *multiply* stations in order to eliminate, as effectually as possible, station errors which frequently far exceed observation errors. The time previously spent at a station was reduced from two or three days to one day or two days so as to permit doubling or trebling the number of stations per month. By properly systematizing this work and depending for certain corrections upon magnetic observatories established at the same time, it was found that the increased speed in the execution of the work brought about no sacrifice in accuracy. In fact, owing to the care bestowed upon the instrumental errors as well as on other parts of the work, the general accuracy of the work subsequent to 1899 has distinctly advanced.

LINES OF EQUAL MAGNETIC DECLINATION AND OF EQUAL ANNUAL CHANGE IN THE UNITED STATES FOR 1905



Another feature enhancing the value of the present maps is due to the fact that in addition to the observations on land, magnetic work at sea was inaugurated in 1903 on the Coast Survey vessels. There were, hence, available the magnetic results obtained by these vessels along our coasts during the four years 1903–1907, as also the results obtained by the Carnegie Institution of Washington, in Canada, Mexico, Central America, and on the Pacific Ocean. (Slide 3 showed the progress to date of the ocean magnetic work.)

The present magnetic maps apply to the date January 1, 1905. In order to be able to refer all observations to this date, as accurately as possible, special attention was paid to the secular variations of the magnetic elements and, accordingly, stations were reoccupied at closer intervals in time, as well as in distance, than had previously been the custom. In consequence, certain unexpected and complicated features of the secular variation could be satisfactorily delineated. It was found that the secular variation had not, in general, progressed in accordance with the predictions from the empirical formula established ten years ago.

We may safely make the claim that in no other country than ours have the phenomena of the secular variation received such careful investigation; the data we possess, in consequence, for this study are unrivaled. Unfortunately, in most other countries, owing to the lack of existing, permanent organizations, the observations have had to be prosecuted more or less intermittently. It is very much hoped that in about ten or fifteen years with the aid of the magnetic data now being accumulated by the Carnegie Institution, it may be possible to extend the investigation of the perplexing phenomena of the secular variation over the globe with the requisite completeness.

It will, of course, not be possible within the brief space of twenty minutes to go into all the various details respecting the magnetic survey of the United States and the results of interest which are being derived from an analytical discussion of the observations. We shall have to content ourselves with the consideration of but one or two of the more important phases of the work.

You have before you one of the magnetic maps constructed on the basis of the available material—the "Lines of Equal Magnetic Declination and of Equal Annual Change for January 1, 1905" (Slide 4). What impresses one most is, doubtless, the manifold irregularities and twists in the various lines. Increased knowledge teaches us that the more numerous the observations the more devious become the lines of equal values. When you see perfectly regular or smoothly flowing lines you may rest assured that they have been either smoothed out or conventionalized or that they depend upon but very few data. Instead of the irregularities being the *abnormal* features, *they* are the *normal* ones, and *regularities* are, in fact, the *abnormal* features. The ocean magnetic work of the Carnegie Institution has likewise shown that practically every land mass exhibits irregularities in magnetic distribution over that which would prevail were the same region covered with deep water.

Similar magnetic maps to the one shown have been constructed for the dip or inclination, the horizontal intensity, the vertical intensity and the total magnetic intensity, as well as certain other special maps, *e. g.*, the magnetic meridians or paths traced out by following the direction pointed by a compass needle, etc. It is hoped that before very long they will pass through the press. These new maps all unite in bearing common testimony to the irregularities in the distribution of the magnetic forces in the United States.

In conclusion, permit me to briefly sketch the general scheme I am following in the analytical discussion of the magnetic conditions prevailing in the United States as exhibited by these maps. Some of you are familiar with the general analytical treatment by spherical harmonics of the earth's magnetic condition, at any stated period, initiated by Gauss. You will doubtless recall that he carried the expansion of the potential to terms of the fourth degree, inclusive, thus involving twenty-four coefficients to be determined by a least square treatment of the available magnetic data. The later analysts have extended the expansion to terms of the sixth order, inclusive, hence determining forty-eight coefficients. However, in spite of the increase in the number of terms and coefficients, the results as computed from the formula differ from the observed quantities to such an extent that no *practical* use, whatsoever, can be made of them. For example, in the United States the formula would give magnetic declinations differing at *least* 1° to 3° from observed values.

Gauss's formula has only a certain theoretical significance, but, as said, no practical value as an interpolation formula. Why is this? Is it due to imperfection or incompleteness of the underlying data? Yes, to a certain extent. For example, all of the various analyses to date have had to be based on maps depending largely on land data, *i. e.*, on data covering but a fourth of the area of the globe. Nothing was known as to the reliability of the map data over the remaining three fourths—the ocean areas. Thus the Carnegie Institution work has shown that the magnetic map data over the Pacific Ocean are erroneous 1° to 3° in declination and dip, and about one twenty-fifth part in horizontal intensity. So we may confidently expect some improvement with the later more accurate data and it is possible that a new formula as based upon these data will give results sufficiently close in agreement with observation over the ocean areas for *practical* purposes if not for *scientific* purposes.

When we come to *land* areas, however, it is questionable whether any general terrestrial formula can be established which will represent the land observations sufficiently closely, even if the expansion be carried farther than it has already been, viz., beyond the sixth degree. The prime reason for this has been made evident from our study of the magnetic field of the United States. We find, namely, that we must deal with irregularities in magnetic distribution of various gradations covering areas of varied extent, a locality, county, state or an entire continent. Thus we may have the magnetic forces observed at any given point in the United States as the resultant effects of (1) a general or terrestrial magnetic field due to the general magnetic condition of the earth, (2) a general, terrestrial disturbing cause which distorts the general magnetic condition of the earth at the place of observation, (3) a continental disturbing effect, due largely to that portion of the North American continent above the general ocean bed, (4) a regional disturbance due to low-lying magnetized masses or earth currents covering a certain region, and (5), a local disturbance due to the magnetized masses or currents in the immediate vicinity.

Now a formula based upon the entire earth can, of course, not include also disturbances of such restricted areas as embraced under the last two heads, viz., regional and local disturbances, but it appears that the present formulæ do not even adequately represent the *continental* effects. In these formulæ we have the various terms advancing and recurring by trigonometric functions of multiples of the longitude and the latitude. Thus a term involving six times the longitude is supposed to continue around the earth six times in unaltered manner. However, such a term arising from the North American continental shelf which in the United States has a width in longitude of about 60°, would not continue around the earth, but would in all probability die out before the European or the Asiatic continent is reached. In other words, it must be recognized that with the recurrent or continuous terms embraced in the higher harmonics of Gauss's formula, we can at the best but "counterfeit" the facts of nature but never get at the actual truth.

Here we are brought face to face with the question: How far is it really worth while to go in the establishment of the formula? The geodesist contents himself with the determination of at most two constants for the figure of the earth. No one, to my knowledge, has succeeded in establishing a formula which represents the actual shape of the earth and exhibits at least the most marked of the earth's manifest irregularities of surface. Professor Love, I believe, has established a formula representing the irregularities of the first, second and third degrees, but has not deemed it worth while to go beyond this extent. And so it would appear to me that the time has come to halt in the establishment of a complex formula involving forty-eight unknowns or more which at the very best can give but an inadequate representation of the actual facts of the earth's magnetism. It would seem more logical to stop with a certain finite number of terms involving a limited number of unknowns which represent, from a physical standpoint, the chief and principal facts of the magnetic condition of the earth. The magnetization resulting from this limited expression we should call our "normal field," or "field of references" as the geodesist calls his adopted figure, the *spheroid of reference.* The residuals from this field of reference would then receive separate or special treatment in accordance with their extent and their character. In conclusion an application of this mode of treatment to the United States was shown (Slide 6).

L. A. Bauer

The Carnegie Institution of Washington

SCIENTIFIC BOOKS

Revision of the Pelycosauria of North America. By E. C. Case. Publication No. 55 of the Carnegie Institution, Washington, July, 1907.

This important monograph deals with the most remarkable group of the Permian vertebrata. The Pelycosauria, popularly known as "fin-back lizards," have been known hitherto only from brief and scattered descriptions principally by the late Professor Cope, mostly based upon very incomplete material. Dr. Case's studies of the last few years, aided by a grant from the Carnegie Institution, have done a great deal towards clearing up our understanding of the structure and relationships of the order. In the present memoir he has brought together all the earlier descriptions, and has redescribed and fully illustrated all the better-known types from the more complete material now available.

The rich and varied vertebrate fauna of the Permian beds of northern Texas and the adjacent parts of Oklahoma was first made known to science by Cope in 1878 and succeeding years. The collections upon which his earlier descriptions were based were obtained for him by Jacob Boll and J. C. Isaac in 1878–80, and by Professor W. F. Cummins, the well-known Texas geologist, in 1881–4. In 1895–7 Professor Cope's collections were greatly increased by the energy of the indefatigable collector, Charles H. Sternberg. All these collections are now in the American Museum of Natural History, along with additional material since obtained by Mr. Sternberg and Dr. Case. Dr. Case has also made considerable collections for the University of Chicago, and the Paleontological Museum of Munich has acquired a large and valuable collection through the exertions of Mr. Sternberg. So far as the reviewer is aware, there are no important collections of vertebrates from the Texas Permian, except in the three institutions named. The preparation of the specimens for study or exhibition is exceptionally difficult and tedious, since the bones are usually encased in a hard flinty concretion which can be removed only by laborious and painstaking chipping. The progress of our knowledge of this wonderful fauna is greatly hindered by this difficulty in preparation.

The vertebrate fauna of the Texas Permian consists chiefly of armored amphibians (Stegocephalia), large and small, and primitive reptiles of several groups. Its prime interest lies in the fact of its great antiquity.

The Permian is the oldest fauna of land vertebrates of which we have any extensive knowledge, illustrates the early stages in the adaptation of the vertebrate phylum to terrestrial locomotion and shows us what the early land vertebrates were like from which the various orders of reptiles and mammals are more or less directly descended. It is from the study of the reptiles and amphibia of this period that we shall obtain the best evidence regarding the relationship of the several orders of reptiles and the origin of the mammals.

The typical Pelycosauria are better described as archaic rather than primitive, since, while for the most part remarkably primitive reptiles, they are in certain respects highly specialized. This is especially seen in the enormously elongated neural spines of the vertebræ, which form a high rigid bony fin on the back, and in the differentiation of the dentition by enlargement of certain teeth to serve as canine teeth, as in carnivorous mammals. This specialization of the dentition is correlated with great changes in the form of the skull and the proportions of its bones, and the development of the back fin, with reduction of the tail and adaptation of the feet and limbs to more truly terrestrial locomotion.

The two best-known genera are *Dimetrodon* and *Naosaurus*. In the first the spines are very long, slender and simple; in the other they are not quite so long, but stouter, and provided with a series of short cross-bars like the yards of a full-rigged ship. *Dimetrodon* is known from the complete skeleton; in *Naosaurus* the proper correlation of the skull is in doubt. These animals were of fairly large size, six to eight feet in length, massively proportioned, the head high, compressed, nearly a foot long in the largest species of *Dimetrodon*, with fin spines over three feet long. Dr. Case considers that the spines must have been connected by a web of tough horny skin, but were probably not covered by flesh. No satisfactory explanation of the use of this fin has been given; the author regards it as illustrating Beecher's law of the exuberance of spines and bony outgrowths in the last stages of evolution of a race. These genera are the extreme stages in the specialization of the pelycosaurs. They are connected by a series of intermediate forms with small aquatic unspecialized types related to *Protorosaurus, Palæohatteria* and other primitive reptiles of the Permian of Europe.

The inclusion of the early stages of the Pelycosaur phylum in the order Pelycosauria is, in the reviewer's opinion, open to some objection. These small primitive genera are structurally ancestral to the typical Pelycosaurs (they are not genetically so, as Dr. Case is careful to point out, since so far as we know they are all contemporaneous), but that is no reason for including them in the order. An order, genus or species is defined by certain facts of common structural peculiarities indicative of descent from a common ancestor and by certain acquired specializations indicative of similar adaptation. The ancestor is a member of the phylum, but not necessarily of the order; it may belong to a more primitive order which has given rise to one or more specialized orders of a later epoch. Unless we hold to this view of their limits it becomes impossible to properly define natural groups. In the opinion of the reviewer the Pelycosauria could be more satisfactorily defined if these primitive genera were left out, to be placed perhaps in the Protorosauria, from which the Pelycosauria would be, structurally speaking, derivable.

The author confirms the views previously expressed by himself and by Osborn as to the general relationship of the order. They belong to the primitive Diapsidan or Rhynchocephaloid group of the Reptilia (superorder Diaptosauria Osborn), *Sphenodon* being the nearest modern relative. Their relationship to the Cotylosauria is more remote than supposed by Cope, and the inclusion of both groups in an order Theromora is inadmissible. Substantially the same views are expressed in recent contributions to the classification of the reptilia by Broom[1] and by Boulenger[2] as

[1] "Classification of the Theriodonts and their Allies," Rep. S. Afr. Assoc. Adv. Sci., 1903.

[2] "On the Characters and Affinities of the Triassic Reptile *Telerpeton elginense*," *Proc. Zool. Soc. London*, 1904, p. 470.

to the position of the Pelycosauria. Broili, however, in his recent memoir upon Permian Stegocephalia and Reptilia of Texas[3] and elsewhere[4] is inclined to hold to the classification of Cope and include them with the Cotylosaurs and Anomodontia in the Theromorpha (Tharomora) as quite nearly related primitive groups.

Dr. Case has shown a praiseworthy conservation in the manufacture of new species, and the tabular and descriptive differentiation of the families, genera and species full and clear. The quality of the illustration varies widely—some of the drawings are excellent—most of the photographic work is poor. The sketch restorations of the better-known genera assist greatly in making the subject clearer. The type revision leaves somewhat to be desired as to method and clearness; it would have been an aid to systematists if the author had differentiated his "types" more clearly, according to the excellent nomenclature given by Schuchert.[5] Some of Dr. Case's "types" are holotypes, others neotypes; "co-type" means sometimes paratype, sometimes neotype, never "co-type" in the generally accepted sense of the word. Many of the original types (holotypes and paratypes) are indeterminate, or unidentifiable, and the species are either indeterminate or rest upon neotypes, but this should have been clearly stated in each case. Lack of clearness in this subject is liable to mislead systematists and compilers who might suppose it necessary to make changes in nomenclature. The reviewer, in preparing a catalogue of the types in the Cope collection, has not found this necessary.[6]

[3] *Palæontographica*, Bd. LI., 1904.

[4] "Stammreptilien," *Anatom. Anz.*, Jena, 1904, Bd. XXV., p. 577.

[5] Science, 1897, p. 636; "Catalogue of Type Specimens in the National Museum," Bull. U. S. Nat. Mus., No. 53, part 1, preface.

[6] *E. g.*, Case refers *Sphenacodon* Marsh to *Dimetrodon* Cope, which it antedates; and *Clepsydrops limbatus* to *Dimetrodon incisions*, a later described species. If definitely referable, this would invalidate both the genus *Dimetrodon* and the species *incisions*. But the older genus and species are in fact regarded as indeterminate and should have been so placed in the synonymy.

Altogether the memoir is a very valuable and useful contribution, and a great step forward in our knowledge of the Permian Vertebrata. As the author premises, we are by no means yet in a position to revise and describe the Pelycosauria in any final and conclusive manner. Nevertheless, his conclusions in regard to the position and relationship of the order are not likely to be very radically altered by future discoveries. It is to be hoped that the remaining groups of Permian vertebrata will be similarly studied and monographed in the near future.

Accurate stratigraphic work is also very much needed in this field. Little is known of it except through the reports of Professor Cummins in the Texas Survey, which, on account of limited time and means and the extensive field to be covered, are of a preliminary and general character and have not been satisfactorily correlated with the paleontological work and with stratigraphic work in adjoining regions. Dr. Case has recently published[7] some preliminary data for more exact stratigraphic work, and Dr. I. C. White in his studies upon invertebrata[8] and Dr. Broili upon the vertebrata[9] have published some valuable stratigraphic observations upon the typical region. Dr. Geo. I. Adams[10] has also made a preliminary correlation with the work of Taff[11] and Gould[12] in Oklahoma. But much more remains to be done before we can arrive at any adequate understanding of the faunal levels in the formation and the evolution of the various phyla during the period.

W. D. Matthew

Mental Pathology and Normal Psychology. By Gustav Störring. Translated by Thomas Loveday. Pp. 298. Swan Sonnenschein and Co. 1908.

In spite of the very general and increas-

[7] *Bull. A. M. N. H.*, 1907.

[8] *Amer. Nat.*, 1889.

[9] *Palæontographica*, 1904, Bd. LI.

[10] *Bull. Geol. Soc. Am.*, 1903, 191.

[11] U. S. G. S., Professional Paper No. 31, 1904.

[12] U. S. G. S., Water Supply and Irrigation Paper No. 148, 1905.

ing interest in the topic of abnormal psychology, there have been practically no summaries of doctrine suitable to the use of students approaching this topic from the psychological point of view. The literature is a medical one, appealing to the alienist; and from this the psychologist has had to gather his material and make his interpretations. The appearance of Dr. Störring's lectures to students at Leipzig was one of the first attempts to bring within reasonable compass some of the aspects of this topic that would be pertinent to students with predominant psychologic interests. It was natural that a contribution of this kind should attract the translator; and the English edition of the work will be welcomed as a valuable resource to professional teachers of psychology. The work quite naturally does not meet the needs of American students as nicely as would a book written with reference to the attainments of the advanced undergraduate and the graduate student in our universities. The attitude of the German lecturer and the mode of handling his data, as well as the maturity of apprehension and general familiarity which he assumes, often go beyond what may properly be expected in an American class-room. As a text the volume will be used *faute de mieux;* but as a book of reference upon the shelves of even a limited psychological library the book merits a well-deserved place. The selection of topics is well considered and the perspective of importance of the data well maintained. There are not that clearness of description and patient exposition of relation which students often expect and which the American lecturer takes such pains to supply. The delineation of symptoms as deviations of mental procedure is given first prominence, though the place of these in actual complexes (disease pictures) is not slighted. Special psychic disorders (notably the delusions and hallucinations, the aphasias, the phobias and functional aberrations) are likewise succinctly presented. The translation is commendable. J. J.

Attention. By W. B. Pillsbury. Macmillan. 1908. (Library of Philosophy.) Pp. 346.

Professor Pillsbury's monograph on "Attention" appeared in French as a volume of the Library of Experimental Psychology. The valuable character of the work was commented upon in a review of the French edition. The English volume is an expansion of the former work and increases notably the value of this contribution to psychology. There is an additional chapter on measurements of the attention, a very important topic; a similar addition treating of the relation of attention to the feelings and to the self, and a useful practical chapter upon the educational aspects of attention. What appeared as a single chapter in the earlier publication on memory, will and reason, is now amplified into three separate chapters. With these additions, the work becomes a complete and admirable handbook to a well-rounded treatment of a topic of prime importance to the student of psychology. Naturally the topic is so central to the group of problems that constitute modern psychology that the work touches upon many of the vital issues of a growing science, and summarizes a body of doctrine indispensable to the right understanding of what mental processes are. The point of view of the author remains unchanged and takes a conciliatory stand with reference to the conflicting views of the nature of the attentive process as hitherto presented. The volume may be emphatically commended.

J. J.

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for March has an article by Bashford Dean on "The Lamarck Manuscript in Harvard" which comprises five papers and nineteen plates. Douglas H. Campbell discusses "Symbiosis in Fern Prothallia" and Charles Depéret presents the second paper on "The Evolution of the Tertiary Mammals and the Importance of their Migrations," this paper dealing with the evidence in the Oligocene of France. Henry L. Bolley has some "Observations regarding the Constancy of Mutants and Questions regarding the Origin of Disease Resistance in Plants" and S. W. Williston discusses "What is a Species," giving a new and elaborate definition too long to be quoted in full. H. S. Jennings gives a most interesting review of "Recent Work on the Behavior of Higher Animals."

The American Museum Journal for May has an excellent and well-illustrated article on "The Use of the Chilcat Blanket," by Geo. T. Emmons, a notice of "New Material from the Congo Free State" and a note on "Preserved Tattooed Heads of the Maori of New Zealand." "Museum News Notes" tell of the various expeditions that are in the field or are about to set out.

The Bulletin of the Charleston Museum for April is mainly devoted to an article by Herbert R. Lass on the "April Bird Life of Otranto." Eighty-one species were observed in three days, the most interesting being the snake-birds which have but recently established themselves in this locality.

The contents of the March issue of *Terrestrial Magnetism and Atmospheric Electricity* are: Portrait of Michel Rykatchew (frontispiece); "Some Microseismic Tremors and their Apparent Connection with Barometric Variations," by John E. Burbank; "Magnetic Survey of the Dutch East Indies" (sixth communication), by W. van Bemmelen; "Biographical Sketch of Michel Rykatchew"; "Störmer's Work on the Physics of the Aurora," reviewed by P. G. Nutting; "Is the Earth's Action on a Magnet only a Couple?" by L. A. Bauer. Letters to the Editor: "Principal Magnetic Storms recorded at the Cheltenham Magnetic Observatory," by O. H. Tittmann; "The Magnetic Character of the Year 1906," by E. van Everdingen. Some of the early issues of *Terrestrial Magnetism and Atmospheric Electricity* have been reprinted so that complete sets can be again supplied. Orders should be sent to the Johns Hopkins Press, Baltimore.

SOCIETIES AND ACADEMIES

THE UTAH ACADEMY OF SCIENCE

On the evening of Friday, April 3, the Utah Academy of Science was organized in the auditorium of the Packard Library, Salt Lake City. A constitution was adopted and the following officers were elected:

President—Dr. Ira D. Cardiff, University of Utah.

First Vice-president—Dr. John A. Widtsoe, Utah Agricultural College.

Second Vice-president—Dr. S. H. Goodwin, Proctor Academy.

Secretary—A. O. Garrett, Salt Lake High School.

Treasurer—E. M. Hall, L. D. S. University.

Councillors—Dr. John Sundwall, University of Utah; Dr. E. D. Ball, Utah Agricultural College, and Dr. W. C. Ebaugh, University of Utah.

Three sessions were held, during which the following program was given:

"The Primordial Element: A Recurring Hypothesis," by Dr. W. C. Ebaugh.

"Origin and Distribution of the Flora of the Great Plateau," by Professor Marcus E. Jones.

"Results of Some Investigations of Parasitic Insects," by Professor E. G. Titus.

"Notes on the Nesting Habits of the Genera *Bombus* and *Osmia*," by Dr. Thilena Fletcher Homer.

"The Origin of the Homopterous Fauna of the Desert," by Dr. E. D. Ball.

"Rusts and Smuts of Salt Lake and Adjacent Counties," by A. O. Garrett.

"Concerning the Radiation from the Nernst Lamp," by Dr. L. W. Hartman.

"Refractory Clay, and the Effects of Ingredients upon the Melting Point," by A. F. Greaves-Walker.

"Recent Researches bearing upon the Physical Basis of Heredity," by Dr. Ira D. Cardiff.

"Researches on Gland Cells," by Dr. John Sundwall.

A motion was carried empowering the council to make arrangements for a July excursion to some of the near-by points of interest.

A. O. Garrett,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The forty-eighth regular meeting was held at the Ebbitt House on Saturday evening, March 28, at eight o'clock. Previous to the meeting a dinner was served to the members present.

The first paper on the scientific program was by Mr. A. S. Hitchcock, entitled "Grass

Types in the Herbaria of Linnæus and Michaux."

During the spring of 1907 the speaker visited various European herbaria for the purpose of studying the type specimens of American grasses. The present paper included an account of the types in the herbaria of Linnæus, at the rooms of the Linnæan Society in London, Gronovius, and Sloane, at the British Museum of Natural History at South Kensington, Swartz at the Stockholm Academy of Science, and Michaux at the Museum of Natural History at Paris. It is well recognized that in the taxonomic investigation of any group of plants it is necessary to determine with certainty the identity of the species described by the older authors. This identification in many cases can be made only by consulting the type specimens. The speaker endeavored from the data at hand to determine for each species the nomenclatorial type specimen. The type specimen is the specimen or one of the specimens from which the author drew up the description. This specimen often supplements or interprets the description which may have been insufficient to identify the species. The Linnæan species of American grasses are nearly all founded upon definite type specimens collected by Kalm, marked by Linnæus with a "K," by Patrick Browne, marked by Linnæus "Br.," and by Clayton, who furnished specimens to Gronovius. Linnæus usually writes a short diagnosis, followed by citations of synonymy: For example, *Panicum dissectum* L. Sp. Pl. 57, 1753, under which Linnæus gives a diagnosis of his own followed by three synonyms, Roy. lugdb., Pluk. mant. t. 350, f. 2, and Sloane, jam, t. 69, f. 2, and finally habitat in Indiis. In the Linnæan herbarium is a specimen upon the sheet of which Linnæus has written "dissectum" and "K." This specimen, from Kalm, is the only one labeled dissectum by Linnæus. Is this the type specimen? The plant is what has been going under the name of *Paspalum membranaceum* Walt. The diagnosis given by Linnæus applies, but is too short to be satisfactory, but his later description, given in the second edition of the "Species Plantarum," leaves no doubt that he refers to the preserved specimen. On the other hand we find that none of the three synonyms cited applies to the specimen. We are therefore justified in regarding the preserved specimen as the type specimen of *Panicum dissectum*. It is true that Linnæus erred in giving the locality as the West Indies, an error which doubtless was based on his Sloane citation.

Paspalum paniculatum L. Syst. ed. 10. 855. 1759. The description is a two-line diagnosis followed by "Sloane, jam. t. 22. f. 2." Some botanists have considered this name to be founded upon the cited Sloane figure, the type of which is at the British Museum and is *Panicum fasciculatum* Sw. But a comparison of the Linnæan diagnosis with that of Sloane shows that they are not at all the same, and that furthermore the former description applies to the plant preserved in the Linnæan herbarium, from Browne, and not to the Sloane plant, hence the Linnæan plant is the type.

Panicum dichotomum L. Sp. Pl. 58. 1753. In this case Linnæus has no diagnosis of his own, but commences with a citation from Gronovius. Hence the type specimen is not the Linnæan specimen (which is not what has been going under the name of *P. dichotomum*) but is the Clayton plant in the British Museum which is the basis of Gronovius's description.

The paper included a discussion of several other cases taken from studies upon the types of Linnæus, Swartz and Michaux.

The second paper was by Mr. W. J. Spillman, who discussed "The meaning of 'elementary species.'" This paper is expected to be published in full in Science.

Haven Metcalf,
Corresponding Secretary, pro tem.

THE CHEMICAL SOCIETY OF WASHINGTON

The 182d meeting of the Washington Section of the Chemical Society was called to order at the Cosmos Club on Thursday, April 9, at 8 p.m. President Chamberlain presided, the attendance being forty-seven.

The following paper was read by Mr. Wade: "Distribution of Nutrients in a Soil," by G.

H. Failyer, J. G. Smith and H. R. Wade. The authors showed the composition of the different separates—clay, silt and sand. The amount of CaO, MgO, K_2O and P_2O_5 is greater in the finer separate—clay. The mechanical composition of two soils might be the same, and yet these soils might be very different chemically, and *vice versa*.

The meeting adjourned to meet at the Chemical Laboratory of the Johns Hopkins University, Baltimore, on Saturday, April 11, at 8 P.M., at which time Professor H. N. Morse addressed the members on "Osmotic Pressure." Professor Morse explained the construction and use of the various apparatus necessary in carrying on his researches. After adjournment the members were given the privilege of visiting Professor Morse's laboratory, where other apparatus was examined. A resolution was passed thanking Professor Morse for his paper, President Remsen for his hospitality, and to the owners of the copper and petroleum works for allowing the members of the society to visit the works. Over fifty members from Washington attended the lecture, at which the attendance was over eighty.

J. A. LeClerc,
Secretary

THE ONONDAGA ACADEMY OF SCIENCES

At the March meeting of the Onondaga Academy of Sciences, Principal John D. Wilson spoke of the "Geographic Influences in the Development of America." He described the form and structure of the continent, its eastern mountain barrier, the three important gateways through them, the character of the people entering by each, the favorableness of the New York entrance, and its importance in regard to location, climate and character of the people entering, and the effect of the favorable environment upon the people. All of these circumstances led him to prophesy that New York will ultimately prove the largest and most important city in the world.

The secretary, Philip F. Schneider, spoke of "The Formation of the Diamond." He described the occurrence of the peculiar cubic carbon in the stony meteorites from Arva, Hungary and Novo Urie, Siberia, and in the iron meteorites from Youndegin, West Australia, and Smithville, Tennessee; also the subsequent discovery of diamonds in these and other meteoric irons, describing with special care the diamonds of the Cañon Diablo meteorite obtained by Foote, Huntington, Kunz and others. He next considered the various methods of producing the diamond artificially, speaking at length of the method so successfully employed by Moissan of utilizing the intense heat of the electric furnace and enormous pressure generated by the sudden cooling of molten iron, and of the experiments of Friedlander of stirring molten olivene with graphite and thus producing diamonds. The analogy between the artificial diamonds and their matrix and those of the meteorites strongly suggests a similar origin in nature. That diamonds will ultimately be proved to have been formed at great depth and under intense heat and pressure either in a magma of molten iron or of olivene is probable, although the careful development of this part of the lecture was deferred until the next meeting.

The following officers were elected:
President—John D. Wilson.
Vice-president—Charles W. Hargitt.
Secretary—Philip F. Schneider.
Corresponding Secretary—Franklin H. Chase.
Treasurer—Louise W. Roberts.
Librarian—Mrs. L. L. Goodrich.
Councillors—D. M. Totman and S. R. Calthrop.

F. H. Chase,
Corresponding Secretary

DISCUSSION AND CORRESPONDENCE

ARE PENSIONS FOR COLLEGE TEACHERS A FORM OF SOCIALISM

I regret to see in Science of April 24, an expression of opinion by Professor J. McK. Cattell about the Carnegie Foundation for the Advancement of Teaching which seems to be based on evidence that will not stand the test of a careful examination. The principle involved is familiar to economic students, for it lies at the basis of a much discussed theory of distribution. What, it is often asked, is the important change demanded by social progress? One answer is: a fairer distribution of wealth and more income to individuals. The other answer is: improve the conditions under which men live so that each generation starts on a sounder basis with better health and fairer conditions for work. Those who hold the first view talk of economic equivalents and contend that gains in any quarter are followed by losses in others, so that modified social conditions give no net gain to the worker except as they increase his income. If I should say to a man holding this view that the introduction of a new food or better sanitation would improve the condition of workmen, he would reply that the cheaper food would be followed by a rise in rent or by lower wages, so that no net economic advantage would remain. I might grant this and yet contend that the main benefit of the change was not the added income but the better health that workmen would enjoy under the new conditions. If trolley lines opened up a new residential section it would also be contended that the cost of transportation to this district and the rise of land values in it would make the expenses quite as high as if the workmen remained in their old houses. Even if this be true it is not a matter of indifference to the workman and his family whether they live in a suburban cottage or in a few back rooms in a crowded tenement district. The conditions under which people live, their health and their vitality, are of far more importance than their income.

Let me illustrate this principle by an application to the university of which I am a member. During recent years salaries have risen from 15 to 20 per cent., but the cost of living has risen much more rapidly, say from 20 to 40 per cent. I do not think it an overstatement to say that the salary of a professor twenty years ago would purchase in goods and services $500 more than it will now. Measured in economic equivalents here is a distinct loss that should be the cause of deterioration. In fact, however, the very opposite has taken place in so marked a degree that it creates a veritable revolution. This change is plainly due to the better conditions under which teachers work. Twenty years ago Pennsylvania had practically no environment, the instruction was drawn from teachers' heads, there was little effective intercourse, no stimulus that called forth the best efforts of teachers, and no objective tests by which the progress and failures of students could be measured. Now we have a modern plant with laboratories, libraries, museums, dormitories, pleasant lecture rooms and other modern conveniences. It is this environment that has counteracted the depressing effects of low salaries and has given a tone to both teacher and pupil which no mere increase of salaries could have effected.

Suppose, for example, a university with fifty teachers should offer either to pay $10,000 a year for typewriters and similar helps, or to raise the salary of each teacher by $200. I doubt if there is a teaching body in the country that would not take the increase of salary, spend the money as they or their wives pleased, and go on with old methods of teaching, writing letters and keeping records. And yet I doubt if there is a single well-informed professor who would not admit that this use of the money would be far less effective in raising university standards than would the environing changes that a staff of typewriters brings about. The difficulty with the most of us is that we will not pay out our own money to get better environing conditions or to free ourselves from routine self-degrading work. But when these conditions are given, the best of us respond to the invigorating stimulus of a good environment and do work of a kind and character that lifts the tone of the university and its scholarship to new levels. Standards are thus set and comparisons made which force the less vigorous and more indifferent into new forms of activity. Soon the whole university feels the throb of a new life, better traditions are formed, the student body catches the new enthusiasm and goes out with better preparation, more efficiency and a greater love of work. All these are due to changes in the environment of teachers and not to the increase of salaries. Income is a matter of small importance when compared with the conditions under which work is done.

The Carnegie Foundation is to be regarded as one of these environing conditions, the improvement of which has done so much for American education during recent years. It gives security and freedom from worry for wife and child, the lack of which has forced many a professor to sacrifice good work to the need of meeting some unexpected outlay for which his regular salary fails to provide. Sickness, accident, life insurance and other extraneous burdens have been met by work that forced the teacher to do some toilsome unremunerative task such as writing reviews at $2 a page, or hack work for publishers at similar rates. The pay for such work is usually not so high as could be obtained by ditch digging or street cleaning. I call to mind a friend who earned this extra cash by directing wrappers. He was secretary of a learned society that appropriated $300 a year for this purpose and he could not let the money slip through his fingers even at the cost of descent to degrading routine and poor health. The university paid him $5 an hour for its work; he earned his extras by working for ten cents an hour. Surely this is a fiasco calling for some environing change.

It also seems odd to me to call schemes for environmental improvement paternal and socialistic. The confusion of thought involved in these statements is due to not seeing clearly the difference between the provision which each age makes for its successors and the care and control which some individuals exert over their contemporaries. We can leave little to our descendants except better conditions, sound constitutions and a freedom to utilize the forces of nature and society upon which their daily lives depend. We make for them the conditions under which they work; the distribution of current income they must settle for themselves. Paternalism and socialism seek to control this annual recurring income and the activities of those who cooperate to create current wealth. Every scheme of social progress calls for a constantly improving environment; but every scheme can not therefore properly be classed as socialistic and paternal. Is it paternalism for parents to give their children a sound constitution? Should their children at maturity be allowed to choose between health and the present worth of a good body, say $20,000? Is the man who tries to buy his health with pills and nostrums superior to him whose health is a gift from his ancestors? Should universities say to professors, "you can have $200 a year or the use of the library; $1,000 a year or the use of a laboratory; $500 a year or the advantages of a cultured society"? And should they say to students, "we will give you $150 a year or the use of the dormitories and gymnasium, and $100 a year or the right to associate with your teachers and fellow students"?

The correct view is that the environing conditions of a university are the gift of past generations to the present. They do not limit the freedom of the present generation. On the contrary, they vastly increase it. So too is the home an accumulation of benefits which past generations give to the present. And all society, to a less degree but in the same way after all, is creating changes which accrue to the benefit of succeeding ages. The inheritance of an improved environment is civilization, not socialism. To confuse environmental change with the social control which socialism seeks to establish is an error that only clear thinking can avoid: but when we do see the contrast it becomes apparent that Mr. Carnegie has wrought for the college teacher a new and higher environment which will give him more freedom, greater zeal and better opportunities to raise the standards and ideals of the young men it is his duty to instruct. Pensions do not differ in effect from lecture rooms, libraries, laboratories, and other environing conditions of university life. May each generation for ages to come produce more men who will add to the efficiency of teachers and universities by bettering the environing conditions of teacher and pupil.

Simon N. Patten
University of Pennsylvania

THE LENGTH OF THE SMALLEST KNOWN SIRENIAN FETUS; GYRE PREFERRED TO "CONVOLUTION"

TO THE EDITOR OF SCIENCE: In the October issue of the *American Naturalist*, under "Scientific Exhibits at the Seventh International Zoological Congress," on p. 633, the fetal manatee shown by me is said to be "approximately an inch and a half long." Since this is supposed to be the smallest known Sirenian fetus it is proper to state that from the root of the flexed tail to the top of the flexed head, allowing two mm. for the depression caused by the removal of the brain, the present length is 53 mm., say two and one-eighth inches. It has shrunk about two mm. since the measurements recorded in the *American Journal of Science and Arts*, August, 1875, where also various aspects are represented upon Plate VIII. In accordance with the criterion applied to the developing human being by Minot ("Embryology," p. 391) this specimen should be called *fetus* rather than *embryo*, because the tail is unmistakably that of a manatee notwithstanding the marked flexures of both ends of the body and the resemblance of the head to that of a horse or other ungulate.

On p. 662 it is said that I "exhibited photographs of human cerebral convolutions." Do not think me over-particular in disclaiming responsibility for the last word. I would no more use "convolution" for *gyre* than "conflagration" for *fire*. The choice was made deliberately in 1881, and published on page 133 of the issue for March 26 of SCIENCE, (the original periodical of that name, of which only three volumes were published). It has been declared upon several subsequent occasions. It constitutes one of many cases of identity between my neural terms and the B.N.A., although the framers of the latter had not the grace to acknowledge the priority of nearly the fourth of a century.

BURT G. WILDER

ITHACA, N. Y.,
April 7, 1908

AMETHYSTINE GLASS

IN connection with the interesting information given in SCIENCE, February 7, p. 239, it may be worth while to call attention to the fact—first pointed out to me by Mr. Irish, of the normal school at Tempe, Arizona—that ordinary bottle glass, when left exposed on the ground out-of-doors in the arid southwest, assumes a strong purple or amethystine color. This I have observed in Arizona, New Mexico and Colorado. Dr. Shedd, when professor of physics at Colorado College, examined some of this glass which I had collected at Colorado Springs, and found that the color was discharged by heat. Many years ago, Faraday made some experiments with glass, noticing a similar change of color; but I have not seen any recent literature upon the subject.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

SPECIAL ARTICLES

SOME NOTES ON MALACOLOGICAL NOMENCLATURE

Two years ago I published a small paper on this matter.[1] On some points my eminent and most competent friend, Dr. W. H. Dall, does not agree with me, and I hope that these lines may contribute to concert between us. This would be the more desirable, as Dr. Dall without any doubt is actually the first among all the living malacologists whose knowledge extends to actual molluscan faunas as well as to extinct ones. Also the divergence of Dall and myself is not one of principle, but only caused by a different interpretation of the international rules.

Dr. Dall during the last years has made many efforts toward establishing names of ancient authors, more or less forgotten. The question in this case can not be that of the more or less convenience in accepting such names, but whether it is necessary to have no other rules for our manner of proceeding, than consequence and logic. Therefore we accept the most disturbing changes, but only in the case of true necessity, and this is not the case at all with such authors as Martyn, Humphrey, Link, Bolten, Mörch and others.

The international rules say in article 25:

> The valid name of a genus or species can be only that name under which it was first desig-

[1] *Nachrichtsbl. der Deutsch. Malacozool. Ges.*, 1906, pp. 1–12.

nated in the condition: (*a*) that this name was published and accompanied by an indication, or a definition, or a description; and (*b*) that the author has applied the principles of binary nomenclature.

This rule confirms what has been accepted by zoologists a long time ago, that is to say, that *nomina nuda* shall not be regarded as established. Concerning the genera, all names given in catalogues without any definition are worthless. I am of the opinion that, also, species figured without the addition of any description can not be accepted. With respect to the generic names, Dollfus[2] is of the opinion that the worthless names rest without value up to the date that they are accepted in a valid publication of another author. This may be correct, but the examples given by Dollfus for the greater part must be refuted. He says that the names of Bolten and Link first acquired good standing in the catalogue of the Yoldi collection published by Mörch in 1852. This catalogue, however, having no definitions, is as completely worthless as the two others just mentioned.

All the generic names of this catalogue, and even some new ones, are given without diagnosis or any definition. Add to this that this catalogue is not at all a scientific publication, but the enumeration of a collection of shells which were to be sold in public auction in 1852. The catalogues also of Humphrey and Bolten are nothing but dealers' auction lists. It is not from such dim sources that science gets its fundamental elements. Quite in the same way, we might consider newspapers scientific publications.

The catalogue of the collection of Rostock studied by Link has never been published. The entire edition has been destroyed by fire and some proof-impressions have had the undeserved destiny of getting to be the object of scientific communications. The catalogue has never been reprinted, and even if it had been published, we could not attribute to it more value than to the similar elaborations of Bolten and Mörch. This opinion of the auction catalogue of the Museum Boltenianum has been expressed long since by the publications of P. Fischer,[3] W. Keferstein[4] and C. Semper.[5]

Dr. Dall has furnished no new data which could justify the rehabilitation of these rejected names. During my recent journey to Europe I have ascertained that my colleagues in this respect retain this opinion.

Another author who has been favored with the rehabilitation of his names by W. H. Dall is Martyn. As early as the year 1861 E. von Martens[6] asserted that the "Universal Conchologist" of Martyn has no authority, because the author is not strictly binomial. And I can find no reason to agree with Dr. Dall in thinking otherwise, being convinced that his arguments are unsuccessful. In this respect I have myself had an important experience. Working in ornithology, I have been impressed like almost all American ornithologists with the admirable publications of Brisson and I have endeavored to rehabilitate his names, but finally I have convinced myself that my endeavors must remain without success. Actually, I am completely sure that the international rules are perfectly in the right in driving from our nomenclature all the authors who are not strictly binomial. I regret this much in the case of Brisson but not in that of Martyn.

In my opinion, we not only have the right, but even the obligation to reject all the generic and specific names which are not formed exactly after the rules contained in article 25, and I therefore wish that Dr. Dall would give up his isolated position and follow the example of our other colleagues. I believe that he can do this so much the more easily, since nobody has contributed more to elucidate the systematic nomenclature than himself. Of all his works, nothing will be lost in this case, as these publications have been elaborated in such a conscientious manner that we need only eliminate the names of Bolten, Link, etc., and

[2] *Rev. Crit. Palaeozoöl. de Cossmann*, IX., 1905, p. 55.

[3] *Journ. de Conchyl.*, 1858, p. 206 ff.

[4] *Malacozool. Blatter*, X., 1862, p. 164 ff.

[5] *Verhand. d. Vereins f. natur. Unterhaltung, Hamburg*, V., 1875, p. 121.

[6] *Malacozool. Blatter*, VII., 1861, p. 141 ff.

take the next name proposed by a binomial author which is accompanied by a definition.

Hermann von Ihering

São Paulo,
March 7, 1908

With the feelings expressed in the letter of my friend, Dr. von Ihering, I have much sympathy, as a quarter of a century ago I myself experienced similar feelings, expressed similar opinions and accepted as exact similar statements by older authors in regard to the publications of Link and some other authors, which greater knowledge and more experience have led me to regard as more or less erroneous.

To be brief, Dr. von Ihering asks us to reject all names unaccompanied by a diagnosis or definition.

But this is not the requirement of the international code of nomenclature. Excluding "diagnosis" and "definition" as universally accepted, the code also admits names "accompanied by an indication." Now, if an indication is not a diagnosis or a definition, what is it? Plainly, a recognizable figure or reference to another work where a figure, or definition, or both, will be found. I believe I am historically accurate in saying that the word "indication" was intentionally inserted in the code to cover exactly such cases. If it were otherwise it is clearly a superfluity in the paragraph of the code just referred to.

It can not be denied that the possession of an exquisitely accurate drawing of an animal, like those of Martyn, is calculated to give a far better knowledge of what the author had in mind than the three or four lines of dog-Latin, without a figure, often used by the ancient binomial authors.

And, if an author refers to page, plate and figure of a standard iconography, for the illustration and diagnosis of the animal he has in mind, in what respect is the diagnosis less effective than if it had been reprinted?

I am, therefore, confident that my friend's major premise is not well taken, but that the code expressly provides for such cases and properly accepts such indications.

We must remember that authors, from Linnæus to Lamarck, and even later, did not feel themselves obliged to accept the prior "nomen triviale" given by another author, but altered and changed to suit their own notions. Thus Gmelin, Lamarck and others borrowed Martyn's names, sometimes retaining his specific name, sometimes adopting his generic name, but rarely giving full credit. The binomiality of Martyn was not questioned by Gmelin or Lamarck, or other contemporaneous writers. I have shown that his names are quite as binomial as those of Linnæus. And von Martens, cited by Dr. von Ihering as rejecting Martyn, proposed to accept his *specific* names, while rejecting his *generic* names, because the latter conflicted with those which were more familiar. Martens himself was not above altering a prior generic name because it did not agree with his assumptions, and, though a most able and learned man, is not to be regarded as an authority on matters of nomenclature.

When a scientific man prepares an original systematic catalogue of a collection in his custody, is the scientific character lost because when that collection comes to be sold, this catalogue is printed for the use of buyers? I do not see why. An "auctioneer's catalogue" implies a catalogue made by an auctioneer and not by a scientific man. But Bolten, Hwass, Link and Mörch were scientific men, or even professors of zoology. Why then reject their work? I think each case must stand on its own merits.

In the case of Link, I formerly believed the tradition that the whole edition of the work had been burned, but I now think this tradition erroneous, on account of the number of copies of Link which have turned up. We have two in the National Museum library, and references to his system, which was taught to his students in the University of Rostock, are not very infrequent in the publications of his contemporaries. At any rate, Link, whose work was published as a university program, gives diagnoses and references to iconographies; so in that respect he is qualified to meet Dr. von Ihering's standard.

I have always been of the opinion that consistency required the rejection of Brisson's names except when they had been validated by a binomial author.

I have rejected the names in the catalogue called the Museum Calonnianum, because it is anonymous, and because it was not issued by any named publisher, though we know it to have been based on a manuscript of Hwass and distributed by George Humphrey.

I have not found that accepting the international code in its full meaning and intention has isolated me from the majority of active workers in the line of my specialty. On the contrary, nearly all those who have had much experience with nomenclatorial matters have, like myself, with some reluctance, arrived at the conclusion that half measures will not do, that a thorough revision is the only way to arrive at permanency, and that each of us must do his share toward this desired result. Wm. H. Dall

U. S. National Museum

P. S.—In order to make sure that my understanding of the rules is correct, I have applied to the secretary of the International Committee on Nomenclature, whose reply is appended.

Dr. Wm. H. Dall,
Smithsonian Institution,
Washington, D. C.

My dear Dr. Dall:

Referring to your letter relative to the points raised by Dr. von Ihering in regard to Article 25 of the International Code, I would invite your attention to a recent opinion rendered by the Commission, namely:

"*The meaning of the word* 'indication' *in Art.* 25a.—The word '*indication*' in Art. 25a is to be construed as follows:

"(A) with regard to *specific* names, an '*indication*' is (1) a bibliographic reference, or (2) a published figure (illustration), or (3) a definite citation of an earlier name for which a new name is proposed.

"(B) with regard to *generic* names, (1) a bibliographic reference, or (2) a definite citation of an earlier name for which a new name is proposed, or (3) the citation or designation of a type species.

"In no case is the word '*indication*' to be construed as including museum labels, museum specimens or vernacular names."

This opinion seems to cover the point of principle under discussion. It does not of course cover the point whether the particular authors mentioned by Doctor von Ihering are to be interpreted as coming under the principle in question. This latter point is dependent upon evidence, but I do not understand that you have asked me to express an opinion on the evidence.

Very truly yours,
C. W. Stiles,
Secretary, International Commission on Zoological Nomenclature

Washington, April 27, 1908

A NOTE ON THE ECOLOGICAL FORMATIONS OF PITTSBURG AND VICINITY

It has occurred to the writer, after reading a recent article in Science,[1] that a generalized classification of the vegetation of Pittsburg and vicinity, as presented recently before the Biological Section of the Pittsburg Academy of Science and Art, might be of interest to many botanists, especially teachers, who may be situated in regions whose land forms are similar to that of Pittsburg or whose vegetation may be classified in a similar manner.

Pittsburg is situated in a region whose soils are quite uniform so far as their chemical composition is concerned, being mainly derived from sandstones and shales, with a few thin strata of limestone, and it takes but little field work to convince one that the all-important factor in the formational structure of the vegetation is to be found in the different conditions of ecological habitats as brought about by physiographic processes. For this region, physiography, in the narrow sense of the term,[2] furnishes an efficient basis for an ecological classification of the vegetation; the details, but not the principles, of classification differing from those of "physiographic ecologists" elsewhere.

The main features of land form which need

[1] Ramaley, Francis, "Plant Zones in the Rocky Mountains of Colorado," Science, N. S., 26:642–643, November 8, 1907.

[2] Geomorphology—that part of physical geography, devoted to the form of the land—coordinate with oceanography and meteorology. See Davis, W. M., "Current Notes on Land Forms," Science, N. S., 25:70–71, January 11, 1907.

to be mentioned in this connection are briefly as follows: The tops of the main hills constitute remnants of an old Tertiary peneplain, now forming a horizon line at about 1,200–1,250 feet above the sea. This peneplain was elevated and dissected by drainage systems and, at the beginning of the Glacial Period, an advanced stage in the cycle of dissection had apparently been reached with wide valleys and graded streams, the latter being about 300–350 feet below the level of the old peneplain, in the Pittsburg region. The drainage system at that time consisted of the "Old Monongahela System," the outlet to which was towards the north to the present basin of Lake Erie.[3] With the blockading of this outlet by ice during the Glacial Period an outlet for this drainage system was effected westward and the Ohio River was formed, and, evidently associated with certain elevations of the land in this region, the drainage system was rejuvenated. This new cycle of dissection has now progressed in the region of Pittsburg to a stage marked by well-developed flood plains in the larger valleys at altitudes of about 720–750 feet above the sea, and about 200 feet lower than the flood plains which were built up during the Glacial Period, or soon after, on the old pre-Glacial valley floor. In the smaller tributaries, however, the streams are still engaged in actively cutting out a lower channel, the narrow recently-formed channel, often a gorge, being usually encountered in the upper third of the stream, while above this point the little streams are still flowing in approximately the same graded channels occupied by them during the existence of the Old Monongahela System.

The more important ecological habitats, as determined by their physiographic origin, and the corresponding ecological plant formations, are briefly as follows:

A. The tops and uppermost slopes of the hills, altitude of 1,050 feet or more above the sea, with a rather thin and infertile soil, are typically characterized in the vicinity of Pittsburg by the *Quercus alba* forest formation. As one stands upon one of the higher hills, this forest, easily recognized by its facies, the white oak, can be seen to comprise all that is left of the natural climax forest around the horizon.

B. Old valleys at the headwaters of the smaller streams of this vicinity, approximately remnants of the Old Monongahela System, at altitudes of not much less than 1,000 feet A.T., usually higher; soil somewhat deeper, more fertile, and more largely transported. This habitat is almost invariably occupied, in undisturbed positions, by the *Fagus-Acer* forest formation, the facies being *Fagus americana* Sweet and *Acer saccharum* Marsh., the beech consocies, however, being more important and often occurring almost pure in limited areas.

C. The narrow ravine or gorge with more or less vertical sides, as brought about recently and being continually extended at the end by the erosive activities of the rejuvenated streams; dark, damp, cool and rocky; elevation about 950–975 feet A.T., usually somewhere in the upper third of the smaller "runs." This habitat is occupied almost invariably by the *Tsuga canadensis* forest formation, the facies being the hemlock, *Tsuga canadensis* (L.) Carr. The transition from this forest formation to the *Fagus-Acer* formation is often as abrupt as is the change in the character of the habitats, neither formation being able to successfully invade the other without a corresponding modification of the habitats through physiographic processes.

D. The flood plains and terraces of the main rivers and, to some extent, continuations of these terraces into the lower parts of the tributaries, of the Old Monongahela System. This is the "900-foot terrace" of which considerable areas are still in existence in Pittsburg and vicinity. The soil is a deep, fertile, gravelly alluvium, usually so situated as to be well drained. This habitat is well characterized by the *Quercus velutina-Q. coccinea* forest formation, the facies being the black and scarlet oaks, respectively, the black oak consocies being the most important. This formation is considerably more dense and exhibits much more prominent layers than

[3] Leverett, Frank, "Glacial Formations and Drainage Features of the Erie and Ohio Basins," U. S. Geol. Survey, Monograph 41:88–100, 1902.

does the first-mentioned *Quercus alba* formation.

E. Talus slopes, at the foot of which are the flood plains of the modern larger rivers and tributaries; soil largely derived from other habitats by landslides, thus usually deep and more or less mixed with rock fragments. The upper part of this habitat, and often the newer or more unstable portions down to the base, is chiefly characterized by what may be termed the *Sambucus pubens* talus thicket formation; facies, the red-berried elder. In the lower portion of the habitat and in the more stable portions this formation is displaced, often plainly *succeeded*, by the next forest formation to be characterized.

F. The present flood plain of the modern rivers and larger tributaries; altitude of about 750–775 feet A.T.; soil a deep, sandy, moist, fertile alluvium. So far as can now be determined this habitat was formerly occupied by a climax *Acer-Ulmus* forest formation; facies—*Acer saccharinum, Acer rubrum, Ulmus americana.* This formation, as indicated by a few isolated remnants, was characterized by a greater number of tree species than any of the other forests of the region. Many large sycamores in this forest are to be regarded as relicts of the next formation.

G. The river banks and low islands subject to inundation during times of floods, especially in winter and spring. This habitat is characterized by the *Platanus-Salix* river-bank forest formation; facies—*Platanus occidentalis* L., and *Salix nigra* Marsh. With the meandering of the stream the habitat often is occupied by the *Acer-Ulmus* forest formation but the sycamores remain as relicts even after the succeeding forest has reached maturity.

H. The sand bars in the rivers, ordinarily covered by shallow water. This habitat is preeminently characterized by the *Dianthera americana* sand-bar formation; facies, *Dianthera americana* L. With the upbuilding of the bar this formation is succeeded by the *Platanus-Salix* river-bank formation.

Besides the above-mentioned formations there are several less conspicuous formations and no mention has been made of various successional formations, especially those of secondary successions incidental to the march of civilization, the purpose of this note being merely to designate the more important plant formations and to point out their correlation with certain conspicuous habitat-structures evolved in the physiographic development of the region.

Otto E. Jennings

Carnegie Museum

THE "PERMANENT PHASE"

For some time it has been generally admitted that all substances are capable of existing in the three phases, solid, liquid, vapor, and some substances, as sulphur, in four phases. We believe that all substances are capable of existing in four phases, and some in more.

To show this notion, we will use the common text-book phase-diagram for water shown in Fig. 1, in which, for the sake of clearness,

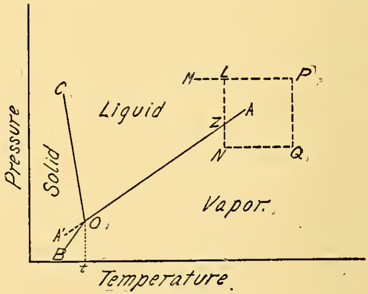


Fig. 1

the curves have been drawn as straight lines, and only the substance in a stable condition is considered. It will at once be seen that OA is the curve of vapor pressure that separates the region of liquid from the region of vapor. However, there is a limiting pressure beyond which the vapor pressure of the liquid can not rise, and therefore at the value of critical temperature and critical pressure A the curve OA abruptly ceases. It is commonly admitted that "for temperatures and pressures beyond A there is no distinction between the liquid and vapor phase, the phases having become identical."

Let us take any value M in the region of liquid, and pass to any value N in the region of vapor; this may be done in a variety of ways and may therefore be represented by straight or curved lines in the figure. However, let us choose to pass from M to N by changing either pressure or temperature, keeping the other constant meanwhile.

First let us change the temperature to that indicated by the value N (which is value L). Now the pressure at L is greater than vapor pressure at constant temperature, therefore at L the substance is a liquid only. Then let us decrease the pressure to that of N. At the pressure and temperature Z where the line LN (LN being any line cutting OA), indicating the drop in pressure, intersects OA, the curve of vapor-pressure, there is a discontinuity in the passage, the phenomenon of "boiling" will ensue, and no further drop in pressure can take place until all of the substance is vaporized. Then the pressure can be lowered till the value N is reached.

If, on the other hand, we follow the line $MPQN$, which does not cut the line OA, we can pass from the state of liquid at M to the state of vapor at N, without any discontinuity whatever. We first increase the temperature, following the line MLP to a value above the critical value. This takes us into the region where there is no distinction between liquid and vapor, so that by first reducing the pressure and then lowering the temperature, we pass without any break, to a substance in the truly vaporous state at N, the substance at no time having been in the state of two distinct phases.

To this last clause we take exception on the ground that we started with the substance a liquid at M, and ended with substance as a vapor at N, and therefore there must be a place in the transition where the substance ceases to be a liquid and begins to be a vapor. This follows just as naturally as it follows that when a ball is thrown into the air it reaches a point where it ceases going up and begins coming down.

By hypothesis, A was the critical value, which means that any further increase in temperature or pressure acting either singly or together can not produce any change in the state of the substance, and it also follows that any decrease of pressure or temperature acting either singly or in unison will place the resultant condition in the liquid or vapor region or on OA. If, as in Fig. 2, we draw

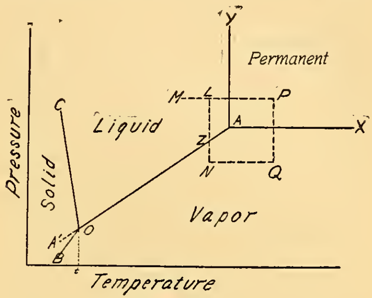


Fig. 2

the limits at which the critical condition can exist, we have YA and AX, because, taking the lowest temperature, that of A, and keeping it constant, and increasing the pressure, we get AY of infinite extent, any value to the left of which, as M, is liquid, and any value to the right, as P, resembles the critical condition at A. Now if we take the minimum pressure, that of A, keep it constant, and increase the temperature, we have AX, any presso-temperature P above AX resembling the substance when at A, while any value below AX, as Q, is vapor.

It is seen, then, that any value within the region YAX is in a special condition, which, for want of a better name, I propose the name "permanent phase." Wm. P. Munger

Vanderbilt University,
Nashville, Tenn.

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

BULLETIN OF THE MOUNT WEATHER OBSERVATORY

Vol. I., Part 1, of a new publication, *Bulletin of the Mount Weather Observatory,* has been issued by the United States Weather Bureau. It bears the names of William J. Humphreys, director, and William R. Blair, assistant director, and is prepared under the direction of the chief of the Weather Bureau (Washington, 1908). In the announcement, signed by the Secretary of Agriculture, it is stated that the *Bulletin*, of which this is the first number, will contain more or less detailed accounts of the researches conducted at Mount Weather. The *Bulletin* will appear quarterly. The chief of the Weather Bureau discusses briefly "The Origin and the Purpose of the Mount Weather Observatory," the last sentence being as follows: "The whole aim of the observatory is the discovery, no matter how nor by whom, of fundamental truths of nature, and of their application to human welfare." Dr. W. R. Blair considers "The Methods and Apparatus used in Obtaining Upper Air Observations at Mount Weather, Va.," which includes the results of the kite flights during June–September, 1907. Professor A. J. Henry concludes with a paper on "The Use of Upper Air Data in Weather Forecasting." The *Bulletin* is illustrated by means of several half-tone views of the kite equipment. There are also diagrams showing the upper air isotherms as determined on different kite flights. This number of the *Bulletin* directs attention, in a striking way, to the work which the Weather Bureau has undertaken at Mount Weather.

EVAPORATION IN THE SALTON SINK

To the *National Geographic Magazine* for January, 1908, Professor F. H. Bigelow contributes some "Studies on the Rate of Evaporation at Reno, Nevada, and in the Salton Sink." Professor Bigelow has been in charge of the Weather Bureau work on evaporation in the southwest, and his preliminary results are full of interest. He states that, although it has been quite generally supposed that as much as eight feet of water will evaporate from the Salton Sea each year, there are now reasons to think that the evaporation may not be more than four or five feet. A temporary experiment station was set up at Reno, Nev., where five towers were built by August 1, 1907, and regular observations were continued until September 15. By that time 100,000 readings of the instruments had been made. It became clear that the reservoir at Reno, which is about 1,000 feet long, covers itself with a sheet of invisible vapor about 30 feet thick, and this vapor acts like a blanket upon fresh evaporation rising from the water. It is proposed to erect two or three towers at the Salton Sea in order to get some idea of the behavior of the vapor sheet lying over that body of water.

TROPICAL TEMPERATURES

The continuation and conclusion of Hann's investigation entitled "Der tägliche Gang der Temperatur in der äusseren Tropenzone" appears in Vol. LXXXI. of the *Denkschr. Wien. Akad. Wiss., math.-naturwiss. Kl.* (1907). The object of this laborious study, so characteristic of the tireless energy and unfailing accuracy which has distinguished all the work of the author, is to obtain, for the tropics, the values needed in order to reduce temperature observations made at different hours to the twenty-four-hour mean. It appears that means based on the daily extremes are quite inaccurate. Hann has, in this second part of his investigation, extended his study to the Indian and Australian tropical region.

FROST IN CALIFORNIA

Professor A. G. McAdie has prepared a short and useful paper entitled "Protection of Fruits and Vegetables in California from Injury by Frost," in which he summarizes the various methods of protection against frost in California, already treated at length in previous publications of the Weather Bureau. The daily weather map for December 21, 1907, is reproduced as illustrating the type pressure conditions upon which frosts are found to occur in California.

R. DeC. Ward

BOTANICAL NOTES

FUNGUS NOTES

In a recent number of *Rhodora* (January, 1908) Dr. W. G. Farlow begins the publication of "Notes on Fungi" which promise to yield critical discussions of much value. He shows that what has been known as *Corticium tremellinum* var. *reticulatum* is, in the first place, not a *Corticium*, but a *Tremella*, and that the variety is a distinct species, to be known hereafter as *Tremella reticulata*. He shows that what has been known as *Synchytrium pluriannulatum* (a parasite in a species of *Sanicula*) is in reality *Urophlyctis pluriannulatus*, and that a uredineous parasite of *Rubus neglectus* and *R. strigosus*, hitherto known as or confused with *Phragmidium gracile*, is *Pucciniastrum arcticum* var. *americanum*. He is further of the opinion that the *Pucciniastrum* on *Potentilla tridentata* is *P. potentillae*. Further notes from this source will be eagerly looked for by mycologists.

In *Annales Mycologici* (V., No. 7, 1907) Professor F. L. Stevens figures and describes "Some Remarkable Nuclear Structures in *Synchytrium*." The paper is a record of facts, and the author does not attempt to base any conclusions upon what he has seen. Other recent fungus papers by the same author are "An Apple-rot due to *Volutella*" and a "List of New York Fungi," in the March and May numbers of the *Journal of Mycology* (1907), and "The Chrysanthemum Ray Blight" in the *Botanical Gazette* (October, 1907). The fungus which causes the ray blight of the chrysanthemum appears to be new, and is described as *Ascochyta chrysanthemi*.

Heinrich Hasselbring's paper on "The Carbon Assimilation of *Penicillium*" in the *Botanical Gazette* for March, 1908, is a contribution to our knowledge of the chemistry of the assimilation of some of the simpler compounds by plants. Among the results noted is the fact that "alcohol, acetic acid and the substances from which the acetic acid radicle CH_3COO—is easily derived are assimilated by *Penicillium glaucum*."

A disease of the sugar cane known as "red-rot" has been investigated by L. Lewton-Brain, pathologist of the experiment station of the Hawaiian Sugar Planters' Association, who has found it to be due to the entrance of the fungus, *Colletotrichum falcatum*, through wounds made by insects or other agents. Once within the tissues of the stem the fungus penetrates the cells, kills them, and gives the affected areas a red color. There is no external sign of the presence of the disease, except in severe cases when the leaves may turn yellow and the whole plant die.

Mention should be made here of Scott and Rorer's paper "Apple Leaf-spot caused by *Sphaeropsis malorum*" in Bulletin 121 of the Bureau of Plant Industry of the United States Department of Agriculture; of W. H. Lawrence's record of "Some Important Plant Diseases of Washington" in Bulletin 83 of the Oregon Experiment Station, and Cook and Horne's "Insects and Diseases of the Orange" in Bulletin 9 of Estación Central Agronómica de Cuba.

Here also may be mentioned Professor Harshberger's paper "A Grass-killing Slime Mould" in the *Proceedings of the American Philosophical Society*, Vol. XLV., recording a case in which the plasmodia of *Physarum cinereum* killed the blades of grass over which they had grown.

NOTES ON ALGAE AND ARCHEGONIATAE

Dr. M. A. Howe continues his interesting Phycological Studies in a recent number of the *Bulletin of the Torrey Botanical Club* (pp. 491–516, 1907) under the title of "Further Notes on *Halimeda* and *Avrainvillea*" accompanying it with six full-page plates. He describes and figures the sporangia of *Halimeda tridens* from Porto Rico, discusses the American species of *Halimeda* of the *H. tuna* group (*H. tuna*, *H. discoidea* and *H. scabra*), discusses the American species of the *H. tridens* group (*H. tridens*, *H. monile*, *H. simulans* and *H. favulosa*), describes the sporangia of *Avrainvillea nigricans*, and enumerates and describes the American species of *Avrainvillea* (*A. nigricans*, *A. longicaulis*, *A. levis* and *A. rawsoni*).

Professor Doctor N. Wille's "Algologischen Untersuchungen" (I.–VII.) contains papers on the development of *Prasiola furfuracea*; a summer form of *Ulothrix consociata;* a new genus of marine *Tetrasporaceae,* which he names *Pseudotetraspora;* on the reproduction of a *Gloeocapsa;* on a species of *Dactylococcus;* on the zoospores of *Gomontia polyrrhiza;* and closes with a list of the Myxophyceae (seven species) and *Chlorophyceae* (twenty-one species) of the neighborhood of the biological station at Drontheim, Norway.

W. D. Hoyt's paper on "Periodicity in the Production of the Sexual Cells in *Dictyota dichotoma*" in the *Botanical Gazette* for June, 1907, deserves mention even at this late date, showing that sexual cells are produced at regular monthly intervals, and have a definite relation to the tides.

Professor Doctor D. H. Campbell's "Studies on Some Javanese *Anthocerotaceae*" in the October *Annals of Botany,* 1907, is the first of two interesting papers. A new genus, *Megaceros,* is described. It has a very large sporophyte (9 cm. high), has no stomata, and contains spiral elaters. The second installment (in the January number) is devoted to the morphology and histology of *Dendroceros* and *Notothylas.* In discussing the affinities of the *Anthocerotaceae* the author regards *Notothylas* as "without doubt the simplest and probably the most primitive," and "the larger species of *Anthoceros,* with their highly developed assimilative tissue and perfect stomata as probably to be considered the highest existing form of this peculiar form of sporophyte." He suggests, moreover, that "it will probably be best to regard *Anthocerotaceae* as sufficiently distinct from the true Hepaticae to form a special class, *Anthocerotes,* as was suggested by Howe" eight years ago.

In a paper in the October (1907) *New Phytologist,* "On the Distribution of the Hepaticae and its Significance," Dr. Campbell adduces good reasons for concluding that "the distribution of the existing liverworts indicates that they are ancient forms whose scarcity in a fossil condition is due to their very perishable tissues."

A third paper by the same author, which appeared in the March (1907) *American Naturalist* and entitled "Studies on the *Ophioglossaceae,*" is a most helpful one for the fern student. The author still adheres to his hypothesis that *Ophioglossaceae* arose from some form resembling *Anthoceros.*

Charles E. Bessey
University of Nebraska

THE NATIONAL CONFERENCE COMMITTEE ON STANDARDS OF COLLEGES AND SECONDARY SCHOOLS

The third annual meeting of this body, which has been known as the National Conference Committee of the Associations of Colleges and Preparatory Schools and is now permanently organized under the above title, was held at the rooms of the Carnegie Foundation for the Advancement of Teaching, 576 Fifth Avenue, New York, N. Y., Friday, April 17, 1908. The committee is composed of delegates from the following organizations, all of which were represented at this meeting:

The New England Association of Colleges and Preparatory Schools,
The New England College Entrance Certificate Board,
The Association of Colleges and Preparatory Schools of the Middle States and Maryland,
The College Entrance Examination Board,
The North Central Association of Colleges and Secondary Schools,
The Association of Colleges and Preparatory Schools of the Southern States,
The National Association of State Universities,
The Carnegie Foundation for the Advancement of Teaching.

A constitution was adopted which defines the purpose of this committee to be to consider standards of admission, matters of common interest to universities, colleges, and secondary schools, and such further questions as may be referred to it. Provision is made that at least one meeting shall be held each year.

Officers to serve for one year were elected as follows: President, President MacLean, of the University of Iowa; Vice-president, Head Master Wilson Farrand, of Newark Academy; and Secretary-Treasurer, Dean Ferry, of Williams College.

A committee of four was appointed to frame a set of units or scale of values for the interpretation of admission requirements and to consider some allied questions. Resolutions were passed advising that work in English and mathematics should be continued through the last school year; recommending that the organizations whose delegates compose the committee be urged to collect data and study the subject of standardizing colleges and universities; and calling the attention of colleges to the fact that lists of accredited schools are now published yearly by the New England College Entrance Certificate Board and the North Central Association of Colleges and Secondary Schools and may be obtained for general reference and use.

Frederick C. Ferry,
Secretary-Treasurer

SCIENTIFIC NOTES AND NEWS

The University of Illinois has celebrated the fortieth anniversary of its founding by a memorial convocation. The address given by Professor C. M. Moss was chiefly a tribute to Dr. T. J. Burrill, vice-president of the university and professor of botany, who has been connected with the institution since its first year.

The *Boston Medical and Surgical Journal* for May 7 forms a *Festschrift* in honor of Reginald Heber Fitz, M.D., LL.D., Hersey professor of the theory and practise of physic in Harvard University, to celebrate his sixty-fifth birthday, which occurred on May 5.

Professor C. F. Brackett, of Princeton University, who recently retired from the Henry chair of physics, was the guest of honor at a dinner this week, given by the faculty and trustees.

At a recent meeting of the Toronto Academy of Medicine his portrait was presented to Dr. Reeve, dean of the medical faculty of the University of Toronto, who was president at the meeting of the British Medical Association held in Toronto in 1906.

A portrait of Dr. John J. M'Kendrick, professor of physiology in the University of Glasgow from 1876 to 1896 and now emeritus professor, was presented to the university on commemoration day held on April 22.

Commemoration day at the University of Glasgow was observed on April 22, when Professor Gray, the successor of Lord Kelvin in the chair of natural philosophy, delivered an oration on Kelvin's work. Honorary degrees were conferred, including the doctorate of laws on Colonel David Bruce, C.B., of the Royal Army Medical Corps; James Johnston Dobbie, director of the Royal Scottish Museum, and Robert Kidston, the geologist.

At the Institution of Electrical Engineers on April 30 Professor Silvanus P. Thompson gave the first Kelvin memorial lecture, his subject being "The Life and Work of Lord Kelvin." Before the lecture Mr. H. F. Parshall presented the institution with a bust of Benjamin Franklin on behalf of the American Institute of Electrical Engineers.

The Fothergillian medal of the London Medical Society has been presented to Sir Almroth Wright, F.R.S.

Nature states that at the annual general meeting of the Institution of Civil Engineers on April 28, Mr. J. C. Inglis was elected president of the institution. The council has made the following awards for papers read and discussed during the past session: A Telford gold medal to Mr. W. Barclay Parsons (New York); a Watt gold medal to Sir Whately Eliot; George Stephenson gold medals to Sir John Ottley, K.C.I.E., Dr. A. W. Brightmore, and Messrs. J. S. Wilson and W. Gore; Telford premiums to Messrs. F. W. Davis (Darlington), C. R. S. Kirkpatrick (Newcastle-on-Tyne), Hugh T. Ker (Glasgow), G. H. Scott, R. R. Gales (India) and S. H. Ellis.

Professor H. Poincaré, professor of astronomy in the Paris École polytechnique, has retired with the title of honorary professor.

Professor Ira O. Baker, for thirty-four years connected with the Department of Civil Engineering of the University of Illinois, has been granted by the trustees leave of absence for one year. Professor Baker will devote himself to the work of revising his book on "Masonry Construction." The executive duties of the department of civil engineering will, during his absence, be assumed by Professor J. P. Brooks.

Mr. E. P. Taylor, of the Colorado Agricultural Experiment Station, has become entomologist of the Missouri State Fruit Experiment Station at Mountain Grove, Mo.

Mr. H. J. Franklin, who takes his doctor's degree at Amherst in June, has accepted a position with the Minnesota state entomologist at St. Anthony Park, Minn. The U. S. National Museum has recently issued a report "On a Collection of Physanopterous Insects from Barbadoes and St. Vincent Islands" prepared by him. He is also engaged in a work on "Bumble Bees of America" under the same auspices.

The Croonian lecture before the Royal Society was delivered on May 14 by Professor G. Retzius, of Stockholm, on "The Structure of the Central Nervous System of the Higher and Lower Animals."

Dr. R. S. Woodward, president of the Carnegie Institution of Washington, addressed the Phi Beta Kappa of New York on May 18, the subject being "The Carnegie Institution of Washington and its Work."

Dr. Raymond Pearl, biologist of the Maine Experiment Station, lectured before the Portland Society of Natural History on the evening of April 21. The subject of the lecture was "The Improvement of Plants and Animals by Breeding."

Dr. H. F. Osborn, president of the American Museum of Natural History, sailed on May 9 to visit the museums of Paris, Madrid, Brussels and Lyons, lecturing at the last university.

Professor N. M. Fenneman, of the department of geology of the University of Cincinnati, will sail for Naples on May 23. He will there join Professor Davis for the study of physiographic problems in northern Italy and France, and will attend the meeting of the Ninth International Geographical Congress.

Mr. Chester A. Reeds has been engaged by the University of Cincinnati to classify and rearrange the fossil collection and to supplement it by acquisitions from the vicinity of Cincinnati. Mr. Reeds has been acting professor of geology in the University of Oklahoma this year.

Professor Morris B. Crawford, Foss professor of physics at Wesleyan University, will sail for Europe on July 4 to spend the summer in England, France and Switzerland.

Mr. Martin J. Iorns, horticulturist at the Experiment Station, Mayaguez, P. R., has gone to Cuba and Florida to investigate the citrus and pineapple industries.

Mr. L. W. Hawley, expert on wood distillation for the Forest Service, has left Washington for Oregon, Washington, Montana and Idaho, to investigate the possibilities of a future turpentine industry in the northwestern portion of the United States.

Professor August Martin, of Berlin, is visiting this country and will attend the sessions of the American Medical Association and the American Gynecological Society.

The American Museum of Natural History will send out three parties in search of fossil vertebrates this summer as follows: (1) To the Upper Cretaceous of Montana, Mr. Barnum Brown in charge. (2) To the Miocene of northwestern Nebraska, Dr. W. D. Matthew in charge. (3) To the Permian of Texas, Dr. E. C. Case in charge.

A cablegram to the New York *Herald* states that the members of the South Sea expedition organized by the newly established Hamburg Scientific Institute for ethnographical exploration in the Polynesian Islands took leave on May 15 at a special meeting of the institute. The expedition will start from Hong Kong on the Hamburg-American line steamship *Peiho,* specially chartered for that purpose for two years. Its leader, Professor Fuelleborn, is well known as an explorer of East Africa, and is assistant at the Hamburg Institute for Tropical Diseases.

Professor Gilbert M. Gowell, who recently severed his connection with the University of Maine after twenty-five years' service, during which his work had been largely concerned with experiments on poultry, killed himself on May 6, at the age of sixty-three years.

DR. PIERRE JACQUES ANTOINE BÉCHAMP, formerly professor at Montpellier and Lille, eminent for his researches in organic chemistry, died on April 15, at the age of ninety-two years.

THE deaths are also announced of M. C. E. Chamberland, the sub-director of the Pasteur Institute, Paris, at the age of fifty-seven, and of M. Alfred Riche, professor of mineral chemistry at the Sorbonne from 1874 to 1899, at the age of seventy-eight.

THE American Nature-study Society will hold a conference on the Training of Teachers of Nature-study at Cleveland, Ohio, on the afternoon of July 3. This conference may be regarded as preliminary to a more extensive consideration of the same topic at Baltimore next December.

THE German Association of Men of Science and Physicians will hold its annual meeting this year at Cologne from September 20 to 26.

THE Eighth International Congress of hydrology, climatology, geology and physical therapy will be held from April 4 to 10, 1909, in Algiers.

THE Chemical Society of Rome, the Chemical Society of Milan, and the Association of Industrial Chemists of Turin will unite to form the Italian Chemical Society.

A SCIENTIFIC society has been formed in Mexico with the title "La Alianza Cientifica Universal." It is described as a ramification of a general confraternity of scientific men which was founded in Paris by M. Leon de Rosny and is intended to include the scientific men of Europe and Latin America. The active president of the Mexican society is Professor Alfonso Herrera, while the president of the republic is honorary president and all the members of his cabinet are honorary members of the Alianza. The list of active members in the federal district consists of professors and professional men—scientific and technical—and government officials.

ACCORDING to the *Journal of the American Medical Association* the annual congress of the Russian Pirogoff Medical Association, the national organization, can not be held this year, as the authorities have refused the usual permit. The February number of the journal issued by the organization was confiscated recently on account of an article by Dr. W. Kanel which failed to pass the censor on account of its alleged revolutionary tendency. The editor of the journal, Dr. J. W. Popoff, is also held legally responsible for permitting the publication of the article.

AT the recent meeting of the National Academy of Sciences held in Washington the following resolution was adopted:

Resolved, That four members of the academy be appointed by the president as a committee on paleontological correlation, including two specialists in invertebrate and vertebrate paleontology, respectively. The present committee shall serve two years only and be eligible to reappointment or substitution of new members in 1910. The committee shall have power to extend its membership so as to secure American and international cooperation.

In compliance with the resolution, the president appointed Messrs. H. F. Osborn and William B. Scott in the field of vertebrate paleontology and Messrs. C. D. Walcott and William H. Dall in the field of invertebrate paleontology.

ON the recommendation of Professor David Todd, of Amherst College, who visited South America and the Isthmus last year, eastern standard time has been adopted at Panama, per order No. 167 of the chairman of the Isthmian Canal Commission. The change went into effect on April 27, the newly adopted standard time being 54 minutes faster than Panama railroad time previously kept, and 18 minutes faster than the local astronomical time at Panama. All departments and divisions of the Isthmian Canal Commission have since that date observed the new standard time. The proposition to adopt the same standard is now before the Ecuadorian government, and Professor Todd has recently received word that the National Geographical Society of Lima has recommended to the

Peruvian government the adoption of eastern standard, or 75th meridian, time for the whole of Peru.

Eight new drainage districts have been organized in the southeastern part of Wisconsin by the soils department of the state university experiment station. This is a particularly favorable season for this reclamation work, since, owing to the dry weather of last fall, the marshes of the central and southern part of the state are much drier than usual. Professor A. R. Whitson, of the university soils department, has recently investigated three of these districts and found that they can be reclaimed successfully and profitably by drainage. The largest of these—the Norway and Dover district in Racine County—is a tract of 17,000 acres of shallow muck underlaid with clay. This land, which is now of little value, as only wild grass can be cut on it once in two or three years, will unquestionably show a high degree of fertility after drainage, when hay, corn and other farm crops will be grown.

The *Yale Alumni Weekly* states that the increased use of the Peabody Museum, owing to the recent Sunday opening, and the cramped space for exhibiting the large specimens and the increasingly large collections have directed attention to the plan for future enlargement. A design for the completed building, drawn by the architect of the wing already erected, J. Cleveland Cady, of New York City, was approved by the late Professor O. C. Marsh, and the drawing now hangs on the walls of one of the office rooms on the second floor of the museum. It represents a large central hall with a wing exactly like the present structure extending down to Library Street. The cost of the central hall alone is estimated at about $300,000, and the accumulated building fund for the purpose is reported at about $150,000. The architect recently communicated with Treasurer McClung with reference to submitting revised plans for the completed museum to meet present needs. Nothing definite has been done in regard to the plans and it is possible that when an adequate museum is erected it may be on the university's new property to the north of the present campuses.

One of the most important economic movements of the day about which the general public has yet learned little is the concerted action of owners of timber in different parts of the country in organizing associations to protect their holdings from fire. In the Pacific northwest, the Washington Forest Fire Association has just elected officers at Seattle and begun work for the year with 3,000,000 acres under its care. The plans include a system of patrol by rangers resembling the work done by the United States Forest Service in guarding against and extinguishing fires. Organizations of similar kind and for a like purpose are at work in Oregon and Idaho. In the latter state, a portion of the expense is borne by taxation and paid from the state treasury. A western railroad company which holds large tracts of timber has taken steps to guard its property from fire, and during the short time that its plans have been in operation, it has met with most encouraging success. Similar work is being done on the other side of the continent. Forest owners in Maine have gone to work in the same systematic way to control the forests' great enemy, fire. Like organizations are found in other parts of the country, showing how fully it is now realized that protection against fire is of the greatest importance. It is safe to say that fires in this country have destroyed more timber than lumbermen have cut. When timber was abundant, the waste passed almost unnoticed, but now that a scarcity is at hand and an actual wood famine threatens in the near future, the owners of forest lands are waking up and taking action to save what is left.

The lectureship on physic founded at St. John's College, Cambridge, by Thomas Linacre in 1515 has hitherto been held for a term of years. It is now, as we learn from *The British Medical Journal,* converted into an annual office, and every year some person of eminence will be asked to deliver one public lecture in the Easter term. This ancient lectureship has been held in the past by many distinguished men; among them were William Barondale, Thomas Gisborne and Sir Thomas Watson, all presidents of the Royal College of

Physicians of London, and by Sir Isaac Pennington, John Haviland and Sir George Paget, who were Regius professors of physic in the university. William Heberden was also a Linacre lecturer, so were Henry Paman and Henry Briggs, who were also Gresham professors. The last named was the inventor of the decimal system of logarithms, and was not a medical man. Perhaps the most distinguished members of the laity who have held the lectureship were Matthew Prior, the poet and diplomatist, and Edward Stillingfleet, Bishop of Worcester. From 1894 until his appointment to be principal of Glasgow University the lectureship was held by Dr. Donald MacAlister. The first lecture under the new scheme was given on May 6, by Dr. Osler, regius professor of medicine in the University of Oxford, who took for his subject Thomas Linacre, his life and work.

The total cost of the buildings erected in the principal cities of the United States in 1907 was $661,076,286, according to Mr. Jefferson Middleton, of the U. S. Geological Survey, who has collected statistics on this subject in connection with his work on the clay-working industries. Compared with the cost of buildings in the same cities in 1906, these figures show a net decrease of $17,634,683, or 2.60 per cent.; they are, however, 2.55 per cent. in excess of the figures for 1905 and 40.86 per cent. greater than in 1904. Although the total cost of buildings in the 49 cities reporting was decreased, the number of permits increased from 181,174 in 1906 to 184,055 in 1907. In some cities more than one building was erected under one permit, but as a rule a permit was issued for each building. The city showing the greatest decrease in cost of buildings is New York, the value of whose operations fell off $41,591,982, or 26.84 per cent. St. Louis showed the next largest decrease—$8,045,526, or 26.87 per cent.; next is Chicago, which reported a falling off of $5,616,245, or 8.68 per cent. Philadelphia, Boston and Brooklyn also showed decreases in 1907, though Brooklyn nearly held its own, the decrease being only $149,304, or 0.21 per cent., a better showing than that of any other of the very large cities in which normal conditions prevailed. In Baltimore, where large gains had been reported in 1904 and 1905 as the result of the fire in 1904, the cost of building operations also decreased, though it was more than twice as great in 1907 as in 1903, when the cost was but $3,327,225. It is probable that most of the decreases were due to the financial disturbance during the latter part of the year, although the decrease in Los Angeles, which has shown remarkable increases in past years, appears to have been due rather to scarcity and high cost of material than to the business depression. Twenty-five cities reported an increase in cost of building operations. In San Francisco, owing to the local conditions following the fire, the increase was $56,574,844, the total amount being nearly 162 per cent. in excess of the cost for 1906. The total number of permits issued in 1907 for buildings in San Francisco was 12,126, and the cost of the buildings was $91,502,240. In 1905, the year prior to the fire, its building operations cost $18,268,753. In Cambridge, Mass., which, with the exception of San Francisco, showed the largest proportionate gain, the erection of several large mercantile buildings swelled the total. Cleveland's building industries seem not to have been affected by the financial depression, showing an increase of $2,915,433, or 22.47 per cent., over the figures for 1906. The reports for Milwaukee show an increase of more than a million dollars, due to the increase in the number of fireproof or fire-resisting buildings erected.

UNIVERSITY AND EDUCATIONAL NEWS

A research laboratory of applied chemistry will be established shortly at the Massachusetts Institute of Technology, with Professor W. A. Walker in charge.

The Hong Kong correspondent of the *British Medical Journal* writes that the governor, Sir Frederick Lugard, convened a meeting on March 18, to consider the possibility of establishing a university in Hong Kong. He announced that Mr. Mody, a Parsee, had placed £15,000 at his disposal for that purpose. The governor was willing to recommend the government to provide a site, and personally was anxious to see the project take shape. He believed that a university at Hong Kong would attract a large number of the wealthy Chinese students who now went to Japan, America and Europe, and would increase the prestige and influence of Great Britain throughout the Chinese empire. To provide an adequate endowment for even the modest beginning proposed, a sum of about £100,000 would be required.

Representatives of the faculties of ten New England colleges met in Providence on May 6 to discuss problems of university administration. The institutions represented are Amherst, Bowdoin, Dartmouth, Harvard, Tufts, Maine, Wesleyan, Williams, Yale and Brown, and the delegates in most cases were the deans.

The George Washington University has established a separate department of psychology, with Williston S. Hough, Ph.M., Shepherd Ivory Franz, Ph.D., and William Carl Ruediger, Ph.D., as teaching staff. There are to be two psychological laboratories, one for elementary class instruction and experiments bearing on educational problems, and one for the advanced research work of graduate students.

Several changes will occur in the science departments at Wesleyan University next year. In the biological department, Mr. David Day Whitney, A.B. (Wesleyan 1904) and candidate for Ph.D. (Columbia) this June, will succeed Mr. Budington as instructor in biology. Two new courses will be added in connection with the laboratory courses now offered in general biological laboratory work, one a course in histology for prospective students of medicine, the other an extensive botany course, designed for those intending either to study forestry or to teach botany. The chemical department will be considerably enlarged and improved, while courses in physical chemistry and electro-chemistry will be introduced. J. W. Turrentine, a graduate of the University of North Carolina (1902), and candidate for Ph.D. at Cornell, where he has been pursuing graduate study for three years, will be instructor in chemistry, to fill the place of Mr. Hale, who intends to study for his degree in Cornell.

At the University of Wisconsin H. A. Parker has been appointed instructor in topographical engineering. The regents also made a number of promotions in the faculty. A. N. Winchell, now assistant professor, becomes professor of mineralogy and petrology, and Associate Professor M. C. Beebe has been appointed professor of electrical engineering. H. J. Thorkelson has been made associate professor in the department of steam engineering. Instructors who have been appointed to assistant professorships are: L. R. Ingersoll, physics; J. G. Fuller, animal husbandry; W. L. Koelker, chemistry; W. G. Marquette, botany; B. M. Allen, anatomy; A. V. Millar, mechanical drawing; R. MacA. Keown, machine design; J. W. Watson, electrical engineering; O. P. Watts, chemical engineering. Chauncey Juday was made lecturer in zoology. New instructors are as follows: J. H. Mathews, physical chemistry; W. E. Grove, pharmacology; W. H. Brown, pathology; Walter J. Meek, physiology; R. C. Disque, electrical engineering. R. T. Craigo has been appointed instructor in mathematics in the university extension division. Assistants who are promoted to instructorships are: F. K. Brainard, physics; W. J. Mead, geology; P. Skadky, mechanical practise, and E. E. Parker, applied engineering. The new assistants include: A. R. Koch, pharmacy; M. C. Otto, philosophy; F. W. Williams, geology; L. F. Ausburger, analytical chemistry; David Klein, chemistry; H. L. Walster, soils, and R. L. Marshall, soils.

Dr. S. O. Mast, Johnston research scholar at Johns Hopkins University and professor of biological science at Hope College, has been appointed associate professor of biology at the Woman's College of Baltimore.

Victor E. Emil, Ph.D., Austin teaching fellow in histology and embryology in the Harvard Medical School has been appointed instructor in biology at the George Washington University.

Mr. Chas. T. Vorhies, of the University of Wisconsin, has been elected to the chair of biology in the University of Utah.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MAY 29, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
MELODY AND THE ORIGIN OF THE MUSICAL SCALE[1]

IN the vice-presidential addresses of the American Association great latitude in the choice of subjects is allowed and taken, but there is, I believe, no precedent for choosing the review of a book, printed fifty-five years before. Helmholtz's Tonenempfindungen, produced by a masterful knowledge of physiology, physics and mathematics, and a scholar's knowledge of the literature of music, has warded off all essential criticism by its remarkable breadth, completeness and wealth of detail. Since it was first published it has been added to by the author from time to time in successive editions, and greatly bulwarked by the scholarly notes and appendices of its translator, Dr. Alexander J. Ellis. The original text remains unchanged and unchallenged on physical grounds. In taking exception at this late day to the fundamental thesis of Part III., I derive the necessary courage from the fact that should such exception be sustained, it will serve to restore to its full application that greater and more original contribution of Helmholtz which he included in Part II. Having given a physical and physiological explanation of the harmony and discord of simultaneous sounds, and therefore an explanation of the musical scale as used in modern com-

[1] Address of the vice-president and chairman of Section B—Physics—American Association for the Advancement of Science, Chicago, 1907–8.

position, Helmholtz was met by an apparent anachronism. The musical scale, identical with the modern musical scale in all essentials, antedated by its use in single part melody the invention of chordal composition, or, as Helmholtz expressed it, preceded all experience of musical harmony. In seeking an explanation of this early invention of the musical scale Helmholtz abandoned his most notable contribution, and relegated his explanation of harmony and discord to the minor service of explaining a fortunate, though, of course, an important use of an already invented system of musical notes. The explanation of the original invention of the musical scale and its use in single-part music through the classical and the early Christian eras, he sought for in purely esthetic considerations—in exactly those devices from which he had just succeeded in rescuing the explanation of harmony and discord.

The human ear consists of three parts—in the nomenclature of anatomy—of the outer, middle and inner ear. The outer and inner ears are connected by a series of three small bones traversing the middle ear and transmitting the vibrations of sound. The inner ear is a peculiarly shaped cavity in one of the hard bones of the skull. That part of the cavity with which we are here concerned is a long spiral passage called from its resemblance to the interior of a snail shell, the cochlea. The cavity has two windows which are closed by membranes. It is to the uppermost of these membranes that the train of three small bones reaching from the drum of the outer ear is attached at its inner end. It is to this upper membrane, therefore, that the vibration is communicated, and through it the vibration reaches the fluid which fills the inner cavity. As the membrane covering the upper window vibrates, the membrane covering the lower window yielding also vibrates, and the motion of the fluid is in the nature of a slight displacement from one to the other window, to and fro. From between these windows a diaphragm, dividing the passageway, extends almost the whole length of the cochlea. This diaphragm is composed in part of a great number of very fine fibers stretched side by side, transverse to the cochlea, and called after their discoverer, fibers of Corti. On this diaphragm terminate the component fibers of the auditory nerve. When the liquid vibrates the fibers vibrate in unison, the nerve terminals are stimulated, and thus the sensation of sound is produced. These fibers of Corti are of different lengths and presumably are stretched with different tensions. They therefore have different natural rates of vibration and a sympathetic resonance for different notes. The whole has been called a harp of several thousand strings.

Were these fibers of Corti very free in their vibration, each would respond to and would respond strongly only to that particular note with whose frequency it is in unison. Because of the fact that they are in a liquid, and possibly also because of the manner of their terminal connections, they are considerably damped. Because of this their response is both less in amount and less selective in character. In fact, under these conditions not one, but many fibers vibrate in response to a single pure note. A considerable length or area of the diaphragm is excited. So long as the exciting sound remains pure in quality, constant in pitch and constant in intensity, the area of the diaphragm affected and the amplitude of its vibration remain unchanged. If, however, two notes are sounded of nearly the same pitch, the areas of the diaphragm affected by the two notes overlap. In the overlapping region the vibration is violent when the two notes are in the same phase, weak when they are in opposite phase. The result is the familiar phenomenon of beats. Such beats when slow are not disagreeable and not without musical value. If the difference between the two notes is increased the beats become more rapid and more disagreeable. To this violent disturbance, to the starting and stopping of the vibration of the fibers of Corti, Helmholtz ascribed the sense of roughness which we call discord. As the notes are more widely separated in pitch the overlapping of the affected areas diminishes. Between pure notes the sense of discord disappears with sufficient separation in pitch. When the two vibrating areas exactly match because the two notes are of exactly the same pitch, and when the two areas do not in the least overlap because of a sufficiently wide separation in pitch, the result, according to Helmholtz, is harmony. Partial overlapping of the affected areas produces beats, and the roughness of beats is discord. Such, reduced to its fewest elements, is Helmholtz's explanation of the harmony and discord of tones which are pure notes.

But no musical tone is a pure note. A musical tone always consists of a combination of so-called partial tones which bear to each other a more or less simple relationship. Of these partial tones, one is called the fundamental—so called because it is the loudest or lowest or, better still, because it is that to which the other partial tones bear the simplest relation. A musical tone, therefore, affects not one, but, through its fundamental and upper partial tones, several areas of the diaphragm in the cochlea. Two musical tones, each with its fundamental and upper partials, therefore affect areas of the diaphragm which overlap each other in a more or less complicated manner, depending on the relative frequencies of the fundamental tones and the relationships of their upper partials. The exact matching of the areas affected by these two systems of partial tones, or the entire separation of the affected areas, gives harmony. The overlapping of these affected areas, if great, produces discord, or if slight in amount, modifications and color of harmony.

In the great majority of musical tones the upper partials bear simpler relationships to the fundamentals, being integral multiples in vibration frequency. Helmholtz showed that if of two such tones one continued to sound unchanged in pitch, and the other, starting in unison, was gradually raised in pitch, the resulting discord would pass through maxima and minima, and that the minima would locate the notes of the pentatonic scale. The intermediate notes of the complete modern musical scale are determined by a repetition of this process, starting from the notes thus determined.

If to this is added a similar consideration of the mutual interference of the combinational tones which are themselves due to the interaction of the partial tones, we have the whole, though, of course, in the briefest outline, of Helmholtz's theory of the harmony and discord of simultaneously sounding musical tones.

Having thus in parts I. and II. developed a theory for the harmony and discord of simultaneous sounds, and having developed a theory which explains the modern use of the musical scale in chords and harmonic music, Helmholtz pointed out in part III. that the musical scale in its present form existed before the invention of harmonic music and before the use of chords. Music may be divided into three principal periods:

1. "Homophonic or unison music of the ancients," including the music of the Christian era up to the eleventh century, "to which also belongs the existing music of Oriental and Asiatic nations."

2. "Polyphonic music of the middle

ages, with several parts, but without regard to any independent musical significance of the harmonies, extending from the tenth to the seventeenth century."

3. "Harmonic or modern music characterized by the independent significance attributed to the harmonies as such."

Polyphonic music was the first to call for the production of simultaneous sounds and therefore for the hearing or the experience of musical harmony. Homophonic music, that which alone existed up to the tenth or eleventh century, consisted in the progression of single-part melody. Struck by this fact, Helmholtz recognized the necessity of seeking another explanation for the invention and the use of a scale of fixed notes in the music of this period. To borrow his own words, "scales existed long before there was any knowledge or experience of harmony." Again, elsewhere he says in emphasizing the point: "The individual parts of melody reach the ear in succession. We can not perceive them all at once; we can not observe backwards and forwards at pleasure." Between sounds produced and heard in discrete succession, there can be neither harmony nor discord, there can not be beats, or roughness or interruption of continuous vibrations. Regarding the sounds of a melody as not merely written in strict and non-overlapping succession, but also as produced and heard in discrete succession, Helmholtz sought another basis for the choice of the notes to constitute a scale for homophonic music. His explanation of this invention can be best presented by a few quotations:

Melody has to express a motion, in such a manner that the hearer may easily, clearly and certainly appreciate the character of that motion by immediate perception. This is only possible when the steps of this motion, their rapidity and their amount, are also exactly measurable by immediate sensible perception. Melodic motion is change of pitch in time. To measure it perfectly, the length of time elapsed, and the distance between the pitches, must be measurable. This is possible for immediate audition only on condition that the alterations in both time and pitch should proceed by regular and determinate degrees.

Again Helmholtz says:

For a clear and sure measurement of the change of pitch, no means was left but progression by determinate degrees. This series of degrees is laid down in the musical scale. When the wind howls and its pitch rises or falls in insensible gradations without any break, we have nothing to measure the variations of pitch, nothing by which we can compare the later with the earlier sounds, and comprehend the extent of the change. The whole phenomenon produces a confused, unpleasant impression. The musical scale is as it were the divided rod, by which we measure progression in pitch, as rhythm measures progression in time. Hence the theoreticians of ancient as well as modern times.

Later he says:

Let us begin with the octave, in which the relationship to the fundamental tone is most remarkable. Let any melody be executed on any instrument which has a good musical quality of tone, such as a human voice; the hearer must have heard not only the primes of the compound tones, but also their upper octaves, and, less strongly, the remaining upper partials. When, then, a higher voice afterwards executes the same melody an octave higher, we hear again a part of what we heard before, namely, the evenly numbered partial tones of the former compound tones, and at the same time we hear nothing that we had not previously heard.

What is true of the octave is true in a less degree for the twelfth. If a melody is repeated in the twelfth we again hear only what we had already heard, but the repeated part of what we heard is much weaker, because only the third, sixth, ninth, etc., partial tone is repeated, whereas for repetition in the octave, instead of the third partial, the much stronger eighth and tenth occur, etc.

For the repetition in the fifth, only a part of the new sound is identical with a part of what had been heard, but it is, nevertheless, the most perfect repetition which can be executed at a smaller interval than an octave.

Without carrying these quotations farther, they will suffice to illustrate the basis which Helmholtz would ascribe to homophonic music and early melodic composition. On this explanation the basis of melody is purely that of rhythm and rhythm based on a scale of intervals. The scale of intervals in turn is based on a recognition conscious or subconscious of the compound character of musical tones and of the existence in tones of different pitch of partials of the same pitch. This calls for a degree of musical insight and discrimination which it is difficult to credit to a primitive art. It is in reality the skill of the highly trained musician, of a musician trained by long experience with sounds which are rich and accurate in quality. This power of analysis goes with supreme skill rather than with the early gropings of an art.

After having developed a theory of harmony and discord based on elaborate experimental and mathematical investigations, which was remarkable in bringing together three such diverse fields as physics, physiology and esthetics, he relegated it to the minor application of explaining the use in modern music of an already existing and highly developed musical scale, and sought an explanation of the earlier use of the scale in melody and its original invention in a principle which is very far from possessing either the beauty or the convincing quality of his earlier hypothesis. He was forced to this by the priority of melodic or homophonic composition. He saw in melody only a succession of notes, no two existing at the same time, and therefore incapable of producing harmony or discord in a manner such as he had been considering.

It is true that melody is written as a pure succession of discrete notes, one beginning only when the other has ceased. It is true also that melody is so sung and so produced on a homophonic instrument such as the voice, flute, reeds or on stringed instruments. This is peculiarly true of the voice, and it is with the voice that one naturally associates the earliest invention of the scale. But while it is true that the earliest song must have consisted of tones produced only in succession, it is not necessarily true that such sounds were heard as isolated notes. A sound produced in a space which is in any way confined continues until it is diminished by transmission through openings, or is absorbed by the retaining walls or contained material to such a point that it is past the threshold of audibility, and this prolongation of audibility of sound is under many conditions a factor of no inconsiderable importance. In many rooms of ordinary construction the prolongation of audibility amounts to two or three seconds and it is not exceedingly rare that a sound of moderate initial intensity should continue audible for eight, nine, or even ten seconds after the source has ceased. As a result of this, single-part music produced as successive separate sounds is nevertheless heard as overlapping, and at times as greatly overlapping tones. Each note may well be audible with appreciable intensity not merely through the next note, but through several succeeding notes. Under such conditions we have every opportunity even with single-part music for the production of all the phenomena of harmony and discord which have been discussed by Helmholtz in explanation of the chordal use of the musical scale. In any ordinarily bare and uncarpeted room, one may sing in succession a series of notes and then hear for some time afterward their full chordal effect.

All the arguments that Helmholtz advanced in support of his hypothesis that the musical scale was devised solely from considerations of rhythm and founded on a repetition of faint upper partials, hold with equal force in the explanation here proposed. The identity of partial tones in compound tones with different fundamentals is one of the conditions of harmony, and the scale devised by considerations of the mutual harmony of the notes sounded simultaneously would, in every respect, be the same as that of a scale based on repeated upper partials. In the one case the identity of upper partials is an act of memory; in the other it is determined by the harmony of sustained tones. All the arguments by Helmholtz based on historical considerations and on racial and national differences are equally applicable to the hypothesis of sustained tones. In fact, they take on an additional significance, for we may now view all these differences not merely in the light of differences in racial development and temperament, but in the light of physical environment. Housed or unhoused, dwelling in reed huts or in tents, in houses of wood or of stone, in houses and temples high vaulted or low roofed, of heavy furnishing or light, in these conditions we may look for the factors which determine the development of a musical scale in any race, which determine the rapidity of the growth of the scale, its richness and its considerable use in single-part melody.

The duration of audibility of a sound depends on its initial intensity and on its pitch, to a small degree on the shape of the confined space, and to a very large degree on the volume of the space and on the material of which the walls are composed. The duration of audibility is only a logarithmic function of the initial intensity, and as the latter is practically always a large multiple of the minimum audible intensity, this feature of the problem may be neglected when considering it broadly. For this discussion we may also leave out of consideration the effect of shape as being both minor and too intricately variable. The pitch here considered will be the middle of the musical scale; for the extremes of the scale the figures would be very different. The problem then may be reduced to two factors, volume and material. It is easy to dispose of the problem reduced to these two elements.

The duration of audibility of a sound is directly proportional to the volume of a room and inversely proportional to the total absorbing power of the walls and the contained material. The volume of the room, the shape remaining the same, is proportional to the tube, while the area of the walls is proportional to the square of the linear dimensions. The duration of audibility, proportional to the ratio of these two, is proportional itself to the first power of the linear dimension. Other things being equal, the duration of audiblity, the overlapping of successive sounds, and therefore the experience of harmony in single-part music, are proportional to the linear dimensions of the room, be it dwelling-house or temple.

Turning to the question of material, the following figures are suggestive: Any opening into the outside space, provided that outside space is itself unconfined, may be regarded as being totally absorbing. The absorbing power of one-half-inch hard pinewood sheathing is 6.1 per cent., of plaster on wood lath 3.4 per cent., of single-thickness glass 2.7 per cent., of brick in Portland cement 2.5 per cent., of the same brick painted with oil paint 1.4 per cent. Of the others wood sheathing is nearly double any of the rest. On the other hand, a man in the ordinary clothing of to-day is equal in his absorbing power to nearly 48 per cent. of that of a square meter of unobstructed opening, a woman is 54 per cent., and a square meter of audience at ordinary seating distance is nearly 96 per cent. Of significance also in this connection is the fact that Oriental rugs have an absorbing power of nearly 29 per cent. and house plants of 11 per cent.

Of course, the direct application of these figures in any accurate calculation of the conditions of life among different races or at different periods of time is impossible, but they indicate in no uncertain manner the great differences acoustically in the environment of Asiatic races, of aboriginal races in central and southern Africa, of the Mediterranean countries, of northern Europe at different periods of time. We have explained for us by these figures why the musical scale has but slowly developed in the greater part of Asia and of Africa. Almost no traveler has reported a musical scale, even of the most primitive sort, among any of the previously unvisited tribes of Africa. This fact could not be ascribed to racial inaptitude. If melody was, as Helmholtz suggested, but rhythm in time and in pitch, the musical scale should have been developed in Africa if anywhere. These races were given to the most rhythmical dancing and the rhythmical beating of drums and tom-toms. Rhythm in time they certainly had. Moreover, failure to develop a musical scale could not be ascribed to racial inaptitude to feeling for pitch. Transported to America and brought in contact with the musical scale, the negro became immediately the most musical part of our population. The absence of a highly developed scale in Africa must then be ascribed to environment.

Turning to Europe, we find the musical scale most rapidly developing among the stone-dwelling people along the shores of the Mediterranean. The development of the scale and its increased use kept pace with the increased size of the dwellings and temples. It showed above all in their religious worship as their temples and churches reached cathedral size. The reverberation which accompanied the lofty and magnificent architecture increased until even the spoken service became intoned in the Gregorian chant. It is not going beyond the bounds of reason to say that in those churches in Europe which are housed in magnificent cathedrals the Catholic, the Lutheran and Protestant Episcopal, the form of worship is in part determined by their acoustical conditions.

This presents a tempting opportunity to enlarge on the fact that the alleged earliest evidence of a musical scale, a supposed flute, belonged to the cave-dwellers of Europe. This and the impulse to sing in an empty room, and the ease with which even the unmusical can keep the key in simple airs under such conditions, are significant facts, but gain nothing by amplification. The same may be said of the fact that since music has been written for more crowded auditoriums and with harmonic accompaniment the air has become of less harmonious sequence. These and many other instances of the effect of reverberation come to mind.

In conclusion, it may be not out of place to repeat the thesis that we would not merely with Helmholtz regard melody as rhythm in time and rhythm in pitch, but also as harmony in sustained tones, and see in the history of music, certainly in its early beginnings, but possibly also in its subsequent development, not only genius and invention, but also the effect of physical environment.

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THE RELATION OF INSTINCT TO INTELLIGENCE IN BIRDS

In the following observations an attempt is made to analyze the behavior of the wild bird in order to ascertain first, how their instincts are modified by their ability to learn, and secondly the degree of intelligence which they ordinarily attain. It may be taken as an axiom that if the bird be intelligent, it must use its intelligence in meeting the emergencies of daily life and the dangers which surround its home. I shall refer mainly to nesting birds. In all cases the conditions are natural and the behavior free.

In considering the young we must distinguish between the altricious and precocious species, and remember that between such extremes every shade of difference exists. The cedar waxwing which is born blind and naked may be taken as a type of the altricious group. The moment it bursts its shell, unfolds and dries off, a new class of stimuli assail it. Its sensitive skin, with its tactile organs and ears, begin to register new emotions. Its most striking initial reaction is to rise upon its pot-belly as upon a central pillar or foot, open its wide mouth, and thus display its light-rimmed scarlet "target" of a throat. This reaction might arise from hunger, but it certainly follows mechanically in response to any sound or vibration to the nest. At birth such a nestling is a nearly perfect reaction machine; its responses are automatic and reflex, and within the limits of fatigue they are as uniform and continuous as the responses of an electric bell. At this sign from the young the parent goes in quest of prey, discovers and seizes it, hammers it to a pulp, it may be, and returns with it to the nest. The nestling repeats the sign, and the food is pressed gently down into its sensitive throat; the swallowing reflex is started, and the little bird gets its first meal. Remove this bird from its nest, and this feeding response is given as regularly and as continuously as before. Now approach the same nest upon the second, or better, upon the third or fourth day and apply the same tests. It will be found that the feeding reaction no longer comes uniformly and invariably, and if the young is again removed from its nest, the response is still more difficult to obtain. The characteristic feeding reaction is now regular and predictable only in the presence of the parent, and in its proper environment—the nest. Therefore in forty-eight hours the young cedarbird begins to show the first sign of intelligence by learning to limit its reactions to those which count, or in other words by learning to recognize the coming of the parent. Yet this association, which seems to mark the dawn of avian intelligence, is often far from precise, for when at the age of eight or ten days of age a nestling rises to stretch on the nest its companions will crowd about it and "beg" in the same excited manner, as if it were really the parent just alighted on the nest with food in bill.

All birds form associations with their nest or the spot on which they are born, and to most it signifies warmth, a place to be fed, and comfort in general. In some cases the young learn to return to the nest, and may go in and out of it for days or weeks. Altricious birds when once out of the nest seldom return, but this is not due to any lack of association, but to their rising instinct of fear favoring that of flight, or at least the desertion of the nest and possibly their concealment by hiding, when the attunement of these instincts is imperfect. In a few cases the same nest or nest-site may be occupied by the same birds for many successive years. There is no evidence that the young of any birds distinguish their nest as a *nest* at all, or as anything more than a place, as a part of a tree or of the earth.

The young kingfisher spends four weeks in its underground tunnel, and towards the close of this period, as I have explained elsewhere, it acquires the curious habit of walking backward. In the education of the young bird it is not necessary to assume that any conscious or deliberate part is ever played by the adults. The phenomena are satisfactorily accounted for by instinct, including imitation on an instinctive basis, and association, involving experience and the power to learn. In altricious birds imitation is not very effective before the young leave the nest, but is more marked in precocious birds at an early period. Imitation is most striking in fully grown but immature young, as in bluebirds, which still follow their parents, but are not wholly dependent upon them, or in gull chicks, which are fed by regurgitation, and often have to wait a long time before the food is produced.

Does the adult bird show intelligence in serving the proper quantity of food, and in distributing it to the young? The answer is no! What the old bird really does in effect is to "test" the reaction of the throat of each nestling, and await the response. If a bird does not respond quickly the food is withdrawn and another is tested. Thus is the food always passed around until a bird with the proper reaction time is found. There is no evidence that such "tests" are deliberately or consciously made. The amount of food taken by the young is determined reflexly by the gullet, which acts as a brake upon the tendency of the young to gorge itself to suffocation. The bird with full gullet can not as a rule respond, and must wait.

Does the old bird display intelligence in the kind of food served, or in the treatment which it receives? It probably does. While a good deal of instinct is involved in all these matters, the parent does not act like a machine, but the young are provided with food adapted to their growing needs. A gull chick, one half hour old, gets small pieces of predigested fish, while at three weeks of age it may be invited to bolt an entire squid.

What can be said of the general intelligence displayed by old birds? We find that their various instincts become modified or refined by habit or association at almost every step. Thus behavior becomes ever more definite, and their life tends to run in grooves. They quickly form the habit of going to their nesting site by a definite path. If the branch which holds the nest is cut off and removed but a few feet away, the old bird will try to follow her usual course and hover at the point in space formerly occupied by the nest, even when in sight of her young, and will repeat these actions many times before actually going to the nest. But this behavior abruptly ends when the new site of the nest is once visited. After the nest is built, or even while construction is in progress, a definite habit of approach is formed, which may involve walking along a certain limb or grasping certain twigs. The habit of entering the nest from a certain side, facing the same way while sitting on the eggs, grasping the same branch when inspecting or cleaning the nest, and leaving the nest in a definite manner, are all more or less stereotyped and fixed by habit in a relatively brief course of time.

Do birds discriminate their own eggs and proper young? Very many do not, but some do, sooner or later. The success of the European cuckoo, or the American cowbird, whose young are reared by foster parents of many species, would argue for little power in this direction. Yet, in some cases, the foreign body is removed, or the nest is deserted through fear.

In the cyclical instincts of the reproductive period intelligence in the wild bird is mainly displayed by the formation of habits through association. In the same way drinking and bathing places, perches, spots for dusting, for sun-bathing and sleeping are resorted to by habit, for longer or shorter periods, according to the other conditions which modify behavior.

How does the wild bird meet emergencies? Do their acts ever suggest abstract thought, deliberation and planning, and do they generally offer any effective aid to companions in distress? Such important subjects can not be summarily dismissed. Many observations would certainly warrant a negative answer to the last two questions, while some would not. Not only do we need more pertinent and reliable observations, but a more exact analysis, as well as more certain criteria.

A chipping sparrow will pluck a horse hair from the mouth of a nestling, while another bird like an oriole will stand by and see its mate hung until dead without attempting to release it. A robin will tug at a string which has caught on a limb, but is never seen to fully meet the situation by releasing the string. It will make several turns of a cord about a limb and leave the other end to hang free without any relation to the nest, so that its effort is useless. It ties no knots. The gull, according to abundant and competent testimony, will carry shellfish to a considerable height, drop them on the rocks or hard ground, and repeat the experiment until it gets the soft meat. This suggests adaptive intelligence or even analogical reasoning, but probably does not rise above the level of associative memory. The habit is probably casually formed, and is certainly rare.

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SCIENTIFIC BOOKS

Early Devonic History of Northeastern North America. Memoir 9, New York State Museum, New York State Education Department, 366 pp., 48 plates, sections, diagrams, maps, etc. Albany, 1908. By J. M. Clarke, State Geologist, and Director of the New York State Museum.

In this magnificent memoir, with its princely plates and exquisite illustrations, the state of New York has once more shown the world how far science and art had reached towards a realization of satisfactory results in describing and illustrating the hard facts of geology in an orderly and delightful manner.

To the student of paleontology and stratigraphical geology this handsome contribution to the history of early Devonian times will be most welcome. It fills a long-felt want, and serves to tie together a number of faunas and formations with others in the State of New York as well as beyond. Science, and geology especially, knows no political boundaries. As Dr. Clarke very aptly puts it, "The New York series of formations spreads away from its typical region to all points of the compass, and in all these directions, however far it extends, light is to be sought for the explication of past geologic conditions in New York." "The state, . . . does not and never can in itself afford the solution of its own problems." Professor James Hall for the sixty-three years that he was in office at Albany had shown that the New York series extended beyond the limits of New York State. The standards laid down by the fathers of geology in northeastern America, like Hall, Logan, Dana, Billings, Emmons and many others, were to be kept high and to the fore.

The subject-matter dealt with by the distinguished successor to James Hall in the memoir before me was obtained by Dr. Clarke in the Peninsula of Gaspé, in southeastern Quebec. After describing the general distribution of the "Early Devonic of New York" and pointing out their extension north and east, he then sets to the task of giving the geology of the region covered by the memoir. The geology of the Forillon, of Percé (a brief sketch of which had appeared in 1903 in advance sheets from the report of the paleontologist, 1904, and in Bulletin 107, Geological Papers, Albany, 1907) the Gaspé sandstones, etc., is followed by descriptions of the various faunas.

Three distinct faunas are noticed, and their rich harvest of forms new to science, or recorded afresh, constitute the bulk of the material on which the memoir is based. They are as follows:

I. Fauna of the St. Alban beds. Forty-eight species.

II. Fauna of the Cape Bon Ami beds. Of this fauna eleven species are recorded.

III. Fauna of the Grande Grève limestones. One hundred and sixty species.

Observations on the Dalmanites of the early Devonian are introduced in the text which throw light upon race characteristics, debility as exemplified in ornamentation of different parts of the organism. *Gaspelichas forillonia,* a new species, is indeed "the most extravagant instance of the development of spines among the trilobites."

This monumental work by Dr. Clarke only serves to enhance his deserved fame as a distinguished paleozoic paleontologist. The plates are all that can be desired, the text likewise is satisfactory, as to both quality and precision. References are made to the good work done in the peninsula by Logan, Billings, Ells, Low and others whom the author does not forget in bestowing names on the new forms met with. Nor does he forget those intrepid missionaries and early French explorers like Lejeune, Jumeau, Lescarbot, Leclercq and de Thune, and the Jerseymen and other settlers of the district who have in any measure contributed to the history and development of Gaspé.

The geology of the "Forillon" with map, is given in which the Gaspé sandstones, the Grande Grève limestones, the Cape Bon Ami beds and the St. Alban beds are separated on paleontological and stratigraphical grounds. This remarkable point juts out into the Gulf of St. Lawrence "like an index finger," from the broad fist of Rosier Cape and Cove, and two of the four geological formations constitute the narrower portion of the slender point, with Cape Gaspé to the north and Shiphead to the south. The vertical distribution of species and the faunas of the different formations and their mode of occurrence are given, together with a special chapter on the "Geology of Percé" in which a geological map in detail is presented giving the succession of the strata, including formations from the Carboniferous down to the Lower Silurian. They comprise the Bonaventure conglomerate (Carboniferous and Devonian in age), the "Percé massive" (Lower Devonian), the Cap Barré massive (Lowest Devonian), Mt. Joli massive, north flank (Upper Silurian), Mt. Joli massive, south flank (Lower Silurian), Cape Canon massive, including limekiln beds (Lower Silurian). The faults noted by Dr. Clarke appear to be of the same character as those of the "Quebec Group" and "Appalachian" folded region, a series of thrust faults, very much like those movements so characteristically described by Lugeon of Switzerland, where strata seem to play leap-frog one over the other. The reproduction of a number of old historic maps and early illustrations of this most interesting and picturesque as well as easily reached region forms no inconspicuous portion of the volume, nor can the delightful water-color reproduction of Percé rock forming the frontispiece go unnoticed. The excellent drawings by Barkentin illustrating the extinct faunas are exquisitely reproduced.

H. M. Ami

Geological Survey of Canada,
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SOCIETIES AND ACADEMIES

THE MICHIGAN ACADEMY OF SCIENCE

The academy held its fourteenth annual meeting at Ann Arbor, Mich., April 2, 3 and 4.

The following officers were elected for the coming year:

President—Charles E. Marshall, East Lansing, Mich.

Vice-Presidents:

Section of Agriculture—A. C. Anderson, East Lansing, Mich.

Section of Botany—Wm. E. Praeger, Kalamazoo, Mich.

Section of Geography and Geology—Wm. H. Hobbs, Ann Arbor, Mich.

Section of Sanitary Science—E. C. L. Miller, Detroit, Mich.

Section of Science Teaching—S. D. Magers, Ypsilanti, Mich.

Section of Zoology—D. B. Casteel, Ann Arbor, Mich.

Secretary-Treasurer—Walter G. Sackett, East Lansing, Mich.

Librarian—G. P. Burns, Ann Arbor, Mich.

On the evening of April 3 the members of the academy were very pleasantly entertained at a smoker given by the Research Club of the University of Michigan.

The titles of the papers presented at the meeting are given below:

Presidential address by Professor Mark Jefferson, of the State Normal College, Ypsilanti. Subject, "Man in West Norway" (illustrated).

SECTION OF AGRICULTURE

(A. C. ANDERSON, VICE-PRESIDENT)

"Some Michigan By-products," by Frank S. Kedzie.

"Mutual Interaction of Plant Roots," by J. B. Dandeno.

"Bird Protection and the Farmer," by Walter B. Barrows.

"The Claims of the Michigan Academy of Science," by W. J. Beal.

"The Cost of Weeds to the Crop," by J. A. Jeffery.

"Studies in Insect Control," by R. H. Pettit.

"Unsolved Problems in Incubation," by J. G. Halpin.

"Variations in the Proteid Content of Corn as shown by Analyses of Single Kernels from the Same Ear," by Andrew J. Patten.

SECTION OF BOTANY

(W. E. PRAEGER, VICE-PRESIDENT)

"More about the Botanical Terra Incognita in and around Ann Arbor," by S. Alexander, Ann Arbor.

"Some Interesting Variations of Common Plants," by Chas. A. Davis, Ann Arbor.

"An Iris New to Michigan," by Chas. A. Davis.

"Seedlings of *Ranunculus Purshii*," by Chas. A. Davis.

"Additional Notes on *Chara*," by Ellen B. Bach, Ann Arbor.

"A Botanical Trip to Thunder Bay Island," by C. K. Dodge, Port Huron.

"Temperature Variations in Peat Bogs," by G. P. Burns, Ann Arbor.

"Problem of the Causes of the Formation of Mechanical Tissues in Plants," by F. C. Newcombe, Ann Arbor.

"Effect of Longitudinal Traction in the Formation of Mechanical Tissue in Stems," by John A. Bordner, Ann Arbor.

"Response of Tendrils to Traction," by Warren D. Bush, Ann Arbor.

"Effect of Swaying by the Wind on the Formation of Mechanical Tissue," by Maude Gilchrist, Agricultural College.

"Poisonous Excretions of Roots," by Richard M. Zeeuw, Ann Arbor.

"Mychorhiza on Michigan Trees," by D. M. Matthews and G. A. Duthie, Ann Arbor.

"Some Mycorhiza-forming Basidiomycetes," by L. H. Pennington, Ann Arbor.

"Can *Fusaria* assimilate Free Nitrogen?" by L. H. Pennington.

"Is Brown-rot of Stone Fruits in Michigan due to *Sclerotina fructigena* or *S. cinerea?*" by J. B. Pollock, Ann Arbor.

"The Ascus Stage of *Sclerotina fructigena*," by J. B. Dandeno, Agricultural College.

"Capillarity of Cellulose," by J. B. Dandeno.

"Toxic Action of Bordeaux Mixture and of Certain Solutions on Spores of Fungi," by J. B. Dandeno.

"Unreported Michigan Fungi for 1907, with an Outline of the Gasteromycetes of the State," by C. H. Kauffmann, Ann Arbor.

"The Development of *Secotium acuminatum* Mont.," by C. H. Kauffmann.

SECTION OF GEOLOGY AND GEOGRAPHY

(E. H. KRAUS, VICE-PRESIDENT)

"Pleistocene Beaches of Saginaw County," by W. F. Cooper, Lansing.

"Note on the Intercalated Devonian Bed (Anderson Limestone) of the Detroit River Region,"[1] by W. H. Sherzer, Ypsilanti.

"The Nature, Distribution and Origin of the Sylvania Sandstone,"[1] by A. W. Grabau, New York, and W. H. Sherzer, Ypsilanti.

"The Decomposition of a Boulder in the Calumet and Hecla Conglomerate," by A. C. Lane, Lansing.

"Some Possible Uses for Peat in Michigan," by C. A. Davis, Ann Arbor.

"Peat Deposits as Geological Records," by C. A. Davis.

"On the Discovery of Permian Reptiles in Pennsylvania and the Bearing of this Discovery on the Pennsylvanian-Permian Border-line," by E. C. Case, Ann Arbor.

"Interpretation of the Chemical Composition of the Mineral Benitoite," by E. H. Kraus, Ann Arbor.

"Cobalt-nickel-silver Deposits of the Cobalt District of Ontario," by R. E. Hore, Ann Arbor.

"Models for the Practical Solution of Problems in Structural Geology," by W. H. Hobbs, Ann Arbor.

"A Deduction from the Study of Bridges which

[1] With the permission of the State Geological Survey.

have been disturbed by Earthquakes," by W. H. Hobbs.

"Daily Range of Temperature," by M. S. W. Jefferson, Ypsilanti.

SECTION OF SANITARY SCIENCE

(JAS. G. CUMMING, VICE-PRESIDENT)

"Present Scope of the National Red Cross," by B. S. Rowland.

"Urticaria Following the Second Administration of Anti-diphtheritic Toxin," by Alexander W. Blain, Jr.

"A Course in Practical Pathology," by F. P. Rouse.

"Blood-sucking Flies," by F. G. Novy.

"The Water Supply of Detroit," by E. H. Hayward.

"Medical Inspection of Schools," by Guy S. Kiefer.

"Sanitation as a Business Proposition," by Frank W. Shumway.

"The Development of Certain Milk Bacteria at a Low Temperature," by W. S. Sayer.

"Bacteriological Studies of Dry and Moist Soil," by Otto Rahn.

"Different Forms of Immunity," by V. C. Vaughan, Sr.

"Opsonic Technique with Lantern Demonstration," by E. C. S. Miller.

"Spirilla of Relapsing Fever," by F. G. Novy.

"Sensitization and its Application to Practical Medicine," by V. C. Vaughan, Jr.

"Bacteria in Ann Arbor Water," by H. D. Boyles.

"The Hydrolytic Cleavage Products of *B. coli communis*," by J. H. Agnew.

"Syphilis of the Placenta," by R. Genung Seland.

"Rabies-hydrophobia," by Jas. G. Cumming.

SECTION OF SCIENCE TEACHING

(S. D. MAGERS, VICE-PRESIDENT)

Biological Conference of Schoolmasters' Club and Science Teaching Section of the Michigan Academy of Science.

"Parental Care of Michigan Fishes" (illustrated with lantern slides), by Jacob Reighard, University of Michigan.

"The Just Claims of Biology in the Curriculum of Secondary Schools," by Otis W. Caldwell, University of Chicago.

"Shall the Study of Botany and Zoology in Secondary Schools take the Form of the Study of Types?" by Nathan A. Harvey, State Normal College.

"Shall the Study of Botany and Zoology in Secondary Schools take the form of Natural History?" by W. P. Holt, Toledo (Ohio) Central High School.

Discussion of second paper, Wm. E. Praeger, Kalamazoo College.

Discussion of third and fourth papers, Miss Grace Ellis, Grand Rapids, Mich., and H. M. MacCurdy, Alma College.

SECTION OF ZOOLOGY

(ALEXANDER G. RUTHVEN, VICE-PRESIDENT)

"A Case of Consecutive Hermaphroditism in the Killifish, *Fundulus majalis*," by H. H. Newman.

"The Bird Environment of the Ann Arbor (Michigan) Quadrangle, with Notes on the Rarer Species," by N. A. Wood.

"Permian Glaciation and the Distribution of Permian Reptiles; a Study in the Geographic Distribution," by E. C. Case.

"Reptiles of Michigan," by Frances Dunbar.

"Additional Experiments on Color Vision in Fishes," by Jacob Reighard.

"Remarks on the Vertebrate Fauna of Northwestern Iowa," by A. G. Ruthven.

"The Ornis of Northwestern Iowa," by Max M. Peet.

"The Bird Life of School Girls Glen (Ann Arbor, Mich.); a Local Ornithological Study," by A. D. Tinker.

"The Distribution of *Lymnæa* in Michigan," by Bryant Walker.

"A Reflecting Water-glass," with a demonstration of the apparatus, by Jacob Reighard.

"On a Method of Sub-aquatic Photography," with a demonstration of apparatus and results, by Jacob Reighard.

"A Statistical Study of Mitosis and Amitosis in an Embryonic Tissue," by O. C. Glaser.

"Observations on the Habits and Life History of Notonectid," by S. F. Hull.

"A Preliminary Note on Insecticides," by R. H. Pettit.

"A Possible Parasitic Habit in the Lepidoptera," by R. H. Pettit.

"Notes on a Biological Survey of the Alma Area," by Hansford MacCurdy.

WALTER G. SACKETT,
Secretary

THE TORREY BOTANICAL CLUB

The club was called to order on April 14, 1908, at 8:30 o'clock, by Vice-president John Hendley Barnhart. Seven persons were present.

The scientific program consisted of two papers, as follows:

The Relation of Chemical Stimulation to Nitrogen Fixation in Sterigmatocystis: Marion E. Latham.

This paper will appear in full in a future number of the *Bulletin* of the club.

Some Forms of Protoplasmic Reaction: H. M. Richards.

The speaker reviewed the more recent literature and theories bearing on the subject of the stimulus and response of protoplasm.

Both of these papers were followed by an interesting discussion, and the meeting adjourned at ten o'clock.

C. Stuart Gager,
Secretary

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

The eighth regular meeting of the session of 1907–8 was held at the Chemists' Club, 108 West 55th Street, on May 8.

Professor Charles E. Munroe, of the George Washington University, addressed the Section on, "Explosions in Mines."

C. M. Joyce,
Secretary

DISCUSSION AND CORRESPONDENCE

THE GERMAN ANATOMICAL SOCIETY

To the Editor of Science: During the recent meeting of the Anatomische Gesellschaft, at Berlin, I noticed several points of management and procedure which seemed to me of value in economy of time, and I send you my notes with the hope that their publication may interest those in charge of the meetings of similar organizations in America.

In the first place, the meetings of our societies often suffer by reason of overcrowded programs. There is not time to present all the papers presented and the chances for discussion of those which are read are reduced to a minimum.

In the German society the number of papers to be presented at a single session is limited by statute to twenty-five and usually but about that number is printed on the preliminary program. This year, owing to the number of titles sent in at an early date, the number was increased to thirty-nine, those in excess to be read only in case others ahead of them were omitted for one reason or another.

This restriction of number of papers allows an increase of the time limit for each person to twenty minutes, but one person is allowed only one place on the program, although he may give two or more papers, provided that he do not overrun his allotted third of an hour. Only once did I notice that a speaker overran his time and he was called to order by the president.

As a rule, the speakers went at once straight to the pith of their communications; wasting no time in historical summaries of previous knowledge of the subject, details of technique or minutiæ of diagrams or specimens exhibited, which only tire and confuse the listener who only wishes to know the new points and the broadest evidence upon which the conclusions are based. Knowing these, he can wait for details until the complete paper is published.

The sessions were announced to begin at 9 a.m. instead of ten o'clock, as is usual with us, and they lived up pretty closely to this schedule. This apparently was well understood, as when the meeting was called to order a goodly audience was present. Were the Americans ever to live up to their late program hour, calling the meeting to order at 10 o'clock instead of "dawdling" until most of the members had got together, the lesson of punctuality would soon be learned and considerable time would be saved.

With this limitation of the number of papers and the economy of time which has been alluded to, there was abundant time for discussion, and all must admit that discussion is frequently as valuable as, sometimes more valuable than, the paper itself. In these discussions there appeared a feature which struck me as of the greatest value. With us the discussion is rarely, if ever, reported, but at Berlin as soon as a speaker had finished his discussion, a page handed him a folio of cardboard with pencil, paper and blotting paper (there are fountain pens in Germany), and the substance of his remarks was at once jotted down and handed to the secretary. For any society which wishes to publish a full account of its proceedings some such method would be of great importance, while any one who has ever acted as secretary and has later tried to get together abstracts of the discussion will at once recognize its value.

J. S. Kingsley

Paris,
April 28, 1908

DATES OF EARLY SANTORIN AND ISCHIAN ERUPTIONS

Owing to conflicting literary sources and the difficulty of reconciling them, the chronology of early volcanic eruptions in islands of the Mediterranean, especially those of the ancient Thera and Pithecusæ, is involved in much uncertainty. The dates assigned to the first two or three eruptions of Thera have been the subject of much discussion, as it is a matter of some historical importance that they should be determined with as much precision as possible, in order thereby to fix divers contemporary events.

A welcome contribution to the literature of this subject is to be found in a recent number of *Hermes* (43, p. 314), in an article by Professor A. Klotz, of Strassburg, entitled "Die Insel Thia." Reasons are given by him for regarding the following as authentic dates of the first three outbreaks of the Santorin group known to have taken place during continuous history: B.C. 196 and 66; A.D. 46. Through a misunderstanding of Pliny's text the last of these is commonly referred to the year 19 A.D., and the intermediate one is seldom mentioned in geological treatises. For a list of eruptions occurring during our present era one may consult the writings of Fouqué and Alfred Philippson, the latter in volume 1 of "Thera" (1899). These two geologists, and also H. S. Washington,[1] have discussed the physical evidence for estimating the time-interval since the earliest eruption of all which can be associated with a period of human culture, and find reason for assigning it to the proto-Mycenæan, or roughly speaking, 2000 B.C.

Early Ischian eruptions have likewise afforded material for debate. A list of all known disturbances is given by Fuchs in his elaborate monograph, "L'Isola d'Ischia," and a slightly different chronology is proposed by Ettore Pais in his recent volume on "Ancient Italy" (1908). According to this author, we have authentic accounts of four eruptions of Epomeus during classical antiquity, as follows: (1) a very early one which drove out the Eretrians and Chalcidians; (2) that which occurred shortly after 474 B.C., and caused the Syracusans to leave the island; (3) that which took place shortly before the birth of Timæus (*ante* 352 B.C.); and (4) one in 91 B.C., which is mentioned by Julius Obsequens. The same author also undertakes to identify the circular lake described by Pliny as having been formed by an earthquake, with the modern Porto d'Ischia.

C. R. Eastman

Harvard University

SPECIAL ARTICLES

A NOTE ON THE PROPORTION OF INJURED INDIVIDUALS IN A NATURAL GROUP OF BUFO

In "Darwinism To-Day" (p. 84) Kellogg draws attention to Conn's reference to a maimed frog which was able, in its natural environment, to survive so serious a loss as the whole of both feet, as illustrating the idea that "selection is not so rigid as to eliminate *all* unfit individuals." Probably every naturalist could cite from his own experience many analogous instances of survival after more or less severe injury. Little is known, however, regarding the actual proportion of maimed individuals in a given group.

In making a study of correlation[2] in the common toad (*Bufo lentiginosus americanus*, LeC.) I had the rather unusual opportunity

[1] *Amer. Journ. Arch.*, 9, p. 504.

[2] *Jour. Exp. Zool.*, IV., 4, 1907.

of individually examining practically an entire natural group and was surprised by what seemed to me the large proportion of injured individuals which were able to live on in an apparently normal fashion. The society consisted of about 450 toads, of which 434 came under careful observation. Of these, 22, or 5.07 per cent., were noticed which showed the results of injury. Many of these injuries were slight, to be sure, yet from the point of view which Conn and Kellogg were considering they should be counted. The list of injured was as follows:

Parts of toes lost, one or both feet: 13 individuals.

One or both feet crushed: 2 individuals. These both were recently wounded and might not have survived long.

Old flesh wounds on arm, thigh and side of body: 1 individual.

Shank broken, healed and 1 to 2 mm. shorter than normal: 4 individuals.

One foot missing and fresh wound on ankle: 1 individual.

Right hand and foot missing: 1 individual. Stumps covered with heavy callosities. In this specimen the normal gastrocnemius muscle weighed 0.435 g., while that of the injured side weighed but 0.180 g.

Shoulder-girdle (coracoid and clavicle) broken completely across near the mid-line: 1 individual. This break had not healed; the ends projecting ventrally under the skin had become covered with heavy callosities.

That injuries such as these are not very considerable factors in non-survival is indicated by the fact that the average weight of the 22 injured specimens was not very different from that of the entire colony—38.5 g., as compared with 44.8 g. The number of injured seems too small to justify the application of precise methods of comparison.

There is the possibility that the males are more liable to injury than the females, since the ratio of injured males to injured females is as 9:10, while in the entire group the ratio is less than 7:10. This is of interest in connection with the fact, brought out in my study on correlation, that the males are throughout their organization less perfectly correlated than the females. Their lower degree of structural correlation may be partly responsible for their greater liability to injury.

But this 5 per cent. injured does not tell the whole story. In addition 16 individuals, or 3.68 per cent., were noticed showing structural "abnormalities," which would seem to have been at least as serious as regards survival as most of these injuries, perhaps more so, since the individual would be affected throughout its existence, whereas an injury would become a factor only after the individual had probably a fair start in life. The following were noted:

One foot misshapen and small: 2 individuals. Possibly the result of injury when very young.

One foot with six toes: 1 individual.

One foot with four toes: 1 individual.

One foot with three toes: 1 individual.

Gall-bladder absent: 5 individuals.

One lobe of liver more or less completely reduced: 5 individuals.

Ventricle deeply furrowed ventrally: 1 individual. Possibly the result of injury when very young.

These individuals were again nearly but not quite of average weight and the males were far outnumbered by the females, the normal ratio of 7:10 being reduced here to 2.3:10. This might possibly indicate that the more perfectly correlated females are the better able to survive congenital abnormality.

This gives a total then of 8.75 per cent. of a natural animal group showing injuries or "abnormalities" which would seem to be rather serious handicaps, but which prove not to be such. Probably other injured or "abnormal" specimens would have been found if attention had been directed toward the subject at the time of observation.

It may or it may not be permissible from the present point of view to include in the list of "abnormal," six specimens of a distinct "variety" distinguished by color and markings, odor, external proportions, character of skin, etc. If these should be included as abnormal the total percentage of "unfit" runs up to 10.1.

It should be added that, on the whole, conditions of life were not rigorous for this group. Food was more than abundant, means of protection and concealment ready, and natural enemies apparently not numerous, so that these percentages may prove to be unusual. They certainly seemed so to me and they are noted here not only as bearing on the general subject of selection, but in the hope that others may make known similar data.

WM. E. KELLICOTT
THE WOMAN'S COLLEGE OF BALTIMORE

BOTANICAL NOTES

FLOWERING PLANT NOTES

W. C. Worsdell in the April, 1908, *Journal of Botany* discusses "The Affinities of *Paeonia*" and concludes that this genus is more closely related to *Magnoliaceae* than to *Ranunculaceae*, but he suggests that it should more properly be referred to a family ("order" in the older sense) by itself which he names *Paeoniaceae*.

Dr. Ernst A. Bessey's paper on "The Florida Strangling Figs," from the forthcoming nineteenth Annual Report of the Missouri Botanical Garden, deals with two native species of *Ficus* (*F. aurea* and *F. populnea*), the first of which has the curious habit of beginning its growth as an epiphyte and later becoming terrestrial by sending down numerous slender roots which eventually thicken and fuse together, finally wholly surrounding and strangling the host. Some striking photographs are reproduced in the plates. The curious fact is brought out that in *F. aurea* the seeds require light in order to germinate, no doubt related to its epiphytic habit.

F. M. Bailey, colonial botanist, continues his systematic "Contributions" in the *Queensland Agricultural Journal*, the November (1907) number containing descriptions of four new orchids from New Guinea, and the February (1908) number one new grass, *Arundinaria coboni* from Queensland.

Professor Doctor J. W. Harshburger has published in the *Proceedings of the American Philosophical Society* (Vol. 46, 1907) a suggestive paper on "Taxonomic Charts of the Monocotyledons and Dicotyledons." Two charts are reproduced, one of the monocotyledons, and the other of the dicotyledons, in which each family is given a place in a genetic tree. In the second chart the Gamopetalae are shown to be derived from two great phyla.

H. S. Hammond publishes a short account (accompanied with a plate of many good figures) of the embryology of *Oxalis corniculata*, in the February (1908) *Ohio Naturalist*, in which he calls attention to "a multicellular haustorium-like organ which is formed from the basal cells of the suspensor," and which burrows its way into the integuments until it finally reaches the testa.

Agnes Chase finds (*Botanical Gazette* for February, 1908) that the grasses of the genus *Triplasis* have fertile cleistogamous flowers enclosed in the sheaths of the stems. In *Amphicarpon amphicarpon* similar cleistogamous flowers occur in the sheaths of the subterranean stems.

Recent numbers of the "Leaflets of Philippine Botany" contain papers on "*Freycinetia* from Lucban," and "Some New Leguminosae" (by A. D. E. Elmer), "Some New and Critical Ferns" (by E. B. Copeland), and "A Fascicle of Tayabas Figs" (by A. D. E. Elmer). In the last paper forty-one species are enumerated.

In a sixty-six-page paper in the *Annals of Botany* for April, 1908, Ethel Sargent discusses the "Reconstruction of a Race of Primitive Angiosperms," this being an abstract of a series of eight lectures delivered in the University of London in May and June, 1907. In it the author holds to the monophyletic origin of the angiosperms, and avows her "complete agreement with the general conclusions" reached by Arber and Parkin in their "Origin of Angiosperms." These general conclusions, it will be remembered, are that the angiosperms were derived from cycadean ancestors similar to *Bennettites*, and that the Ranal is the most primitive of the angiospermous types. The paper is well worth reading at this time when botanists are looking with increasing favor upon the strobilar theory in their speculations as to the origin of the angiospermous flower and, as a result, the origin of the group of *Angiospermae*.

BIOGRAPHICAL NOTES

As an echo of the very general celebration of the bicentenary of Linné, the altogether admirable biographical sketch entitled "Carl von Linné" by Professor Dr. N. Wille is worthy of mention. Originally published in "Samtiden" for 1907, it is now republished as an eleven-page pamphlet in the Norwegian language, and is accompanied by a good portrait of Linné as he appeared about the time when he issued his greatest works, the "Species Plantarum" and the "Genera Plantarum."

A pamphlet entitled "Memorials of Lucien Marcus Underwood" is a sad reminder of the loss which botanical science sustained by the death of the distinguished botanist. The first paper is a biographical sketch by Dr. C. C. Curtis. From it we learn that he was born October 26, 1853, on a farm in central New York, a region already famous as the birthplace, nearly half a century earlier, of Dr. Asa Gray. Here he spent his boyhood working on the farm, attending first the country district school, and later a near-by academy (seminary), still later he went to college (Syracuse University), graduating in 1877. Then came a period of teaching various subjects in various places, including the Morrisville Union School, Cazenovia Seminary, Hedding College (Ill.), Wesleyan University (Ill.), Syracuse University, DuPauw University, Polytechnic Institute (Ala.) and Columbia University (1896). Eleven years of fruitful work in the university and the New York Botanical Garden, and then came the end on November 16, 1907. The second paper is an appreciative tribute by Dr. M. A. Howe, and this is followed by a list of publications including 212 titles. On examination one finds that more than half of these titles deal with *Hepaticae* and *Pteridophyta*. His first paper appeared in 1878 and the last in 1907. The pamphlet closes with a collection of the resolutions passed by various institutions and societies.

A considerable portion of the April number of the *Journal of Mycology* is given to the life and work of William Ashbrook Kellerman, its founder and editor. He was born in Ashville, Ohio, May 1, 1850, received his collegiate education in Cornell University (graduating in 1874) and the University of Zurich (Ph.D., 1881). For five years he was a teacher in a state normal school (Wisconsin), then professor of botany in the Agricultural College of Kansas, from which he transferred to the Ohio State University in 1891. Four years ago he organized a scientific expedition to Guatemala, and followed it with a second, third and fourth. In the last, when near the end of the trip, he was stricken with a disease which caused his death March 8, 1908. The list of his publications includes upwards of 232 titles. His first paper, on the development of the flowers of *Gunnera chilensis* (inaugural dissertation), appeared in 1881, and the last installment of his well-known and very useful "Index to North American Mycology" was issued in the current number of the *Journal of Mycology*, on April 15, 1908. In 1885, with J. B. Ellis and B. M. Everhart, he began the publication of the *Journal of Mycology*, continuing it until its transfer to the United States Department of Agriculture, four years later, and resuming its publication again in 1902 and continuing it until his death. In 1903 he began the publication of a most helpful leaflet, the *Mycological Bulletin*, designed to help teachers and pupils in the public schools to know something about fungi. In the words of his sympathetic biographer, "the loss of such a man, upright in character, possessed of lofty ideals, and an enthusiasm which was an inspiration to all with whom he came in contact, will be felt not only by his students, but by botanists the world over."

Professor Dr. Pammel has rendered a distinct service to botanists in the preparation of a sketch of the life and work of Dr. Edwin James, and its publication in the *Annals of Iowa* (Vol. VII.). Edwin James was born on a farm in Vermont, August 27, 1797, fitted for college in the country grammar school, graduated from Middlebury College in 1816. Later he studied medicine and thus acquired the degree of doctor of medicine. In 1820 he became the botanist and surgeon to Major Long's expedition to the Rocky Mountains. Ten years later he resigned from the army, and within a few years settled near Burlington, Iowa, where he engaged in farming. He died October 25, 1861. *Jamesia,* a very pretty Rocky Mountain shrub of the botanical family *Saxifragaceae* was dedicated to him by Torrey and Gray.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

THE ADMINISTRATION OF SYRACUSE UNIVERSITY [1]

SYRACUSE, N. Y., April 17, 1908.

DEAN WILLIAM KENT,
Syracuse University.

Dear Sir: The executive committee and the chancellor are firmly though reluctantly persuaded that your usefulness in this university is at an end and that your continued presence among us would be increasingly prejudicial to the peace and success of the university.

You have been a disappointment to the administration from almost the beginning of your official relation to the institution. We can not hope that you will be capable of any improvement in the future.

Without going into particulars, you will appreciate the fact that the trustees of a university can not possibly retain a dean who can not meet the chancellor or president of the institution upon amicable and even confidential terms and whom the chancellor can not address concerning the work of his college without being subject to the embarrassment of controversy and contention.

As much as I regret therefore the duty that is imposed upon me, I am compelled, acting upon the advice and with the unanimous concurrence of the executive committee of Syracuse University, to inform you that your connection with the university will be terminated with the close of the present college year. I am advised further by the executive committee to inform you that if you prefer to submit your resignation, you may have that privilege.

Very truly yours,
JAMES R. DAY,
Chancellor

SYRACUSE, N. Y., April 20, 1908.

CHANCELLOR JAMES R. DAY,
Syracuse University.

Dear Sir: I beg to acknowledge receipt of your favor of the 17th inst., informing me of the unanimous action of the executive committee, and giving me the privilege of submitting my resignation.

Before deciding whether to submit my resignation now or to ask you to prefer charges against me and to let me be heard in my defense before being dismissed by a vote of not less than twelve trustees, according to section 4 of the university charter, I ask you to be more specific in regard to the following statement in your letter:

"You have been a disappointment to the administration from almost the beginning of your official relation to the institution. We can not hope that you will be capable of any improvement in the future."

If I have been a disappointment to the administration (I suppose that means yourself personally) I have not, as far as I know, been a disappointment to the trustees, faculty, students or alumni. I have not only done my duty as dean and professor of mechanical engineering to the best of my ability, but with all due modesty, I think no one else could have done it any better in my place. This question I am willing to leave to the judgment of experts in engineering education.

If I leave here at the end of five years' hard service it is only fair that my efforts in behalf of the college should receive such commendation from the board of trustees as I think they deserve, and that it should be made clear that I leave here not on account of any failure in my duty as dean or professor nor for any lack of ability as teacher or administrator, but only on account of the personal feelings of the chancellor.

I therefore request that you appoint a committee of three trustees, not members of the executive committee, to investigate into all matters relating to my administration of the offices I have held for the past five years, and report their conclusion to the executive committee.

Yours truly,
WILLIAM KENT,
Dean of College of Applied Science

[1] There is here printed the recent correspondence between the Rev. Dr. James R. Day, chancellor of Syracuse University, and Professor Wm. Kent, dean of the College of Applied Science, together with a statement which Professor Kent has prepared at the request of the editor.

Syracuse, N. Y., April 21, 1908.

Dean William Kent,
Syracuse University.

Dear Sir: Answering your letter of April 20, there is no provision in our charter and by-laws nor is there any precedent for the trial of an officer or professor of the university whose connection with the institution it is desired to terminate.

There is no reason for any departure from the usual procedure in your case. Therefore it is certain that the trustees will not establish the precedent which you demand.

If you do not care to accept the alternative of a resignation, then the report of the committee will be presented to the trustees for their action. The language of the report is: "The executive committee, believing that the interests of the university require that harmonious relations should exist between the administrative heads of the university and the deans of the several faculties, is of the opinion, in view of the circumstances, that the connection of Dean Kent with the university should be terminated, and recommends that the matter be presented to the board of trustees at the next annual meeting."

The resolution was presented by one of the most eminent and judicial members of the committee and adopted unanimously. The provision permitting you to resign was adopted later, entirely as an alternative which you might prefer.

As to the number of trustees required to act in such cases: as the June meeting is never short of the required quorum, the action will be final and completed at that meeting.

If the chancellor's "personal feelings" were the only ground of complaint, that were enough. The trustees of this or any other university would not retain a dean objectionable to the head of the institution. That appears in the action already taken. It is not necessary to raise the question of the impression you have made upon any of the members of the executive committee or our patrons.

Understand the matter clearly: You are offered the privilege of presenting your resignation if you prefer. If you do not, your removal will be recommended to the trustees by the unanimous action of the meeting of the executive committee, held April 17. You can have no doubt of the decision in the case.

If you prefer that it take the form of dismissal, you certainly will have that choice. I have no personal wish as to how you decide the matter.

As the executive committee has also requested me to make the necessary recommendation of your successor, and as I have reported to you the action of the committee concerning you, I consider the matter closed, so far as my duty in the case is concerned.

Very truly yours,
James R. Day,
Chancellor

Syracuse, N. Y., April 21, 1908.

Chancellor James R. Day,
Syracuse University.

Dear Sir: I acknowledge receipt of your favor of 21st inst., containing the report of the executive committee. As it does not appear that there is any occasion for haste in the matter, I will defer my decision for the present.

Yours truly,
William Kent,
Dean of College of Applied Science

STATEMENT OF DEAN KENT

According to the charter and by-laws of Syracuse University its government is vested in a board of sixty trustees. The majority, or thirty-two, of them are appointed by certain conferences of the Methodist Church—nearly all of them being Methodist ministers—for terms of six years. The others are mostly business men, or men prominent in finance and in the professions in Syracuse, New York city and other places. All authority is vested in them by the charter, but, as a matter of fact, they have practically divested themselves of this authority and given it to the chancellor, who not only rules the university, but rules the board of trustees. The trustees meet twice a year only, and it is rarely that more than one half of them are present. The business transacted is purely formal. There are no reports of committees on the separate colleges; there are no reports called for from the deans of the colleges. The trustees know practically nothing about the internal working of any of the colleges. Mr. Archbold, the president of the board, is vice-president of the Standard Oil Company and a warm personal friend of the chancellor.

The L. C. Smith College is a school of engineering, but there is not a single engineer on the board of trustees, and during the past five years not a trustee has ever consulted with the dean on the work of the college.

When spoken to about it, some of them have admitted that they were negligent in the matter, but said it was not possible for trustees, who are busy men, to spend any time on details; they necessarily had to leave all such things to the chancellor. Other universities, however, have expert engineers on their boards of trustees who are very active in seeing that the engineering college is kept up to the standard of other engineering colleges throughout the country in methods of administration, in curriculum and in equipment. At Syracuse University the chancellor himself does not take any active interest in the college of applied science. He attends a faculty meeting only once a year, and practically all of his administration of the college is done through the medium of the superintendent of buildings, who acts also as the chancellor's valet and spy.

This superintendent is a rather remarkable man. His connection with the university began as janitor of Crouse College. From that position he has been gradually advanced until he is not only superintendent of buildings, charged with their heating, lighting and repairs, but is also supervisor of new construction and purchasing agent. His salary is equal to that of the highest paid professor in the university, and his power is greater than that of any dean or any faculty. Four years ago he had a quarrel with the professor of practical mechanics in the L. C. Smith College, Professor W. M. Towle, and told tales to the chancellor about him which caused his dismissal. His successor, Professor George D. Babcock, was continually in trouble with the superintendent, who interfered with his work and equipment, and rather than submit longer to his interference he resigned a year ago. Professor Cardullo, who was instructor in machine design, was appointed to succeed Professor Babcock. He is a most able man, a man whom it would be to the best interests of the university to retain, but he also is about to leave on account of the trouble which the superintendent has made for him. My predecessor, acting dean Chas. L. Griffin, had to leave five years ago on account of the actions of the superintendent of buildings. It is entirely probable that the chancellor's prejudice against me is due chiefly to that same man's tale-bearing. Two or three months ago on one occasion he was so grossly insulting to Professor Shepard, of Smith College, that Professor Shepard demanded of the chancellor that the superintendent should make an apology to him or he would at once resign. The chancellor compelled the superintendent to make an apology, which is the only instance known of his being curbed by the chancellor. He is the chancellor's constant companion and confidant and appears to have more influence over him than any other single person in the university. As to his relations to the faculty, students and alumni, it is doubtful if he has a single friend or adherent. It would be difficult to find a man more universally hated. The chancellor seems to be the only man connected with the university who believes in him.

The chancellor has charged me with being a "disappointment to the administration [which means himself] from almost the beginning of his official relation to the institution" but he has not made a single specific charge in that matter. He also says that I can not meet him on amicable terms and that he can not address me concerning the work of the college without being subjected to the embarrassment of controversy and contention. The foundation for all these statements is of the flimsiest possible character. I have never refused to meet the chancellor in an amicable discussion of any subject, and the little controversies we have had have scarcely averaged more than one per year, and usually they lasted not over five minutes. The following is a statement of all my controversies with the chancellor, in five years, so far as I remember them:

1. A few weeks after taking office in 1903, I made a social call on the late Dean McChesney, in his office, in the college of Fine Arts. We discussed the work of the Fine Arts college and the relation of fine arts to education. Dean McChesney mentioned the

call to the chancellor, and the latter called me to account for it, saying, "You are going out of your province as dean in making such visits, and will find plenty of work to do within the four walls of your own college." The idea of such limitation was resented by me and I replied that I did not intend to narrow myself in any such way, but intended to study all educational questions that I wished to and to visit any place where I was welcomed. This talk probably prejudiced the chancellor against me, as it indicated that he was dealing with a man of independent mind, who would not submit to an undeserved rebuke. It also revealed the chancellor's propensity for petty fault finding and scolding, and showed the manner of man with whom I must deal. The incident was of trifling importance, however, and caused no lasting resentment.

2. Relations were very cordial up to January, 1904. I then presented, with a request for their consideration, to the chancellor, a package of letters which had been written, at my request, by the heads of departments of the college, showing what was needed for the improvement of the course and equipment. Accompanying these was a letter of transmittal, giving my own ideas. The letters were discourteously refused, the chancellor saying: "Take them away, I don't want to see them. Don't you know that professors are always asking for everything they can think of?" whereupon I took the letters away leaving only my own with the chancellor. The letter was never answered, and the matter caused no controversy as neither party ever referred to it again.

3. The next friction occurred in June, 1905. The chancellor wrote that he had expelled a certain student belonging to the L. C. Smith College. I replied that the man was not in college, having been dropped seventeen months previously, and that the printing of his name in the catalogue issued April, 1905, was a mistake. The chancellor's attention was also called to about forty names of men who had not been in college during the year beginning September, 1904, yet who were listed in the catalogue. To this the chancellor replied in a letter dated June 13, 1904: "Your trouble is that you have not informed yourself as to the method of listing our students in the catalogue. A student who is present within a catalogue year for any time goes into the catalogue. . . . I do not like to have you state that such a number of students are in our list who are not in college. It reflects upon the institution. Suppose you call on me to discuss such matters as this instead of writing." Accordingly a conference was held in which I protested against padding the catalogue as essentially dishonest, and done for the purpose of misleading people as to the size of the university, and stated that I did not want Smith College misrepresented that way. The chancellor became enraged, and gave a characteristic exhibition of his bad temper, which would lead an onlooker to believe that he is about to have an apoplectic stroke. The rage was short, and we met at the chancellor's reception the next evening, as if nothing had occurred. The catalogue padding continued till this year, when it was changed. The present edition contains a correct list of the students in the L. C. Smith College during the year beginning September, 1907.

4. Another trifling dispute during 1905, concerned a statement I had written for a pamphlet describing the work of the college. This was to the effect that a year of practical instruction in a machine shop, in addition to the high school course, afforded the best preparation for an engineering course. The chancellor struck these words from the manuscript. I protested that I had given not only my own opinion, but that of the most advanced engineering educators on the subject, and offered to show their printed words. The chancellor said he cared for no one's opinion, and would allow no such statement to appear under the imprint of the university.

5. During the college year 1905–6, the chancellor and I attended the annual meeting of the Albany Association of Syracuse Alumni at Schenectady. Although we rode together from Syracuse to Schenectady, the chancellor

would not permit any discussion of college affairs, although the opportunity was excellent. I made a little speech at dinner to the alumni and said to thirteen from the College of Applied Science, who were in the employ of the General Electric Co., at Schenectady, that I hoped they would soon be so numerous and strong in influence that they could elect one of their number to an alumni trusteeship, so that their college could be represented by its own alumni. For this I was taken to task by the chancellor, who stated that the alumni trustees represented the university rather than any particular college. To this, I replied, that the plan of having each college represented on the board of trustees was a good one, and one that would soon be acted on if the university grew. This talk indicated to the chancellor that he and I had radically different ideas on university government. No further differences occurred until December, 1906.

6. On December 11, 1906, while I was in the chancellor's office on formal business, he stated that complaints had been made of disorder in L. C. Smith College—"rough housing," he called it—and that he wanted it stopped. At the perfectly natural inquiry as to who had told him, the chancellor became violently angry and began to rage. I left the room as soon as possible without losing my temper, or creating any disturbance. This trouble did not blow over as quietly as others had done, for the next day the chancellor sent a three-page, scolding letter beginning as follows: "My dear Dean Kent—I wish you to decide between this time and the meeting of the trustees in January as to whether you are to act harmoniously with the administration of this university and treat the chancellor with civility and respect. I will not permit you to repeat the incident of yesterday morning in my office and the language which you used after you left my office." Another paragraph contained the most remarkable statement: "I called your attention to certain lack of discipline in your college. You had no right whatever to begin to interrogate me as to who the authority was in the case, and if you had had experience as an educator you probably would not have done so. It would have occurred to you that that would be impossible." This letter created a difficult situation. It was from a peevish, irritable man, under a severe nervous strain from the castigations of the press for six months past, on account of his violent attacks on President Roosevelt, and a man incapable of reasoning in the same manner as other men. It was also evident that he had been misled by some tale bearer and held exaggerated ideas as to slight breaches of discipline. In such a case, no answer but a most abject apology would satisfy him, such as no man would write and retain his self-respect. Therefore, a long letter was sent him, from which the following is quoted:

> Replying to yours of the 13th inst., I do not need to wait a single day to decide that it is my honest intention to act harmoniously with the administration of the university and to treat the chancellor with civility and respect. I am not aware that I have failed to do this in the past.
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> You speak of the "incident yesterday morning" in your office. As far as I can remember that incident, it was merely that you informed me that complaints had been made to you of "rough-housing," as you called it, in this college, and I asked you the perfectly natural question who made the complaints and why did the person who made them not make them to me, and you refused to give me the information. If I am wrong in this statement of the incident, I wish you would correct me.
>
> . . . You say I have "no right whatever to begin to interrogate" you "as to who was the authority in the case." Perhaps I have no right to interrogate you about this or any other matter, but if my ability as an administrator is attacked by persons making complaints, I think I ought to know who makes such complaints, and to have them made not in general terms, but with detailed specifications as to the particular things complained of, with dates of the events, and the names of the offending students if they are known. Then I can intelligently take such steps as may be necessary to punish the offender and to prevent a repetition of the offense.

To this the chancellor replied with a long characteristic letter, in which the following sentences appear: "I do not propose to permit you to act the 'bull in the china shop,'" "I will be the judge of whether I shall give you the names," "Permit me to say that I do not wish that question raised in the future. When I tell you that there are certain things in your college that require correction, I wish it to be accepted as sufficient authority that I make this statement. I am responsible for it, and I don't propose to have you put me on the witness stand for cross-examination. It is simply a piece of insolence." To this I replied in a short letter in part as follows: "It will make it much easier for me to suppress disorder if, when it is complained of to you and not to me, you will request the person making the complaint, if he (or she) is connected with the university to make it to me direct, and furnish me with the particulars of the occurrence so that I can investigate it promptly. . . . There are several remarks in your letter which are of a personal nature and have nothing to do with the main question, viz.: the question of disorder in this college, and I do not refer to them further than to say that my judgment differs from yours, but yet I hope we may differ as gentlemen and remain on cordial terms." The chancellor then gave his ideas on the duty of a dean in a three-page letter, in which he said: "It is not for you to tell me what to do in the premises. It seems to be an exceedingly difficult thing for you to learn the duties and limitations of your office as dean. You are not acting in any independent capacity or in an independent college. You are in your position to assist the chancellor." He closed with stating, "You will please to consider this incident closed with this letter, if you propose to work with me upon the terms which happily exist between myself and the other deans." I, of course, considered the incident closed.

7. The next difficulty did not come up for about thirteen months. Outbursts on the part of the chancellor, of the character outlined above, happened only once or twice a year, and I considered that I did not need to think of resigning for at least a year, as I saw the chancellor not over twice a month and then only for five or ten minutes at a time. During the thirteen months, the chancellor attended only one Smith College faculty meeting, and did not meet me in the college except on that occasion. Finally, in January or February, 1908, there were three conflicts, all originating in one source—the interference of the superintendent of buildings with Professor Cardullo, professor of practical mechanics. He made two attacks on Cardullo to the chancellor: (*a*) for fixing the brushes of an electric motor without consulting him; (*b*) for not compelling students to clean their lathes after using them. These attacks were due solely to the superintendent's animosity to Cardullo, and I so told the chancellor, thereby arousing his wrath. The third conflict occurred when I requested the chancellor to make an inducement for Professor Cardullo to remain at Syracuse, he having applied for a position to the dean of a western college. This caused another outburst of rage from the chancellor.

The above are the only conflicts of any importance I had with the chancellor up to April 17, 1908, when I received the chancellor's letter of dismissal. On all of these occasions I could have met him on amicable terms for a friendly discussion, had not his dictatorial and discourteous manner made such a discussion impossible.

In regard to my administration of the offices of dean and professor of mechanical engineering, as far as I am aware, no complaint has ever been made against me by any trustee, professor, student or alumnus, nor has any one of them said that I ever treated him otherwise than with courtesy and consideration. It is difficult to come to any other conclusion than that the sole reason for my dismissal is the irrational personal feeling of the chancellor, due to my not submitting humbly to his petty fault-finding and scolding.

It will be difficult for any one not personally acquainted with the chancellor to understand the existing state of things at Syracuse University, and how it is possible that the head of a great university could act as he has done. Perhaps a brief statement of the personality and the ideals of the chancellor may explain the situation.

The reason why Syracuse University is what it is is the overpowering personality of the chancellor. He is a large man, physically and otherwise, 63 years of age, and over six feet tall, and weighing over 250 pounds. He has a magnificent voice, a power of eloquence, and mastery of an audience equal to that of William Jennings Bryan and a capacity for invective like that of Senator Jeff Davis. Pompous in carriage, irritable in temper, and often discourteous in manner, he paralyzes the voice of any one who has the temerity to differ in opinion with him. But to those who are willing to suppress their own opinions, to defer to him in everything, to say yes to everything that he says, even to take a scolding in silence and humility, if he happens to be in a scolding mood, he is kindness itself. He has many good qualities, he is generous to a fault to poor students in distress, enjoys a good laugh and a good story and therefore has many friends among those who have not had occasion to incur his displeasure. He is preeminently a Methodist preacher, a pulpit orator of great power, and pulpit orators always have their admirers who think that a great orator is necessarily a great man. It is a common saying that "you can get along with the chancellor if you know how to take him." The "knowing how" is to suppress one's individuality, never to offer one's own opinion, to flatter his vanity, and never under any circumstances to enter into a controversy or discussion with him. He never comes to a faculty meeting of the College of Applied Science except once a year, but he presides over the faculty of Liberal Arts and keeps it in a proper state of subservience and stagnation. One member of that faculty says: "No one ever dares express an original opinion in the faculty meeting for fear he will be snubbed by the chancellor." I have been thus treated by him in a meeting of the university senate, before I learned that the senate is not a deliberating and legislative body, as it appears to be, according to the charter, but a mere registering body, the chief duty of its members being, never to do anything but to vote "yes" on a few purely formal matters.

The chancellor's ideal of a university seems to be: the chancellor, a board of trustees who provide funds and approve of the chancellor's way of spending them; large grounds; numerous large buildings, the largest stadium in the country, the largest college gymnasium in the world, the largest college of liberal arts in the state; the most brawny athletes and the greatest number of victories in inter-university athletic contests; and for the future, more real estate, an agricultural college, an industrial college, an alumni hall, to contain an auditorium capable of seating 5,000 people, the largest college assembly hall in the country; a hundred thousand dollars to spend on beautifying the campus, and enough students, male and female, to make it from a real estate point of view, one of the four biggest universities in the country, the other three being Harvard, Chicago and Leland Stanford. And while these ideals are being realized, there is neglect of the intellectual growth of the university, and short-sighted parsimony as to the teaching force.

The end and aim of these ideals and these ambitions is the glorification of the chancellor. Like the King of France, who said, "l'etat c'est moi," and the Roman Emperor, who said, "See this great Rome which I have builded," the chancellor says, "See this great university which I have builded." "I am the university." When I suggested to the chancellor that it would be well to have a committee of the trustees investigate the condition and needs of our college he said, "No, I am the committee." So far is it true that he is the committee, that although there are sixty trustees, not one of them during the past five years has ever visited the college for the purpose of inquiry into its needs, its methods or its efficiency as an engineering college, nor has the dean ever been called on to make a report of its condition. The trustees have no intercourse whatever with the faculties, they have no committees on the colleges, nor even on buildings and grounds. They leave everything to his autocracy, the chancellor. He is the committee, but one that is as dormant in regard to the College of Applied Science as the trustees themselves are.

There is another ideal of a university which Syracuse does not yet seem to have acquired. It is that it is a group of colleges, chiefly professional, each of which has a large degree of autonomy, and its business is not chiefly growth in real estate and in numbers of students, but first and foremost the giving of the best education possible to its undergraduates, by means of the best instructors and the most complete equipment that money can secure, and second, the advancement of knowledge by postgraduate work, fellowships in research, publication of researches, etc. Such a university has a democratic instead of an autocratic government, and a board of trustees, who, if they are not active in its affairs, at least to some extent are in touch with the faculties, giving them sympathetic encouragement. In such a university the alumni of each college are represented in the board of trustees and in the working committees, and they take an active interest in college affairs.

Syracuse University is not a sectarian institution in the sense that the doctrines of any religious sect are especially taught therein. Nevertheless, it may be properly called a Methodist institution inasmuch as it is completely under the control of the Methodist church and was organized by the Methodists.

According to the charter there are to be not less than 20, nor more than 60 trustees. The by-laws prescribe that each of eight Methodist conferences, in New York and New Jersey, shall elect four trustees residing within its bounds, which make 32, a majority of 60. This majority insures the Methodist conferences having absolute control of the university whenever they desire to exercise it. Of the 28 remaining trustees one is Chancellor Day, a Methodist minister, and the catalogue shows three other Methodist ministers, two of them, however, deceased. Of these 28 trustees six are alumni trustees, being elected by the alumni association of the university. Two of them, however, are salaried officers of the university, namely, the treasurer and the dean of the medical college.

Let us see how the Methodist church exercises its power of control over the university. It elects the chancellor, whose first qualification seems to be that he shall be a Methodist minister. This is not for the reason that a minister is any better qualified for such a position than a business or professional man would be, or than a professional educator, but that he may properly represent the Methodist denomination.

The next qualification seems to be that the chancellor should be a strong man. Recently a trustee, also a Methodist minister, wrote to me and said: "I have long been a trustee and was connected with the university when the persecutions on the part of some professors led Chancellor Sims to think that he could not stand it any longer and in spite of our persuasion he resigned. He had the sympathy of the trustees in all that struggle and we felt very well satisfied that in Chancellor Day we secured a head to the institution who could not be driven away by hostile professors." In the same letter, while referring to the chancellor's demand for my removal by the trustees at their next meeting, he said: "The chancellor was appointed by the trustees as head of the institution, and while I do not know what they will do if the matter comes up, it is my opinion that they will stand by the chancellor and let anybody go who gives him trouble."

From the above it is evident that the trustees do not care to give themselves any trouble with the government of the university. It is not apparent that any attempt was made to discover the grievances of the professors against Chancellor Sims, which might have led to the alleged "persecutions." Neither was it a question whether Chancellor Sims was or was not a good administrator. He had the sympathy of the trustees right or wrong. The same is true of the present chancellor. He has been appointed by the trustees as head of the institution, and they will stand by him and let anybody go who gives him trouble, notwithstanding that the trouble may have been of the chancellor's making. Neither does there seem to be any investigation as to the merits of any trouble which arises between the chancellor and those under him. The chancellor is to be supported regardless of the fact that injustice may be done thereby.

The conference members of the trustees forming a majority appear to have no duties except to attend meetings of the board twice a year. They listen to the chancellor's report, approve all his recommendations, eat a dinner and adjourn. The other trustees, the business men, are busily engaged with their own affairs and turn the whole administration of the university over to the chancellor. Vacancies in the board of trustees, other than the conference members, are filled by the chancellor nominating one of his personal friends to the position. This gives him practically unlimited power; the board of trustees being made up first of some of the chancellor's rich friends, and secondly, of the inactive conference trustees. The board allows him to do as he pleases and agrees to all his recommendations, even to mortgaging the university for $400,000 to obtain funds to build the largest college gymnasium in the world, and, if the ideas of the trustee quoted above are followed, to dismiss the head of one of his colleges without any investigation on the part of the trustees to discover whether the dismissed man is a suitable person for the position or not, and without giving him any opportunity to present his side of the case.

The chancellor thus has unchecked power, which always tends to tyranny. The chancellor has, therefore, become a czar.

The conference trustees while they have it in their power to see that the university is provided with the best possible system of government, and while they have every opportunity to study by visiting other universities, what the best system of government is, have abdicated all their power and delivered it to a czar. Under such circumstances it can not be expected that the educational interests of the university can be well managed, any more than it can be believed that the governments of Russia and Turkey are the best governments under the sun. It is not to be expected that one man, however able he may be, possesses all the wisdom necessary to the proper outlining and developing of the many varied courses of a large university.

The remedy for this state of affairs is entirely within the control of the Methodist church. Controlling as it does the majority of the board of trustees, it can, if it so wills, give the university the best governmental system possible. Would it not be well for the Methodist General Conference to request its committee on education to study the subject and report to the several conferences which have jurisdiction of colleges, what should be the best system of administration in a university, in order to make it as efficient an educational institution as possible and be a credit to the Methodist denomination?

William Kent,
Dean of the College of Applied Science
Syracuse University

CONFERENCE ON CONSERVATION OF NATURAL RESOURCES

The Conference of Governors on the Conservation of the Natural Resources of the country, held in the White House, May 13–16, proved a notable occasion. Except a few detained or called away by pressing state business, all the governors of the states and territories, including Hawaii and Porto Rico, took part, as did the governors' advisers, the justices of the Supreme Court, the members of the cabinet, the presidents of the leading scientific and technical organizations, and a few special guests, including Messrs. Andrew Carnegie, James J. Hill, W. J. Bryan and John Mitchell. President Roosevelt presided throughout two of the five sessions, and during a part of each of the other three. It was the consensus of opinion that the condition and probable duration of our leading resources were summarized more completely than ever before; and that the deliberations did more to emphasize the importance of research relating to the physical phenomena of the continent than those of any other earlier assemblage.

So far as the relations among the states and between these and the national government, are concerned, the general opinion expressed in public addresses and personal conversation was that the conference marked a new era, comparable only with that opened by the Philadelphia Conference in 1787, at which the constitution was framed.

Numerous resolutions were introduced, and were referred to a committee consisting of Governors Newton C. Blanchard, of Louisiana (chairman); John F. Fort, of New Jersey; J. O. Davidson, of Wisconsin; John C. Cutler, of Utah, and M. F. Ansel, of South Carolina; which committee, after weighing all the resolutions, expert statements, and other matter germane to the conference, framed and submitted a general declaration of principles which, after discussion, was unanimously adopted. While the value of any formal document necessarily falls below that of the consensus of opinion and feeling among the nation's executives, it may be regarded as the chief tangible result of the conference. It is as follows:

We, the governors of the states and territories of the United States of America, in conference assembled, do hereby declare the conviction that the great prosperity of our country rests upon the abundant resources of the land chosen by our forefathers for their homes, and where they laid the foundation of this great nation.

We look upon these resources as a heritage to be made use of in establishing and promoting the comfort, prosperity and happiness of the American people, but not to be wasted, deteriorated or needlessly destroyed.

We agree that our country's future is involved in this; that the great natural resources supply the material basis upon which our civilization must continue to depend, and upon which the perpetuity of the nation itself rests.

We agree, in the light of facts brought to our knowledge and from information received from sources which we can not doubt, that this material basis is threatened with exhaustion. Even as each succeeding generation from the birth of the nation has performed its part in promoting the progress and development of the Republic, so do we in this generation recognize it as a high duty to perform our part; and this duty in large degree lies in the adoption of measures for the conservation of the natural wealth of the country.

We declare our firm conviction that this conservation of our natural resources is a subject of transcendent importance, which should engage unremittingly the attention of the nation, the states, and the people in earnest cooperation. These natural resources include the land on which we live and which yields our food; the living waters which fertilize the soil, supply power and form great avenues of commerce; the forests which yield the materials for our homes, prevent erosion of the soil, and conserve the navigation and other uses of our streams; and the minerals which form the basis of our industrial life and supply us with heat, light and power.

We agree that the land should be so used that erosion and soil wash shall cease; that there should be reclamation of arid and semi-arid regions by means of irrigation and of swamp and overflowed regions by means of drainage; that the waters should be so conserved and used as to promote navigation, to enable the arid regions to be reclaimed by irrigation, and to develop power in the interests of the people; that the forests, which regulate our rivers, support our industries and promote the fertility and productiveness of the soil, should be preserved and perpetuated; that the minerals found so abundantly beneath the surface should be so used as to prolong their utility; that the beauty, healthfulness and habitability of our country should be preserved and increased; that the sources of national wealth exist for the benefit of all the people, and that monopoly thereof should not be tolerated.

We commend the wise forethought of the President in sounding the note of warning as to the waste and exhaustion of the natural resources of the country, and signify our high appreciation of his action in calling this conference to consider the same and to seek remedies therefor through cooperation of the nation and the states.

We agree that this cooperation should find expression in suitable action by the Congress within the limits of, and coextensive with, the national jurisdiction of the subject, and complementary thereto, by the legislatures of the several states within the limits of, and coextensive with, their jurisdiction.

We declare the conviction that in the use of the natural resources our independent states are interdependent and bound together by ties of mutual benefits, responsibilities and duties.

We agree in the wisdom of future conferences between the President, members of Congress and the governors of the states regarding the conservation of our natural resources, with the view of continued cooperation and action on the lines suggested. And to this end we advise that from time to time, as in his judgment may seem wise, the President call the governors of the states, members of Congress and others into conference.

We agree that further action is advisable to ascertain the present condition of our natural resources and to promote the conservation of the same. And to that end we recommend the appointment by each state of a commission on the conservation of natural resources, to cooperate with each other and with any similar commission on behalf of the federal government.

We urge the continuation and extension of forest policies adapted to secure the husbanding and renewal of our diminishing timber supply, the prevention of soil erosion, the protection of headwaters, and the maintenance of the purity and navigability of our streams. We recognize that the private ownership of forest lands entails responsibilities in the interests of all the people, and we favor the enactment of laws looking to the protection and replacement of privately owned forests.

We recognize in our waters a most valuable asset of the people of the United States, and we recommend the enactment of laws looking to the conservation of water resources for irrigation, water supply, power and navigation, to the end that navigable and source streams may be brought under complete control and fully utilized for every purpose. We especially urge on the federal Congress the immediate adoption of a wise, active and thorough waterway policy, providing for the prompt improvement of our streams and conservation of their watersheds required for the uses of commerce and the protection of the interests of our people.

We recommend the enactment of laws looking to the prevention of waste in the mining and extraction of coal, oil, gas and other minerals with a view to their wise conservation for the use of the people and to the protection of human life in the mines.

Let us conserve the foundations of our prosperity.

SCIENTIFIC NOTES AND NEWS

The house of representatives concurring with the senate and by a unanimous vote, has granted an annuity for life of $125 a month to the widows of the late Major James Carroll, surgeon, U. S. army, and the late acting assistant surgeon, Jesse W. Lasear, whose lives were sacrificed in the study of yellow fever in Cuba.

Professor William James, who has been giving a course of lectures on philosophy at Oxford University, received there the degree of doctor of science on May 12.

Dr. Edward S. Morse has been elected a member of the Astronomical Society of Belgium.

Mr. Francis Darwin, F.R.S., has been nominated the representative of Cambridge University at a meeting convened by the Linnean Society of London, to be held in July in celebration of the fiftieth anniversary of the reading of the joint essay by Charles Darwin and Alfred Russel Wallace "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection."

Mr. A. E. Shipley, F.R.S., was elected president of the Association of Economic Biologists, which held its sixth annual meeting at University College, last month.

On May 12 Professor F. T. Trouton began a course of two lectures at the Royal Institution on "Why Light is believed to be a Vibration" and "What it is which Vibrates." The Friday evening discourse on May 15 was delivered by Dr. H. T. Bulstrode on "The Past and Future of Tuberculosis," and on May 22 by Professor J. C. Kapteyn on "Recent Researches in the Structure of the Universe."

The Croonian Lectures before the Royal College of Physicians, of London, will be delivered June 18 to 30, by Dr. A. E. Garrod, on "Inborn Errors in Metabolism."

The German emperor has presented Professor Dörnfeld, head of the German Archeological Institute at Athens, with a sum of $1,000 for the purpose of starting excavations on the site of the ancient Pylos.

E. C. Parker, assistant agriculturist at the Minnesota Experiment Station, will sail on June 30 to become expert adviser to the government officials of Manchuria. With W. H.

Tombave, now connected with the University of Pennsylvania, he will be employed in instituting modern methods of agriculture in Manchuria.

Mr. Roy C. Andrews, of the department of mammalogy of the American Museum of Natural History, has gone to Vancouver Island for the purpose of spending several months at the whaling stations on that coast. His work will be the securing of photographs, notes and measurements, which will furnish the data for a preliminary study of the Pacific species of whales.

Mr. V. Stefansson, the ethnologist, who spent the winter of 1906–7 among Esquimaux in the region of the delta of the Mackenzie River, is preparing to start for the mouth of the Coppermine River, about 460 miles east of the Mackenzie, to spend another year among the natives.

Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory, has left Washington for Mt. Wilson, near Pasadena, California, where he will continue observations, conducted for a number of years both in Washington and in California, on the amount of heat received on earth from the sun.

Professor George P. Merrill, head of the department of geology of the United States National Museum, has gone to Coone Butte, Arizona, to be present at a number of deep borings to be made in the so-called Canyon Diablo crater, the cause of which has been a puzzle to geologists ever since it was brought to their attention. This crater-form depression in the desert is nearly three quarters of a mile across and about six hundred feet deep. Some men of science have believed it to be an extinct volcano and others, to be the record of the impact of a huge meteor which struck the earth centuries ago. Professor Merrill made a study of the depression last year, and in drawing conclusions upon the evidence brought back, he stated: "This, of course, absolutely precludes the formation of the crater by any deep-seated agency, and I have been forced to consider an origin by impact of a stellar body." The present borings in search of a buried meteor or meteoric irons and other phenomena may furnish additional material to account for its origin.

The Magnetic Survey yacht *Galilee*, chartered by the Carnegie Institution of Washington and under the command of W. J. Peters, returned to her home port, San Francisco, on May 22, after an absence of nearly three years. The total length of the cruises traversed in the Pacific Ocean during this period is about 65,000 miles. This closes the ocean magnetic work for the present until the construction of a vessel specially adapted for the work has been completed. Plans for the new vessel are now being prepared by Henry J. Gielow, naval architect and engineer.

Dr. W. J. Holland, the director of the Carnegie Museum, has completed the installation of the cast of the *Diplodocus* presented by Mr. Andrew Carnegie to the German emperor. It stands in the Lichthof of the Zoological Museum at Berlin and occupies the entire west side of the great room. On May 15 Dr. Holland went to Paris to install a similar replica in the National Museum in the Jardin des Plantes. While in Berlin Dr. Holland attended the sessions of the International Anatomical Congress. On May 5 he addressed a meeting of the *Gesellschaft Naturforschenden Freunde zu Berlin* and on May 13 a dinner in his honor was given, at which the cultusminister and the heads of all the departments of the university and of the various learned societies in Germany were present by invitation.

We learn from *Nature* that the president of the Board of Trade has appointed a committee to prepare a program for the consideration of the delegates to the International Conference on Electrical Units and Standards to be held in London in the ensuing autumn, and to make arrangements for the reception and assembly of the delegates attending the conference. The members of the committee are Mr. G. R. Askwith, K.C.; Sir John Gavey, C.B.; Dr. R. T. Glazebrook, F.R.S.; Major P. A. MacMahon, F.R.S.; Major W. A. J. O'Meara, R.E., and Mr. A. P.

Trotter. Mr. M. J. Collins, of the Board of Trade, will act as secretary to the committee.

The members of the committee appointed to arrange for Germany's participation in the International Congress on Tuberculosis that is to meet in Washington next September include Victor, Prince of Hohenlohe and Count von Lerchenfeld; Baron von Knesebeck; Dr. Abb, secretary of the civil cabinet of the emperor at Berlin; Dr. Bumm, president of the Imperial Board of Health, and Professor Dr. Schjerring, general chief of the army sanitary corps. Dr. von Bethmann-Hollweg, the president of the committee, is the imperial secretary of the interior. Ernst von Mendelssohn Bartholdy, of the banking house of that name, and a member of the Prussian Diet, is the treasurer. Besides the members of official rank the list contains the names of many eminent men of science, including those of Dr. Robert Koch and Professor von Behring.

The tablet in honor of Dr. Horace Wells, discoveror of anesthesia, which was sent to this country from Madrid by the Spanish Odontological Society, has reached Hartford by way of the Spanish minister at Washington. The memorial is composed of a silver plate surrounded by a wreath of white metal showing laurel leaves on one side and the oak on the other, with laurel berries in white and acorns in gilt. Above the plate is an ancient lamp with its light burning. The tablet is thirty-three inches by two feet. It bears the following inscription: "The Spanish Odontological Society to Horace Wells. Madrid, January 14, 1907."

We learn with regret of the death of Dr. Heinrich Maschke, professor of mathematics in the University of Chicago, at the age of fifty-five years.

M. Albert de Lapparent, the eminent French geologist, has died at the age of sixty-seven years.

We regret also to record the death of Dr. K. Möbius, professor of zoology at Berlin, at the age of eighty-three years.

The U. S. Civil Service Commission announces an examination on June 17 to fill two, and possibly three, vacancies in the position of medical interne (male) and one vacancy in the position of medical interne (female), at $600 per annum each, with maintenance, in the Government Hospital for the Insane, Washington, D. C., and vacancies requiring similar qualifications as they may occur.

Tables at the laboratory of the United States Bureau of Fisheries, at Beaufort, North Carolina, will be available for the use of investigators after July 1. Requests for further information should be addressed either to the Commissioner of Fisheries, Washington, D. C., or to the director of the laboratory, Beaufort.

The public opening of the Museum of the Staten Island Association of Arts and Sciences at the Borough Hall, St. George, Borough of Richmond, took place on Saturday afternoon, May 23.

The provision of a Pasteur Institute for Burma is said to be now assured, though some little time must elapse before the work can be started.

We learn from the *Journal* of the American Museum of Natural History that the museum has secured as a loan exhibit the series of eight paintings of Mt. Pelé, Martinique, made by the late Professor Angelo Heilprin of the Philadelphia Academy of Natural Sciences and Yale University. Professor Heilprin visited Martinique during the eruptions of 1902 and 1903, first as the delegate of the National Geographic Society and afterwards on his own account. The paintings now at the museum were made from sketches, photographs and other studies in the field and are valuable not only from an artistic point of view, but also from their giving a record of the impressions of an observer who was a scientist as well as an artist. The paintings have been installed in the lobby of the central hall of the second floor.

UNIVERSITY AND EDUCATIONAL NEWS

The public bequests announced under the will of the late Mr. T. Webb include £5,000 to University College, London, to be used and applied, so far as is practicable, for the purposes of physical research, and £5,000 to University College of South Wales and Monmouthshire, also for physical research.

The London *Times* states that the new university established by the legislature of Alberta will open its first term next September. The site for its buildings is a fine one of 250 acres at Strathcona, on the Saskatchewan River, opposite Edmonton, the provincial capital. The plans have not yet been prepared; and, meanwhile, the university will have the use of a large school building in Edmonton. The scheme of the university's work and buildings is comprehensive; but in the first term there will only be one combined faculty, of arts and science, giving B.A. and B.Sc. degrees. Dr. H. M. Tory, the president, formerly professor at McGill University, says he expects to begin with 40 or 50 students. The province has set apart for the revenue of the university one fifth of the educational land tax and one fifth also of the tax on joint stock companies; and the legislature will make special grants for building. The convocation consists of the university graduates resident in Alberta, numbering 364, about half of whom are alumni of Toronto University. This body of graduates also elects five of the fifteen members of the senate.

We learn from the New York *Evening Post* that the construction of the building to be used by the geology department of Williams College is progressing rapidly. The exterior will be of red brick, painted a colonial yellow to match West College, and the trimmings will be of white marble. There will be two stories and a basement. Lecture rooms, laboratory, library and workshop will be in the basement. A museum will occupy the whole of the first floor, and around the walls will be placed fragments of old Clark Hall. The building should be ready for occupancy at the beginning of the next college year.

The Summer School of The Connecticut Agricultural College, which holds its seventh annual session July 1 to 24 inclusive, has arranged for special courses in nature study, pedagogy, and elementary agriculture. The Summer School is planned to meet the needs of teachers and others who wish to learn something about outdoor life.

The trustees of the George Washington University have adopted a recommendation that no student will be hereafter matriculated in the Department of Medicine who can not give his full time to study. The work will begin at nine o'clock in the morning and continue throughout the day, the evening work being discontinued except so far as is necessary to provide for students already in the school. This action puts all the work of the university in the day time.

The numbers of medical students in German universities during the summer course of 1907 were as follows: Münich, 1,248; Berlin, 876; Freiburg, 645; Leipzig, 498; Würzburg, 449; Heidelberg, 397; Kiel, 340; Marburg, 291; Bonn, 277; Breslau, 277; Jena, 275; Tübingen, 242; Strassburg, 233; Königsberg, 216; Halle, 210; Greifswald, 201; Erlangen, 199; Göttingen, 176; Giessen, 173; Rostock, 122. Total, 7,345.

At Yale University Dr. Henry Lord Wheeler, '90 S., has been promoted to be professor of organic chemistry in the Sheffield Scientific School, and Dr. Joseph Barrell, '00 Ph.D., to be professor of geology in the college. New appointments and promotions were: Ernest Wilson Sheldon, '07, and Horace T. Burgess, '06, to be instructors in mathematics; Clarence Curtiss Perry, '04 S., from assistant to be instructor in physics and steam engine; Clifford Whitman Bates, '05 S., and Charlton Dows Cooksey, '05 S., from assistants to be instructors in physics.

Dr. Wm. M. Wheeler, curator of invertebrate zoology in the American Museum of Natural History, has been appointed professor of economic entomology in the Graduate School of Applied Science of Harvard University.

Errata: In the article on "Geological Climates" by Dr. J. M. Schaeberle in the issue of Science for May 18, on page 784, last line of first paragraph, second column, for "that" read "than," and on page 785, first column, tenth line of first paragraph, for "other" read "ether."

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JUNE 5, 1908

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OPPORTUNITIES FOR YOUNG MEN IN SCIENCE[1]

OPPORTUNITIES IN BOTANY

SOME of us have been assured by those who have had to do with the program that the sharers in this symposium are not to feel themselves fettered by the specific limitations of their assigned topics.

Hence my liberty in asking first why we should be concerned at all in any special effort to increase interest in science work as a profession. General interest in science is another matter. The aim of this symposium, however, appears to be to point out why a choice of their life work from the various branches of science is a desirable choice for young men to make.

It may be reasonably inferred, if only from the remarks made this morning in the discussion upon what shall be the dues of this organization (so happily placed at one dollar), that we have nothing very great in the way of financial compensation to offer. For that very reason, if we are good economists, should we not be the last to encourage more strenuous competition for the apparently limited number of real competences which exist for the sustenance of life workers in science? Yet we are most cheerfully engaged in doing that very thing. Though there may be far from enough to go around in generous portions, let us by all means have more in at the feast. There may be compensation in the extra-prandial proceedings.

An editorial in a recent science peri-

[1] From a symposium at the organization meeting of the Illinois State Academy of Science.

odical estimates that fewer than five thousand persons in the United States are professionally engaged in science investigation or in the teaching of science up to the research point. Of these it reckons that fewer than one thousand should be counted real contributors. What are one thousand among eighty million? We must accept the fact that several European nations excel us in this respect.

It comes to mind that our inferiority herein may be due as much to absence in the minds of the educated public of the aims and actual work in science progress as to anything else. Herein is, perhaps, the best reason for such a symposium and for such an organization as has just been perfected. These words of Matthew Arnold seem appropriate:

> The great men of culture are those who have had a passion for diffusing, for making prevail, for carrying from one end of society to the other, the best knowledge, the best ideas of their time; who have labored to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive; to humanize it, to make it efficient outside the clique of the cultivated and learned.

The point is, then, that our real science workers are both too few and too remote from the general public. They work very largely in another world than the one of common conception. From the world of common knowledge they must, perhaps always, remain aloof. But may not the real value of their work be at least adequately conceived?

In Europe the magazines and even the shop windows furnish evidence of the popular interest in science progress. Wherever the forward movement is most active you catch a quick reflection of it in the popular press. There the public is said to be really much concerned of late with what is sometimes called the "passing of Darwinism." What does the American public know or seriously care about Darwinism being on its "deathbed"? Here our editors shun the rather dry and obscure authorities in favor of picturesquely-worded and sensation-charged celebrities; and, reciprocally, the authorities shun the editors.

Yet are we not ready to admit that the modern aspect of "national progress" depends very largely upon the number of properly qualified persons who are engaged in science research, and, perhaps as much, upon the extent to which the general public follows their advance?

Does not the fault for this large American gap between science workers and the general public lie much with the scientists who have held aloof; who have rarely taken it as part of their task properly to popularize the problems on which they are at work; who have let misrepresentation go almost unchecked; who have done much to form a sort of aristocracy of their own kind?

But, wherever the fault lies, we must lessen the gap. The constitution we have just adopted explicitly commits us to this. Unless there develops more popular interest in the great truth search, in this and its many other aspects; unless there develops more feeling of personal responsibility in finding out for one's own self, and less of being easily satisfied with the first plausible explanation, then the national peril for lack of "clean truth" to which Dr. Chamberlin made reference this morning is surely not very difficult to perceive; a reference which, by the way, has some responsibilty for this digression from my topic.

Specifically, of the opportunities in botany, we can say that the demand for trained botanists continues to exceed the supply. Such demand is, of course, especially for young men ready to begin their service at compensation less than the theoretical value of the service rendered. Further, it is almost exclusively a demand for men to whom the service means at least as much as the compensation. But, as such, it is unquestionably a vigorous and growing demand.

The most extensive employer of young botanists in America is the United States government, and we are very reliably informed that the various bureaus of the Department of Agriculture are in positive need of more men adequately trained in plant morphology and physiology than they can find. Such training is usually sufficiently well attained in two or, at most, three years of graduate study.

It is becoming increasingly difficult to differentiate between botanists pure and simple and special students of agriculture. Yet we are loath to lose good men through a mere juggling of terms, as botanist into agronomist or something like, even though the latter cashes in better. So, among present-day opportunities in botany should not be overlooked the one of being botanist in fact only, with sedulous avoidance of a name which suggests nothing of the large cash values upon which this section of the profession, under its many aliases, may justly pride itself.

For teachers of botany the market is still brisk, though the upward tendency is not perhaps so marked as in other lines of demand. Doctors of philosophy in botany are commanding beginning salaries in teaching positions which average about fifty per cent. more than those offered eight years ago. These are in the main, of course, positions of collegiate or equivalent rank. It is for teachers of lesser training that the demand has shown a barely perceptible falling off. But this is more than offset by the increasing demand for teachers of agriculture for the rural high schools. What botany in some quarters is threatened with losing as a high school subject, agriculture has already more than gained. Since the question has become very largely one of teaching much the same subject in a more efficient way, we may expect that botany, in this respect, will be a graceful loser.

In the Philippines a "practical" botanist is wanted in every province, of which there are more than thirty, to take in charge the immensely important educational side of the problem, especially from the standpoint of the agricultural possibilities. No stereotyped problem here, nor meager compensation therewith!

The opportunities for amateur work in connection with the academy should, perhaps, receive a word of comment. Apart from its large educational function, I take it that the contributory work of the academy will confine itself, in the main, within state boundaries. With such limitation, and assuming the cooperation of a considerable and favorably distributed number of persons, an ecologically annotated geographic catalogue is perhaps the first task which suggests itself. Such work for such an organization has the peculiar virtue of simplicity in its individual parts, absolute necessity for extensive cooperation, and the very large value of the final symposium. The humblest sharer in the work may be thoroughly satisfied that his part is quite as important as almost any other part.

Of intensive area work in ecology, Cowles's work on the dunes and Gleason's quite recent study of sand-flat areas of the Illinois River forcefully suggest the considerable number of similar, yet untouched and equally attractive, problems within the state.

The native prairie plants, made historic by their striking floral aspects alone, remain undisturbed in but few and restricted areas. The salvation of a strip of native prairie large enough to reveal the original ecological factors may be already impracticable, but the academy may well have in mind the establishment of a state garden of the native plants.

Fresh acres in garden and field will be given each year to the new experiments in plant breeding, and here, too, the amateur may well lend a hand, though our agronomical friends may question whether such a suggestion is pertinent among points for amateur *botanists.*

In closing, I beg to submit a definite suggestion for which I must again seek excuse in that incontestable statement of our president this morning, that in lack of clean truth there lies national peril.

Nowhere in our educational literature is the absence of clean truth more conspicuous than in the nature-study books which are in common use in the graded schools. Nowhere has the unauthorized word had wider play or more credulous following. Untrained teachers have had nature study thrust upon them and have turned with avidity toward whatever seemed to offer help. Composites of sentiment and inaccuracy have been liberally supplied as "supplementary reading."

The suggestion is that there be issued in the name and under the direct auspices of the academy a series of leaflets upon science topics suitable for use as material in nature study and geography. Such topics should be treated especially from the standpoint of the state in so far as they lend themselves suitably to such treatment. Such leaflets should be available to the public schools at low cost. An educational editor, perhaps a member of the standing committee upon publication, might have in charge the apportionment of topics to members willing to cooperate, and ample discretion in editing to suit the educational needs in view should be allowed such an editor.

In objection, the point may be raised that in its very infancy the academy would be rash to venture to finance such a scheme. It may be confidently stated, however, that funds sufficient for such purpose would be at the disposal of the academy in case such proposal meets its good will.

A similar service has been and continues to be rendered by the Cornell Nature Study and Agricultural Leaflets.

John G. Coulter

OPENINGS FOR CHEMISTS

Eighteen years ago, as I was sitting in a café in Munich one evening, talking to a young Englishman, he said to me "England has the present but America has the future." He meant, of course, that while England at that time stood in the forefront of progress, industrially as well as politically, the conditions were such in America, both in our command of natural resources and in the character of our people, as to make it practically certain that the lead in both respects must go to America in a not far-distant future.

In the years which have passed since that time, this prophecy has been going on toward a rapid fulfillment. As an illustration, we may take the manufacture of iron. At that time, more iron was manufactured in England than in any country in the world, but within a few years afterwards the production in America exceeded that in England, and it is now very much greater here than there.

In this increased industrial activity in America, chemists have played and are playing a very important part. In this very industry of the manufacture of iron and steel, twenty-five years ago very few chemists were employed in this country, but to-day chemists are required not only in the large establishments where steel is produced, but in foundries and factories of all kinds where large amounts of iron are used.

What has happened in the iron industry has happened also in a great variety of other industries. To speak of the different lines in which chemists are to-day employed would be almost to give a list of the important industries of the country. There is in these and in chemical work in general a rapidly increasing diversity. During the past year the American Chemical Society has established an abstract *Journal* which intends to give an account of all new work in chemistry which is published in the world. The abstracts in this journal are classified in thirty divisions, and this illustrates the great variety of industries and directions in which chemists are interested.

The amount of knowledge which has been accumulated in chemical science is so great that I feel safe in saying that the detailed knowledge in this science is greater in amount than the whole mass of scientific knowledge in all sciences fifty years ago. I do not, of course, mean that the value of this chemical knowledge is greater than the value of the scientific knowledge fifty years ago, but merely that its amount is greater, and I say this for the purpose of emphasizing the diversity of interests among chemists.

It is estimated that there are about eight thousand chemists employed in the United States at the present time. One of the previous speakers has referred to an estimate that there are only five thousand scientific men in the United States. While I do not suppose that all of the eight thousand chemists can be properly classed as scientific men in the sense in which the term was used by the former speaker, I am inclined to think that this number indicates that there are many more scientific men in the United States than would correspond to that estimate. The increase in the number of chemists during the past twenty-five years has been very largely occasioned by the employment of chemists in the industries. A quarter of a century ago, nearly all of the chemists in the United States were engaged in teaching, while to-day the majority are undoubtedly working in industrial lines.

But it is not merely in the industries that the number of chemists has greatly increased during this period. Thirty years ago, very few educational institutions could have been found which had more than three or four chemists on their staff. In the institution with which I am connected, the staff includes more than thirty chemists who are engaged in teaching or research, and I do not think that the institution is unusual in this regard.

Very large numbers of chemists have also been required in recent years by agricultural experiment stations and by government bureaus. Since the enactment of the pure-food law especially, the demand for chemists to fill positions in connection with the bureau of chemistry has largely exceeded the supply of suitable men, and during the past summer many of those who have been called upon to answer inquiries for chemists to fill positions have been compelled to reply that they had no suitable candidate to recommend.

W. A. Noyes
University of Illinois

OUTLOOK FOR YOUNG MEN IN GEOLOGY

Probably our academy can do no one thing more useful than to encourage the young men and women of talent who are looking forward to a career in science. By this is not meant a deliberate effort to divert men and women from other work to ours, but rather the holding out of a helping hand to those whose inclinations are toward a scientific career, but who hesitate for fear that there is either no work or no place for them.

It is well known that men of science receive relatively poor financial returns for their work. Capable and industrious workers make a good living, but rarely are able to accumulate wealth. This is true of geologists as of others, and I for one am by no means sure that a change in this regard would bring to our profession any larger number of men of the highest talent and devotion. Be that as it may, the best which can be now offered to the hesitating young man is a good living while he does his work. The opportunities for making his way are found in these lines of activity: (*a*) teaching, (*b*) survey work and (*c*) industrial positions.

Geology is seldom taught in high schools and secondary schools though there is a strong and increasing demand for teachers in physiography. This affords an excellent opening for beginners. In the colleges, universities and mining schools geology is taught as frequently as the other sciences and there are, accordingly, as many positions open.

The largest number of professional geologists in this country are connected for a whole or a part of their time with official surveys or bureaus. The greatest of these is the U. S. Geological Survey, which in the season just closed maintained ninety-three geological field parties. These each included from one to three geologists or aids. In addition many of the topographic and other field parties were engaged upon work so closely related to geology as to afford suitable opportunity for service on the part of beginners at least. In the forest service and in other branches of government work still other men are employed. Thirty-one of the states now have state geologists or equivalent officers and sustain more or less geological work. This work varies greatly in character from refined paleontologic investigations to the registering of mining prospectuses and bureau of information work. In some cases only a few hundred dollars are appropriated for the summer field work, perhaps, of the professor of geology at the university, and in others several thousand dollars are given annually and ten or a dozen field parties maintained. State survey work, where available, offers peculiar advantages to the beginner, since on account of the small force there is less specialization.

In mining and industrial work geologists are finding an increasing number of opportunities. Many railways, mining companies, development companies, etc., now employ one or more geologists. This indicates a welcome change of attitude in the public recognition of our work, but for the time being it cripples survey work by drawing away many of the best men. These positions are eagerly sought and pay relatively well, but usually offer only restricted opportunities for research work and often prohibitive conditions as regards publication. It is to be hoped that in time these restrictions will largely disappear.

Granted, then, that properly equipped and willing workers may rest assured of positions being open to them, the vital question remains as to the work to be done. To some extent, in geology, pioneer conditions have passed. In our portion of the world geologic mapping on some scale has very generally been done. In much of Canada, in Alaska, in parts of Mexico and in most of South America pioneer conditions, as regards geology, still prevail. Very little of either Africa or Asia has been carefully studied so that as regards systematic work alone the bulk of our task is still before us. If also we measure the work from the point of view of development of ideas, the task is even more attractive. Geology has heretofore been mainly in the qualitative state. Its workers have been busy developing the processes involved and have had only the crudest means of elimination when it was necessary to test one hypothesis against another. As Van Hise has pointed out, we have now at least entered into the quantitative stage and this means nothing less than the reduction to an orderly basis of the accumulated observations of all the years past. As we accomplish this we shall change our science from an inexact one of hypothesis to an exact one of law; and we shall then stand on an equal basis as regards certainty with our associates of the physical and mathematical sciences. This is certainly a field large enough and important enough to attract the best energies of any man or woman. If our academy shall help to put the right man in touch with his problem and the means of solving it, we shall quickly justify its existence.

H. FOSTER BAIN

URBANA, ILL.

OUTLOOK FOR YOUNG MEN IN PHYSICS

Mr. Chairman and Gentlemen: Sudden and unexpected as this call is, I feel bound by the courteous manner in which the invitation is extended to respond.

The opportunities offered by the science of physics may for convenience, at least, be grouped under the four following heads:

(1) *Research.*—To him who finds his "manifest destiny" in investigation, the recent discoveries of physical science have vastly multiplied the opportunities for new discoveries. To illustrate; when Hertz in the autumn of 1888 showed us how to produce electric waves, a tremendous field was opened to research. The various properties of waves of different lengths under different conditions all had to be studied. Every year some new domain of this kind is made ready for occupation by the earnest and serious student.

(2) *Applied Physics.*—For him who has that practical turn of mind which characterized Franklin and has yet preserved an interest in pure science (which also characterized Franklin) there is always a rare opportunity. In the autumn of 1831 Faraday not only discovered the induction of electric currents, but also actually made an electric motor and an electric generator about the same time. But it was not until the late sixties that the dynamo became a commercial success. This delay is typical of the mental hysteresis which generally separates discoveries in physical science from their industrial applications.

It was seven years after Hertz's discovery of electric waves before Marconi showed them to have commercial value; and it has taken practically twenty years to employ them for transatlantic messages. In these intervening periods lies great opportunity for the alert "practical mind."

(3) *Engineering.*—Nearly all the great engineering concerns of America are looking for more men than they can find of the broadly trained type—men who are acquainted, *at first hand,* with the general principles of physical science. A man may know every machine in the shop of an engineering firm and yet not know how to design a new mechanism to meet a new want or a new circumstance. What is demanded to-day is, therefore, not so much an acquaintance with present-day practise as a thorough mastery of the fundamental principles of engineering—and these are mainly the principles of physics.

(4) *Teaching.*—The high salaries which engineering concerns are offering to men well trained in physical science and to men of executive ability have had the effect of leaving vacant many excellent teaching positions in physics. The door is wide

open for him who enjoys this line of work and who is willing to leave behind all hope of opulence.

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OUTLOOK FOR YOUNG MEN IN ZOOLOGY

In the ten minutes allotted, I shall attempt to answer six questions of special interest to those who are planning to enter zoology as a profession. Through the kindness of Professors Mark, Minot, Comstock, Sedgwick, Reighard, Lillie, Conklin, Ward and Jennings, who have generously responded to my appeal for information, I am in a position to state the outlook for young men somewhat from the standpoint of their experience. As far as possible, the answers to the questions relating to the topic assigned me will be given in the words of the above-named zoologists.

1. *How do the chances for getting good positions compare with those of a decade ago?*

All of the zoologists who have expressed an opinion on this question agree that the chances are much better than they were a decade ago. Professor Comstock writes: "I should say that they are much better. It is only fair to emphasize, however, that the man who takes up work along these lines purely as a financial venture, apart from other considerations, will be disappointed. And I should say also that a large part of the demand for entomologists in recent years has been due largely to the great increase of this kind of work in the Department of Agriculture at Washington. Many men have found places with Dr. Howard or have taken places vacated by others who have gone to Dr. Howard. If the government support of this kind of work were to cease it would make a great difference in the chances for getting good positions."

Dr. Mark writes: "Have been surprised that the demand has increased so rapidly. This has been more noticeable in the field of comparative anatomy than in other lines during the past five or ten years."

According to Dr. Minot, "There is great difficulty in getting any men for positions in anatomical and zoological laboratories, and I believe that for a few years the opportunities will be unusually good. But for heaven's sake, do not encourage any mediocrities to go into science. If you can, have them Oslerized at sixteen."

Dr. Conklin thinks that the chances of a young man's going at once from his graduation to the headship of a department are probably not so great now "as they were a decade ago."

Dr. Jennings says that "it is difficult to get the men needed for positions in zoology, and this is true all along the line from assistantships up to full professorships."

2. *Is it ever necessary for a man with a doctor's degree to rest on his oars for a year because no desirable college or university position is open to him?*

The reply of Dr. Lillie is typical of the answers given to this question: "In the course of a good many years several of our doctors of philosophy have accepted positions in high schools and normal schools; in such cases it has usually been a matter of preference with them. So far as I know, there has never been a case of one of our doctors of philosophy being obliged to go without a position for even a year."

According to Dr. Jennings, "many excellent positions have gone to men without the doctorate."

3. *Does the number of desirable positions equal the number of candidates?*

Dean Ward writes that "there have been more desirable positions in zoology which have come to my attention in the last five years than I could have filled three times over if every one of my advanced students had been ready to consider such opportunities. We have not been able to furnish enough teachers to supply the college demand, nor enough collectors and workers for museum and government positions. The expansion in connection with college teaching, the demand for more men in old institutions and for new men in those recently founded has exceeded the supply."

Dr. Reighard writes that in his department "the number of applications for candidates to fill positions in biology and zoology has for some years fallen far short of the supply. I have had about ten applications for the present year and have been able to fill *none* of them with men directly from my laboratory. Two were, however, filled with men who have recently been here. These were applications for *men* and for positions above secondary-school grade."

4. *Has the number of men entering zoology as a profession increased or decreased?*

"There certainly has been no increase in proportion to demand," says Dr. Jennings. Dr. Reighard, however, writes that "the number of students in advanced classes with the definite purpose of preparing to teach in institutions above secondary-school rank, is *less*."

5. *Are any new fields opening up for zoological students?*

According to Dr. Sedgwick "The demand for men in physiology and sanitary biology is particularly brisk, especially in the latter subject. For several years it has been impossible to meet the demands for young men properly equipped to fill positions in sanitary or industrial biology."

Dr. Reighard writes that "to a certain extent new fields are opening up: (*a*) I have had two applications within a month for men to fill positions in experimental research work particularly breeding experiments, in agricultural colleges under the Adams act. (*b*) There is a slowly increasing demand for men to undertake museum work. We have difficulty in keeping good museum men here. (*c*) Some of the older educational institutions are reorganizing their zoological departments and expanding them. (*d*) The normal schools are seeking men (and women) with the newer, ecological training, capable of organizing work along 'natural study' lines. I have had a couple of calls of this sort within a few months."

According to Dr. Jennings, "Some new fields are opening for zoological students. The various research institutions recently established take a number. The Adams act recently enacted by Congress promises to call a number into the service of state experiment stations, and has begun to do so already. I should judge that many more educational institutions require competent men in this line, or a greater number of them, than was the case a few years ago. On the whole, I should say that the prospects are excellent in zoology at present, particularly for the investigator."

6. *Is the demand for zoologists likely to continue as great as at present?*

There seems to be good reason to believe that the conditions which have kept up the demand for the past decade will continue in the next. Even financial depression such as that of the present time does not seem to diminish the number of students in higher institutions of learning nor the demand for additional instructors. The policy of the General Education Board and of the Carnegie Foundation will tend not only to open up new positions for younger men, but also to make college and university positions more attractive.

From such considerations, we need not hesitate to encourage the exceptional man whose tastes lead him in that direction to enter zoology as a profession, with the well grounded hope of attaining such a position as his talents deserve.

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THE CHEMICAL EDUCATION OF THE ENGINEER[1]

The academic education of the civil engineer is a thing of yesterday; or rather, it is a thing of to-day. Yesterday it was not. I use the word, "civil" in its original sense. Balbus was, without doubt, a military engineer. The great roads of antiquity were built by soldiers. In the Motherland, yours and mine, there were no roads till the Roman legions made them. On this continent, the canoe and the blazed trail were sufficient till Braddock's three hundred axemen hewed their way through the forest from the sea to Fort Duquesne, and our Governor Simcoe connected Lake Ontario with the lake that bears his name by the military road which, in imitation of the old Roman Watling Street, he called, as we call it still—Yonge Street.

But steam changed all this. With steam came railways; and with railways came the civil and the mechanical engineer, and to them has been added, in our own day, the electrical engineer. At first, the civil and the mechanical engineer learned their trade, like everybody else in those days, by apprenticeship. They learned to play the fiddle by playing the fiddle, without any lectures on the physical and the physiological bases of harmony or any exercises "zur Fingerfertigkeit." And grand musicians they were, those old masters who wrote their opera on staves of iron ruled across two continents; whose treble was the shriek of the locomotive, and whose bass was the roar of the blast furnace, whose choruses were sung by the toilers of the nations, and whose libretto was the record of the world's progress.

It is a truism that genius often gains its end by bursting barriers and breaking rules. But for all that, we have come to think that education will not hinder the genius, and will surely help the engineer.

It is noteworthy that France, where one word stands for both genius and engineering, led the way in this matter. Engineering education dates from the foundation of the École des Ponts et Chausées. Germany followed; then America, like one born out of due time, but now become the greatest of the Apostles. Nay, at last, even my countrymen, clothed as they are with a contempt for theory which throws off the undulations of the intellectual ether more completely than polished nickel, backed by a conservatism more impermeable than infusorial earth, even Englishmen are giving signs of viscosity; and British public opinion is flowing forward with a motion like that of a glacier, slow, indeed, but sure and irresistible.

We agree then that the engineer shall be educated. But shall chemistry form one of the subjects of his education? Assuredly yes. For what is an engineer? He is a man who devises and supervises the construction and use of engines—contrivances—that is, for yoking the forces of nature to the service of man; and what are chemistry and physics but the ordered and methodical study of these forces and of their action on the materials of which machines are constructed and upon which they work.

I am speaking to-day as a chemist to chemists, and it is safe to say that we are all pretty well agreed as to the kind of teaching that is best for the professional chemist, whether his career is to be technical or academic.

[1] Read at the Chicago meeting of the American Chemical Society.

So, too, there are certain sufficiently obvious considerations which would guide us in shaping a chemical course for a mining engineer. Chemistry is chemistry even if you call it metallurgy and assaying; and those of us who have helped to frame a curriculum in chemical engineering know that the great problem is to keep the engineering twin from smothering his chemical brother.

About all this a great deal has been written and a great deal has been said, and we are, I think, most of us, so far, in substantial agreement.

But what about the chemical education of the civil and mechanical engineer? We may at once admit that chemical problems form but a small proportion of those which confront him. It is true that the combustion of fuel, the incrustation of boilers, and the rusting of metals, the preservation of timber, the setting of cement, the action of explosives, all involve questions of chemistry, and their consideration forms part of the daily work of the engineer. But in many such cases he can accept the results of previous investigations without troubling himself about the way they were obtained, and in others he can call in the chemist to his aid. The engineer is not a chemist, and for him chemistry must be reckoned as one of his "culture subjects." It is exactly here that the difficulty of the teacher begins. He is called upon to teach chemistry to boys who are not going to be chemists, who have no wish to become chemists and who ought not to be encouraged to think that they are being made chemists.

On the one hand, he must make his subject sufficiently interesting to attract to it a due share of that energy upon which there are so many other and, in the student's judgment, more pressing calls; and, on the other hand, he must not lead the student to suppose that, after attending a few lectures and performing a few laboratory experiments, he will be able to pose as a chemical expert.

This is a real difficulty; and it is all the greater because chemistry is looked upon by the public as a utilitarian subject—a study which is supposed to have, as of course it has, a practical bearing upon daily life.

One of my teachers used to illustrate to his class the value of the study of mineralogy by saying to them: "Suppose a farmer brought you a bit of hard yellow mineral and said to you: 'Sir, what is this? You have attended a course of lectures on mineralogy, can you tell me if it is any good? It occurs in great abundance on my farm. Is it gold or what is it?' " And he went on to show how, with the aid of a watch glass, the student could dissipate the golden dreams of the credulous husbandman.

One of my colleagues, who is a graduate of Oxford, somewhat grudgingly admitted that it was desirable, in a new country such as Canada, that a young man should learn chemistry, because he might through its aid discover a silver mine.

The notion that chemistry is a study which has a high value as a mental training, as a means of broadening and deepening the mental outlook—in a word, as a means of culture on a par with mathematics and languages and history—is still very far from the point of view of the man in the street.

Now, the undergraduate is the son of the man in the street; and he brings to college his father's point of view, his father's prejudices, and his father's limitations—together with a cocksurety that is all his own.

Our first task then is to give the young engineer the chemist's point of view. Our point of view is ever changing, and our view of truth changes with it and is always incomplete. It is the tangent to the curve that represents the evolution of our knowledge of the truth, and it coincides with that curve only at that infinitesimal interval of time that we call now. As we look into the future, it diverges more and more widely from the truth, and we can only keep in the true path by continually shifting our view-point and continually changing our views. This is the first thing we should teach our students. But our present view of the truth, though certainly incomplete, is not necessarily false. If our data are reliable, if our measurements are accurate, if our calculations are correct, it does really represent the facts as we now know them. It is real knowledge. It will become out of date with the lapse of time, but it will not be contradicted; it will not be exploded. This is the next thing to be taught. The recognition of these two cardinal principles constitutes the scientific habit of mind. This is essentially the difference between the mental attitude of the man of science and that of the man in the street. Our first duty is to impress this way of looking at things on the plastic minds of our pupils, not by precept only, but by example, by illustration, by reiteration till it becomes a part of their nature.

But it is not enough to give a boy the chemist's point of view. We must also try, as far as time and opportunity allow, to make him see the things the chemist sees. We must get him to look beneath the surface of the forms of matter that surround him and discern, at least in some dim way, the throbbings of the living forces within them and around them.

And here let us beware of serving up knowledge in individual platters. Do not let the student get into his head that there is one chemistry of the metals and another of the non-metals, or that organic chemistry and inorganic chemistry have any real existence except as guide cards in a catalogue.

The student's time is so short and so crowded with other studies that only a few types can be chosen. But let those types be selected so as to cover, as far as may be, the whole field; let them be as typical as possible, and make the student understand that they are types. Thanks to the great Russian Pilot, this is an easy task now in comparison with what it used to be in the days when some of us launched our bark on the yet uncharted sea.

Above all things, let us see to it that the student never for one moment flatters himself with the notion that what we require him to know is all there is of chemistry that is worth knowing! Let us make it abundantly clear to him that we are only teaching him to read the language of chemistry and that the selections we set before him are only exercises in translation—not a corpus poetarum.

When I speak of teaching the student to read the language of chemistry, I am using no empty metaphor. This is the kernel of the whole matter. What we have to do is just this—to teach him to *read* chemistry; to interpret chemical phrases; to give him clear notions as to the meaning of the conventions by which the chemist expresses his ideas.

This, as I have said before, is mental training of a high order. But it is more than that. The utilitarian side of the question must not be overlooked any more than the cultural aspect. The time will come, sooner or later, when the engineer will want to find out what is known about the chemistry of some subject in which he is interested. Very likely his need will be urgent; it is certain his time will be scant. If he has had the education I speak of, he will know where to look for information; and he can use it when he finds it. If he meets a phrase he can not construe, he will know how to use his dictionary. A statement couched in chemical language, or symbols, will not make him shut the book like a nineteenth-century chemist confronted with a sign of integration.

Nothing will arouse and retain the student's interest so effectually as frequent references to those points of contact between theory and practise, where the abstractions we are trying to teach him become concrete in the problems he will have to face.

And here let me say what I have hinted before, that it is a mistake, I am sure, to keep organic chemistry a sealed book to the engineer. If we consider the various applications of chemistry to daily life and to industry, it is surprising to note how many of them are concerned with the chemistry of the carbon compounds. Fuel, explosives, sanitation, the decay and preservation of timber, pigments, oils, paper, textile industry, fermentation, the preparation and preservation of food, all have to do with organic chemistry. Let any one read a list of patents, or the classification of abstracts in the *Journal of the Society of Chemical Industry,* and this will be made abundantly clear.

It may be objected that in the time at his disposal the student can only acquire a smattering of this great subject, and that such a smattering is worse than useless. I readily grant the first contention, but I emphatically deny the second. If by the abusive term "smattering" we mean a little knowledge, then that smattering is dangerous only when it carries with it unconsciousness of its own littleness, and I hope I have made myself sufficiently clear as to the importance of keeping always before the student his own limitations.

The cure for superficiality, that bugbear of the pedant, is not to blindfold the eyes, but to train the eyesight, and the student whose mental vision is thus sharpened will not only be able to see clearly the things that lie before him and about him on the threshold of our science, but he it is who will most readily discern the vastness and the richness of the territory at whose frontier he stands; and he who will most humbly and most surely walk in any of its paths along which his business or his pleasure calls him.

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SCIENTIFIC BOOKS

The Integrative Action of the Nervous System. By CHARLES S. SHERRINGTON. New York, Charles Scribner's Sons. 1906. Pp. xvii + 411. $3.50.

This volume contains the Silliman Memorial Lectures delivered at Yale University in 1904. In it the author focuses the work which he has carried on with such assiduity on the functions of the central nervous system considered as an organ for coordination. This side of nervous physiology has perhaps received less attention of late than the study of the activities of the individual nerve fiber or cell; though, to be sure, the author is able to refer to a long list of fellow workers, brought together into a valuable bibliography, among whom the most prominent are perhaps Exner and Goltz. It may, however, be safely said that the author's own contributions, in range and precision, now entitle him to rank at the head of students of this phase of the subject. The function of nervous tissue is, in a word, to conduct, and so to integrate—to enable the organism, in reacting on its environment, to act as a harmonious whole. To understand this function, one must, of course, penetrate the mystery of nerve conduction; but besides, and to some extent independent of that, one must know what are the paths of conduction and how they are interrelated. The present work is not concerned specially with topography, but with the general facts of the interrelation of nerve paths.

The unit of coordination is the simple reflex, though this is itself an artificially simplified unit, "because all parts of the nervous system are connected together and no part of it is probably ever capable of reaction without affecting and being affected by various other parts." Nor does there exist, normally, such a thing as a resting condition, but every reflex supervenes upon a previous condition of reflex activity, and the modifications which it produces in that condition, by reinforcement and inhibition, are part and parcel of itself. The only adequate picture is that of a total reflex "pattern," which may analytically, though somewhat artificially, be considered as made up of a combination of simple reflexes, and which, in response to a stimulus, gives way to a new reflex pattern.

The simple reflex results from the joint action of three organs, the receptor or sense organ, the conductor, and the effector organ, which last is usually composed of muscular or glandular tissue. Regarding the receptor, it may be said that its function is to lower the threshold for a particular sort of stimulus—mechanical, chemical, photic—while simultaneously raising the threshold for other stimuli, so as to make possible different reactions to different classes of stimuli. The "pain" end organs form an exception to this rule, in that they are not specially adapted to any one physical stimulus, but respond to a stimulus of any sort which threatens injury to the part where the pain organ is located. In regard to the effector organ, it may be noted that it is not usually a single "muscle" in the anatomical sense, but may be either more or less than that.

It is, however, the conductor organ, especially that part of it that lies in the nerve centers, which gives to reflex action most of its variety and peculiarity. The characteristics of reflex conduction are brought out by contrasting it with the simpler conduction that is observed in nerve trunks. No less than eleven points of difference are detailed by the author. Some of these, such as the irreversibility of reflex conduction, as contrasted with the reversibility of conduction in nerve trunks, have long been recognized. The slowness of reflex conduction has also often been emphasized, but the author shows that the important difference here is rather the great dependence of speed in reflex conduction on the intensity of the stimulus. When the stimulus is strong, the conduction through the centers shows no special slowness, but when the stimulus is weak the reflex may be very much delayed. Again, in contrast with nerve trunks, which cease their activity promptly on the cessation of the stimulus, the reflex shows "after-discharge," which may be very prolonged when the stimulus is intense. The intensity of the reflex discharge is less closely dependent on the intensity of the stimulus than in the case of the nerve trunk or the muscle. The intensity of reaction of the nerve trunk is a continuous, and almost mathematical function of the intensity of the stimulus; but while something much like this may be said of some reflexes, in others the reaction remains practically constant for all intensities of the stimulus which are strong enough to elicit the reflex at all, and in still others the intensity of reaction remains constant for a considerable range of stimulus, only to make a sudden jump at a certain critical intensity. The threshold value for an effective stimulus is also much more variable in the reflex, since the internal condition of the reflex arc, as dependent on other simultaneous or preceding stimuli, is much more variable than that of the nerve trunk. Summation of subliminal stimuli is in the reflex arc much more likely than in the nerve trunk to produce a response; some reflexes can scarcely be elicited by a single momentary stimulus. When the stimulus is repeated, the rhythm of response in the nerve trunk follows closely that of the stimulus; whereas reflexes are apt to have a rhythm of their own, which is very slightly if at all controlled by that of the stimulus. The rhythm of different reflexes differs; in some it is as high as 12 per second; while in the dog's scratching reflex it is from 5 to 6, and in the "crossed stepping reflex" as low as

2.3 per second; and some reflexes consist of a single indivisible discharge. The rhythm of reflex discharge may be conceived as dependent on a "refractory phase" somewhere in the arc, similar in a broad way to the refractory phase of the heart. Whereas the refractory phase of a nerve trunk is not longer than .001 second, that of reflex discharge, varying in different reflexes, sometimes reaches as high as a second. The author has studied in a penetrating way the question of the seat of the refractory phase in the reflex arc. He shows that it can not lie in the muscle or motor neurone, nor in the sense organ or sensory neurone. It must lie in the central distributing and coordinating neurones, each of which has a refractory phase adapted in duration to the particular use of its reflex. Dependent on the central neurones is also the inhibition of muscular activity opposed to the reflex. As compared with the nerve trunk, the reflex arc is also much more susceptible to fatigue, shock, deprivation of oxygen, and the action of anesthetics. It is interesting to observe that the author inclines to attribute all these peculiarities to the synapse or surface of separation between connecting neurones, and that he is favorable to their explanation by the physical properties of such a surface of separation, with its well-known power to produce partial, selective and polarized osmosis, and to restrict the movement of ions.

Passing from the simple reflex to the combination and coordination of reflexes, the author emphasizes first of all the principle of the "common path." Reflex arcs which start at different parts of the skin or other sense organs may converge so as to act on the same muscle or group of muscles. Thus, for example, the flexors of the joints of the hind limb can be aroused by stimulating almost any point on the skin of that limb, as well as from certain other parts of the surface and interior of the body. More than this, the same muscles are called into play in other reflexes, such as the scratching or the stepping reflexes, in which the time relations differ from those seen in the flexion reflex. It appears that the muscles, and with them the motor neurones which directly control them, can be aroused from various sources, and in ways that differ to a greater or less extent. The motor neurone, extending from the cord to the muscles, is therefore a common path, forming part of many reflex arcs. This fact is important in understanding coordination. There are reflexes which use the same muscles in the same way; they may be called allied reflexes. As they can make simultaneous use of the same muscles without interfering in any way with each other, they tend to reinforce each other. But there are reflexes which make use of a given set of muscles in ways that are incompatible with each other; one may require the inhibition of activity where the other requires the activity, or they both require activity, but in differing intensity or duration or rhythm. Such opposed reflexes could not, and do not, have simultaneous use of the same muscles. When the final path is open to one of them, it is closed to the other. And it is closed absolutely. If the stimuli appropriate to two antagonistic reflexes are simultaneously applied, one or the other appears, but never a compromise or average of the two, which would indeed be a useless reaction. If during the progress of one reflex the stimulus to another is applied, it may cause a cessation of the first and its replacement by the second, but the transition is abrupt; the first does not shade off into the second. If a stimulus, at first weak and arousing a local reflex, is gradually increased in intensity, the reflex tends to spread to other muscles and other members, but all the components so added to the original focal reflex are allied. The total reflex pattern at any moment—except for reflexes neutral to each other and without influence on each other, which may coexist to a very limited extent—may thus be analyzed into a combination of allied simple reflexes.

In the *succession* of reflexes quite a different principle comes into play, for it is commonly true that a reflex is followed by an antagonistic reflex. One frequent form of sequence is the return after a reflex to the posture present before the reflex. This posture was itself reflex, and the return to it is by no means a passive movement, but is an active compensatory reaction. Very frequent in the spinal as well as in the intact animal are alternating reflexes, as stepping, scratching, etc. One of the most important original contributions of the author is the discovery of "successive spinal induction." A reflex which has been just preceded by an antagonistic reflex is found to be more readily excited than usual and to have greater energy. Inhibition of a reflex is "followed by a rebound to superactivity." As is the case in the heart muscle, so also in the spinal cord, the period of inhibition is not simply equivalent to a period of rest, but the activity of a reflex after active inhibition is greater than after repose. This fact has much to do with the orderly and adaptive sequence of an animal's movements.

Since it seldom happens that an animal is subjected to only one stimulus at a time, there is usually a competition between stimuli for control of the common paths. Prominent among the factors which make for success in this competition is intensity, the more intense stimulus having the advantage. But the intensity of the physical stimulus must be considered in connection with its location, for within the "receptive field" of a reflex, the more central portions give the reaction with weaker stimulation than do the more peripheral. Account must also be taken of other simultaneous or immediately preceding stimuli, since simultaneous stimuli that tend to arouse the same reflex, or preceding stimuli that have inhibited it, favor its appearance. The relative fatigue of different reflexes also influences the result of the competition. And, finally, the different *species* of reflexes are elicited with unequal ease. At the bottom of the scale stand the tonic reflexes, which very readily yield to others; and at the top, easiest to arouse, stand the reactions to injurious ("painful") stimuli, or to other stimuli which, considered from the point of view of sensation, have a strong affective tone.

In the chapters devoted to the brain, we find, besides the author's revision of the motor area, which is by now familiar, the observation that cortically originating movements are related in the same ways as spinal reflexes, being mutually allied, antagonistic or neutral. From the cortex, as in reflex excitation, the same stimulus which arouses a movement inhibits the opposing muscles. Also, the species of movements which can most easily be aroused by reflex paths can likewise be most easily aroused from the cortex, while such as can not be easily aroused reflexly are also very difficult of access by cortical stimulation. Flexions are in general easily aroused, extensions with difficulty. This does not mean that the "cortex is in touch with the flexors alone and not with the extensors. It means that the usual effect of the cortex on these latter is *inhibition*." The muscles of the body are not all on a par as regards reaction to stimuli, but may be broadly grouped into two systems, a *tonic* system, in which the extensors of the limbs are prominent, and a *phasic* system, in which the flexors are prominent. The muscles of the tonic system are usually kept in a condition of feeble tonic contraction, by means of which the posture of the animal is maintained. The phasic system responds to intercurrent stimuli; the posture is abandoned, inhibited, and a brief reaction, the first step in which is usually flexion, occurs, after which a compensatory movement brings back the previous posture. The stimuli which bring about tonus originate largely in the interior of the limbs and in the otic labyrinth. This system of sense organs is excited by mechanical means, especially by movements and tensions resulting from the contractions of the muscles and the movements and positions of the body. The chief center of this system, or, as we may call it in terms derived from the segmental conception of the nervous system, the ganglion of the system, is in the neighborhood of the principal sense organ belonging to it; this ganglion is the cerebellum. The cerebrum, similarly, may be considered as the ganglion of the great sense organs of the head, which have as their peculiar function the receiving of stimuli from a distance. It is because they receive stimuli from and make possible reactions to a wider environment that these sense organs of the head dominate the whole system of phasic reactions; it is for the same reason that the cerebrum is dominant.

Bringing as it does the methods of minute and continued observation and of close reasoning into a field where the casual has been the rule, the book deserves, and requires as well, attentive study. Its importance to the physiologist is evident. The physician will find a number of special topics, such as the nervous symptoms of strychnin poisoning, of tetanus, and of shock, made the subject of careful investigation. The psychologist also will find a number of points of special interest, such as a study of certain fundamental aspects of binocular vision, an experimental test of the James-Lange theory of the emotions, and suggestive analogies between certain laws of spinal reflexes, such as reciprocal inhibition and successive induction, and familiar facts of attention and of sensation.

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SCIENTIFIC JOURNALS AND ARTICLES

THE contents of the June number of *The American Journal of Science* are as follows: "Determination of the Molecular Weight of Radium Emanation by the Comparison of its Rate of Diffusion with that of Mercury Vapor," by P. B. Perkins; "Paleozoic Formations in Trans-Pecos, Texas," by G. B. Richardson; "Rectification Effect in a Vacuum Tube," by H. A. Perkins; "Life of Radium," by B. B. Boltwood; "New Occurrence of Proustite and Argentite," by F. R. Van Horn; "Occurrence of Gedrite in Canada," by N. N. Evans and J. A. Bancroft; "Iodometric Determination of Arsenic and Antimony Associated with Copper," by F. H. Heath.

THE editors of *The Botanical Gazette* announce that the price is to be advanced from $5.00 to $7.00 a year on July 1, 1908. They say: "You will easily realize that the financing of *The Botanical Gazette* has always been a problem, and you will not be surprised to hear that the University of Chicago has been obliged to contribute about $2,000 annually toward its support. It is not probable that the amount of this subsidy can be increased in the future, and at the same time the cost of production has been growing greater year by year. An interesting comparison has been instituted between *The Botanical Gazette* on the one hand and five leading botanical journals of Europe on the other in the matter of size and prices. It appears that on the average these journals give their readers 648 pages a year each, 12 plates, and 122 text figures, and the average price is $6.50. The *Botanical Gazette* on the other hand gives 945 pages, 45 plates, and 182 text figures, and its subscription price has been $5.00 in spite of the greater cost of manufacture in this country. The advice of numerous botanists has been sought and freely given, and with great unanimity their opinion favors the maintenance of the present standard of size with an increased subscription price; for it seems evident that the pressure of publication is increasing rather than diminishing. In view of the whole situation, it has been decided to increase the annual subscription to $7.00, in the belief that this represents a fair charge for the service rendered. The new rate will be applied to subscriptions begun or renewed with the July number, 1908, and thereafter."

SOCIETIES AND ACADEMIES

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-third regular meeting of the Chicago Section of the American Mathematical Society was held at the University of Chicago, on Friday and Saturday, April 17–18, 1908.

Professor G. A. Miller, vice-president of the society and chairman of the section, presided at all of the sessions. In opening the meeting he referred to the great loss of the society in the recent death of Professor Heinrich Maschke and appointed a committee, consisting of Professors E. B. Van Vleck, Alexander

Ziwet and H. E. Slaught, who presented the following resolutions on behalf of the section:

Whereas, in the death of Professor Heinrich Maschke the Chicago Section of the American Mathematical Society suffers the loss of one of its most honored, influential and beloved members, your committee on behalf of the section hereby expresses its deep appreciation of his services and character.

From the first organization of the Chicago Section until the present session Professor Maschke has been one of its most active and inspiring members. By his genial qualities, his unusual sympathy as a teacher, his integrity and intellectual honesty, he has won and held the affection of those who have known him. By his ability as an investigator he has contributed greatly to the development of productive mathematical scholarship in the formative period of the society, and in his own person he has exemplified the influence of German scholarship which has contributed so potently to this development. In the death of Professor Maschke the section for the first time feels the loss of one of its leaders.

The following papers were read before the section:

Dr. C. H. Sisam: "On a locus determined by concurrent tangents."

Professor W. B. Ford: "On the integration of the equation

$a_0(x)u(x+2)+a_1(x)u(x+1)+a_2(x)u(x) = 0$."

Professor D. R. Curtiss: "On the real branches of implicit functions in the neighborhood of multiple points."

Mr. L. L. Dines: "A method of investigating numbers of the forms $6^\kappa \cdot s \pm 1$."

Professor L. E. Dickson: "Criteria for the irreducibility of a reciprocal equation."

Professor L. E. Dickson: "On reciprocal abelian equations."

Professor L. E. Dickson: "On the congruence $x^n + y^n + z^n \equiv 0 \pmod{p}$."

Professor Jacob Westlund: "Note on the equation $x^n + y^n = nz^n$."

Mr. F. H. Hodge and Mr. E. J. Moulton: "On certain characteristics of orbits for a general central force."

Professor G. A. Miller: "The central of a group."

Dr. A. E. Young: "On the problem of the spherical representation and the characteristic equations of certain classes of surfaces."

Dr. A. C. Lunn: "A continuous group related to von Seidel's optical theory."

Dr. A. C. Lunn: "A minimal property of simple harmonic motion."

Dr. A. C. Lunn: "The deduction of the electrostatic equations by the calculus of variations."

Mr. A. R. Schweitzer: "Remark on Enriques' review of the foundations of geometry."

Mr. A. R. Schweitzer: "On the calculi of relations, classes and operations."

Professor E. J. Wilczynski: "Projective differential geometry of curved surfaces, fourth memoir."

Dr. G. D. Birkhoff: "Irregular integrals of ordinary linear differential equations."

Professor R. D. Carmichael: "On the general tangent to plane curves."

Professor R. D. Carmichael: "On plane algebraic curves symmetrical with respect to each of two rectangular axes."

Professor O. D. Kellogg: "Note on the geometry of continuously turning curves."

Dr. I. Schur: "Beiträge zur Theorie der Gruppen linearer homogener Substitutionen."

Mr. W. D. MacMillan: "On the character of the solutions of homogeneous linear equations with periodic coefficients."

Mr. A. R. Schweitzer: "On the quaternion as an operator in Grassman's extensive algebra."

The next meeting of the section will occur in December, 1908.

H. E. Slaught,
Secretary of the Section

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY

In conjunction with the American Ethnological Society, a meeting was held on March 23, at the American Museum of Natural History.

Professor Arthur O. Lovejoy spoke on "Fire Cults: their Distribution and Characteristic Features, with a Hypothesis Respecting their Origin and Meaning." While the most wide-spread of the observances relating to the sacred fire is the custom of maintaining, either upon the domestic hearth or in a communal shrine, a fire that, except upon periodic ceremonial occasions, is never permitted to go out—a practise which by itself might be regarded as a mere convenience or necessity, invested in the course of time with supernatural or magical import—there are other fire-observances, occurring usually among the same peoples, which also have a bearing on the significance of the fire-cult. Especially significant is the annual or cyclic ceremony of extinguishing the old fire and kindling new by some archaic method, as the central and most solemn rite in the transition to a new year—*e. g.*, at the planting of the first seed or the first eating of the new crop (Rome, Celtic Ireland, Eskimos, Iroquois, Muskoki, Aztecs, Ouichuas and others). Widely diffused are also the customs of passing new-born children over or around the fire (*cf.* Greek myths of children rendered immortal by this means); of leaping through fires at certain seasonal festivals, as the Roman Palilia, the Johannisfeuer celebrations, etc.; of employing fire as a fertility charm for crops and herds; of celebrating essential parts of the marriage ceremony before the household fire; of using fire in initiation rites. An analysis of these observances and a consideration of the reasons actually given for certain of them by Iroquois and Maori makes it probable that the sacred fire was by many races conceived, not as a practical convenience, nor as an unmotivated ancient custom, nor as a device for frightening away demons, nor as a negative purifying agency merely, but as a vehicle of life force or magical energy—*manitou, wakonda* or *mana;* that the health and prosperity of the household or tribe were believed to depend in part on the fire's perpetuity, vitality and purity; and that the fire, like all natural forces, was thought of as subject to periodicity, to a tendency to grow old and weak, and accordingly as in need of periodic renewal.

In a paper on "The Psychology of Dreams," Dr. Robert H. Lowie called attention to the services which scientific dream psychology can render to the ethnologist. A knowledge of the investigations carried on in this field will enable him to view critically the plausible but inaccurate dicta of popular psychology. Knowing, for example, the theory of dreams advanced by Delage, the ethnologist will not naïvely accept the assumption of Wundt and Radestock that dreams of recently deceased relatives have largely influenced the development of belief in a hereafter. A positive benefit is derived when mythological figures of obscure origin, such as dwarfs, gorgons, etc., are derived from the distorted images of some dreams—Wundt's Fratzenträume—as a conceivable source. From a purely psychological point of view, the speaker urged the desirability of fuller dream-records, especially in regard to varieties of hypnagogic experience.

R. S. WOODWORTH,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 203d meeting of the society, on March 25, 1908, Mr. Willis T. Lee spoke informally regarding the "Local Upturning Sedimentary Rocks at their Outcrop." Grand Mesa in western Colorado rises 5,000 feet or more above the general surface to the south and west, and is surrounded by a steep escarpment. The general dip of the beds is 2.5°, but where they crop out in the sides of the mesa for a distance of 75 miles or more, the dip is often 5° to 8° or more. It is usually greatest in the projecting points and becomes less inward or toward the mesa, flattening to the general inclination of 2.5° within a distance varying from a few hundred feet to a quarter of a mile.

The upturned parts may represent the bases of eroded anticlines, monoclines or domes, but this suggestion is apparently invalidated by the occurrence of dip only toward the mesa and practically at right angles to the outcrop; or the phenomenon may be due to weathering of the exposed sediments combined with relief of pressure as the superincumbent rocks were eroded away. This finds support in the observation that the rocks are often most steeply upturned in the projecting points of the cliffs. On the other hand, it is not certain that relief of pressure would have any influence on the inelastic rocks, or that the shales underlying the beds in which the upturning is most conspicuous would expand on exposure to the weather. It is probable that hydration and carbonation of the rocks may account for the upturning.

Mr. D. B. Sterrett described the discovery of meerschaum in New Mexico, which is of interest since the world's supply, coming chiefly from Asia Minor, scarcely meets the demand. A chemical analysis, by Mr. George Steiger, of material from the Dorsey claim, twelve miles northwest of Silver City, corresponds very closely with the composition required by the formula generally given for meerschaum, that is, $2H_2O + 2MgO + 3SiO_2$. The mineral occurs in fissures, joints and seams in a magnesian limestone formation, probably of Ordovician age. Two varieties were observed, massive and nodular meerschaum. Only surface material was available for examination. This possessed many of the properties of ordinary meerschaum, including the important one of absorbing a mixture of wax and nicotine. On the other hand, the majority of the specimens examined were heavier than meerschaum ordinarily used for carving, and some of them contained tufts of fibrous material which made it difficult to work and polish.

Regular Program

The Intrusive Rocks of Mt. Bohemia, Michigan: Mr. Fred. Eugene Wright.

Mt. Bohemia is located near the end of Keweenaw Point, Michigan, and consists in large part of lava flows and interbedded conglomerates of the Keweenaw formation. On its south flank a peculiar intrusive rock mass is exposed which is unique in character and has long attracted the attention of geologists. Two rock types occur within this intrusive body—a dark, granitoid rock consisting chiefly of red, idiomorphic oligoclase (Ab_9An_2), pyroxene and magnetite in such proportions that chemically the rock is practically identical with the Keweenaw ophites. This rock was originally called *orthoclase gabbro* by Irving in his monograph on the copper-bearing rocks of the Lake Superior region, but the name *oligoclase gabbro* seems preferable in view of the fact that practically no free orthoclase is present in the rock. The second rock type is entirely surrounded by the first, and is brick red in color; qualitatively it consists of minerals identical with those of the enclosing oligoclase gabbro, its essential constituents being quartz and red idiomorphic oligoclase with subordinate amounts of the colored constituents. The alteration of the different constituents in the two rock types is characteristic and in every way similar, and substantiates the inference that they are genetically closely related, and that the red rock is an aplitic phase of the oligoclase gabbro. It may, therefore, be termed *gabbro aplite.* The position of the two rocks in the quantitative classification of Cross, Iddings, Pirsson and Washington is: for the oligoclase gabbro, Class III., Order 5, Rang 4, Subrang 3; in short, *Bohemial Auvergnose;* for the gabbro aplite, Class II., Order 4, Rang 3, Subrang 4 (*Bohemial Tonalose*). The geologic relations of the two rocks were discussed in detail with a view to a possible eutectic relation of the constitutents in the aplite which would then be the last to crystallize, and by a process of fractional crystallization be forced toward the center. By actual experiment, however, it was found that, on heating powder of both rocks in an electric resistance furnace for one hour at 1,132° C., the aplite had just begun to melt, while the oligoclase gabbro had only sintered slightly; while at 1,150°, under the same conditions, both the gabbro aplite and the oligoclase gabbro showed signs of fusion. (These temperature measurements were made by Dr. W. P. White, of the Geophysical Laboratory. His courtesy is herewith gratefully acknowledged.) This temperature range is so slight that the idea of eutectic relations in the dry melt is at least not strongly substantiated by experiment. The objections to any inference which might be drawn from the behavior of rocks of this type in the dry state were pointed out and the means for attacking such problems briefly indicated. The contact relations of the aplite to the oligoclase gabbro (change in granularity, etc.) were also briefly considered, together with the contact metamorphism of the adjacent ophites by the intrusive oligoclase gabbro.

Some Structural Details in the Pittsburg Region: Mr. G. C. Martin. (No abstract furnished.)

The Mapping of Landforms: Mr. F. E. MATTHES.

An attempt is offered in this paper to place the mapping of landforms on a more rational basis than has obtained hitherto, and to establish such fundamental principles as may serve to guide the topographer in the judicious representation of the relief on reduced scales, and thus lead to greater uniformity and consistency of interpretation.

In the first place a thoroughgoing analysis and classification of landforms seems necessary for a general groundwork.

Beginning with the continent as the largest unit landmass, several primary subdivisions of a comprehensive nature—*physiographic provinces*—may first be blocked out. Each of these again may be divided into smaller tracts or *physiographic regions,* each of them a distinct physiographic unit. Thus the entire Appalachian complex, from the New England ranges down to Alabama, may be spoken of as a "province"; each of its subdivisions, like the Alleghany Plateau, the Ridge-and-Valley Belt, or the Piedmont Plateau, on the other hand, as a "region."

The character of the relief of a "region" varies, as a rule, considerably from one part to another, and further subdivision into *topographic districts* suggests itself; each district having a distinct and fairly uniform *topographic character* of its own. "Topographic character" as a specific term, therefore will be used as referring properly to topographic districts. Analyzing now what determines topographic character, we find that three factors enter into it: (1) the vertical measure of the relief, (2) the types of landforms represented, (3) the disposition or manner of assemblage of the topographic units.

For the topographer's purpose it is helpful to resolve the landscape into component landmasses each of which may be considered by itself as a topographic entity or unit. Thus each mountain, spur, ridge, hill, mesa, terrace, cliff, fan, flood-plane, dune, sink, moraine, drumlin, cirque, cone, etc., constitutes a topographic unit. Obviously there are as many different kinds of topographic units as there are types of landforms. Not only, but the units of a given type frequently occur associated in different sizes, and are therefore capable of being further classed by order of magnitude. Thus an entire mountain range, a single mountain on the same, a master spur of the mountain, a small spur of the master spur, a spurlet of the small spur, etc., constitute units of successively lower orders of magnitude, yet all belonging to the same type of stream-carved landforms. The topographic character of a given district then depends largely on the kinds and sizes of topographic units represented within its compass. Contiguous districts, however, characterized by the same topographic types and the same height of relief, may yet differ conspicuously in topographic character because of differences in the disposition of the units. A third factor must therefore be taken into account, namely, the disposition, grouping or manner of assemblage of the topographic units. This concept is covered for stream-dissected districts, by the term "*topographic texture,*" and the same may perhaps with propriety be extended to others not composed of units of stream-dissection, so that it will serve to designate the manner of assemblage of topographic units of *all* types. Thus a number of different textures may be recognized, such as coarse, fine, uniform, irregular, graded, homogeneous, heterogeneous, simple, intricate, linear, trendless, radial, peripheral, etc.

Starting with this classification of landforms and this concept of topographic character as a basis, it is now in order to proceed with the formulating of criteria for the use of the topographic delineator.

From the foregoing it follows at once that a map which aims to give an expressive representation of the relief must satisfy three conditions: (1) it must correctly indicate the measure of the relief; (2) it must faithfully delineate the true character, shape and size of each topographic unit; (3) it must be reliable as to the relative position and orientation of the units, that is, it must show the texture characteristic of each district.

These rules apply to all topographic maps, whatever the scale or the nature of the cartographic device used for the representation of the relief (whether contouring, hachuring or shading).

A number of corollaries follow, a few of which will be cited:

Elimination of units too small for delineation should proceed by order of magnitude. In a consistent map units of a certain order should not appear in one place and be omitted elsewhere.

Elimination of units of one order should not result in the enlargement of those of a higher order. The delineation of the latter, in order to be expressive, should so far as possible *suggest* the presence and character of the detail suppressed.

Consecutive reductions in scale should carry with them elimination of correspondingly higher orders of units.

In conclusion, it may be stated that the practical application of these principles by the topographer in the field proves to lead to no revolutionary changes in mapping methods, but on the contrary confirms the soundness of the practise, intuitively established though it may be, for the most part, of our ablest modern cartographers.

Ralph Arnold,
Secretary

DISCUSSION AND CORRESPONDENCE

GEOLOGICAL CLIMATES

To the Editor of Science: Dr. Lane, in his interesting paper published in Science for April 10, urges certain readers not to accept my "*ipse dixit*" but rather to await further promised demonstration.

With the added evidence given in the last issue of Science (pp. 784–5) it seems hardly necessary to point out that, so far as theories relating to terrestrial phenomena are concerned, it now rests solely with the scientists to demonstrate, if possible, that some vital flaw exists in my published work; so long as this can not be done, "most modern theories of geological climate" must certainly be regarded as "upset," *for these theories are based upon an adopted value for the temperature of space which is* (according to my demonstration) *too great by nearly three hundred degrees of the centigrade scale* at the earth's distance from the sun; and this result is practically independent of the errors of observation, for even if we should assume the measured focal temperature to be one thousand degrees in error, the provisional value (1°.5) for the temperature of space would be altered only a degree or so.

My result for the absolute temperature of space is not a speculative one; until it is proved incorrect it must stand as a demonstrated fact which is in no way dependent on other demonstrations to be given "later on."

It may not be out of place to remark that by attaching too much importance to the occasionally unguarded assertions of great authorities we are apt to retard, or to discourage, original work along lines still demanding rigid investigation. That a purely empirical formula like Stefan's should, by common consent, be honored to the extent of being called a "law," is misleading; that one of our great living authorities should refer to "The establishment of Stefan's law"[1] is still more misleading.

For myself, the most remarkable feature of this whole controversy is the fact that it has escaped the attention of scientists that, on purely theoretical grounds, the results deduced with the aid of Stefan's formula (or any other formula except the Newtonian) can not be in agreement with the principle of the conservation of energy.

J. M. Schaeberle

Ann Arbor, Mich.,
May 18, 1908

"AMETHYSTINE BLUE."

To the Editor of Science: On page 825 of Science, May 22, 1908, Professor T. D. A. Cockerell calls attention to the development of the color of amethyst in glass exposed to strong light, and also mentions that this color is discharged by heat.

I am writing this brief note to call attention to the fact that the phenomena mentioned in Professor Cockerell's communication have long been known to chemists, and the explanation of same is very simple, viz., bottle glass is usually made of cheap raw materials;

[1] Science, March 27, p. 503.

and the sand used usually contains more or less iron. During the process of its manufacture the iron enters into the composition of the glass, and if present as a ferrous compound gives to the glass a green color. To dissipate the green color manganese peroxide is added to the melt for the purpose of oxidizing the ferrous iron to the ferric state. Under these conditions if only a small quantity of iron be present the pale yellow of the ferric salt will not be observed; besides, the yellow will be neutralized by the violet of the manganese salt, thereby producing a colorless glass. Now it is well known that glass decolorized with manganese slowly becomes red-violet when long exposed to light, but remains colorless when protected from the light. The phenomenon is merely an instance of chemical action in solid solutions; the effect of heat shows it to be a reversible reaction. The amethystine color is due to the presence of a manganese salt. Light promotes the development of the manganese salt; heat reverses the reaction.

Henry Winston Harper
The University of Texas,
Austin, Texas,
May 25, 1908

To the Editor of Science: Professor Cockerell's note on the coloration of glass, published in Science of May 22d, seems to call for a word of discussion. It is not necessary to go to arid regions to observe the phenomenon. The globes of the street-lamps used in the City of Philadelphia, colorless when first put up, become in the course of two or three months distinctly violet, and in a year very strongly so. That the effect is the direct result of exposure to sunlight is proved by the fact that those surrounded by trees require a much longer time for the appearance of the color.

As to recent literature on the subject, five or six extensive papers, as well as several brief notes, have appeared within the last three years; it seems unnecessary to give a list of these here, as they are fully recorded by Mr. Ross A. Gortner.[1] The general conclusion from these various studies is that the development of the color is due to the oxidation of the manganese in the glass, although the exact mechanism of the change is not understood. Whether the tints produced in a great variety of substances by exposure to radium preparations are of the same character as those brought about by sunlight and ultraviolet light in glasses has never been definitely ascertained; but it appears more probable that they belong in the class of colloid colors, such as the red of glass containing metallic gold, the blue of sodium chloride heated in sodium vapor, and, possibly, the violet of the amethyst-quartz found in nature.

Edgar T. Wherry
Philadelphia, Pa.

THE ITALIAN ARCHIVES OF BIOLOGY

To the Editor of Science: The publication of the *Archives Italiennes de Biologie*, founded by Professor Mosso, after having reached forty-eight volumes and its twenty-fifth year met with a grave interruption in its career, owing to the strike of the typographers at Turin, and it has been found necessary to make new arrangements for the continuation of the journal. The next number is shortly to be issued under the auspices of the new administration. The publication remains, as in the past, under the direction of Professor Angelo Mosso, with Professor V. Aducco and Professor U. Mosso as coeditors. It will still have the cooperation of biologists in sundry Italian universities. The original articles and summaries published in the *Archives* represent faithfully the progress of biology each year in Italy. The appearance of the journal will be improved, and the editors make an appeal for increased support from America. The publication has acquired a high standing and ought certainly to be among the journals taken by every university in the country. The subscription price is 40 frs. for the two annual volumes. Subscriptions should be sent to the

[1] "Some Effects of Sunlight on Colorless Glass," *American Chemical Journal*, Vol. 39, 1908, 157–162.

Administration des Archives Italiennes de Biologie, Via Acquarone, Genova, Italy.

Charles S. Minot

Harvard Medical School,
May 29, 1908

SPECIAL ARTICLES

AN INTERPRETATION OF ELEMENTARY SPECIES

The original idea which led to the development of the theory of so-called elementary species is found in Darwin's gemmules. Existence of these gemmules was proposed to explain the supposed transmission of acquired characters. Weismann, acting on Darwin's idea as a suggestion, developed a very elaborate theory of heredity. To consider the relation of Weismann's philosophy to the subject in hand would take us too far from our present object, though this relation is important. De Vries, going directly back to Darwin and doing away with that part of Darwin's theory which postulated the migration of gemmules of the various cells of the body to the germ cells and assuming that the germ plasm is composed of these gemmules—or as de Vries calls them, pangens, has developed a very elaborate theory, not only of heredity, but also of evolution, based on the assumption that the individual is merely an assemblage of parts, each of which constitutes an hereditary character and each of which develops from a particular pangens in the original germ plasm of the fertilized egg. He conceives a definite species to be made up of a definite number of these hereditary characters. The addition of a new kind of pangens to the germ plasm causes the developed organism to differ more or less from other individuals which preceded it. If this difference relates to a single pangens, then the new and modified form of the organism is looked upon as an elementary species. It differs from its congeners by an elementary difference. The ordinary species may contain within it a large number of elementary species, each differing from those nearest related to it by the possession of a single pangens not possessed by its nearest relatives.

The work of Nilsson in Europe and of Shull in this country have been considered as strengthening the idea of elementary species. Nilsson has been able to obtain varieties of wheat and other plants that may be assumed to be absolutely uniform except for such differences as are caused by environment. Some of the distinct strains differ very little, but this difference is absolutely constant, and the different individuals within one of the elementary species are as like each other as so-called identical twins. They offer no further chance of improvement by selection. Shull has, in like manner, obtained supposedly elementary species of corn which breed true, the various individuals of a given strain being as much alike as identical twins. He was led to look upon a corn field as simply a heterogeneous collection of these elementary species and hybrids between them.

These so-called elementary species can easily be accounted for on the old Darwinian idea of gradual evolution, as will be shown below. They are, therefore, in no wise a confirmation of the pangens theory of de Vries. The demonstration is as follows: Let A, Table I., represent a Mendelian character which is more or less variable in the different individuals in which it appears, these differences being hereditary. Let B and C represent other Mendelian characters similarly variable. The variations in these characters may have come about gradually, as Darwin supposed variation to occur, or they may have come about in any other manner. Suppose A^1 represents the first character as it appears in a particular homozygous individual. A^2 may represent this same character in another homozygous individual, the difference between A^1 and A^2 being so slight as not to be certainly discernible. In like manner A^3 differs from A^2 so slightly that the two can not be certainly distinguished, but A^3 differs from A^1 sufficiently to be distinguished. So with the other A's. Any one of them in the series from A^1 to A^{10} differs so slightly from adjacent A's as not to be certainly distinguishable from them, but may be distinguished with more and more certainty as we recede from the selected A in the series. The exponents of B and C have a similar meaning. While we have assumed the series A^1 to A^{10} to be continuous, this series may have gaps in it not bridged over by *living* intermediate forms. Each of these "allelomorphs" is supposed to be phylogenetically related to the others in the same series, and the differences between them may be supposed to be analogous to the differences between the individuals of a large and variable species. We have merely taken the case in which the series is continuous to show that such continuity is consistent with the phenomena under consideration.

TABLE I

A^1	A^2	A^3	A^4	A^5	A^6	A^7	A^8	A^9	A^{10}
B^1	B^2	B^3	B^4	B^5	B^6	B^7	B^8	B^9	B^{10}
C^1	C^2	C^3	C^4	C^5	C^6	C^7	C^8	C^9	C^{10}

TABLE II

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A^1A^5:	A^1	A^1	A^1	A^1	A^5	A^5	A^5	A^5
B^3B^8.	B^3	B^3	B^8	B^8	B^3	B^3	B^8	B^8
C^2C^6:	C^2	C^6	C^2	C^6	C^2	C^6	C^2	C^6

TABLE III

(1) × (1)	A^1A^1,	B^3B^3,	C^2C^2.
(2) × (2)	A^1A^1,	B^3B^3,	C^6C^6.
(3) × (3)	A^1A^1,	B^8B^8,	C^2C^2.
(4) × (4)	A^1A^1,	B^8B^8,	C^6C^6.
(5) × (5)	A^5A^5,	B^3B^3,	C^2C^2.
(6) × (6)	A^5A^5,	B^3B^3,	C^6C^6.
(7) × (7)	A^5A^5,	B^8B^8,	C^2C^2.
(8) × (8)	A^5A^5,	B^8B^8,	C^6C^6.

Under our hypothesis all the various forms of A will be allelomorphic; likewise those of B and those of C. In order to have a concrete case, suppose that the three characters considered are characters of the corn plant. A may govern the length of the tip on the corn husk, the various exponents indicating the relative development of this tip. B may represent breadth of leaf and C length of internode. It is to be understood, of course, that we are referring now only to differences which are hereditary and our exponents refer to degrees of difference which are hereditary. Now let us select an individual corn plant at random from a field. Suppose the gametic constitution of the plant selected is that shown in the first column of Table II. With reference to the length of the husk tip it is heterozygote, one of the allelomorphs tending to produce a very short tip, the other a tip of medium length. With reference to the breadth of leaf, our selected plant is also heterozygote, one of the allelomorphs tending to produce a moderately narrow leaf, the other a moderately wide leaf. With reference to the length of internode, the allelomorph C^2 would correspond to a short internode, while C^6 corresponds to a moderately long one. Now on the well-known behavior of Mendelian character pairs, when our corn plant, after close fertilization, produces reproductive cells, we shall obtain, with reference to the three characters considered, eight types of gametes, as shown in Table II. The fortuitous union of these eight types of gametes produces sixty-four fertilizations, consisting of twenty-seven different types, eight of which are homozygote with reference to each of the characters concerned. These eight homozygote types are shown in Table III. Now, if we neglect any evolutionary changes which may have occurred in each of these hereditary characters during one generation, each of these types shown in Table III. will reproduce so true to type that there will be no variation at all except that due to environment; and we have eight so-called elementary species, each reproducing as true to type as branches from the same twig of an apple tree.

It is very clearly seen that each of these elementary species is merely a cross-section of the real variable species, and that the major part of the variation in a corn field is accounted for simply as a result of the recombination in each generation of Mendelian characters, each of which may vary between wide extremes just as a species varies under the Darwinian theory of evolution. For instance, the first elementary species in Table III. is a cross-section of the species through A^1, B^3 and C^2 of Table I.

By properly selecting the parent plant we could get other so-called elementary species intermediate between any two of those shown in Table III. An interesting example of this arose at the recent meeting of the American Breeders' Association. Dr. Shull reported his work in which he had selected out the elementary species produced by a self-fertilized corn plant. With reference to number of rows of grain on the cob some of the forms he happened to get showed a strong tendency to produce ears with ten rows and others with fourteen rows. None had twelve for their mode, and he had been led to the belief that amongst the elementary species of corn none of them, when purely homozygote, tends to produce twelve rows. Dr. E. M. East, of New Haven, who had done some similar work, had happened to get a cross-section of the species which tended strongly to produce twelve rows and not ten or fourteen, which is just what one would expect if the present view of elementary species is correct.

Under this view, a so-called elementary species is simply a completely homozygous form, which necessarily reproduces itself with almost absolute fidelity. The number of such forms possible in a species depends on the number of independent Mendelian characters present, and the degree of variability of these characters. The various forms under which one of these characters exhibits itself may represent a continuous series such as we have assumed above, or the series may be broken at various points, leaving gaps which are bridged only in the ancestral lines of the allelomorphs having a common descent, just as we find the case to be with large and variable groups of organisms.

It is seen, therefore, that if Darwin's idea of the manner in which evolution occurs is true, then *the results secured by the breeder of so-called elementary species are a necessary result of Mendelian behavior of Darwinian characters.* The remarkable fidelity with which so-called elementary species reproduce themselves is thus seen to be in entire accord with the theory of gradual variation taught by Darwin.

The work of Nilsson, Shull, East and others who have segregated these forms that propagate as true to type from seed as cuttings, is of great importance to biological theory, as well as to the art of the breeder. Nilsson is making commercial use, on a large scale, of the principle involved. Tracy, in breeding seedling varieties of cassava, is doing the same thing on a smaller scale, though his work is only just beginning to show positive results. The seedlings of the cassava plant are ordinarily about as variable as those of the apple. Some three years ago, Professor S. M. Tracy, at the request of the writer, undertook to secure homozygote forms of cassava at Biloxi, Miss. He now has a few varieties nearly completely homozygote, and it is believed that within one or two seasons their culture on a commercial scale will be an accomplished fact. This, it is hoped, will rejuvenate an industry which had died because of the uncertainty of propagating cassava from cuttings.

At least in self-fertilized species, these completely homozygote forms offer splendid material for studying evolutionary changes, and especially for studying those changes induced by change of environment. They should soon become the starting point for some fundamentally important investigations.

W. J. Spillman
U. S. Department of Agriculture

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

KASSNER'S "DAS WETTER"

A very useful little book has just been published by Professor Carl Kassner, observer at the Royal Prussian Meteorological Institute in Berlin, and Privatdocent at the Technische Hochschule in that city ("Das Wetter, und seine Bedeutung für das praktische Leben," 8vo, Leipzig, Quelle und Meyer, 1908, pp. 148). The plan of the volume is rather different from that of other books dealing with the same subject. Its aim is to set forth, for the information of the average reader: (1) The historical development of weather forecasting; (2) the basis of modern weather forecasting and (3) the relations of the weather to the every-day life of man. The section dealing with the historical development of forecasting summarizes briefly the results of Hellmann's investigations into meteorological folk-lore and literature. Special attention may be directed to the third section, which is an innovation in meteorological text-books, dealing with the importance of weather conditions in practical life. Professor Kassner has collected and classified a considerable number of illustrations of the relation of weather conditions to man's life, activities and health. Many of these examples are not new to those who have worked along the same lines, but the collection of such illustrations will make them widely useful. Professor Kassner has given us a book which occupies a unique field. The low price of the volume (1 Mark, 50 pf.) brings it within reach of a large number of persons.

LAKE CHAD—ITS DESICCATION

In a recent address entitled "From the Niger to the Nile" (*Scot. Geogr. Mag.*, Jan., 1908), Lieut. Boyd-Alexander noted the supposed decrease in the area of Lake Chad. It is his opinion that the lake does not alter much in size, and that the supposed greater original area is due partly to inaccurate surveying and partly to the fact that certain villages are several miles distant from the lake, giving the impression that they were formerly on the lake shore. The position of these villages, Lieut. Boyd-Alexander believes, is due to the danger of flooding during the blowing of the Harmattan, which causes the water to flow 600 yards over the land with an ordinary wind, and drives it as far as two miles when the wind is strong. Where there are good banks, and where the water is not influenced by the prevailing winds, there are many villages close to the lake. A chain of islands, once separate and now more or less joined by a marsh, has also given the impression of increasing aridity, but this change may very likely be due to the silting of mud and sand against the obstruction of the islands by the opposing influences of the Yo and the Shari, the two rivers that feed the lake.

A RAILWAY WIND GAUGE

Since September, 1903, a wind-gauge has been set up near Ulverston, in England, to protect trains from risk in crossing a very exposed viaduct. The apparatus is fixed at the west end of the Levens viaduct. Its actuating part consists of two boards, kept in a vertical position by springs, and the movements of which are shown on a chart by means of the customary pen and clockwork appliances. A pen is operated by either board according to the direction of the wind, and for greater exactitude of time, the chart-paper, over sixty-five feet long, is perforated, the holes in the paper corresponding with studs in the clockwork wheel. When the wind pressure reaches 32 pounds to the square foot the spring-boards referred to are adjusted to make an electrical contact, ringing bells in the signal cabins on either side of the viaduct. When this occurs, all trains are detained until the force of the wind moderates. Any such interruption is telegraphed to the superintendent of the line. In February, 1907, a velocity calculated as equivalent to 65 miles an hour was recorded.

THE MOON AND CLOUDS

J. R. Sutton, meteorologist of the De Beers Consolidated Mines, at Kimberley, South Africa, writes "On the Lunar Cloud-Period" in the *Trans. So. Afr. Philos. Soc.*, Vol. XVIII., Part 3, Dec., 1907. The cloud observations at Kimberley have been worked up for eighty-seven lunations, from January 1, 1900, to January 13, 1907. The inference which the author thinks may fairly be drawn from his results seems to be that if the results "do not go far enough to prove that there is a lunar influence over the clouds, they do not prove that there is not. There are, at any rate, a number of interesting coincidences which seem to be worth elucidation."

MOUNTAIN SICKNESS

In a recent paper on "Mountain Sickness and its Probable Causes," by T. G. Longstaff (Spottiswoode and Co.), the author gives abstracts from the accounts of high mountain-climbing expeditions, and includes the experiences of aeronauts during high balloon ascents, the results of experiments in pneumatic chambers, and his own observations. He believes that mountain sickness is produced by (1) mountain lassitude, due to imperfect oxygenation, and (2) by excessive fatigue and exhaustion.

LONDON FOG AND COUNTRY FOG

London fogs are often very thick; very dark, of the "pea-soup" variety; and very "dry." Fogs in the surrounding country at the same time are clean, white and wet. The difference is largely a question of the impurities, the "dust" of various kinds, in the air of the city. In *Symons's Meteorological Magazine* for December, 1907, a recent case of this kind is noted. On November 11, in the evening, there was a thick, dry fog, "with the pungent fumes of oxide of sulphur very noticeable" in London. Fifteen miles out of the city the fog was white and extremely wet.

NOTE

With the present number of Science, the publication of these "Current Notes on Meteorology and Climatology" ceases, so far as the undersigned is concerned. This step has become necessary owing to the increasing pressure of other work whose accomplishment is imperative, and for reasons of health which can not be disregarded.

Since the first publication of these "Notes" on May 1, 1897, they have appeared in 166 numbers of Science, on 721 separate topics. In addition, 19 book reviews and 7 short communications on meteorological subjects have been contributed by the writer during the same period.

If during the past twelve years the undersigned has been able, in some slight way, through these "Notes" to help his fellow workers in meteorology and climatology, and in science generally, to keep up with the more important advances in the science of the earth's atmosphere, he will feel well repaid for his labors. Robert DeC. Ward

Harvard University,
Cambridge, Mass.,
April 27, 1908

LETTERS CONCERNING THE ADMINISTRATION OF SYRACUSE UNIVERSITY

Garrison-on-Hudson, N. Y.,
May 23, 1908.

Chancellor James R. Day,
Syracuse University, Syracuse, N. Y.

Dear Sir: I have received from Dean Kent a statement in regard to his dismissal from Syracuse University. It appears that you are unwilling to give the reasons for this action beyond the statement that he has been a disappointment to the administration and is *non grata* to the chancellor. It is obvious that a dean should work in harmony with the head of a university, and that there should be courtesy and consideration on both sides. If, however, a dean or a professor is placed in a position of subservience to the president, so that he has no freedom or initiative in his own department, or if he may not freely present his views to the president and to his colleagues, then his position is not tolerable, and no man of ability and independence would willingly accept a position in a university in which such conditions obtained. I do not mean to imply that there is such a deplorable state of affairs at Syracuse, but the dismissal of Dean Kent without a full statement of the grounds seems to confirm the reports that I have received from other sources to the effect that the chancellor regards deans and professors as subject to his individual will.

I venture in the interests of higher education to ask: (1) The grounds leading to the dismissal of Dean Kent; (2) Whether it is true, as alleged, that a professor who should show sympathy with Dean Kent would be liable to dismissal, and (3) whether you regard it as proper to dismiss a professor, if such action would not have the approval of his colleagues on the faculty.

I assume that I may print this letter and your reply in Science.

Very truly yours,
J. McK. Cattell

Garrison-on-Hudson, N. Y.,
May 29, 1908.

Chancellor James R. Day,
Syracuse University, Syracuse, N. Y.

Dear Sir: I regret that your reply to my letter may not be printed, as it is a clear statement of the policy of academic administration which obtains widely in this country. I myself believe that this policy—according to which the president has autocratic control, subject only to an absentee board of trustees receiving its information from him alone—is subversive of true university ideals. If all American universities should adopt such methods, we must look elsewhere for our best moral, social and intellectual life. If certain institutions only follow them, they will find it increasingly difficult to fill their chairs with men of the best type and indeed to maintain themselves as universities in the proper sense. You say: "Our professors have nothing to do with the hiring, continuing or dismissing of professors or students." This may be your law and policy, but it is not true as a matter of fact. There is a developing group consciousness among scientific and university men, which will make it difficult to fill properly a chair made vacant by methods that they do not approve.

Very truly yours,
J. McK. Cattell

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

Mr. John D. Rockefeller has offered to give $500,000 for a hospital to be erected in connection with the Rockefeller Institute. It is understood that the necessary endowment will be provided when the hospital is ready. The letter from Mr. John D. Rockefeller, Jr., to Dr. L. Emmet Holt, secretary of the board of directors, is as follows:

Understanding that in the judgment of your board a hospital building is desirable in order to facilitate the work of research for which the institute was founded, my father will provide for the purchase of land and the erection and equipment of a suitable hospital building, whatever amount may be necessary, up to a total of $500,000, payments to be made as the work progresses.

My father thus enlarges the scope and possibilities of the institute in grateful recognition of the services of Dr. Simon Flexner, as director, rendered in those orderly and progressive scientific investigations, which, sanctioned and encouraged by your board, and aided by learned associates and assistants, led him at length to the discovery of a cure for epidemic cerebro-spinal meningitis.

DARWIN CELEBRATION

The American Association for the Advancement of Science will devote one day during convocation week next at Baltimore to the celebration of the centennial of the birth of Charles Darwin (February 12, 1809) and the semicentennial of the publication of the "Origin of Species" (November 24, 1859). The program so far as arranged is as follows:

Introductory remarks by the president of the association, T. C. Chamberlin, University of Chicago.

"Natural Selection from the Standpoint of Zoology," by Edward B. Poulton, Oxford University.

"Natural Selection from the Standpoint of Botany," by John M. Coulter, University of Chicago.

"The Direct Effect of Environment," by D. T. MacDougal, Carnegie Institution of Washington.

"Mutation," by C. B. Davenport, Carnegie Institution of Washington.

"The Behavior of Unit Characters in Heredity," by W. E. Castle, Harvard University.

"The Isolation Factor," by David Starr Jordan, Stanford University.

"Adaptation," by C. H. Eigenmann, Indiana University.

"The Bearing of Recent Cytological Studies on Heredity and Evolution," by E. B. Wilson, Columbia University.

"Evolution and Psychology," by G. Stanley Hall, Clark University.

"Recent Paleontological Evidence of Evolution," by Henry Fairfield Osborn, Columbia University.

In the evening a dinner will be given, after which certain addresses of a more general nature will be given. It is proposed to print these addresses in a volume to appear during the centennial year.

SCIENTIFIC NOTES AND NEWS

At the meeting of the American Medical Association held this week at Chicago the following distinguished foreign men of science are announced to present papers: Dr. A. E. Schaefer, professor of physiology in the University of Edinburgh; Dr. C. E. Beevor, last year president of the London Neurological Society; Dr. E. T. Collins, lecturer on ophthalmology at the Charing Cross Hospital and Medical School; Dr. August Martin, professor of gynecology at Greifswald, and Dr. E. F. Sauerbach, professor of surgery at Marburg.

At the annual meeting of the American Association of Pathologists and Bacteriologists, held in Ann Arbor, Mich., on April 17 and 18, Dr. Harold C. Ernst, of the Harvard Medical School, was elected president.

Columbia University has conferred the degree of doctor of science on Professor Charles F. W. McClure, professor of comparative anatomy at Columbia University.

The Boylston Medical Prize for 1908 has been awarded by Harvard University to Professor James Homer Wright for an essay entitled "The Histogenesis of the Blood-Platelets."

Professor Otto Bütschli, of Heidelberg, and Professor A. G. Nathorst, of Stockholm, have been elected foreign members of the Linnean Society, London.

Dr. W. N. Shaw, F.R.S., has been elected a member of the Athenæum Club for "distinguished eminence in science."

At the annual meeting of the Harvey Society, held May 15, 1908, the following officers were elected for the coming year: *President,* James Ewing; *Vice-president,* Simon Flexner; *Treasurer,* Edward K. Dunham; *Secretary,* F. C. Wood; *Council,* Graham Lusk, S. J. Meltzer, Adolf Meyer. The society adopted a resolution as follows:

Resolved, That, in the desire of Dr. Graham Lusk not to undertake again the duties of president of the Harvey Society, its members express to him their cordial appreciation of the great value of his services to the medical sciences in this country in founding the society, in successfully administering its affairs during its early growth, and in placing it upon a substantial basis. The place now occupied by it abundantly demonstrates the wisdom of Dr. Lusk in organizing a medium of communication between the laboratory and the medical practitioners; and whatever the society shall accomplish in the future will be due in no small part to the worthy example which he has set.

The annual meeting of the International Association of the Marey Institute will be held at Paris on June 8. The following physiologists have undertaken to give demonstrations: Messrs. Barcroft, Bull, Carvallo, Demoor, Grutzner, Hurthle, Lapicque, Nogues, Pachon, Phillippson, Tchiriew, Tissot, Weiss of Koenigsberg, Weiss of Paris, Zwaardemaker.

The Sigma Xi Society, of the University of Chicago, held its regular spring meeting on May 19, 1908. Five new members were admitted to the society. Professor J. U. Nef gave the address of the evening upon "The Chemistry of the Sugars from the Standpoint of Methylene-dissociation."

The eleventh annual meeting of the Medical Library Association was held in the John Crerar Library and the Chicago Public Library on June 1, under the presidency of Dr. George Dock, of the University of Michigan.

Mr. Herbert L. Bridgman represented the United States at the International Polar Congress, which convened at Brussels on May 29.

Dr. C. F. Wahrer was elected president of the Iowa State Medical Society, at the session held at Des Moines on April 22.

Dr. R. P. Hibbard, soil bacteriologist of the Bureau of Plant Industry, has been elected to the position of soil bacteriologist and plant pathologist in the Mississippi State Experiment Station. He will have charge of the new department from June 1.

Dr. Adolph Cluss, professor of agricultural chemistry and technology in the Imperial Agricultural High School of Vienna, Germany, is visiting the colleges of agriculture and experiment stations of the United States.

On May 21, Dr. Alexander Scott gave the first of a course of three lectures at the Royal Institution on "The Chemistry of Photography."

Professor William Arnold Anthony, since 1894 professor of physics and electrical engineering at the Cooper Union, New York, died on May 29, at the age of seventy-three years.

Mr. Francis B. Forbes, author of a work on the flora of China, died in Boston on May 21, at the age of sixty-eight years.

Drs. Raikes and Wray, government medical officers at Singapore, have died of plague contracted while performing a post-mortem examination on a patient who had died while in quarantine.

DR. CHARLES JAMES CULLINGWORTH, an eminent British gynecologist, author, among other works, of a biography of Oliver Wendell Holmes, died on May 11, at the age of sixty-seven years.

THE Rev. Father Eugene Lafont, for many years professor of physical science at St. Xavier's College, in India, has died at the age of seventy-one years.

THE death is also announced of Mr. Caleb Barlow, chief preparator of fossils in the British Museum (Natural History), and of Dr. Gustav Guldberg, professor of anatomy at Christiania.

THE Fifth Pan-American Medical Congress will take place in Guatemala, C. A., this year from August 5 to 8, inclusive.

A BRAZILIAN psychiatrical, neurological and medicolegal society has been organized. Meetings are held monthly at Rio de Janeiro at the National Hospital for the Insane. Professor J. Moreira is the first president of the society.

PROFESSOR A. E. VERRILL, of Yale University, has sold to that university his very valuable collection of marine invertebrates, acquired during his work for the U. S. Fish Commission from 1873 to 1887. The collection is the duplicate of one secured at the same time and since transferred to the National Museum at Washington.

PRESIDENT ROOSEVELT has signed the act providing for an area of twenty square miles in Montana for a range to maintain the American bison. This area the government will buy and fence, while the people are invited to subscribe for the purchase of the animals.

THE act making appropriations for the legislative, executive and judicial expenses of the government for the year ending June 30, 1909, which includes the appropriations for the United States Bureau of Education, provides for an increase of only $1,250 over the amount for the current year. The additional amount includes an increase of $1,000 in the salary of the Commissioner of Education, making it $4,500 per annum; also an increase of $250 in the appropriation for books for the library, current educational periodicals, other current publications, and completing valuable sets of periodicals, making the amount available for such purposes, $500. No appropriation whatsoever was made for the investigation by the Bureau of Education of special educational problems, for which purpose the secretary of the interior strongly requested an appropriation of $40,000.

PRESIDENT ROOSEVELT has suggested to Congress the appropriation of $20,000 for the salaries and expenses of three commissioners and a secretary, who shall for this government inquire into the opium evil. A letter from Secretary Root, accompanying the president's note, suggests that each country which has signified to the United States its willingness to make such an investigation appoint commissioners who shall make inquiries in their own countries. He further proposes that all these commissioners meet at Shanghai, China, on January 1, 1909.

A CONFERENCE of representatives of the United States Department of Agriculture and of the agricultural experiment stations of several states to consider plans for supplying serum for the prevention and treatment of hog cholera was held at Ames, Iowa, on May 28. The department was represented by Secretary of Agriculture James Wilson, Dr. A. D. Melvin, chief of the Bureau of Animal Industry, and Dr. M. Dorset, chief of the biochemic division of that bureau, and invitations have been extended by the department to the experiment stations of a number of states convenient to the place of meeting to send representatives. The conference took place on a farm which has been used by the Bureau of Animal Industry for experimental work with hog cholera for several years.

A REPORT on a study of an unusual collection of fossil fish from Ceará, a state of northern Brazil, by Dr. David Starr Jordan and John Caspar Branner, of Leland Stanford University, has been published by the Smithsonian Institution. The study was made under the assistance of a grant from the institution. The collection was taken from sandstone layers of the Cretaceous period.

The authorities of Peabody Museum, of Yale University, have made arrangements for securing additions to the mammal collection through Captain B. D. Cleveland, who commands a vessel soon to sail from New Bedford, Mass., on a voyage to Kergulen Island in the Antarctic Ocean.

Dr. Hamilton Rice, of Boston, who has returned from an eighteen months' trip to the headwaters of the Rio Negro, in Colombia, has given to the Peabody Museum, of Harvard University, a valuable collection of ethnological material which he obtained from the natives of the region around the upper Uaupes River. The collection includes dance costumes, feather, headdresses, rattles, whistles, drums and other paraphernalia used in their dances and ceremonies, blow guns with poisoned arrows, ordinary bows and arrows, ceremonial staffs used for carrying the heads of the enemy, and various household objects such as wooden seats, hammocks, baskets, etc.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. James A. Patten, of Chicago, has given $150,000 to Northwestern University for a gymnasium.

The Sheffield Scientific School of Yale University has purchased a site at the end of Rocky Beach off Bradley Point, Savin Rock, on which an experiment and collecting station will be erected. During the past year the school voted to support a table at the Marine Biological Laboratory, and the structure at Bradley Point is intended for the use of experimenters during the months of the college year when Woods Hole is not accessible.

The American Ethical Union's summer school of three weeks, usually held at Plymouth, Mass., will this year be held at Madison, Wis. The school will be opened on July 5, in the Historical Library, and will include a series of forty-five lectures. Among the speakers are Dr. Henry Neuman and Percival Chubb, of New York University; Dr. David S. Muzzey, Dr. John L. Elliott, and Mrs. Anna Garlin Spencer, of the New York Ethical Culture School; William Mackintire Salter, of Cambridge; Professor Nathaniel Schmidt, of Cornell; Professor Charles Zueblin, of the University of Chicago, and Dr. Henry Moskowitz and Leslie W. Sprague, of the New York Ethical Society.

Dr. Walter R. Crane, instructor in the department of mining of Columbia University, has been elected professor of mining and dean of the school of mines of the Pennsylvania State College.

Robert M. Yerkes, A.B. (Ursinus), 1897, and A.B. (Harvard), 1898; Ph.D. (Harvard), 1902, has been promoted to be assistant professor of comparative psychology at Harvard University.

Instructors at Cornell University have been appointed as follows: F. A. Molby, G. W. Naysmith, A. A. Somerville and O. Tugman, in physics; F. D. Shetterly, in chemistry; C. A. Stewart, in geology; J. P. Schaeffer, in anatomy; W. C. Capron, in machine design; M. C. Earnsberger, in power engineering; G. D. Conlee, in experimental engineering, and J. N. Frost, in veterinary surgery.

The following appointments have been made at the University of Cincinnati: Instructors: Biology, Harry L. Wieman; mathematics, C. N. Moore; physics, Taylor S. Carter. The terms of R. E. C. Gowdy, Hanna fellow in physics; L. D. Peaslee, teaching fellow in zoology, and L. W. Sauer, teaching fellow in botany, have been renewed for 1908–09.

At the North Dakota Agricultural College: Firman Thompson, instructor in agricultural chemistry, has resigned to accept a position at the Delaware Agricultural College. Professor H. L. White, of the Medical College of the University of Vermont, has been elected as assistant professor of physiological chemistry and toxicology, and J. W. Ince, instructor at McGill University, has been elected instructor in agricultural chemistry.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JUNE 12, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION F—ZOOLOGY
THE AMERICAN SOCIETY OF ZOOLOGISTS

A JOINT session of the Central Branch of the American Society of Zoologists with Section F, Zoology, of the American Association for the Advancement of Science was held at the University of Chicago, December 30, 1907, to January 4, 1908. This was the sixth meeting of the Central Branch of the American Society of Zoologists, and the largest in its history. President S. A. Forbes, of the Central Branch, presided at all the sessions, as President E. B. Wilson, of Section F, was unable to be present.

The society met at 2:30 P.M., December 30, at which time E. B. Conklin, the retiring vice-president of Section F, delivered an address upon "The Mechanism of Heredity." The following are the titles and abstracts of papers presented at this meeting.

On the Specific Gravity of the Constituent Parts of the Egg of Chætopterus and the Effect of Centrifuging on the Polarity of the Egg: FRANK R. LILLIE, University of Chicago.

As the result of experiments with centrifugal forces of graded powers, the author concluded that the protoplasm of the polarized ovocyte of *Chætopterus* possesses both a polar and a concentric organization of its *ground substance,* which is the basis of the so-called "segregation pattern," or arrangement of granules ("substances") within the egg, and which determines the axis of embryonic development. This organization of the ground substance is not substantially altered by centrifuging, though it may be temporarily distorted thereby.

These conclusions depend upon the following considerations and observations:

I. *Concentric Organization.*—If the ground substance be perfectly homogeneous, granules moving under the influence of centrifugal force will pass in straight lines centrally and distally, according to their respective specific gravities, and will not be held in any intermediate position. Aggregation of granules in definite configurations or intermediate positions after centrifuging are *prima facie* evidence of differences of resistance of the ground substance.

Such definite configurations are found in the egg of *Chætopterus* after the action of low centrifugal powers with perfect constancy; and these together with the evidence derived from study of the normal structure enable us to infer the following concentric organization of the ground substance: (1) An ectoplasmic layer of considerable density, open at the animal pole; (2) an intermediate more fluid layer which is especially developed at the animal pole, where it comes to the surface; (3) a ring of greater density, enclosing (4) a large subcentral, more fluid mass. The last corresponds in position and approximately in size with the original location of the large germinal vesicle.

As a consequence of this organization of the ground substance, the small basophile granules within the central, more fluid area aggregate in the dense ring bounding it, when low centrifugal powers are used. This aggregation is situated towards the axis of the centrifuge, as the basophile granules are of low specific gravity, and is lunate in cross-section; it contrasts vividly with the surrounding parts of the egg after staining in strong basic dyes, such as thionin. Higher powers of the centrifuge drive such granules through the dense ring into the "clear zone" which contains the basophile granules from other parts of the egg. The acidophile granules also show typical configurations. The central, more fluid mass is practically emptied of granules when low centrifugal powers are used, because those within it are driven into the dense ring bounding it and those without do not penetrate the dense ring to enter it.

II. *Polar Organization.*—The polarity of the ovum before and after centrifuging appears to be the same whether the karyokinetic spindle retains its original position or not. This is inferred from the fact that the polar axis of centrifuged eggs (as determined by the position of the polar bodies appearing subsequent to centrifuging, and the later development) bears no constant relation to the axis of stratification of granules produced by centrifuging. Therefore the position of the granules of the egg does not determine its polarity. The latter may, therefore, be either a persistent feature of the ground substance, or may be determined by whatever point on the surface the maturation spindle happens to reach if displaced by centrifuging. The latter proposition appears highly improbable because (1) the polarity of ovocytes with intact germinal vesicle does not appear to be determined by the point on the surface to which the germinal vesicle may be thrown by centrifuging (limited number of observations of author); (2) the position of the maturation spindle displaced by centrifuging is constant, viz.: in the clear band, but the polar bodies are frequently formed outside this band; (3) in other animals no cases are known where the position of the nucleus has been shown to determine polarity, but, on the contrary, the polarity of the ovum is known to determine the position assumed by the cleavage nuclei. Therefore, it is believed that in *Chætopterus* the ground substance retains its polarity after centrifuging and that the place of formation of the polar bodies is thereby determined.

III. As to specific gravity of the cell contents, the so-called gray cap, which is specifically lightest, is made up of residual substance of the germinal vesicle and numerous small granules that are blackened by osmic acid and are soluble in xylol, hence presumably fat granules. The intermediate or clear band contains the majority of basophile granules; the distal hemisphere contains the acidophile granules, and of these, those originally contained in the ectoplasm appear to be heaviest.

The Variability of Zygospores in Spirogyra quadrata (Hass.) formed by Scalariform and by Lateral Conjugation, and its bearing on the Theory of Amphimixis: L. B. WALTON, Kenyon College.

With the object in view of obtaining data bearing upon the purpose of *amphimixis*, and the causes tending to produce *variability*—problems which have long remained most elusive in everything except theory—a biometrical investigation in respect to the comparative variability and correlation in 400 zygospores of *Spirogyra quadrata* (Hass.) formed by scalariform and by lateral conjugation was undertaken.

In the first instance (scalariform conjugation) we deal with the results of conjugation between remotely related cells belonging to different filaments. In the second instance (lateral conjugation) we deal with the results of conjugation between sister or adjacent cells of the same filament, a condition closely related to the phenomena of parthenogenesis in other organisms. If the conjugation of germ cells from remotely related individuals tends to variability as Weismann and others would have us believe, conversely the union of closely related cells should afford a decreased variability, the minimum appearing in parthenogenetic forms.

The results show a condition directly contrary to this, the zygospores of lateral conjugation being approximately 21 per cent. more variable in length and 31 per cent. more variable in diameter than those produced by scalariform conjugation. Consequently direct evidence is afforded in support of the theory of Hatschek (1887) that sex exists for the purpose of limiting and not for the purpose of increasing variability.

A comparison of constants, the general discussion, methods of measurements, as well as a review of the literature, particularly papers by Warren, Kellogg, Pearson, etc., will be given in the completed paper.

A Contribution towards an Experimental Analysis of the Karyokinetic Figure: F. R. LILLIE, University of Chicago.

The alternative hypotheses (1) that the poles of the karyokinetic figure (centrosomes) are centers of force which acts outwards and exerts its effect at a distance (centrosome theory) and (2) that the centrosomes are merely centers of insertion of the organic radii (mitome theory), may be tested experimentally. On the first hypothesis, spindles that move through the protoplasm would produce new asters in the form of radiating "chains of force" (Hartog); on the second hypothesis the moving spindle would drag the organic radii with it and produce considerable distortion of the karyokinetic figure. On the first hypothesis, not only the rays of the asters, but also the fibers of the spindle, must be interpreted as chains of force, and the chromosomes as well as centrosomes may be centers of force. Therefore, in any movement of the spindle through the cytoplasm, it is conceivable that its material also is constantly changing. If, therefore, the karyokinetic figure were suddenly moved from protoplasm of one morphological character into protoplasm of another, comparison of the normal and experimental conditions of the karyokinetic figure would furnish evidence for deciding between the two hypotheses.

The unfertilized eggs of *Chætopterus* enable us to make such a test. After they have remained in sea water fifteen to twenty minutes, each possesses a large karyokinetic figure fixed at the animal pole, and this figure remains at the mesophase for hours. If such eggs be centrifuged with relatively low powers (1,150 revolutions in 30 seconds to 1,750 revolutions in 45 seconds) not only may the karyokinetic figure be moved through the cytoplasm, or the latter caused to flow past the spindle, but new configurations arise in the cytoplasm, owing to central or peripheral displacement (with reference to the direction of the centrifugal force) of the granules suspended in the ground substance of the cytoplasm. The most important of these configurations for our purpose is a dense accumulation of the basophile granules a little central to the middle point of the egg. This is a new formation called suddenly into existence, within 30 to 45 seconds, and contrasting strongly with the remainder of either normal or centrifuged eggs.

If a pole of the spindle enter this basophile mass, the granules of the latter appear to be rearranged in radiating lines that can be interpreted only as chains of force. Apparently the original radiations of the pole in question are lost, or are reenforced. The rays of the aster in the basophile mass are actually more numerous than in the karyokinetic figures of control eggs, as determined by counting.

Any part of the basophile mass that enters the spindle appears also to be rearranged in chains of force: one finds that the part of the spindle within the basophile mass usually stains correspondingly, and thus contrasts strongly with the part without, and this is probably due in the first place to infiltration of basophile granules; but the modified part of the spindle is also fibrous in its structure and the interfilar spaces are empty of granules, so that it would appear that the infiltrated granules are arranged in chains.

Such distortions as are found in either the rays of the aster or the fibers of the spindle are explicable on the chain of force hypothesis; because it has been shown by Hartog that chains of force consisting of iron dust suspended in glycerine or balsam will bear great distortion before rupturing; and this is due in the first place to the fact that the longer path of a distorted chain is more permeable than the relatively resistant medium in which the permeable chains of particles are embedded, and in the second place (to a certain extent) to the viscosity of the medium.

The mitome hypothesis appears inadequate to explain the results of the experiments, and may certainly be regarded as disproved if actual counts show a definite increase in the number of astral rays proceeding from the pole embedded in the basophile mass.

If the center of force hypothesis be accepted, the results show that the basophile granules are extremely permeable to the "mitokinetic force" (Hartog) and that the ground substance is highly impermeable. Acidophile granules are also impermeable; or at least they are not arranged in chains of force.

The Pacific Scientific Institution: Wm. A. Bryan, Honolulu, T. H.

The institution recently incorporated in Honolulu has as its immediate object the promotion of a thorough biological and ethnographical survey of the Pacific Islands. Its more inclusive object, however, as stated in its charter, is "to encourage in the broadest sense and most liberal manner investigation, research and discovery in the Pacific Ocean and to make application of knowledge thereof to the improvement of mankind."

It is the design of the incorporation to create an international cooperative research institution in Hawaii by the affiliation of institutions at home and abroad, that will provide in the center of the region to be studied, a modern institution with adequate funds and facilities to carry forward rapidly the work of discovery and exploration and to make the practical application of the new facts thus gathered to the scientific and economic betterment of the world.

An especial board of trustees has been named to receive in trust, funds and property with which to promote the objects of the institution. Substantial progress has already been made toward providing such important facilities as a biological station, botanical garden and an aviary or zoological garden, all of which, as organized, will form departments of the institution and be supplementary to the scientific equipment already existing in Honolulu.

The field explorations of the institution will be carried on by an especially equipped yacht provided with auxiliary power. This vessel will use Honolulu as a center, and from it proceed to visit the Pacific islands, group by group. Fifteen years is allowed for completing the field explorations.

An international council composed of distinguished scientists and scholars will select an honorary staff of leading specialists who will have advisory supervision over the work, assistants and publications in the especial departments into which the investigation will be divided.

The scope of the general inquiry and survey, the disposition of the material collected, as well as the publications of the institution have been worked out along lines of helpful cooperation with a view to the definite advancement of scientific work in the region to be treated. The whole undertaking has received much favorable indorsement from prominent scientists and educators as well as from philanthropists and men of affairs.

The Biochemical Action of Copper Sulphate on Aquatic Microorganisms: AMOS W. PETERS, University of Illinois.

The concentrations of $CuSO_4$ required to kill protozoa instantly and to inactivate the normal enzymes of their protoplasm were compared. Protozoa—*Paramœcium* and *Stentor*—were freed from débris, separated from other organisms, and washed free from the organic matter of their native culture liquid, by the use of a filter of fine silk bolting cloth upon a separatory funnel, followed by the use of a centrifuge. The concentrations required to kill instantly differed greatly according to conditions, the values found ranging from 12 to 60×10^{-8} gram molecular parts of $CuSO_4$, $5H_2O$ per c.c. The presence of diastatic and various other enzymes in the cell-bodies of these protozoa was demonstrated with complete freedom from such inaccuracy as could arise from the presence of bacteria. The methods used and the results obtained in the preparation of these enzymes will be reported in a separate communication. The diastatic enzymes were tested, with all necessary controls for their action upon starch, and the results were measured by both the Fehling and the polarimetric methods. At the concentration of $CuSO_4$ equal to that of the killing point of the same organisms which furnished the enzyme, diastatic ferments are nearly or completely inactivated and their activity increases as the concentration of $CuSO_4$ diminishes. Whether the same correlation exists with other enzymes and whether the cell bodies absorb and concentrate the $CuSO_4$ from dilute solution, is still under investigation.

Minimal Size in Form-regulation: C. M. Child, University of Chicago.

The minimal size of pieces capable of complete form-regulation in a given species is not a constant quantity, but varies according to the region of the body involved and in some species with age. It may also vary to a certain extent with the physiological condition of the individual.

In *Tubularia* and *Corymorpha,* for example, a much larger piece is necessary for the formation of a complete hydranth and stem in the distal region of the original stem than in the proximal region.

In *Planaria maculata* a piece from the middle region of the body must be much larger than one from the terminal regions to produce a complete animal.

Similar differences are found in various other species of cœlenterates and turbellaria.

As regards age differences, the minimal size of pieces capable of producing a complete animal is relatively greater in newly hatched specimens of *Planaria simplicissima* than in adult animals, though as regards actual size the reverse is the case.

Evidently, then, minimal size in these species is not simply a matter of a certain number of cells or a certain constant amount of living material, but is dependent rather on the position and function of the parts in the original whole. We may probably go a step farther and assert that it is primarily dependent upon the rapidity of physiological or functional changes with change of level in the whole. Where this change is relatively rapid a piece of given length is physiologically more nearly a complete system than a piece of the same length in a region or at an age where the change from level to level is less rapid.

These facts constitute strong evidence against the cell theory in its more special form, for the number of cells may differ very widely in minimal pieces from different regions. They point to correlation between parts as the essential feature in regulatory and probably also in normal development—at least in certain stages.

Galvanotropism of Bacteria: J. F. Abbott, Washington University.

It being ordinarily understood that bacteria do not respond to the influence of a galvanic stream too weak to kill them, it seemed important to determine whether this be really so; and second, to determine, if a tropic response be obtained, in how far this might be altered by change in environmental conditions.

Results of extended work on *B. termo* and *B. subtilis* demonstrated without any question that pure cultures of these bacteria gather under the influence of very weak currents at the cathode and follow repeated reversals of the poles.

Pure cultures grown in acid-modified and alkali-modified peptone-gelatin appeared to respond in most cases, though not in all, in opposite manner, alkali cultures gathering at the cathode and acid cultures at the anode.

These results seem to be in harmony with those of Greeley on paramecium and give color to the conception that the galvanotropic response may be due to, or directed by, the physico-chemical constitution of protoplasm.

Work along this line is being continued.

Some Reactions of the Pomace Fly (Drosophila ampelophila) to External Stimuli: FREDERIC W. CARPENTER, University of Illinois.

Drosophila is negatively thermotropic to high and low temperatures. In reacting on a horizontal surface to the temperature stimulus the insect usually describes a continuous curved line, and gives little evidence of random movements indicating "trial and error" behavior.

Experiments with light have shown that *Drosophila* is positively phototropic. If one eye is covered with an opaque cap, the insect, in spite of the unilateral stimulation, creeps in a fairly direct path toward the light, although often showing a tendency to deviate toward the side of the normal eye. Occasionally a fly will perform circus movements, but this behavior is exceptional.

A violent uncoordinated motor reaction or convulsive reflex may be produced by stimulating *Drosophila* either by a high temperature, or by a low temperature, or by intense light (at a temperature of 30° C.) or by such irritating chemical substances as ammonia or acetic acid.

Behavior of Perichæta and Lumbricus toward Stimuli of Various Intensities: E. H. HARPER, Northwestern University.

Stimulation of the anterior end on one side gives reactions of five types corresponding to the strength of the stimulus. The weak negative reaction of type I. is the terminus likewise of the next two types owing to the gradual subsiding of the stimulus. The medium reaction of type II. is therefore two-phased, retraction of the head being only the first phase. The increased intensity of the first phase in type III. (strong reaction) determines the backward crawling, allowing the posterior end to take the lead. The extension of the same strong condition of contraction over the posterior end in the very strong reaction of type IV. prevents backward crawling owing to the weaker adaptiveness to backward as compared with forward movements. Strong turning with forward movement is, therefore, the very strong type of reaction. Type V. is a convulsive reaction. Type III. shows three subtypes according to strength of stimulus. Subtype III. (*b*) introduces squirming of the anterior end; III. (*c*) includes a rolling reaction produced by contracting the longitudinal muscle bands in sequence, which follows the squirming and precedes the backward movement. This rolling reaction wipes off the stimulating substance with secreted mucus. As variants may be noted omission of backward crawling from III. (*b*) and (*c*). Trial and error is not recognized in this apparently determinate series of reactions, though, as others have noted, the movements of type I. may be random. Of course the same description may be applied to V.

The Reaction of Amphibian Embryos to Tactile Stimuli: G. E. COGHILL, Denison University.

With reference to the reaction to a tactile stimulus upon the region of the trigeminus or vagus, embryos of *Triton torosus* may be grouped into three classes: (1) Individuals which from the first and during a considerable period respond regularly or almost regularly with a heterolateral (away from the side touched) head movement. (2) Individuals which for a relatively short period are irregular in the direction of the head movement and then enter upon a long period of heterolateral reaction. (3) Individuals which are at first asymmetrical in response, then enter upon a short period of irregularity and finally upon a period of heterolateral reaction, or pass directly from asymmetry to the heterolateral type.

The heterolateral head movement is a unit in the "action system." This unit is predetermined regardless of any experience on the part of the individual. The first response to a touch on the tail bud is a head movement and as the whole trunk comes to be flexed the movement still begins in the head region and progresses caudad. The earliest conduction paths, then, of the lower part of the cord are longitudinal and afferent, and the two halves are physiologically distinct during this phase of development. Specimens that are asymmetrical for head stimulation are so for tail stimulation also.

The Phylogenetic Differentiation of the Organs of Smell and Taste: C. Judson Herrick, The University of Chicago.

Physiologists have not yet succeeded in finding a well-defined criterion for the separation of these senses in terms of the character of the stimulus, nor can they be easily distinguished psychologically. Nevertheless, their nervous mechanisms are very different and these anatomical differences seem to have assumed practically their definite form in the very lowest vertebrates. In seeking for the explanation of this differentiation of two chemical senses in low aquatic vertebrates, attention is directed to the character of the motor responses as giving the key to the evolution of the very diverse reflex paths for smell and taste. The typical response to stimulation of the taste buds within the mouth is a visceral reaction (mastication, swallowing, etc.); that of olfactory stimuli is a somatic reaction, usually toward or away from the source of the stimulus. A quite different set of nervous pathways is involved in the latter case from that of the former. Assuming that smell and taste have evolved from a common type of undifferentiated chemical sense, this difference in mode of reaction to chemical stimuli within and without the mouth is adequate to call forth in the course of further evolution the structural differences which we find between these organs in higher vertebrates.

The Mesencephalic Root of the Trigeminus in Reptiles and Mammals: J. B. Johnston, University of Minnesota.

This bundle of fibers has long been known in man and mammals and described as the descending or cerebral motor root of the trigeminus. The writer has described it in selachians, ganoids and anurans as a part of the sensory root. The same is now found to be true in reptiles (turtle, snake) and in mammals (mole, cat, white rat, pig embryo and human embryo of 15.5 mm.). In the adult mammals studied the bundle in question is made up of two parts. One part arises from the spinal trigeminal tract at about the level of the facial nerve, runs dorsalward through the substantia gelatinosa, turns cephalad between the gelatinosa and the vestibular centers, passes over the dorso-caudal surface of the motor nucleus of the trigeminus, and gains the internal face of the brachium conjunctivum near the fourth ventricle. Here it is joined by the second part, which comes up from the sensory trigeminal root among the trigeminal fibers to the cerebellum. The combined bundle has on its mesal and ventral side a column of large and small cells which is closely related to (merges with) the vestibular nuclei. The bundle and column of cells continue forward into the mesencephalon in the well-known manner.

In the human embryo studied (and pig embryos also) the relations of the sensory and motor roots at their connection with the brain are such that there seems no possibility of confusing the two. The bundle under consideration is made up in the same way as above described and is further clearly separated from the motor root by the intervening lateral groove of the brain. This groove separates the dorsal and ventral halves of the brain wall (Flügelplatte and Grundplatte, His); the sensory root and the mesencephalic bundle are dorsal to this groove, the motor root ventral to it. The sensory and motor portions of the trigeminus are at this time widely separated. At the level of the exit of the fourth nerve the mesencephalic bundle holds a position between the central and peripheral limbs of the trochlearis which is characteristic for all vertebrates. Dorsal to the peripheral limb of the trochlearis, however, is to be seen in the human embryo a large bundle which runs from the tectum mesencephali into the cerebellum, the tr. tectocerebellaris which occupies this same position in lower vertebrates. Hence, the cutaneous sensory fibers are distributed through the whole length of the dorsal half of the brain wall as far forward as the superior colliculus. *The roof of the midbrain is still in part a primary cutaneous sensory center*, even in man. This gives the strongest morphological support to the account of the evolution of the cutaneous, auditory and visual primary and secondary reflex centers and the cerebellum out of a primitive longitudinal column or zone whose functions were at first simple cutaneous sensory.

The Epibranchial Placodes of Ameiurus melas and nebulosus: F. L. LANDACRE, Ohio State University.

The epibranchial placodes in *Ameiurus* arise just posterior to the dorsal portion of each gill slit and give rise to elements in the cranial ganglia quite distinct from those of the dorso-lateral placodes and of the neural crest.

The ectodermal area in which the placodes occur is indicated first by active mitosis and later by a process of proliferation which is almost complete; and the ganglion is almost detached from the ectoderm before it comes into contact with cells from the dorso-lateral placode and neural crest except in the case of the third division of the tenth nerve.

The placodal portions of the seventh, ninth and first two divisions of the tenth nerves have been followed to a late stage and give rise to the portions of these ganglia which furnish communis fibers to these nerves.

Whether the epibranchial ganglia furnish gustatory fibers only or general visceral fibers also has not yet been certainly determined, but the evidence is very strong that they give rise to special visceral or gustatory fibers only.

The direction of proliferation of the placodal cells is backward, and their first connection with the remaining portions of the cranial ganglia is by means of a delicate intermediate cell mass.

Pinkus's Nerve in Amia and Lepidosteus: CHAS. BROOKOVER, The University of Chicago.

Search for Pinkus's nerve in adult *Amia* by macroscopic and microscopic methods failed to show the root which Allis described running back to the forebrain. The ganglion was found as Allis described it in larval *Amia*. A similar ganglion was found in larval stages of *Lepidosteus osseus*. The cells of the ganglion become scattered in *Amia* after the 50 mm. stage, when there are two hundred and fifty cells. In adult *Amia* the large cells from the larval ganglion were recognized to the number of one thousand on each olfactorius. They have the appearance of functional nerve-cells among the olfactory fibers as the latter break up into small bundles to enter the Schneiderian membrane.

There is some evidence that the cells are those of a sympathetic ganglion in *Amia*.

Each of the thousand cells does not send an axone back into the brain unless these fibers enter the olfactory bulb under the guise of osmotic axones. Such Golgi and Cajal preparations show morphological similarities to sympathetic cells. There are many points of similarity between Pinkus's nerve in the bony ganoids and Locy's nervus terminalis in sharks. There are two ganglia in the course of the nerve in *Squalus acanthias* and some of the cells are multipolar.

The "Primitive Pores" and the Sensory Ridges of the Lateral Line of Polyodon spathula: Henry F. Nachtrieb, University of Minnesota.

The "primitive pores" or pits. The many-layered epithelium of the skin passes, without change, into the mouth of each pit and then gradually becomes reduced as it passes toward the bottom of the pit, where it consists of two layers or of two distinct layers with interspersed pseudostratified areas. The cells are of two distinct types. The more conspicuous cells are large, clear columnar cells resting upon the basement membrane and containing centrally located nuclei with two to six distinct nucleoli (using the term in a general sense). The other type is, as a rule, a more or less flattened cell lying on the outer ends of the basal cells. They fit in closely between the rounded ends of the basal cells and consequently have an uneven lower surface. For convenience we may call them cover cells. Each cover cell contains a large, more or less irregularly shaped nucleus with, as a rule, but one nucleolus. Some of these cover cells clearly extend to the basement membrane, and various stages between a definite cover cell and a basal cell, with reference to both the cytoplasm and the nucleus, have been observed. A basal cell may be completely covered or send a small finger-like projection up between the contiguous covering cells, or there may be a pore-like opening above it between the cover cells. The cells here called basal cells have been designated as supporting cells and the cells corresponding to what are here called cover cells have been designated sense cells, thus interpreting the pit as a sense organ. There are no structures supporting this interpretation. Well-preserved material and the elimination of all artifacts indicate that the primitive pits of *Polyodon* are simple glands that secrete a peculiar mucus-like substance.

The sensory ridges of the lateral canal are about .6 mm. long and in transverse sections cover the floor (or wall next to the muscles) of the canal. The epithelium is a simple flat epithelium excepting in the sensory ridges, where it is more or less columnar and consists of two types of cells. One is a relatively large clear cell resembling the basal cells of the primitive pits. These cells either do not rest on the basement membrane at all or only through very thin extensions. The other rests upon the basement membrane, and is a more slender and more irregularly shaped cell with a distinct oval nucleus. In the neighborhood of the clear cells, they generally overlap or cover the outer ends of the clear cells. Neither type of cell has any peculiarly differentiated free surface. As in the case of the primitive pits fine nerve fibrils end between the cells. A more or less evident network has been observed on some of the denser cells, which appear to be of two kinds, a supporting and a sensory cell. Clear cells discharging their contents into the canal are not infrequently seen in well-preserved material. While hairs or hair-like processes have not been definitely made out on any of these cells, the innervation and general appearance as well as the experiments of Parker and others indicate that these ridges are sense organs. There is no evidence that the primitive pits are or ever have been a part of the lateral line system.

Microscopic preparations were shown in connection with the paper.

Cranial Nerve Components in Amphiuma: H. W. NORRIS, Iowa College.

A preliminary outline of the more salient features of the origin and peripheral distribution of the cranial nerves of Amphiuma with reference to their components. Kingsley's account of the I. and II. nerves is confirmed. The eye-muscle nerves have the typical origin, but are all rudimentary, especially the VI. The IV. and VI. have not been described hitherto. The V. nerve is characterized by anastomoses with branches of the VII. Its origin is that described for *Necturus* by Kingsbury. The VII. nerve arises by five rootlets: three lateral line, one each communis and motor. In addition it receives general cutaneous and communis fibers from the IX. Branches: (1) *supra-orbital trunk,* lateral line (*ophthalmicus superficialis* VII.) and general cutaneous (V.); (2) *infra-orbital trunk,* lateral line (*buccalis* VII.), and general cutaneous (*maxillaris* V.); (3) *palatine,* communis; (4) *hyomandibular trunk,* lateral line, general cutaneous, communis and motor. The hyomandibular give rise to: the *alveolaris* (communis), *mentalis externus* and *mentalis internus* (lateral line), *jugularis* (general cutaneous, motor, together with some lateral line fibers), and the *ramus lateralis* (lateral line mostly, if not entirely). The ramus lateralis VII. is peculiar to Amphiuma. It runs to the posterior part of the body, but its neuromasts on the trunk of the body have not been determined. In addition to the anastomoses already mentioned the VII. nerve has the following: between the palatinus VII. and the ophthalmicus profundus V.; in the manner described for *Amblystoma* by Coghill; between the alveolaris VII. and mandibularis V.; between the ophthalmicus profundus V. and the ophthalmicus superficialis VII. and buccalis VII.; between the alveolaris VII. and the pretrematicus IX., two anastomoses; between the palatinus VII. and the pretrematicus IX., Jacobson's commissure; between the jugularis VII. and the IX.–X. ganglion, anastomosis IX.–X. and VII. The latter anastomosis has only general cutaneous and communis fibers. The IX.–X. nerve complex arises from the brain by five groups of rootlets. Peripherally the branches of the IX.–X. agree in general in their distribution with those of *Amblystoma* as described by Coghill. The first branchial nerve (IX.) contains only communis and motor fibers; the second and third branchial nerves (X.) contain general cutaneous, communis and motor fibers. A fourth branchial nerve, poorly developed, arises from the ramus intestinalis. The first spinal nerve (*hypoglossus*) arises by four rootlets, two dorsal and two ventral, as described by Kingsley. It does not anastomose with the X. nerve.

The Participation of Medullated Fibers in the Innervation of the Olfactory Mucous Membrane of Fishes: R. E. SHELDON, The University of Chicago.

In the carp (*Cyprinus carpio*) medullated fibers enter the submucosa region of the olfactory capsule distributing in part to the Schneiderian membrane. There they probably end in free nerve terminations, as there are no special end organs developed. These fibers are derived from the supra-orbital trunk, which is made up of general cutaneous fibers from the Gasserian ganglion (n. ophthalmicus superficialis trigemini) and sensory fibers from the facial (n. ophthalmicus superficialis facialis). This latter nerve is acustico-lateral from the lateralis ganglion of the facial and visceral sensory from the geniculate. The fibers entering the mucosa are certainly not lateralis, as no canal or pit organs are there found; the fibers are also smaller than are the lateralis fibers. They may, therefore, be either general cutaneous or visceral sensory, with the preponderance of evidence in favor of the former, partly on the ground that the medullated innervation in mammals and birds, the other forms in which such fibers are known, is trigeminal and partly because the weight of evidence in the teleosts is against the supposition that visceral sensory fibers are present in this region. Young cod and gold fish were studied with reference to the presence of medullated fibers in the mucosa, but none could be demonstrated.

The Ischio-coccygeal Plexus as a Pathway for Cutaneous Innervation in the Leopard Frog: Elizabeth Hopkins Dunn, The University of Chicago.

Gaupp in the 1896 edition of Ecker's und Wiedersheim's "Anatomie des Frosches" makes no mention of a cutaneous innervation by way of the ischio-coccygeal plexus, branches from which are there traced to the pelvic viscera and the posterior lymph heart.

In dissection of the ischio-coccygeal plexus of *Rana pipiens* the nervus coccygeus was found to send several terminal branches to a limited area of the skin about the cloacal opening.

At the point in the nerve at which the last visceral branch is given off a study of the relations of the individual fibers was undertaken. The last visceral branch contains from fifteen to twenty medullated fibers, the cutaneous portion about forty medullated fibers.

The small number of medullated fibers at this point makes possible the isolation of the individual fibers by teasing in glycerin. One per cent. osmic acid was used as a fixing and staining reagent.

A careful study of material, including the trunk of the nerve above the point of branching and the visceral and cutaneous branches in their continuity with the main trunk, revealed in three consecutive preparations the division of at least one medullated fiber in each preparation occurring in the trunk just above the point of separation of the branches. Of these dividing fibers one limb passed toward the viscera while the other continued with the cutaneous portion of the nerve.

The weight of evidence seems to be in favor of the afferent character of these fibers.

If this be true, unless an independent functional value can be established for the individual neuro-fibrillæ in the neuraxis, it would appear that we have in such a distribution of the ramifications of a single nerve fiber an anatomical explanation for the close connection between visceral and cutaneous areas which has been suggested by the findings on the pathological side shown by Head's classic work on disturbance of sensation with reference to visceral disease.

A close physiological connection between the pelvic viscera and the adjacent regions may also be accomplished by means of such dividing fibers.

Degeneration in the Ganglion Cells of Cambarus bartonii Gir: Hansford MacCurdy, Alma College.

Within the last decade a large number of experiments have been performed on vertebrated animals to ascertain to what extent the nerve roots, ganglia and ganglion cells are affected when a nerve trunk has been severed. The results have varied greatly, but in by far the greater number of these experiments, distinct alterations in the size and structure of the parts affected have been reported and in some cases complete degeneration of ganglion cells has been said to occur.

In a series of experiments on the abdominal ganglia of the crayfish, *Cambarus bartonii* Gir, ganglion cells have been found to undergo degeneration in twenty to thirty-eight days after the connectives anterior and posterior to the fifth ganglion have been severed. A smaller number of cells were affected in the fourth and the sixth than in the fifth ganglion. The histological changes in these ganglion cells are apparently similar and correspond to those described for similar structures in the nerve cells of vertebrated animals.

Place-modes for the Sacrum and the First Hæmal Arch of Necturus: FRANK SMITH, University of Illinois.

Data on the sacrum and first hæmal arch of 504 specimens of *Necturus* form the basis for place-modes of these two characters in specimens collected in Lake Erie at Venice, Ohio.

Of sacra involving two symmetrically placed sacral ribs, eight are modifications of the eighteenth vertebra, 347 of the nineteenth, 78 of the twentieth and two of the twenty-first. Two specimens have each two pairs of sacral ribs, one pair each on the nineteenth and one on the twentieth vertebra. Fifty-two specimens have two sacral ribs asymmetrically disposed. These involve two of the eighteenth, nineteenth, twentieth and twenty-first vertebra and are found in five of the six possible relations. Twenty-five have the right sacral rib in advance and 27 the left one. Fifteen specimens have three sacral ribs which involve two of the eighteenth, nineteenth and twentieth vertebræ and have seven of the eight possible relations. Four have the unpaired rib anterior to the paired ones, and the others have it posterior.

The first hæmal arch is on the twenty-second vertebra in 177 specimens, on the twenty-third in 303 and on the twenty-fourth in 24. In two specimens a half hæmal arch is formed on the twenty-first vertebra. Of thirty sacral ribs borne on the eighteenth vertebra, all but one are associated with a hæmal arch on the twenty-second, and nearly all are in males. The correlation coefficient between the position of the sacrum and that of the first hæmal arch is $.47 \pm .013$.

Three hundred and nine specimens examined for sex include 129 males and 180 females. A comparison of the mean positions of the sacral ribs and of the first hæmal arches of the sexes shows clearly that the sexes should be considered separately in determining place-modes. Variability in both characters is somewhat greater in the males.

Mean of positions of attachment of sacral ribs in 504 Lake Erie specimens, $19.19 \pm .014$; in 129 males, $19.126 \pm .03$; in 180 females, $19.28 \pm .025$. Mean of positions of first hæmal arch in 504 specimens, $22.70 \pm .015$; in 129 males, 22.57; in 180 females, 22.82. These means are exceeded by the corresponding ones for the 100 specimens studied by Bumpus by an amount greater than that involved in the probable errors.

The Habits and Structures of the Larva of Culex perturbans: JOHN B. SMITH, Rutgers College.

The larva of *Culex perturbans* is unlike that of all other known culicid larvæ in that it does not live in free water or merely on the bottom surface. It works its way into the soft bottom mud a distance of from two to four inches and attaches itself by its modified anal siphon to the roots of grasses. By means of serrated processes it breaks through the outer surface of the roots, attaches itself by means of recurved hooks, and obtains its supply of oxygen from the vascular system of the plants. The swamp areas inhabited by this species are those densely overgrown with grasses in which no other mosquito larva lives and among which no fish or other enemies are found. (See *Entomological News,* Vol. XIX., page 22, plates 3 and 4, January, 1908.)

Note on a Trematode Parasite in a Hen's Egg from Northern Minnesota: W. S. Nickerson, University of Minnesota. (Read by title.)

A Comparison between the Implantation Stages in Dipodomys and Geomys: Thomas G. Lee, University of Minnesota.

A study of a series of early developmental stages in *Dipodomys* taken previous to and during the process of the implantation of the ovum shows a general correspondence with the same stages in *Geomys* as previously described by the writer.

Dipodomys is the third rodent so far described in which the decidual cavity is formed in the ventral portion of the uterine mucosa outside of and independent of the uterine lumen. Perforation of the ventral portion of the uterine epithelium and the extrusion of the blastocyst occurs at a somewhat earlier stage of development than in *Geomys.* Consequently, the opening between the uterine lumen and the newly formed decidual cavity is at all times much smaller proportionally in *Dipodomys* than in *Geomys.* The blastocyst in *Dipodomys* does not become attached to the margin of this opening as is so characteristic of *Geomys,* but sinks down into the decidual cavity.

In both *Dipodomys* and *Geomys* there is for some time a functional yolk-sac placenta which is later substituted by an allantoic placenta.

The Ecological Succession of Bird Associations: Chas C. Adams, University of Chicago.

The breeding grounds of birds must be considered as fundamental in any attempt to determine their habitat relations. Those species which regularly breed in the same habitat form a bird association or society. The succession upon Isle Royale, Lake Superior, has been attempted by the study of the history of the environment correlated with the character of the birds. From a reef in the lake to the forested island there has been a definite environmental change; and, correspondingly, in all probability, a corresponding change in the bird life. Upon the habitat preferences of the present avifauna the general succession in the past may be roughly approximated. As the lake level lowered and the depressions became invaded by the forest, the aquatic association has been succeeded by the shore and bog-forest kinds; and these in turn by the birds frequenting the aspenbirch-balsam or maple forest. All habitats, under present conditions, tend to become transformed into that of the climax forest, with its avifauna or association. This method of environmental interpretation, as a problem of succession, gives a new point of view for the study of the development or evolution of the avian environment and the "struggle for existence" among birds.

A Statistical Study of Midsummer Birds of Illinois: S. A. Forbes, University of Illinois.

This paper contains a preliminary statement of some of the more general results of a census of summer resident birds of Illinois, giving the entire bird population of a strip 150 feet in width and 428 miles long (12 square miles), one third of this area being in southern, one fourth in central, and two fifths in northern, Illinois.

The method of the enumeration was such as to give the numbers of each species found on measured areas, taken at random, of each crop or other distinguishable kind of surface. The responsible observer, Mr. A. O. Gross, determined 7,740 birds belonging to 85 species—an average of 645 birds to the square mile, of which 18 per cent. were English sparrows. On this basis, the total summer population of the state numbers about 30,750,000 birds, of which five and a half millions were English sparrows. Eighty-five per cent. of these birds belonged to one fourth of the species. The ten most abundant species, and the numbers seen of each, were as follows: English sparrow, 1,414; meadow-lark, 1,025; bronzed grackle, 900; mourning-dove, 461; dickcissel, 393; red-winged blackbird, 347; prairie horned lark, 296; flicker, 197; robin, 194; and field sparrow, 186.

The English sparrows decreased in numbers per square mile from north to south (perhaps because of a diminishing population southward and a consequent progressive diminution of their breeding areas), 100 sparrows in northern Illinois being represented by 77 in central and 56 in southern; but the native birds increased from north to south, apparently for climatic reasons—100 in northern Illinois being represented by 116 in central and 129 in southern. The same gradation was still more pronounced in winter residents, which averaged 384 birds to the square mile in northern, 582 in central and 832 in southern, Illinois. The general average for the whole state and the entire year, as represented by 1,591 miles of travel and a census area of 44¼ square miles, was 722 birds to the square mile.

By comparison of the midsummer numbers with the average for the fall migration period, a wave of denser population was detected, running from north to south and rising with the progress of the migration. The central Illinois average for October was 2.3 times that for July, August and early September.

The original relation of the Illinois bird fauna to prairies was still discernible in the fact that half of these summer birds were found in pastures and meadows, although only a little over a third of the area inspected was in grass. Corn fields, on the other hand, which covered 32 per cent. of the area, contained but 15 per cent. of the birds, and these most largely English sparrows.

As an example of the local and numerical distribution of species, that of the meadow-lark was given, and as an example of the composition of the bird fauna of an ecological situation, the birds of the pasture were separately discussed. Meadow-larks, while numbering 85 to the square mile for the whole area covered, were very unequally distributed, averaging 266 to the square mile in fields of stubble, 205 in meadows, 144 in pastures, and 10 in corn fields, and not occurring at all in forests or among shrubbery. They increased notably in number from north to south—100 in northern Illinois being represented by 175 in central and 215 in southern.

Pasture lands were the preferred resort of the most abundant midsummer species, and contained 27 per cent. of all the birds seen. In average density of population, however, they were surpassed by meadows, which contained 920 for each square mile, to 878 in pastures, 562 in stubble and small grain, and 300 in fields of corn. The commonest pasture birds were the English sparrow, the crow-blackbird, the meadow-lark, the horned lark, and the field sparrow, abundant in the order named, and together making more than half the summer residents of the pasture lands of the state.

The impression made by this general examination of the present bird population of the state of Illinois was that of a remarkable flexibility and tenacity of the associate and ecological relationships of birds in the face of revolutionary changes in their environment. Apart from the results of the introduction of the English sparrow, and the direct destruction of game birds and birds of prey, the main effect of human occupation seems to have been the withdrawal of most of the prairie birds from the area devoted to Indian corn, and their concentration in pastures, meadows, and fields of small grain—situations which most nearly resemble their original habitat.

Significant Changes in the Breeding Ranges of Certain Birds of the Ohio Valley and Lower Lake Region: Lynds Jones, Oberlin College.

These changes, during a period of seventy years, are a gradual but decided shifting northward of the breeding areas of twenty-five species of birds, or fully twenty per cent. of the breeding birds of the state of Ohio. The movement can not be accounted for by the changes attendant upon the settlement of the region, because the breeding habitats have not been materially changed. Rather the northward movement seems to be the expression of a gradual elimination of the less fit and as gradual an improvement of the species.

The Relation of Ecology to General Biological Problems: A symposium by H. C. Cowles, V. E. Shelford, C. C. Adams, the University of Chicago. To be published in full in Science.

A Study in the Sex-ratio in Drosophila Ampelophila: W. J. Moenkhaus, University of Indiana.

The sex-ratio in *Drosophila ampelophila* is 1 male to 1.14 females. The sex-ratio is inherited. If the sex-ratio of many pairs of this species taken from the same parents as determined in different pairs shows a wide range of variation in this respect. The ratio may vary from a slight preponderance of males to a strong preponderance of females in a proportion of 1 to 2 or greater. By breeding the offspring from pairs showing a selected ratio, these again show a ratio approaching that of their parents. Thus, by selection, a strain in which the females bore a relation 1.6 to 1 male was produced. This ratio, by selection, can be maintained. A male strain has not yet been attempted.

By mating females from the "female" strain with males from a strain in which the sex-ratio is 1 to 1, and *vice versa,* the sex-ratio of the offspring is in every case that of the strain from which the females were selected. From the results in five such experiments it is concluded that in this creature the sex is determined altogether, or nearly so, by the female, the male having nothing or little to do with it.

The objection that might easily be brought forward, that the selection in these experiments may be nothing more than the selection of those pairs in which one sex or the other tended to die and, hence, led to a preponderance of one sex or the other, has not been met satisfactorily experimentally, but it is not regarded as a factor of any importance.

Thomas G. Lee,
Secretary

University of Minnesota

(To be concluded)

SCIENTIFIC BOOKS

SCIENTIFIC PUBLICATIONS OF THE AMERICAN MUSEUM OF NATURAL HISTORY FOR 1907

In Volume XXIII. of the *Bulletin* of the museum there are almost one thousand—978, to be exact—printed pages, comprising thirty-six separate papers from nineteen authors, with fifty-three plates and eighty-three text figures. Many papers are of typical technicality, others have a wider range and engage popular attention.

The very enviable fame enjoyed by the American Museum for its unsurpassed halls of vertebrate paleontology suggests the precedence of the papers on this topic; indeed, by enumeration, over one third of the titles belong here.

The first paper is by Dr. L. Hussakof: a short description of the fossil surgeon fish, *Zebrasoma deani* n. sp., from the West Indies, and significant as the first instance of a fossil of the family being found in America. It is hypothetically referred to the Eocene. The second paper is by Dr. W. D. Matthew, devoted to the elaboration of a lower Miocene fauna from South Dakota, which, it is contended, connects the latest of the White River beds (Oligocene) with the Loup Fork sediments (upper Miocene) and which is characterized by two rather sharply contrasted faunas, that of the lower Rosebud beds and that of the upper, in both of which are found Carnivora, Rodentia, Perisso and Artiodactyles and (in the upper Rosebud) Insectivora, and of which finally the author says: "It is peculiarly satisfactory therefore to find a fauna which is intermediate between two stages hitherto disconnected, and enables us to perceive the exact relationships between genera which could until now be connected only in a general or provisional way." The details given in this paper are very interesting, as that the resemblance of the Oligocene and lower Miocene Canidæ (Canidæ and Mustelidæ alone appear in the Carnivora) to species inhabiting South America is marked, that the specialization of the limbs and feet of lower Miocene hares "were practically as far advanced as any of their modern descendants," and the description of a new genus of mustelines, *Megalictis*, and of which "the teeth indicate an animal fully as predaceous as the wolverene but the skeleton points to more fossorial habits." At many places in this important contribution there is impressed upon the reader the sense of the writer's detached judgment, his freedom from preconception or prejudice, and a willing deliberation in drawing conclusions.

Professor H. Fairfield Osborn furnishes four articles, among which the "Tertiary Mammal Horizons of North America" easily claims preeminence. It is an effort at correlation which will be closely studied, and offers a résumé of the observations of a host of investigators in the field. The faunal currents indicated in the sixth phase, with South American land connections, and in the fifth and seventh phases with Eurasiatic invasions, suggest the speculations which the distinguished author has successfully associated with his name. The remaining three papers of Professor Osborn are "Mounted Skeleton of the Columbian Mammoth," "Points of the Skeleton of the Arab Horse" and "A Mounted Skeleton of *Naosaurus*," in which last the two plates, one of the skeleton and one of a restoration or model by Charles R. Knight, fairly startle the observer.

Mr. E. C. Case contributes three articles, two of systematic value, "The Skull of *Bolosaurus striatus* Cope," "The Genus *Zatrachys* Cope" and a geological estimate, of much interest, of the Permian beds of Texas. A very suggestive study, in so far as it is charged with a consideration of morphological changes and their possible causes, comes from the pen of Professor Earl Douglass; it is entitled "New Merycoidodonts of Montana," and discusses a fossil group of artiodactyles related to the Cervidæ. An excellent paper by Mr. Barnum Brown forms article XXXIII. and analyzes the contents and relations of "The Hell Creek Beds of Montana." Dr. O. P. Hay follows the last writer with the description of "Seven New Species of Turtles from the Tertiaries of the United States." These turtles prove to be of striking interest. One, *Macrochelys temminicki* Hay, was found in probable Pliocene deposits on the western coast of Florida. It was about the size of the alligator snapper which inhabits to-day the region from western Georgia to Texas, but is quite distinct in structure; another species is a new box-tortoise "found in Pliocene or early Pleistocene deposits near Savannah, Georgia, and which exceeded in size any living species of box-tortoise." Among these suggestive fossils an example of *Aspideretes* (*A.*

singularis Hay) possesses unusual value. "The specimen is beautifully preserved and furnishes the nearly complete skeleton. Only one other skull belonging to the Trionychoidea is at present known that is older, and no other trionychoid skull so old is known that is accompanied by the shell." The papers in vertebrate paleontology close with one by J. W. Gidley in which the author presents a "Revision of the Miocene and Pliocene Equidæ of North America."

Near the center of the volume is an imposing article by the editor, Dr. J. A. Allen, which recalls a conflict which lately occupied the pages of this journal. The article is entitled "The Types of the North American Genera of Birds," and is a vigorous plea for the principle, in nomenclature, of elimination.

There are two articles by Professor R. P. Whitfield, the founder of the *Bulletin*, and the veteran paleontologist of the United States, one describing, for the first time, a species of *Hoploparia* (a lobster) from the American Cretaceous, and the second upon the interesting *Unios* brought by Mr. Barnum Brown from the Laramie clays of Montana.

Entomology has in the recent issues of the *Bulletin* increased its claims upon the space of the publication; indeed a process of cleavage in the *Bulletin* itself might not inappositely follow, as a consequence of the swelling proportions of entomological themes. There are fourteen entomological papers, some of them of very considerable length and all noteworthy, with particular interest centering in those of Beutenmüller, Wheeler and Cockerell.

Mr. Beutenmüller contributes "Notes and Descriptions of New Forms of Catocala," "New Species of Gall-producing Cecidomyiidæ," "Notes on North American Cynipidæ" and an authoritative study of the "North American Species of Rhodites and their Galls."

Professor Wm. M. Wheeler is the author of two extended papers of unquestionable interest. The paper on "The Polymorphism of Ants" repays attentive perusal. The subject of course pertains to the most fascinating chapters of science and the skillful and experienced author develops it with unmistakable attractiveness. The second paper of Professor Wheeler's introduces the reader to a second domain of entomology and leads him to the homes and environment of the "Fungus-growing Ants of North America." As Professor Wheeler almost instinctively remarks, "not only are these habits of interest as a most unusual specialization in diet—for all ants were originally and many are still exclusively entomophagous—but the successful cultivation of such delicate plants as fungi presupposes an astonishing range and complexity of adaptation even for these very plastic insects."

Professor T. D. A. Cockerell contributes four excellent articles dealing particularly with the fossil insects and spiders of Florissant, Colorado. Mr. James G. Needham describes two new genera of Æschninæ (dragon flies); Dr. W. D. Kearfott, "Microlepidoptera from the Black Mountain Region of North Carolina," and James A. G. Rehn, some Australian Orthoptera.

A geological paper by Dr. E. O. Hovey upon the "Western Sierra Madre of the State of Chihuahua, Mexico," conducts the reader most instructively through regions of tropical tablelands, intervening bolsons; over "wastes of sand and arid soil, held in place to some extent by bunch grass, greasewood and mesquite"; across river-traversed or lake-dotted plains, the narrative being plentifully interspersed with geological studies of igneous intrusions, erosions, metamorphism, mines and physical features, of which perhaps the extremely level basin floors are not the least striking. The paper is well illustrated.

The volume also contains an interesting paper on Australian and Asiatic bees described from specimens belonging to the museum, and an especially informing and luminous article by Alexander G. Ruthven on a "Collection of Reptiles and Amphibians from Southern New Mexico and Arizona," a region which in several directions has furnished zoological novelties and stimulated the curiosity and zeal of collectors.

The anthropological publications of the museum comprise "Gros Ventre Myths and Tales," "Religion of the Arapaho" (the latter in the series of the Mrs. Morris K. Jesup Expedition), both by A. L. Kroeber, and "The Shasta," by Roland B. Dixon, under the results of the Huntington California Expedition.

L. P. GRATACAP

SOCIETIES AND ACADEMIES

THE AMERICAN CHEMICAL SOCIETY NORTHEASTERN SECTION

THE eighty-fourth regular meeting of the section was held on Friday, April 24, at eight o'clock P.M., at the Tech Union, Boston. About fifty members were present. Professor W. H. Walker, of the Massachusetts Institute of Technology, presented a paper on "The Corrosion of Iron and Steel," with illustrations. Pure iron is very rare, but has been prepared by the reduction of pure ferrous oxalate in a vacuum furnace. Small amounts of sulphur, carbon, phosphorus, etc., have marked effects upon the properties and corrosion of iron. Iron and steel as made at the present time appear to corrode more rapidly than products made forty years ago. (A sample of iron known to have been exposed to the weather for thirty-four years was shown with little corrosion, while a sample of steel fence wire exposed only six years was very much corroded.)

The theories of corrosion were outlined as follows:

Carbon dioxide theory: this was the earliest and has been supported by many authorities and appears in the text-books. The reactions proposed are: $4(Fe + H_2O + CO_2) = 4FeCO_3 + 4H_2$, and $4FeCO_3 + 6H_2O + O_2 = 4Fe(OH)_3 + CO_2$. This theory appears to account for the facts that corrosion is accelerated by the presence of carbon dioxide, and that alkalies inhibit corrosion. Certain experiments of G. T. Moody appeared to show that no corrosion occurs if carbon dioxide is absent.

Electrolytic theory proposed in 1903 by W. R. Whitney was based on the following experiments: Iron immersed in copper sulphate solution became plated with copper, since the copper ions with positive charges have a less electrolytic solution pressure than the iron. Since water is slightly dissociated, its hydrogen acts as a metal, and hence iron, when put into water, dissolves at a rate proportional to the concentration of hydrogen ions in the water, and to the relative ease with which hydrogen can be liberated upon the iron. Any acid which increases the concentration of the hydrogen ions will thus accelerate corrosion, while alkalies which decrease the hydrogen concentration will inhibit corrosion.

A repetition of Moody's experiments in detail established his observed facts but not his conclusions. Using phenolphthalein, it was found that alkali dissolved from the glass apparatus was sufficient to account for the slow action at first. Immersion of the iron in chromic acid renders the iron passive. But using Jena flasks carrying capillary tubes through the stoppers, and boiling the water, then quickly introducing a piece of iron and boiling again, all oxygen and carbon dioxide was expelled. While still boiling the capillary was sealed. After several days no corrosion could be observed, but on concentrating the water in a platinum dish, a good test for iron was obtained in each case, using sulphocyanate. Numerous repetitions of the experiments with elaborate precautions to prevent occlusion of gas in the iron, showed that iron went into solution every time. This supports the electrolytic theory. When bits of iron were immersed in water containing a little potassium ferricyanide and phenolphthalein, surfaces of opposite polarity on the iron soon became manifest; points at which hydrogen is liberated, *i. e.*, cathode points, became red, since hydroxyl ions are there set free. The anode points became blue, owing to the iron going into solution. The rate of solution of iron in water depends upon the electrolytic solution pressure of the iron and the hydrogen, upon the osmotic pressure of the iron ions in solution, and upon the "over-voltage" which must be overcome before the hydrogen ions pass from the ionized to the free state. The solution of iron in water becomes continuous if the cathode portions are depolarized. By using hydroxylamine or potassium dichromate as depolarizers it was found that the iron dissolved from the anode was equal to that added to the cathode portion. Oxygen acts as a depolarizer, as was shown in an experiment with a porous cell filled with, and surrounded by, water containing both ferricyanide and phenolphthalein, and connecting a piece of iron in the cell with a platinum plate in the outside liquid. The platinum showed a red color and the iron colored the liquid blue. But if the platinum were dipped in pyrogallol solution to remove oxygen from its surface, no action appears for some time until oxygen is absorbed from the air. Various experiments proved the rate of corrosion of iron in water to be a linear function of the partial pressure of the oxygen in the atmosphere above the water.

The passive condition of iron caused by chromic acid may be due to a film of oxygen formed on the iron. If heated in a vacuum this oxygen is removed: also the presence of small amounts of electrolytes destroy the inhibiting effect, and the method is of doubtful industrial value.

The more homogeneous the iron, the better it resists corrosion, since there is less opportunity for local currents to be set up. The segregation of phosphorus, sulphur, manganese, etc., in steel ingots, necessitates discarding 5 to 20 per cent. of the top of the ingot, to produce a uniform and homogeneous product. Presence of much manganese in steel indicates also much sulphur and phosphorus and hence much segregation.

Considerable discussion followed the paper and the view was expressed that both iron and steel of high degree of purity and homogeneity should be reasonably resistant to corrosion. Numerous specimens of corroded and uncorroded old iron and steel were shown, and also solutions containing phenolphthalein and ferricyanide made solid with agar-agar and containing bits of iron, to demonstrate the progress and phenomena of corrosion.

Frank H. Thorp,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 204th meeting of the society, on April 8, the following papers were presented informally:

A Wolframite-topaz Ore from Alaska: Adolph Knopf.

At the Oregon claim, Lost River, Alaska, an argentiferous ore, consisting of wolframite, galena and stannite embedded in a gangue of radial topaz with subordinate fluorite, forms a stringer lode 1 foot wide. The mineralization has taken place along a line of faulting in a dense-textured limestone of Ordovician age. Topaz is regarded as distinctive of cassiterite veins, and this occurrence of topaz as a carrier of sulphide minerals, therefore presents a number of novel features.

Mr. F. E. Wright exhibited informally three contact minerals—gehlenite, hillebrandite and spurrite, from Velardeña, Mexico, collected by Messrs. J. E. Spurr and G. H. Garrey and examined by the speaker. Of these, gehlenite appears not to have been observed before on this continent, while hillebrandite and spurrite are new species.

Regular Program

Studies in Mechanics of Allegheny Structure: Mr. Geo. H. Ashley.

A brief review of Appalachian structure as a whole, the recent theories as to the causes therefor, and some figures from the structure west of the Allegheny front in central Pennsylvania were presented. A study of the Chestnut Ridge anticline southwest of Punxsutawney shows that with a chord of 14 miles and a rise of 740 feet, the folding involved a shortening of 4.9388 + feet. If the arch were self-supporting it would exert a tangential thrust of about 290,000 tons per square foot, or about 1,000 times the crushing strength of the materials, so that it must always have been supported from below. Furthermore, had the segment of the arch been filled by the excess matter due to a crustal shortening of 4.938 + feet, a wedge 2,244 miles deep would have been required, an impossibility if isostatic adjustment be true. It would seem, therefore, that the segment was probably filled by material moved out from the adjacent synclines so that the structure from one syncline to another actually approached a convex arch between two concave arcs. The total structural shortening northwest of the Allegheny front was between 35 and 40 feet.

The faulting in the Allegheny tract from Alabama to Pennsylvania shows remarkable parallelism in lines approximately 45° from the strike of the folded structure or from the direction of the force causing the folding. These faults were always of the type known as "normal"; but the fault faces showed striæ running from 37° to 65° from the horizontal, indicating a large horizontal element in the motion. Although entirely normal, the dislocations were evidently due to the yielding of the rocks under high tangential pressure along stress planes.

Secondary Enrichment in Granite-Bimetallic mine, Philipsburg, Montana: W. H. Emmons.

The Granite-Bimetallic lode is a tabular body of silver ore from 1 to 20 feet wide which has been stoped for 4,500 feet along the strike and 2,600 feet in depth. The vein fills a fissure in monzonite along which there has been but little movement. The primary ore has a gangue of quartz and rhodochrosite inclosing a large quantity of pyrite, arsenopyrite, tetrahedrite, and tennantite, with some galena and zinc blende. Sparingly scattered through this ore are small specks of pyrargyrite, realgar and orpiment. This ore carries from 20 to 30 ounces of silver and from $1.50 to $3 in gold. Above the low grade sulphides extending from 500 to 1,000 feet below the surface is a zone of enriched oxide and sulphide ore in which the primary ore is cut by veinlets of ruby silver, argentite, native silver and horn silver. This ore carries over 100 ounces silver and $5 gold. Above the rich oxide and sulphide zone is a zone of leached oxides which extends to the surface. This ore carries less than 40 ounces silver and $2 gold.

An analysis of the mine water from a long drainage adit shows that it contains .000,147 SO_4, .000,160 iron with traces of silver and gold. These figures indicate that about .6 of a ton of iron and sulphate compounds are carried out of the mine every twenty-four hours. It is well known that iron sulphate solutions will dissolve silver and that these are precipitated again by the action of sulphides which carry an excess of sulphur. Enrichment was favored by a relief which furnished an ample head; by fracturing of the vein subsequent to the deposition of the primary ore; and by abundance of sulphides in the primary ore.

Revision of the Age of Niagara Falls: Mr. J. W. Spencer.

From the now partially buried remnants of the river banks Mr. James Wilson, C.E., and the writer were able to locate the position of the falls at the time of Father Hennepin's visit (1678). It was thus found that the rate of recession in 227 years had been substantially the same as during the 63 years between the survey of Hall (1842) and of the writer (1904–5), namely, an average rate of 4.2 feet a year. The recession of the American Falls is very slow, and this water added to the main falls would increase them by only five per cent.

Through soundings it was found that the present mean rate of recession of 4.2 feet a year has obtained only since the Falls passed a point 1,100 feet below the apex, with an effective height in recession taken at 180 feet. The time required was 260 years. Thence, northward, for 6,200 feet, the mean effective height (on account of the absence of the barrier at the Whirlpool Rapids) was 240 feet, with the rate of recession thereby increased to 5.6 feet a year. Beyond, for 10,200 feet, to near Sinclair Point, the effective height was 260–280 feet, increasing the rate of retreat to 6.5 feet a year, with the necessary time ratio of 1,570 years. As the Whirlpool only required the clearing away of the drift material, no time allowance is made for its opening. From its outlet to the head of Foster Flats (3,200 feet), with the water descending 240 feet, the rate was 5.6 feet a year, requiring 570 years. Thus, the Falls have receded about four miles, with the full volume of the river (except for a slight diversion, noted by Taylor) in 3,500 years.

From the head of Foster Flats to the end of the canyon is a distance of about three miles, and in the retreat of the Falls throughout this section only the Erie waters supplied the river (15 per cent. of the present). While receding 600 feet past the upper end of Foster Flats the height of the Falls was 240 feet, with rate of recession 15 per cent. of 5.6 feet. The proportional time allowance was 700 years. Below this point, for a distance of 13,300 feet, there were two and three falls, but the work of the upper one is now so well established that it alone furnishes the data necessary for computations. The mean height was 105 feet, and with the volume of 15 per cent. of that of the present day, the proportional rate of recession was reduced to 0.42 of a foot. This increased the time required to 31,600 years. There still remain 450 or 500 feet of the gorge to its end. Here the height of the Falls was 35 feet, so that their recession, with the small volume of water, was very slow, or proportionally only an eighth of a foot a year, at which rate 3,200 years were required. Thus, the formation of this lower and older stretch of the gorge required 35,500 years, or 39,000 for the total recession. The above figures are based on the assumption that the rainfall has been secularly uniform, with no greater increase of the drainage basins than at present.

Philip S. Smith,
Secretary

THE TORREY BOTANICAL CLUB

The meeting for April 29, 1908, was called to order at 3:45 P.M. by Vice-president John Hendley Barnhart. Fourteen persons were present.

The following abstracts were submitted by the authors of the papers presented:

The Boleti of the Forest Herbarium: William Alphonso Murrill.

This paper will shortly be published in full in one of the periodicals of the club.

Suggestions for Future Work on the Flowering Plants of the Local Flora: Roland M. Harper, chairman of the Phanerogamic Division of the Committee on the Local Flora.

There is probably not another spot in North America which has so many different kinds of country within a short distance of it as New York City. In consequence of this geographical diversity there are found within one hundred miles of here over one half of the species of flowering plants credited to the northeastern United States and adjacent Canada.

The earliest botanists in this region had their hands full with merely collecting, classifying and describing the plants. After nearly all the species had been described the next step was to record the known localities for each, and to prepare "floras" of certain limited areas. Since the middle of the nineteenth century a great deal of attention has been paid to anatomy, physiology, pathology and cryptogamic botany. Nomenclature was a leading topic for discussion among botanists a decade or two ago, and a little later ecology came into prominence, but for various reasons the latter has not proved very attractive to amateurs, at least here in the east. Experimental evolution is now attracting considerable attention, but there are very few persons qualified for this kind of research.

At the present time amateurs seem to be doing very little to advance our knowledge of the local flora, but there is no good reason why this should always be so. Notwithstanding the inroads of civilization, and the vast amount of botanical work that has already been done in this vicinity along certain lines, there are still awaiting solution here innumerable problems which can be successfully attacked by any one possessed of a fair knowledge of plants and a little spare time.

Very little of the vegetation of this vicinity has been described, still less photographed, our natural habitats have hardly been classified, and some of them have never even been adequately defined. Our dunes, marshes and Palisades, the pine-barrens of Long Island and New Jersey, and various other easily accessible places have been little damaged by civilization, and offer a fertile field for study, but the opportunities for ascertaining their natural condition are growing less every year, so no time should be lost.

We have very little definite knowledge of the flowering periods, modes of dissemination, natural habitats and boundaries of the ranges of some of our most familiar plants. To illustrate some of the many taxonomic, geographical, ecological, phænological and statistical problems which now confront us, a list of about twenty illustrative questions was submitted, and recommended to the consideration of the members of the club. Answers to them, or suggestions of similar questions, were earnestly invited.

The paper will be published in full in a future number of *Torreya*.

Exhibition of Specimens recently collected in Jamaica, with Remarks: N. L. Britton.

A specimen was exhibited of the nest of the Jamaica swift made from the downy seeds of species of *Tillandsia*, and presented to the New York Botanical Garden by F. B. Sturridge, Esq., of Union Hill, Moneague, Jamaica.

Fruits were also shown of the Jamaican species of *Hernandia*, preserved in formalin, together with herbarium specimens from the same tree, found by Mr. William Harris and myself on the wooded hill near Dolphin Head, a mountain near the western end of Jamaica, and collected March 21, 1908. This tree is one of the largest of the Jamaican forests and apparently either very rare or very local in its distribution. It attains a height of at least 30 meters and a trunk diameter of over a meter. It has not been very definitely known to botanists, inasmuch as Patrick Browne in the "Civil and Natural History of Jamaica," published in 1756, knew of its occurrence there only by rumor, and it is not recorded for Jamaica by Grisebach in the "Flora of the British West Indian Islands." In the treatment of the genus in De Candolle's "Prodromus," Meissner attributes it to Jamaica on the authority of Patrick Browne, but Mr. Harris, in his extensive exploration of the forests of the island, had not been able to find much of it until this discovery near Dolphin Head, where a tree some 20 meters high was cut down and fine fruiting specimens obtained. An examination of these specimens in comparison with those of the other species indicates that the Jamaican tree differs from those of the other West Indies and of the East Indies, and should be defined as a species new to science.

C. Stuart Gager,
Secretary

DISCUSSION AND CORRESPONDENCE

THE ADAMS FUND

It is needless to repeat in this paper what the Adams Act is, except to emphasize that the appropriation was made for the purpose of conducting original investigations in all branches of agricultural science, and that those institutions and investigators that draw from the funds keep before them the obligation under which they are placed when they accept the conditions of the funds. There is, I think, a certain class of workers in the experiment stations who fear that the work under the Adams Fund will prove too technically scientific, and therefore seem to think that greater latitude should be accorded each station in the use of its pro rata of the funds.

During the many years that experiment stations have existed in this country, with few exceptions, they have done mostly demonstrative work, and results have necessarily been empirical, and admitted only of local application. Many of them have spent their time and energy farming, and making special experiments with fads, trying to eradicate "fogy notions" about the effect of the dark and light nights on planting ordinary farm crops, or satisfying any popular belief. The demands that have arisen from time to time among the farmers, especially the southern farmers, have been of this nature, and have determined in a great measure the progress of some of the stations. Even now, we sometimes hear arguments to the effect that experiment station work should never overshoot the heads of the average farmers, and even in scientific work we should try to simplify the work so the farmer can understand it.

I am by no means a favorer of anything

done at experiment stations that does not eventually redound to the good of the farmer, but, at the same time, I would have uppermost in mind what really benefits the farmer, not so much what he thinks benefits him. Institutions of this kind are organized for the purpose of deriving far-reaching conclusions, and the schemes to be worked out should be determined by those who have made a deep study of agriculture in its broadest sense, and not by those who have had handed down to them the ideas they daily put in practise. Agriculture is the greatest of all vocations, at least of all industries, and yet it is only recently that science has been directed along agricultural lines, and it has probably been well for the work that the above conditions have existed. In the first place, there were few men who were prepared to undertake the work, and, second, appropriations have been hard to get.

It is now twenty years since the organization of experiment stations, and a new era of progress and possibility is upon us and we should dismantle ourselves of the old robes of skepticism in regard to agricultural sciences. Some of the stations have always had high ideals, many of them have been bordering the scientific phase of agriculture for a good many years, but others have always held and still hold to the idea that they must busy themselves trying to satisfy the immediate demands of an uneasy public. Stations that do not busy themselves with the fundamental laws of agricultural science may always expect to have this kind of work to do; for the farmer finds out what is wrong before such stations are able to give out something more promising. In that case the farmer is the leader instead of the stations.

This condition was seen and fully contemplated by Mr. Adams, when he introduced a bill to increase the annual appropriations for the national and state experiment stations, else the special clause providing for a specific phase of station work would never have been incorporated in the bill. If all stations had conformed to the high ideal that some of them have always maintained, it would never have occurred to him that the funds must be set aside for research work. He knew as we all know that the practical side of station work is indispensable, not only to the good of the farmers of the states, but to the theoretical work as well, and feeling, as I have intimated before, that many of them were depending altogether on this phase of the work, he set about to raise the standard by specifying that the new funds must be used to prosecute original research work, and to make his purpose carry he had the funds put into the hands of the Secretary of Agriculture, whose duty it is to see that the said funds shall not be misspent.

By virtue of these limitations, it becomes the duty of those who enter into the work to confine themselves strictly to the scientific phase of agricultural work. If they carry out the original purpose of the funds, they must in the course of their work hit upon the basic or fundamental principles that in the end determine real progress. The day of experimentation must yield to the inevitable day of investigation, and the investigator must not undertake a diversity of projects, but work along narrow lines that he may be fully able to concentrate his mind on the purely technically scientific phase of his work. In fact, there is little room to doubt that a project is admitted under the provision of the funds, only as the investigator interprets it from the standpoint of science. It may have practical application, but must be scientific. It may be work on old themes, but it must be a new phase of them.

In view of the considerable confusion brought about by the use of the Adams Fund at the stations, I wish to emphasize that no greater mistake can be made than to preach immediate application of results from those who are working under it. This was not contemplated by Mr. Adams. Farmers have to be educated gradually to an acceptance of any valuable scientific truth in agriculture, and to persuade them that they should keep abreast with men of science is to demoralize them in the extreme, and fill their minds with skepticism. When larger truths have become feasible, the farmers will be the ones to reap the benefit, and until they have become feasible, let them be confined to the scientific workers. The man or institution that has not already begun to lay broad foundations may well be considered among the condemned. Only those who have the true spirit of investigation will win out under the Adams Fund. Instead of winning out by popularity, they will win out in spite of popularity, if they must work for popularity. Being able to reduce science to the popular is no indication of success, whether it be astronomy, meteorology, physiology, pathology, botany, bacteriology, medicine, or what-not. The fact that any truth becomes popular in any degree should be because of its broad application, and should, and generally does, bespeak years of sacrifice on the part of some investigator. Whatever is worthy to be called truth is worthy the best there is in us, and especially should this be so in agricultural science, where results will benefit almost the whole of the human race.

R. J. H. DELOACH,
Botanist
GEORGIA EXPERIMENT STATION,
EXPERIMENT, GEORGIA

LIKELY PLACES FOR EVIDENCE AS TO THE HISTORY OF THE EVOLUTION OF THE ANTHROPOID APES AND PRIMITIVE MAN

THE recent discovery of the chimpanzee in a part of Africa where it had not been previously known to exist enables us now to define a few regions in which the gorilla, the chimpanzee and the pygmies are found in conditions suggestive of the possibility of the discovery of fossils of their ancestry in a good state of preservation.

Until these new loci could be determined, the geological character of other regions where one of the three occurred was not such as to encourage hopes of the kind.

The writer is engaged upon the determination of these likely places, and wishes now to call attention to the matter, so that in the exploration going on in Africa the scientific importance of the matter may receive due attention. The pygmies are now known to have existed practically *in situ* for three thousand years, and there is abundant antecedent probability that the two great anthropoids there now have been there for as great or greater a length of time.

Indeed, the writer believes that it will soon be possible to indicate localities, of less than a few hundred square miles in area, in which the likelihood of discovering these fossils is very great. His own explorations have partly been responsible for this conclusion, and an increasing knowledge of the geology and petrology of the great African crest has helped to augment the surmise. Correspondence on this subject is invited.

S. P. VERNER
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SPECIAL ARTICLES

A SIMPLE REFLECTION GONIOMETER

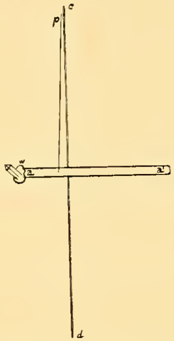
THE lack of a reflection goniometer has probably prevented many persons from measuring crystals and has consequently limited the study of crystals. The use of the contact goniometer is confined to fair-sized crystals with faces of appreciable size. Minute faces even on large crystals can not be measured by the contact goniometer.

In order to encourage the study of crystals the writer desires to describe a simple and convenient reflection goniometer which can be made of materials costing but fifty cents. It is simply Penfield's cardboard contact goniometer, model B,[1] fitted with an axis. The axis, upon one end of which the crystal is mounted, is provided with a pointer by which the interfacial angles may be read off.

The accompanying figure is a diagrammatic cross-section of the apparatus. *cd* is the cardboard protractor, consisting of a semi-circle of seven cm. diameter. *aa'* is the axis which is a cylindrical piece of wood four mm. in diameter and about five cm. in length. This axis must fit snugly into the eyelet of the protractor so as not to wobble when it is revolved. On one end of the axis is a piece of wax, *w*, upon which the crystal is mounted. *p* is a fine piece of wire attached to the axis, by means of which interfacial angles are read off on the protractor.

[1] Sold by E. L. Washburn & Co., New Haven, Conn. (price, 50 cents). It is better to cut off the celluloid arm of the protractor.

The crystal is mounted so that the intersection edges of the faces to be measured are parallel to and almost in line with the axis. The goniometer is held so that the crystal is close up to the eye, that is, with the protractor part extending perpendicularly in front of and away from one. The crystal is rotated by means of the axis until the reflected image of a window bar, electric light or similar object for a particular face coincides with



some line of reference such as a chalk mark on the floor, a ruler or the edge of a table. The reading is taken for this face, then the crystal is rotated until a similar image is obtained for an adjacent face. The difference between the two readings is the desired interfacial angle (supplement angle). And so on for other faces in the zone. As the protractor is a semi-circle, only 180° of a zone may be measured at one time and the crystal must be remounted for the rest of the zone. A face must always be connected up with its image.

The sources of error are: first, the edge can not be made to coincide exactly with the axis, and second, the angles can not be read much closer than quarter degrees. Yet the goniometer furnishes a simple method of measuring small crystals with bright faces even when the faces are minute, and of testing whether a given face lies in a given zone.

Some measurements obtained on pyrite crystals will show the accuracy of the instrument. The calculated angles are indicated in parentheses alongside the measured angles. $210 \wedge 311 = 25°$ $(25° 14')$; $311 \wedge 211 = 10°$ $(10° 2')$; $211 \wedge 111 = 20°$ $(19° 28')$; $210 \wedge 100 = 27°$ $(26° 34')$; $210 \wedge 111 = 38°$ $(39° 14')$. These faces were all bright and gave good images, but some of them were less than one half mm. in width.

Austin F. Rogers
Stanford University, Cal.

THE EXISTENCE OF RŒSTELIA PENICILLATA AND ITS TELIAL PHASE IN NORTH AMERICA

In taking up the study of the flora or fauna of a new region systematists attempt to make use of established names. In doing so they sometimes apply them to forms afterwards found to be wholly unlike those for which the name was originally intended. The name then occurs in the literature and the matter of determining what the species listed under it really are may require much subsequent study. Such is the case, in the mycological literature of North America, with *Rœstelia penicillata*,[1] a very old European name dating back to the time of the earliest mycological workers. It was chiefly applied by the first American authors attempting systematic work in this field to the form *Rœstelia pyrata*, now known to be distinctly American, but some other entirely distinct forms such as *Rœstelia globosa* and *Rœstelia lacerata* were often referred to it, so that it is not possible to determine in every instance just what species some earlier American writers had in mind when they used the name *R. penicillata*. It was frequently used in local catalogues and was much overworked, until somewhat later it was authentically shown by an American investigator[2] that the genuine *R. penicillata* of Europe was a very characteristic form differing materially from anything then known in this country. At that time, however, exploration had not extended beyond the eastern and central states, and that there should occur in the western mountains strange and different forms is not a matter of surprise, but that

[1] *Rœstelia penicillata* (Pers.) Fries, Sum. Veg. Scand., **2**: 510. 1849. (*Æcidium penicillatum* Pers.; Gmel. Syst. Nat., **2**: 1472. 1791.)

[2] Thaxter, *Proc. Am. Acad.*, **22**: 265. 1886.

R. penicillata should exist there is an item of peculiar interest. The fact that the first specimens of it collected in that region were described as a new species, *R. fimbriata*,[3] serves as a natural continuation of the confusion regarding the species in America, and it may be properly remarked here that there has also been some confusion in Europe regarding its identity. To reiterate, then, the name *R. penicillata* was introduced into American literature and first made to apply to forms afterwards found to be distinctly American, it was next decided that it belonged exclusively to a European species not occurring in North America, and that view is probably the prevailing one at present.[4] Now, when we make out that we have the species to which the name in its proper usage belongs, we find that it has already been described under an independent name.

Discovery that this peculiar rœstelial form existed in this country immediately raised the question as to why the telial phase should also not occur. Turning to the work of European investigators[5] who had conducted culture experiments, it was soon made out that the *Gymnosporangium* stage was also very characteristic and unlike any of our well-known American species. An examination of several large herbaria had not revealed any such specimens, and since it was known to have such a peculiar form it seemed evident that it had never been collected in this country. The fact, however, that the rœstelial form existed here seemed convincing evidence that the telia should also occur. Several collectors in the proper regions were then interested in the matter, the form was described to them and they were asked to be on the lookout for it in the field. The results were most gratifying, for two collections were made during the season of 1907, one in Colorado and another in Alberta, Canada.[6] These specimens agree well with the foreign ones in general appearance as well as in size and shape of the spores and other microscopic details. Their host is the dwarf juniper, *Juniperus siberica*.

Having concluded that *Rœstelia penicillata* existed in this country and with it, a *Gymnosporangium* identical with the form culturally connected with it in Europe, it becomes a point of interest to inquire the name of the *Gymnosporangium*. European writers usually refer to it as *Gymnosporangium tremelloides* of R. Hartig. Hartig established his name in 1882 after he had made cultures. *Rœstelia penicillata* has been known since 1791 and many authors have referred to it, therefore it did not seem probable that its telial phase, conspicuous as it is, should have remained uncollected until 1882. A study was then begun which ended in the decision that the original *Tremella juniperina* of Linnæus's "Species Plantarum" was none other than the telial phase of *Rœstelia penicillata*. The specific name *juniperina* becomes, therefore, the name of the species, and if we refer it to *Gymnosporangium* the combination is *Gymnosporangium juniperinum* (L.) Mart., Fl. Crypt. Erlang. 333. 1817.

Frank D. Kern
Purdue University,
Lafayette, Indiana

[3] Arthur, "New Species of Uredineæ," I., *Bull. Torrey Bot. Club*, **28**: 666. 1901.

[4] Farl. Bibl. Index, **1**: 77. 1905. "Under *Æcidium piratum* are given the references to the *Æcidium* of *Gymnosporangium macropus*, but, as the names *Æcidium piratum* and *Æcidium penicillatum*, the latter being in fact the name of a European species not found in North America, have been confused by some American writers, some of the following references may belong to other species."

[5] R. Hartig, *Lehr. Baumkr.*, **1**: 133. 1882; Ed. Fischer, *Hedw.*, **34**: 1–6. 1895; Tubeuf & Smith, "Diseases of Plants," 389. 1897.

[6] The Colorado specimen was collected at Laveta, June 20, 1907, by Miss Allen, of Professor F. E. Clement's party of summer students, and communicated by Professor E. Bethel, of the East Side High School, Denver, Colo. The Alberta collection was made at Laggan, July 20, 1907, by Professor E. W. D. Holway.

RESEARCH DEFENSE SOCIETY[1]

A society has been formed, with the name of the Research Defense Society, to make

[1] Lord Cromer has accepted the presidency of the Research Defense Society, to the organization of which we recently called attention, and has addressed this letter to the editor of the London *Times*.

known the facts as to experiments on animals in this country; the immense importance to the welfare of mankind of such experiments; and the great saving of human life and health directly attributable to them.

The great advance that has been made during the last quarter of a century in our knowledge of the functions of the body, and of the causes of diseases, would have been impossible without a combination of experiment and observation.

The use of antiseptics, and the modern treatment of wounds, is the direct outcome of the experiments of Pasteur and Lister. Pasteur's discovery of the microbial cause of puerperal fever has in itself enormously reduced the deaths of women in child-birth.

The nature of tuberculosis is now known, and its incidence has materially diminished.

We owe the invention of diphtheria antitoxin entirely to experiments on animals.

The causes of plague, cholera, typhoid, Mediterranean fever and sleeping sickness have been discovered solely by the experimental method.

Not only have a large number of drugs been placed at our disposal, but accurate knowledge has replaced the empirical use of many of those previously known.

The evidence before the Royal Commission has shown that these experiments are conducted with proper care; the small amount of pain or discomfort inflicted is insignificant compared with the great gain to knowledge and the direct advantage to humanity.

While acknowledging in general the utility of the experimental method, efforts have been made by a section of the public to throw discredit on all experiments involving the use of animals. The Research Defense Society will therefore endeavor to make it clear that medical and other scientific men who employ these methods are not less humane than the rest of their countrymen, who daily, though perhaps unconsciously, profit by them.

The society proposes to give information to all inquiries, to publish *précis*, articles and leaflets, to make arrangements for lectures, to send speakers, if required, to debates, and to assist all who desire to examine the arguments on behalf of experiments on animals. It hopes to establish branches in our chief cities, and thus to be in touch with all parts of the kingdom; and to be at the service of municipal bodies, hospitals and other public institutions.

The society was formed on January 27 of the present year, and already numbers more than 800 members. It is not an association of men of science or of medical men alone; its membership has been drawn from all departments of public life, and includes representatives of every class of educated Englishmen and Englishwomen, including many who have taken an active part in the prevention of cruelty to animals. This fact is in itself a remarkable protest against the attacks which have been made on the researches that the society has been formed to defend.

The annual subscription is 5s. to cover working expenses, but larger subscriptions or donations will be gladly received. The acting hon. treasurer, *pro tem.*, is Mr. J. Luard Pattisson, C.B. (of the Lister Institute); and an account in the society's name has been opened with Messrs. Coutts and Co., 440 Strand. The hon. secretary is Mr. Stephen Paget, 70 Harley Street, W., to whom all communications should be addressed.

THE ADMINISTRATION OF SYRACUSE UNIVERSITY[1]

Syracuse University,
June 3d, 1908.

To the Board of Trustees of Syracuse University.

Gentlemen: I hereby decline to tender you my resignation as Dean and Professor of Mechanical Engineering in the L. C. Smith College of Applied Science, and ask you to

[1] This letter from Dean Kent to the board of trustees of Syracuse University is printed for the information of scientific men. It need scarcely be said that Science is ready to print a statement in justification of the administration of Syracuse University from the chancellor or from any responsible source.—Ed.

vote upon the question of my dismissal, which has been recommended by the Executive Committee. I thus give you the opportunity to vote against a faithful servant of the University in order to please the Chancellor.

I believe the trustees are satisfied that the vague, indefinite and unsupported charges made against me by the Chancellor have no foundation in fact but are based on his unreasoning imagination, and that if it were possible to give me a fair trial before a jury of expert engineering educators, I would not only be acquitted of all charges, but would be commended for my five years of faithful and efficient labors. I believe, moreover, that the majority of the trustees would gladly vote to retain me in my position but for the fact, as I stated in a letter to the trustees dated May 29th, that "they are afraid that if they voted against the Chancellor he would resign, and as the University needs money, which they think he alone can raise, he must be retained for his money-getting ability, no matter how objectionable he may be in other respects."

I think the trustees are mistaken in their idea that the Chancellor is the only one who can raise money for the University, for other colleges and universities all over the land are getting large sums of money without his aid. Even if it were true that he is needed as a money-raiser, I venture to suggest to the trustees that the two capacities in which the Chancellor is preeminent, viz., oratorical power and power of getting money, do not necessarily qualify him for the exercise of autocratic power over all the interests of a great university. They do not qualify him as a judicious spender of money, as an educator, as a judge of men, as a ruler of deans and faculties, as a disciplinarian, as a landscape artist, as an architect, or as a harmonizer of conflicting interests or ideas. The autocratic system of government of a university is a bad system.

A writer in the *Independent* of December, 28th, 1905, thus described the situation in a university under autocratic control:

> When the wisdom of letting a man lord it over an aggregate of employees instead of conferring with a company of scholars is questioned, the answer is the efficiency with which the autocrat can get things done. The president gets money and students and builds marble palaces. . . . The president may draw students from one institution to another; he does not create them. The marble palaces may be mausoleums for the preservation of the corpses of dead ideas and monuments erected to the decay of learning.

I suggest that if it is necessary to have an orator and a money getter for the chancellor of a university, there is no reason why his activity should not be confined to those things in which he is an expert. There is no reason why he should be given autocratic power in things in which he is not expert. The administration of these things had better be left to the separate colleges, to the University Senate, to committees of trustees, or to minor officials, as may be most suitable for the different objects to be accomplished.

In closing I wish to comment on a rumor which I am informed is being industriously circulated. It is to the effect that I have entered upon a fight to do all the damage I can to Syracuse University. Nothing could be further from the truth. In fact, I have often said, and I say now, that the fight I have been making is the best thing that could happen to the University. I am giving it a house-cleaning which it very much needs; I am bringing to the light of day some things that should be exposed; I have revealed the existence of certain diseases, and have prescribed the remedies; that is all. Some day the University will have a higher ideal than that of mere bigness, a Chancellor who is an educator and who will not try to be an autocrat, a board of trustees that will be in touch with educational affairs, and deans and faculties who can keep their positions without sacrificing their self-respect. Then the humiliation through which the University is now passing will be forgotten and it will reach the dignity of being one of the great intellectual centers of the world.

Very respectfully,

WM. KENT

HANOVER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Since the preliminary announcement of the special summer meeting to be held at Hanover, New Hampshire, June 29 to July 3, was published and mailed with the number of Science for May 29, the permanent secretary has learned that Sections I and L will not hold the meetings announced. Section B (Physics), and Section E (Geology and Geography), will therefore be the only sections to hold stated meetings for the reading of papers at Hanover. These sections will meet in conjunction with the American Physical Society and the Geological Society of America.

This fact need not deter members who wish to visit Dartmouth College at this time and take the excursions announced. Hanover is a charming little town and has a delightful summer climate. It is in the center of a most interesting region and members are urged to attend the meeting.

This reduction in the number of sections which will hold sessions makes it all the more important that members of Sections B and E and others who attend should go on the Certificate Plan. Members living only a short distance from Hanover, paying railroad fares of even less than one dollar, should take out a certificate and secure the two thirds of one fare reduction of the original ticket, since, unless at least 100 certificates are viseed at Hanover, the reduction in fare will not be operative. This will mean that, owing to the neglect of nearby members to take out certificates, members coming from a distance may possibly be deprived of the advantage of the reduction.

L. O. Howard,
Permanent Secretary

Smithsonian Institution,
Washington, D. C.

SCIENTIFIC NOTES AND NEWS

The inaugural session of the Dublin meeting of the British Association will be held on Wednesday, September 2, at 8:30 p.m., when Mr. Francis Darwin assumes the presidency, in succession to Sir David Gill, and will deliver an address. On Friday, September 4, the first evening discourse will be delivered by Professor H. H. Turner, of Oxford University, on "Halley's Comet." On Monday, September 7, the second evening discourse will be delivered by Professor W. M. Davis, of Harvard University, on "The Lessons of the Colorado Cañon." The concluding meeting will be held on Wednesday, September 9, at 3 p.m.

The following appointments have been made to the staff of the Rockefeller Institute for Medical Research: P. A. Lewis, assistant in pathology; A. I. Kendall, assistant in bacteriology; A. R. Dochez, fellow in pathology; A. O. Shaklee, fellow in physiology and pharmacology. The following promotions have been made: John Auer, associate in physiology and pharmacology; Don R. Joseph, assistant in physiology and pharmacology; Alexis Carrel, associate in surgery; J. W. Jobling, associate in pathology; Benjamin T. Terry, assistant in protozoology; Donald D. Van Slyke, assistant in biological chemistry; Walter A. Jacobs, assistant in biological chemistry; Bertha I. Barker, fellow in pathology; R. V. Lamar, fellow in pathology.

Professor F. Silvestri has come to New York for the purpose of studying the collections in The American Museum of Natural History, whose guest he will be during the summer months. Professor Silvestri holds the chair of entomology in the School of Agriculture, Portici, Italy.

The towns of Breslau and Bremen have given £500 each; those of Halle and Königsberg, £150 each; those of Stettin, Duisburg and Altona, £50 each; and the German Medical Societies' Union, the German Public Health Association and the German Surgical Society, £25 each, towards the establishment of the Robert Koch Institute.

The University of Pennsylvania has conferred its doctorate of science on Dr. Edwin G. Conklin, who leaves the university to accept the headship of the department of biology of Princeton University.

George Washington University has conferred its doctorate of laws on Mr. F. J. V.

Skiff, director of the Field Museum of Natural History, Chicago.

Sir Frank Lascelles, the British ambassador in Berlin, attended on May 23 the celebration of the eightieth anniversary of the foundation of the Gesellschaft für Erdkunde zu Berlin and received, on behalf of Captain R. F. Scott, R.N., commander of the British National Antarctic Expedition, 1900–4, the gold medal which the society has conferred upon him.

Dr. B. H. Scott, botanical secretary of the Linnean Society, has been elected president to succeed Professor W. A. Herdman. The gold medal of the society has been conferred on the Rev. T. R. R. Stebbing, F.R.S.

Mr. Alfred Marshall, who recently resigned the professorship of political economy at Cambridge, and with it his professorial fellowship at St. John's College, has been elected an honorary fellow at that college.

Dr. Hermann Kobold has become editor of the *Astronomische Nachrichten*.

Professor Robert DeC. Ward, of Harvard University, sails for Rio de Janeiro on June 20, as a member of the Shaler Memorial Expedition to South America. Professor Ward will spend about seven weeks in Brazil, where he intends to make certain climatological and geographical studies. He returns to the United States at the end of September.

Dr. Edmund Otis Hovey of the American Museum of Natural History, who visited the West Indies immediately after the eruptions of Mt. Pelé and La Soufrière in 1902, is now making an extended tour of the islands with a view to supplementing his studies in vulcanology. It is expected that he will return to New York about July 23.

Professor Collier Cobb, of the University of North Carolina, has joined Professor W. M. Davis for geographical work in Italy.

Dr. James H. Woods, who occupies the position of assistant professor of philosophy at Harvard University, is at the present time continuing his studies of the several Hindu systems at Maha-Baleshwara, a hill-station in the Western Ghauts, about one hundred miles southeast of Bombay.

At the first annual meeting of the Worcester Polytechnic Institute Chapter Sigma Xi, on June 8, Dr. Arthur Gordon Webster, professor of physics at Clark University, gave the address on "The Object of Scientific Investigation."

The annual address before the Colorado Chapter of the Sigma Xi, at the University of Colorado, was delivered on May 30, by Dr. Florian Cajori, of Colorado College. Dr. Cajori took as his subject the history of the theory of the conservation of energy.

Dr. C. P. Steinmetz delivered a lecture in the Engineering Societies' Building, New York, on Sunday, May 17, before the students and friends of the New York Electrical Trade Schools, his subject being "The Future of Electricity."

The address at the ninth annual commencement of the Clarkson Memorial School of Technology on June 12 will be given by Dr. Henry Taylor Bovey, dean of the Faculty of Applied Science of McGill University.

The British Association of Technical Institutions has decided to make the following awards: Prize for the best essay on "The Bearing of Technical Education on Industrial Progress" to Dr. John Ryan, Grove-house, Milltown, county Dublin, £25; and for the best essay on "The Bearing of Technical Education on Agriculture and Industries of a Rural Character" to Mr. Edgar Chamberlain, Municipal Technical School, Monk's-road, Lincoln, £25.

At the annual meeting of the American Neurological Association, held recently in Philadelphia, the following officers were elected: *President,* Dr. S. Weir Mitchell, Philadelphia; *vice-presidents,* Drs. Pearce Bailey, New York, and Frank W. Langdon, Cincinnati; *secretary and treasurer,* Dr. Graeme M. Hammond, New York City, and *councilors,* Drs. Henry M. Thomas, Baltimore, and Charles W. Burr, Philadelphia.

At the annual meeting of the Department of Microscopy of the Brooklyn Institute of Arts and Sciences the following officers were elected for the ensuing year: *President,* John

J. Schoonhoven; *vice-president,* Thomas I. Miller; *secretary,* Agnes Vinton Luther, *curator,* James Walker. This is Mr. Schoonhoven's fourth year as president of this society.

UNIVERSITY AND EDUCATIONAL NEWS

The Court of Appeals at Albany, N. Y., has handed down a decision in which the efforts of the next of kin of Josephine Louise Newcomb, widow of Warren Newcomb, who died in New York City in 1901, to set aside her will, executed in Louisiana, and to secure a portion of her estate, are nullified and her bequest of her entire estate of about $2,000,000 to the H. Sophie Newcomb Memorial College of New Orleans, a department of Tulane University, is sustained.

At the commencement exercises of the Massachusetts College of Pharmacy it was announced that the college had acquired an endowment fund amounting to $150,000 by the terms of the will of Warren D. Potter. Mr. Potter, who was a wholesale druggist, died a number of years ago, and by the provisions of his will a residue of his estate reverted to the college two years after the death of his wife.

George Washington University has received a gift of $5,000 from the alumni association of Colorado.

In the period from 1893 to 1899 the funds of Stanford University, including the estate of Mrs. Stanford herself, were completely tied up by litigation, leaving the university no income save the sum annually allowed by the Probate Court to Mrs. Stanford for the maintenance of her personal service. During this period Mrs. Stanford devoted all funds accessible to her to the maintenance of the institution. Among other things she possessed a very valuable collection of jewels, the gift of her husband, many of them being of historic interest. These were held by her in reserve for the use of the university, about half of them being sold in London by her at the time of the queen's jubilee, and the proceeds were made available to the university at a time when they were sorely needed. By the terms of her will the rest of these jewels were to be sold and a "Jewel Fund" constituted, the proceeds of which were to be devoted in perpetuity to the purchase of books for the University Library. By the act of the trustees of the university this fund has now been segregated as a library endowment. The fund as at present constituted amounts to $500,000, the interest annually being $25,000.

The report of the syndicate appointed to superintend the provision of buildings for the Department of Agriculture, at Cambridge, states that the university has provided a suitable site adjoining the Botany School, and that a sum of nearly £13,000 has been subscribed or promised by the Drapers' Company and by a number of prominent landowners towards the cost of the building. Plans have been prepared which meet with general approval, but the building can not be begun until a further sum of at least £2,000 has been subscribed.

Dickinson College, Carlisle, Pa., is this week celebrating the hundred and twenty-fifth anniversary of its foundation. Oberlin College celebrates its seventy-fifth anniversary.

Dr. Joseph Barrell has been promoted to a professorship of geology at Yale University.

Dr. S. R. Williams, tutor in physics in Barnard College, Columbia University, has been appointed associate professor and head of the department of physics at Oberlin College.

At Harvard University Mrs. Wilfred MacDonald has been appointed instructor in mathematics, and Mr. D. C. Rogers, assistant in applied psychology at Harvard University.

Warner Brown, Ph.D. (Columbia), assistant in psychology in Columbia University, has been appointed instructor in psychology in the University of California.

At the Northwestern University Medical School, Dr. Prentiss, of Harvard University, has been appointed assistant professor of anatomy, and Dr. S. Walter Ransom, associate in anatomy.

Dr. Wolfgang Ostwald has qualified as docent in physiology in the University of Leipzig.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JUNE 19, 1908

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PLANT PATHOLOGY IN ITS RELATIONS TO OTHER SCIENCES

IN the naming of this association of scientists, The Illinois Academy of Science,[1] there was recognized a very subtle tendency in advancing civilization and modern educational thought. It has often been noted that as civilization becomes more highly developed, it also becomes more complicated, and men become more dependent upon one another. So, too, as knowledge increases in volume and in extent, the fields of study which were formerly quite independent grow closer together, and, new fields opening up, find themselves involved with many others already existing. We are finding, in fact, that knowledge is a unit—not a mere assemblage of disconnected ideas, so that it is advantageous, now and then, to examine a new science, and to discover, in so far as we can, with what other parts of the body of science it may be intimately related. Therefore, it has seemed advisable to consider, this morning, how plant pathology is related to other sciences.

Plant pathology is one of the youngest, and perhaps one of the least understood, of the recently developed sciences. When considered in its broadest meaning, it is for plants, as medical science is for man, a study of the normal, and of the diseased conditions of the organism. In the narrower and more widely accepted sense, however, it deals with the abnormalities

[1] This paper was read before the academy at its first regular meeting, held at Decatur, Illinois, February 22, 1908.

both of form and of function, which in animals are, and in plants may be, called diseases. There is one other phase also which must always appear, that of the prevention and the cure of the maladies.

Few people who have not studied the matter realize the very large loss of money occasioned each year by these plant diseases, and fewer yet know that much has already been done to diminish this loss, and much more will be done when more scientific and detailed study is carried on by a larger number of investigators scattered widely over the country. A conservative estimate of the loss caused by the bitter rot of apples throughout the country each year, is ten millions of dollars. In the state of Illinois, the loss, due to corn rot, for the past year, is estimated at perhaps two hundred and eighty thousand dollars. But we want to know what may be done to reduce such losses. It is a part of the work of the plant pathologist to discover how this may be done, and for many diseases a remedy has been found.

By proper spraying methods, on a commercial scale, ninety per cent. of the loss from peach yellows has been saved. Oat smut has nearly lost its terrors for the scientific farmer, because of the method of "seed" treatment which kills the smut spores. In New York a properly sprayed vineyard gave a net profit of over fifteen hundred dollars more than the same vineyard, unsprayed, yielded the previous year. Diseases of various origins have been treated and the loss caused by them has been materially reduced. Moreover, the importance of this work is increasing with the growing population, for crops are becoming more extensive and crowded, a condition which gives two of the important factors that tend to produce great epidemics of diseases.

The science of plant pathology, like bacteriology, is very closely related to botany, and in a broad classification of the sciences would be considered a part of that great subject. Yet, with equal justice, it may be considered as a separate science, closely related, first to botany, then to zoology, chemistry and physics.

The affiliations with botany are varied and strong. If we consider those diseases which are caused by parasitic fungi, as rusts, mildews and so forth, or by bacteria, as many "wilts" of garden plants, or even by the parasitic flowering plants, such as the dodder and the mistletoe, we must first know the names and the systematic relations of these invading organisms. Here at the outset we come in touch with that great department of the science, systematic botany, which, for very many years, engaged the entire attention of botanists.

Hand in hand with this first part of the investigation goes the study of the morphology of the parasite, for to determine the name we must know the peculiarities of form and of structure which distinguished it from all of its relatives. Moreover, the parasite, if it grows on two or more different plants, may show various modifications of its own form, according to the plant on which it happens to develop. Thus, the common grain rust, *Puccinia graminis,* when growing on its alternate host-plant, the barberry, produces entirely different kinds of spores from those on the grains. Pathology and morphology cross paths also at another point. A large and important field of study now being developed is that of the correlation of the natural structure of the plant attacked, with the modifications due to the disease. This work is essential for two reasons. We may thus learn, in regard to diseases caused by organic beings, in what manner the parasite attacks and destroys the host-plant. A disease, however, may not be caused by an organism, but may result from certain known or unknown improper physical conditions of the plant's environment. Hence this study may result in a better differentiation between these so-called "physiological diseases," and the derangements caused by parasites.

Plant physiology is no less important in the study of plant diseases than morphology. We must know the normal functions of the plant attacked, and be able to realize in what way they have been deranged. Thus, if a parasite is the cause of the disease, it may bring about the death of the host-plant in one or more of the following ways: It may strangle the plant by clogging the water-conducting vessels, as in the bacterial "wilt" of melons, already referred to. Again, it may give out a poison which kills the protoplasm of the cells affected, as De Barry describes for one of the *Sclerotinia* diseases. The third method is by absorbing the food, water or the protoplasm itself, from the cells of the host. This seems, at the present time, to be the most common mode of attack, especially in those diseases, like leafspots, which remain localized in some organ. When an organism has the power of injuring more than one kind of plant, its own functions may be modified according to varying conditions. This is important in seeking means of curing or of preventing the disease. A good example is the common grain rust mentioned previously, which, though identical in form and appearance, on wheat, oats and rye, can not be taken from any one of the three hosts and grown on either of the others.

Plant pathology not only owes much to these departments of botany, but also to bacteriology. Laboratory methods which have been found useful in the latter have been adapted to the somewhat different needs of the former. The use of culture media, though not so absolutely necessary for elementary work in pathology as it is in bacteriology, is, however, very common, and, doubtless, special media for special organisms are more numerous here than in the allied science. Since Dr. Burrill, of the University of Illinois, demonstrated in 1879 that in one instance, at least, the pear blight, a plant disease might be caused by bacteria, many diseases have been shown to be of similar origin, and here, naturally, the pathologist becomes very closely allied with the bacteriologist.

Of more and more importance to the country is forestry, on which, eventually, large portions of the land must depend for rainfall and for timber. With this is closely allied our science of plant pathology. There are many diseases of trees, which, unless curbed, threaten the growing of forests. One need but to refer to the "punk" disease of the longleaf and of the shortleaf pines and to similar decays of other forest trees, to justify this claim. Indeed, this is so important that a forest pathologist has recently been appointed by the government to study these diseases more carefully. It is unnecessary to dwell upon the increasing importance of the science to agriculture, for we have already noted their close relation.

We have seen that botany in all its phases is intimately associated with the study of plant diseases, but now we will consider what other sciences have an interest in it.

We turn naturally to zoology as the science next to botany, and in many ways it may well be so considered. To plant pathology it is related chiefly through the pathological conditions which arise as a result of the attacks of various worms, insects and even higher animals. In this way, many galls, such as the well-known oak-galls and the nematode root-gall, which inflicts so much damage, originate. The stripping of the leaves from trees, and the ever-present injuries to farm products cause conditions for pathological study. Many diseases are transferred from plant to plant by animals of nearly all classes, and the combined efforts of zoologists and of pathologists will be necessary to combat this evil. Dr. Erwin F. Smith enumerates bees, the potato beetle, snails and slugs as known transportation agents for various diseases. Moreover, we do not yet know how many diseases of animals, both domesticated and wild, may be due directly or indirectly to plant diseases. Cases have been reported where serious results have attended the feeding of diseased fodder to live stock; and flour, made from infested grain, may cause serious results in man.

The relations between plant pathology and chemistry are perhaps more intimate, but at first glance less apparent than those already noted. The most obvious connection is through the work which the chemist and the pathologist have done together in developing the manufacture and the use of fungicides. To the farmer, this has seemed the most practical side of pathological work, because of the immediate results in saving crops. A less noticeable but even more important contribution of chemistry is the analysis of soils and of fertilizers, by which we can better know the conditions of optimum growth for various crops, and the best conditions for growing plants which are resistant to disease. The good resulting from this kind of investigation can not be overestimated, for, as a man in good physical condition is able to resist the attacks of many diseases, so a plant, if given the best conditions for growth, will be able to combat the various parasitic organisms which would otherwise destroy it. In another way chemistry will prove in the future a valuable ally in studying plant diseases. In the healthy plant certain products of growth are formed whose chemical nature must be known. When the plant is diseased, these organic compounds, acted upon by the enzymes produced by the attacking organism, or otherwise changed in composition, must be examined again to determine the nature of the change.

The relations existing between plant pathology and physics are not so well defined as in the cases already cited. If, however, we keep in mind that there is, in the study of botany, a physical as well as a physiological side, these relations are more easily seen. The ascent of water in trees; the conduction of water, food-elements and foods, and reaction to gravitation and to other physical stimuli are problems which the physicist must aid us in solving, though connected with these there are undoubtedly many vital processes which modify the mere physical forces. In a diseased plant the effects of these physical forces are modified probably more than we now realize. We may mention as examples of these modifications the stoppage of water-conducting elements in woody plants, the weakening of the tenacity of wood, and similar changes in the physical conditions of plants.

This is not the place to state more definitely the problems in plant pathology waiting to be solved with the aid of other sciences, but we may note in closing that in the past the interrelations of the sciences have not been entirely disregarded, for such men as Pfeffer and Pasteur, by using methods of sister sciences, have made valuable additions to our knowledge of botany.

Ernest Shaw Reynolds

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION F—ZOOLOGY THE AMERICAN SOCIETY OF ZOOLOGISTS

II

Inheritance of Comb Form in Poultry: C. B. Davenport, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

Genetics in Swine Hybrids: Q. I. and J. P. SIMPSON, Palmer, Ill.

In the year 1896 the writers began experiments with swine for economic results and for determining the relative potential of sex; but the uncovering of Mendel's laws has since broadened our inquiry.

The material has comprised nine pure and distinct breeds.

Two breeds, although of identical color, do not act alike under hybridization, showing a difference in their color determiners.

Combinations are made where coat color is full dominant, but skin color complete recessive, in the same animal.

We find the wild *sus scrofa* full dominant over every observable character and instinct of the Tamworth—even fooling the naturalists.

The solid hoof of the "Arkansas Mule Foot" is dominant over normal breeds; but intermediate grades of hoof are made at will.

Examples are shown of a transferrence of color, following shedding of the hair; of finely mingled roans; of segmented coloring of individual hairs (like the banded hairs of the wild Texas peccary), all showing that two colors may exist in the same cell—one of them passively awaiting its biochemic stimulus.

Instances are noted of the testes acting as this stimulus and, from the apparent mass of evidence, that color may exist in cells, unexhibited, is drawn a conception that seems to emasculate the "allelomorph to its absent" theory, now held by some renowned experimenters.

Of two red breeds, identical in tint, crossed with a white breed, one produces roans only; while the other makes only mosaics, showing that the first red breed is of solid color origin, and the last, of pattern origin. And the known history of each confirms this.

Color quantity in the individual is in ratio to the sum of its parents' colors.

A cause for the white belt in horse, swine, ox and India tapir is thought to be embryonic, and its more anterior location on swine is ascribed to blastomere divergence between these species.

Among the nine breeds used in hybrid experiments, it was discovered that some breeds would pair with equal color-potential. And the broods from these exhibit two distinct classes, equally divided, indicating the slightly inexact division of a chromosome in the oogenesis or spermatogenesis of a parent; and when confirmed by further experiment will show a fruitful cause for variation, within a breed or species.

We have found to be absolute, the Mendelian reseparation of units in swine color-hybrids.

When we say that with morphologic and color units the breeder may now add, combine and fuse, can extract, precipitate and analyze for purity—as with chemicals—that he may almost create designs at will, it is not said in egotism; but in profound acknowledgment to you men of science who show the way. And whilst the breeder's interest is not uppermost in your research of nature's evolution, his gratitude is none the less.

Report on Some Experiments in Transplanting Species of Leptinotarsa into new Habitats, with Remarks upon the Significance of the Mode: W. L. TOWER, University of Chicago.

Inheritance of Crest and Color in Canaries: C. B. DAVENPORT, Carnegie Station for Experimental Evolution, Cold Spring Harbor, New York. (Published in *Proceedings* of the Eastern Branch.)

A Litter of Short-tailed Dogs: R. M. Strong, The University of Chicago.

A fox-terrier bitch gave birth on October 31, 1907, to five pups—four males and one female. One of the males had practically no tail, and the other pups had short tails of various lengths. The tails were measured on November 28, as follows: The female and one male had tails measuring about 1¼ inches. A third male had a tail 2½ inches long, and the fourth male's tail measured 4 inches. The female and the tailless male are being reared for breeding studies. The mother's tail is short, and it has the appearance of having been cut at some time. The male parent is unknown, and the condition of the mother's tail at birth has not yet been satisfactorily determined.

Some Stages in the Embryology of certain Degenerate Phoridæ and the supposedly Hermaphroditic Genus Termitoxenia: Charles T. Brues, Public Museum, Milwaukee, Wisconsin.

The family Phoridæ form an interesting group of Diptera on account of a number of genera which are partially or wholly wingless in the female sex, and very degenerate in other respects.

The oogenesis of a species of the Texan myrmecophilous genus *Ecitomyia* was studied and compared with that of *Termitoxenia,* another form of aberrant Phoridæ which has been investigated by Wasmann. The resemblance is very close and serves to confirm the writer's opinion of the close relationship between *Termitoxenia* and other Phoridæ.

The gross features of the embryology of *Termitoxenia* were studied and found to present no remarkable divergence from the same stages in some other Diptera. They do not confirm the supposition of Wasmann that these insects give birth to the imago stage with a suppression of the larva and pupa, since the oldest embryos found are no farther advanced than those of certain viviparous flies like *Sarcophaga,* which give birth to living larvæ.

The writer could find no evidence in support of the hypothesis that these animals are hermaphroditic.

Suggestions for a Natural Classification of the Family Lymnæidæ: Frank Collins Baker, Chicago Academy of Sciences.

The fresh-water pulmonates have been gradually undergoing the splitting process so notably carried out in the land snails by Pilsbry, Dall and others. The family Lymnæidæ contained, until recently, the genera *Lymnæa, Planorbis, Physa* and *Ancylus,* besides several other small genera. *Ancylus* and *Physa* have been separated, forming the families Ancylidæ and Physidæ, each characterized by peculiarities of shell, radula and genitalia. Of the old Lymnæidæ there still remain *Lymnæa* and *Planorbis,* each falling into a sub-family. A study of these two groups seems to point inevitably to their separation into two families, Lymnæidæ and Planorbidæ, the former having a long-spired shell, a unicuspid central tooth, bi- or tri-cuspid lateral teeth, and the male genitalia with strong muscles protracting and retracting the male organ, which forms a distinct penis and penis sac. In Planorbidæ the shell is discoidal, the central tooth is bicuspid, the laterals are tricuspid, with a modified mesocome in the typical genus, and the male organ is destitute of the strong muscles of *Lymnæa* and is not strongly differentiated into penis and penis sac. In *Planorbis* the tentacles are long and filiform while in *Lymnæa* they are flat and triangular.[1]

As thus restricted, the Lymnæidæ present a homogeneous group of snails which may be divided into several genera and

[1] Pompholaginæ will probably also be found to rank as a family.

subgenera. Generic characters may be found in the genitalia (shape of prostate, relative size and form of penis and penis sac) the radula and the shell. It was found upon studying the genitalia that the groups *Radix, Megasoma, Galba* and *Acella*, which had been founded upon shell characters, could also be distinguished by differences in the genitalia.

Only the North American species have been critically examined;[2] the application of the above criteria results in the following tentative classification:

Family LYMNÆIDÆ Broderip. 1839

Subfamily Lymnæinæ Dall. 1870

Mantle margins retained within margin of shell.

Genus *Lymnæa* Lamarck. 1799. Type, *Helix stagnalis* Linné.

Genus *Pseudosuccinea* Baker, nov. Type, *Lymnæa columella* Say.

Genus *Radix* Montfort. 1810. Type, *Helix auricularia* Linné.

Subgenus *Polyrhytis* Meek. 1876. Type, *Limnæa kingii* Meek.

Genus *Bulimnea* Haldeman. 1841. Type, *Limnæa megasoma* Say.

Genus *Acella* Haldeman. 1841. Type, *Limnæa haldemani* (Desh.) Binney.

Subgenus *Pleurolimnæa* Meek. 1866. Type, *Limnæa tenuicostata* M. & H.

Genus *Galba* Schrank. 1803.

Subgenus *Galba* (typical). Type, *Buccinum trunculatum* Müller.

Subgenus *Stagnicola* Leach. 1830. Type, *Buccinum palustre* Müller.

? Subgenus *Leptolimnæa* Swainson. 1840. Type, *Buccinum glaber* Müller.

Subfamily Amphipepliidæ Baker, nov.

Mantle margins enlarged, covering a portion of the shell.

[2] Several foreign genera are not here included, as their anatomy is unknown. The study of these genera will not, it is believed, materially change the outline here presented.

Genus *Amphipeplea* Nilsson. 1822. Type, *Buccinum glutinosum* Müller.

Genus *Cyclolimnæa* Dall. 1905. Type, *Limnæa involuta* Harvey.

Pigmentation in the Feather Germs of a White Ring-dove Hybrid: R. M. STRONG, University of Chicago. (Read by title.)

The Sense of Smell in Birds: R. M. STRONG, The University of Chicago.

This is a preliminary report of investigations that are not yet completed. The olfactory sense was studied in buzzards and ring-doves, but principally in the latter. The behavior of four ring-doves with reference to the odors of cologne, violet sachet powder, and oil of bergamot, was observed with the aid of a labyrinth. This apparatus was provided with four apartments opening into a central square enclosure. The doves were fed twice a day in one of these apartments which was chosen at random. An odor was driven out of the chamber containing the food, into the central enclosure, by a gentle air current. Similar air currents emerged from the other apartments as controls. An air exhaust was located at the center of the apparatus. The labyrinth was ventilated after each feeding, and this series of experiments has been continued for about three months.

A significant but not regular improvement in the accuracy of finding the food was observed. The conclusion reached is that birds may be stimulated by the odors employed, but it is also probable that little use is made of olfactory stimuli.

A morphological study of the olfactory apparatus of birds is in progress.

The Anatomy of a Typical Pennatulid: C. C. NUTTING, University of Iowa.

A demonstration with lantern slides of the use of photography of objects under water in illustrating the gross anatomy of an alcyonarian, and also the first detached description of the structure of a pennatulid. (Monograph in progress.)

On the Distribution of Certain Salmonidæ in Wisconsin: George Wagner, University of Wisconsin.

A discussion of the occurrence of the lake trout and certain Coregoni in Wisconsin, with special reference to the physical characters of the lakes concerned.

The Process of Heredity as Exhibited by the Development of Fundulus Hybrids: H. H. Newman, University of Michigan.

In the spring of 1905 the writer, after familiarizing himself with the experimental work on heredity of the last decade or so, came to the conclusion that this work dealt too exclusively with definitive characters and scarcely at all with the origin and development of these characters. Being firmly convinced that heredity is essentially a developmental phenomenon, it seemed necessary to make a study of the process of heredity as exhibited in living embryos, watching for the origin of characters and studying their development in pure bred and hybrid forms.

Very favorable material was found in two species of killifish, *Fundulus heteroclitus* and *F. majalis.* These offered sufficiently wide differences morphologically and physiologically, in eggs, embryos and adults, for experimental study. The most important differences for the study of heredity in early development were differences in size and protoplasmic content of the ova; in time rate of development; in quality, distribution and time of appearance of pigment; in rate and time of establishment of the heart rhythm; in resistances to unfavorable conditions; and the inter-influences of these and other characters.

The following are some of the results obtained:

1. The influence of the sperm of the less rapidly developing species showed a measurable retarding effect upon the egg of the more rapidly developing species in a comparatively short time, usually after about eighteen hours, at which time the blastodisc is beginning to spread out over the yolk. In the reciprocal cross there was a somewhat later, but just as marked, accelerating effect.

2. The influence of maternal and paternal factors was not of constant potency, but alternating waves of parental influence emphasized the fact that heredity is essentially a process involving rhythms of parental influence and constant flux of characters.

3. Certain dominant and hyperdominant characters were shown to be the secondary physiological effects of a primary blending of characters, or, as the necessary result of mere mechanical restrictions, such as size of egg membrane or amount of yolk available.

4. In order to avoid all sorts of complex and contradictory conditions, it was found necessary to equalize the physiological conditions of the parents. Only males and females freshly brought in and at the height of their spawning activities, would give even approximately uniform results in different experiments.

5. It was also found necessary to equalize the environmental conditions of developing embryos. Otherwise highly complex conditions arose that obscured the study of heredity.

6. In view of the fact that external factors, such as physiological condition of parents and environmental conditions of embryos, showed such a marked influence in disturbing the process of heredity, it seems necessary to emphasize the potency of external factors in heredity. Heredity seems to be in essence a developmental process, determined partly by the architecture of the germ-plasm and partly by

external conditions. If either is altered the result is an interference with ideal heredity, which may be defined as identity in process of development between parent and offspring. These two conditioning factors of heredity are of equal potency, since each is efficient only in the presence of the other.

The Rate of Growth of the Egg-yolk in the Chick, and the Significance of White and Yellow Yolk in the Ova of Vertebrates: OSCAR RIDDLE, The University of Chicago.

A method has been found by which the rate of growth of the egg-yolk of the chick may be easily measured. If the fat-stain Sudan III. be fed to laying hens at intervals of one, two or more days, the stain can be found later in the form of concentric red rings in all of the rapidly growing ova. The actual rate of growth varies widely—0 to 2 mm.; but one day of growth normally includes a layer of white yolk and a layer of yellow yolk. It is probable that the layer of white yolk represents the part which is grown during the later hours of the night, and that the yellow yolk is yolk of more rapid growth produced during the remainder of the day.

In the turtle's egg there is a concentric layer of white and another of yellow yolk for each of the four years required (Agassiz) for the complete growth of these ova. Here the yellow yolk undoubtedly corresponds to a part of the egg which is rapidly grown.

A consideration of the formation and arrangement of white and yellow yolk in the ova of the several groups of vertebrates leads to the conclusion that everywhere among these animals white yolk is yolk of relatively slow growth, and that the yellow yolk is yolk of more rapid formation.

For the more intimate explanation of the concentric layers, etc., of white yolk one must take into account two factors which seem to have been overlooked, namely, the reversible action of enzymes which in periods of hibernation or low feeding must tend to analyze and break up the large yolk granules at the periphery of the yolk; at the same time some of the newly formed products of decomposition will leave the peripheral part of the ovum and become distributed between the latter and the surrounding circulating blood according to the requirements of the partition coefficient of each of these substances.

The remarkable arrangement, and apparent elaborate organization of some of the most prominent morphological elements of the larger egg-cells thus receive their physiological explanation.

A Comparison of the Reactions of a Terranean and a Subterranean Species of Isopod: A. M. BANTA, Marietta College.

An investigation of the fauna of Mayfield's cave near Bloomington, Indiana, suggested the desirability of studying the reactions to various stimuli (light, tactile stimuli, etc.) of some cave species in comparison with the reactions to the same stimuli of a near relative living in other situations. The blind cave isopod *Cæcidotea stygia*, and the common asellid, *Asellus communis*, were selected.

It was desired to determine if the increased development of tactile organs in cave animals was accompanied by an increased sensitiveness to tactile stimulation. The experiments proved this conclusively. A second point was to determine the relative sensitiveness of the two animals to light. The cave species proved to be very little sensitive to light compared with its outdoor relative. With directive light the threshold of stimulation was about 2.2 candle-meters with *Asellus* and about 80 candle-meters with *Cæcidotea*. It was also desired to find out, if possible, what were the factors determining the distribution of the one species within caves, while the nearly related form, though living in the same region, did not take to that habitat. Both species were found to be negatively phototropic ordinarily, and were negative to all intensities to which they responded at all; but *Asellus* after having been in darkness three hours or longer was positive in its response to any intensity to which it responded at all (2.2 candle-meters or greater intensity). This affords an explanation on the basis of reactions to light alone of the occurrence of *Cæcidotea* within caves and *Asellus* outside of caves. *Cæcidotea* responds to such intensities as to enable it to avoid daylight, while *Asellus,* after once having been in darkness for a time, is positive in its response to light, so that, while the former would tend to remain within the darkness of caves, the latter, if it got into a cave, would after a time become positive in its response to light and escape if it happened to come within reach of light from the outside. Another possible factor in determining the cave distribution of the one and not of the other species is the apparently greater discriminative power of the *Cæcidotea* in selecting food. *Asellus* takes with its food a large amount of inorganic matter, while *Cæcidotea,* living as it does where organic matter is relatively very scarce, takes only a small amount of inorganic matter with its food.

The Development of the Thymus in the Pied-billed Grebe: Charles E. Johnson, University of Minnesota. Presented by H. F. Nachtrieb.

The observations here presented are based on a study of the thymus in *Podilymbus podiceps* of approximately the following ages: 4½, 5, 6, 6½, 7, 7½, 8 and 8½ days.

The embryonic thymus in this species of grebe is derived from two separate anlagen the third gill-cleft and the fourth inner and outer gill-pouches. The first anlage arises as a pouch-like outgrowth of the third gill-cleft and the second as a similar outgrowth of the fourth endodermal pouch, to the lateral wall of which elements are added from the fourth ectodermal pouch. Through cell proliferation these pouch-like structures become solid bodies, at the same time becoming separated from the germ layers and finally becoming united, on each side, into a single body, the embryonic thymus. The union or fusion into a single body on each side appears to be largely due to two causes. In the first place, the anlagen become straightened so as to come to lie parallel with the long axis of the neck, which tends to bring them together. In the second place, the medianward shifting of the jugular vein crowds the second anlage over against the first so that the anterior end of the second overlaps the posterior end of the first.

The thymus anlage furnished by the third gill-cleft is larger than that arising from the fourth gill-pouches, and the part played in its formation by the ectoderm is also greater in the former than in the latter.

Four well-defined ectodermal and endodermal gill-pouches are present in embryos about four and one half days old. There is also present a postbranchial body, or structure corresponding to a fifth endodermal pocket, as an evagination of the posterior wall of the fourth inner gill-pouch where this opens into the pharynx. Later on this postbranchial body becomes constricted off and disappears rather rapidly.

On the left side a portion of the third gill-cleft lying between the pharynx and the anlage of the thymus becomes converted into an epithelial body. For a period of about three days this body is continuous with the pharyngeal wall, on one hand and with the pouch-like anlage of the thymus, on the other. Both connections are then lost and the body disappears before the end of the seventh day. This epithelial body has not been observed on the right side in any of the series studied.

In connection with the second gill-cleft a cell-thickening in every way similar to the thymus anlage of the third gill-cleft is formed simultaneously with the latter, but it begins to degenerate about the sixth day and takes no part in the formation of the thymus.

The Chromosomes in the Gryllidæ: W. J. Baumgartner, University of Kansas.

In a former paper the writer showed that the shape assumed by the chromosomes of *Gryllus domesticus* during the prophase and metaphase of the first spermatocyte division was constant and could be used as a differential characteristic. The spermatocyte has 11 chromosomes.

The examination of nine other species of this family shows a great variation in shape, size and numbers of chromosomes. The highest number is 29 spermatogonic elements and the lowest 13. The accessory in all the species studied exhibits the same peculiarities of shape and behavior as described for *G. domesticus.*

Three species have 23 chromosomes agreeing with the Acrididæ as described by McClung and others.

In several species certain chromosomes can be readily recognized by their shape and size. The tree crickets have 19 spermatogonic chromosomes, of which the accessory and four others are very long. In the prophase the four long ones unite into two enormous rings. If these rings are multiples, *i. e.,* quadruple, as one might easily conclude, then the number of elements in the two species examined is really 23.

Apitlus agitabor has 7 spermatocytic chromosomes. Of these one is the accessory, one is ordinary in size and simple in shape, and the other five are large rings. Should these last prove to be quadruple then the real unreduced number here is also 23.

Nemobius fasciatus has 8 chromosomes in the first spermatocyte, of which 4 are much larger and ring-shaped. Quadrupling these gives a real number of 23. But *Nemobius exigeus* has nine elements, of which also 4 are large rings. Quadrupling these and doubling all but the accessory, we get 25. The number of elements in two other species can not be reduced to 23 by any marked size and shape differences.

Our result shows the three species have 23 chromosomes. Four species can be reduced to 23 by using the "multiple chromosome" idea and three species can not.

The Gryllidæ also have much greater difference in shape and size of chromosome than the Acrididæ. The difference of shape has a marked tendency to be constant.

Was the Hydroid or the Medusa the Original Form of Hydromedusæ? C. C. Nutting, University of Iowa.

The development of typical forms of Hydromedusæ was briefly described and the alternation of generation discussed.

The elimination of successive terms in the life histories was described and the various methods of reproduction presented, showing the two lines of divergence to the medusa-form, on the one hand, and the hydroid form, on the other; ending in the free medusa without fixed hydranth and the fixed hydranth without medusæ, respectively.

The argument of ontogeny as showing the phylogeny of the group points to the hydranth as the more primitive form. The homology of hydranth and medusa.

The argument based on radial symmetry points toward the same conclusion.

The Cause of Dominance in Heredity and Experimental Production of Variability in Dominance: W. L. Tower, University of Chicago.

An Important Period in the History of the Sex Cells of Rana pipiens: Bennett M. Allen, University of Wisconsin.

The Experimental Production of Germinal Variations, Methods, Precautions and Theory of their Causation: W. L. Tower, University of Chicago.

Exuviation, Autotomy and Regeneration in Ceratium: C. A. Kofoid, University of California.

The cellulose exoskeleton or theca of the dinoflagellates by virtue of its form resistance, specific surface and specific gravity is an important organ of flotation. Prolongation of the three horns and surface differentiations in the form of lists, fins, ribs and rugosities increase the specific surface and thus facilitate flotation. Walls thickened by age or by compensatory regeneration cut off access of light to the chloroplasts and also increase the specific gravity. Low temperatures increase the molecular friction of water and thus increase its buoyant properties. Changes in vertical location of these pelagic protozoa or modifications in the temperature of the circumambient medium thus demand an adjustment of this organ of flotation to the changed conditions of environment.

In many dinoflagellates the exoskeleton is shed periodically *in toto* by ecdysis either with or without schizogony. In *Ceratium,* at least in the marine species, ecdysis is unknown. In schizogony of *Ceratium* the theca is parted diagonally along definite suture lines between the plates and each daughter cell regenerates the missing half, maintaining the ancestral facies throughout by compensatory regeneration. Long-continued schizogony gives rise to individuals of senile aspect with heavy rugose exoskeleton. Examination of San Diego plankton has brought to light evidence of the fact that heavily armored *Ceratium* in warm surface waters drop off this exoskeleton by exuviation, piecemeal, plate by plate, and regenerate a new wall of more delicate texture.

In deeper levels or in plankton at San Diego of semitropical facies autotomy of the horns is frequent. This autotomy may occur at any level of the horns from the tip to the base. It occurs in both antapical horns coincidently and may also appear in the median apical horn. It is regulatory in character, for the specific type of balanced relationship of the antapicals is approximately preserved. Autotomy is an adaptation to flotation at deeper levels or in higher latitudes.

Regeneration of the horns after autotomy and also renewed growth of the horns without autotomy result in an increase in specific surface and are adaptations to flotation in higher levels or lower latitudes. This regeneration is usually terminal, but is sometimes basal in location on the horns. It is also regulatory in character, preserving the balanced relation of symmetry or asymmetry of the horns which is characteristic of the species.

Muscle Attachment to the Body Wall in the Nymphs of Anax: W. A. Riley, Cornell University.

The alary muscles of the nymph of this dragon-fly are exceptionally favorable for the study of the relation of the muscles to the body wall. The hypodermal cells at the point of attachment of the muscles are very much elongated (about $50\,\mu \times 5\,\mu$), and in specimens fixed in alcohol and stained in Delafield's hematoxylin there is every indication that the attachment is through the intermediary of these cells. However, in thin sections (2μ–3μ) fixed in Flemming's fluid and stained in iron hematoxylin it is seen that the muscle fibrillæ pass through the cells and thus attach directly to the cuticle. Study of developing muscle indicates that, in Snethlage reports for *Artemia,* the cells are epithelial muscle cells which give rise to the chitin, on the one hand, and to the muscle as well.

The Skeletal Parts of the Sand-dollar: EMILY RAY GREGORY, Wells College.

The test of the sand-dollar follows the structure typical for echinoderms, but has some interesting modifications. The apical region is occupied by a single plate which functions as the madreporite. The minute pores are irregularly arranged and increase in number as the animal grows. There are genital pores at the junction of the central plate and the first pairs of interradials 1–4, but the pore is wanting in the interradial area 5. Ocular pores occur between the central plate and the first pairs of ambulacral plates. The anus is found on the ambitus between the rows of interradial area 5. Oral plates are wanting and there are only minute calcareous granules in the membranous peristome. The ring of plates nearest the mouth consists of ten (paired) ambulacral plates, and five, therefore unpaired, interambulacrals. Some authors appear to refer to this now as the peristome. The coronal portion of the test with its peculiar petal areas is familiar. The line of the ambitus does not correspond to the sutures between the plates. The perignathic girdle is reduced to an inconspicuous ridge, but on the unpaired interradials there are wedge-shaped apophyses to support the lantern. The number of plates on the oral surface is established by the time the test is 7 mm. in diameter; after this these plates increase in size but not in number. The number of plates on the aboral surface increases until the diameter of the test is 46 mm. After that a few more plates may be added to the petal area as the last interambulacrals increase in size. Increase in the number of plates occurs only at the edge of the central plate and is, of course, greatest in the ambulacral area. There may be seven or even nine plates in the petal to one interradial. All the plates of the ambulacral system are primary; no such secondary and tertiary plates are found here as are seen in *Echinus* (Chadwick). The pores in the petal area are all between the plates. Elsewhere they may pass through the plates. The unpaired pores increase in number from the petal to the edge in wedge-shaped areas which meet, and there is a dense ring of them about the ambitus where there may be three or four rows of pores through a single plate.

The inner surface of the skeleton shows remarkable structures. The distal half or third is almost covered with pillars and ridges which grow from both surfaces and fuse, leaving small irregular spaces between. The spines in cross-section are star-shaped, with four to thirteen points. Longitudinally they show a fenestrated structure. Six forms are to be distinguished in different areas.

A Study of Colorado Entomostraca: GIDEON S. DODDS, University of Colorado.

Up to 1902 but 10 species of *Entomostraca* were listed from Colorado. That year Beardsley published a list which included 24 species new to the state. His collections were from the plains region. In 1904 Professor Henry B. Ward added 8 species from alpine lakes in the Pikes Peak region, and in 1907 Chancey Juday listed 10 more from Twin Lakes. Three others are listed by Marsh in the same year. These 55 species are, so far as the writer can learn, all that are known for the state.

Collections have been made by the author from a number of lakes on the eastern slope of the Rocky Mountains. These lakes comprise a pretty complete series, from plains lakes at an altitude of about 5,000 feet, to lakes at 11,500 feet which are never free from snow and ice. The alpine *Entomostraca* and the factors governing their distribution are being studied. Collections show that there is a rich Entomostracan fauna, except in the very highest lakes, where all animal life is scarce. The writer has thus far determined 14 species, three of which are new to the state.

The Relation between Habitat and the Taxonomic Characters of Gryllus: Frank E. Lutz, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

Size of taxonomic characters is a function of the factors of the environment.

Sociology applied to Pigeons: Wallace Craig, State Normal School, Valley City, North Dakota.

Zoology and psychology have long labored to explain the elaborate singing and cooing, dancing and strutting, and other such performances of birds. The results have been most unsatisfactory—zoology and psychology are not sufficient to explain such behavior, for it needs sociologic treatment.

An intimate acquaintance with pigeons impresses one with the fact that their cooing and strutting performances are a kind of ceremony. Just as the primitive man must perform a certain ceremony upon every important occasion in his life, so the pigeon must give a certain call or coo, and must go through a bowing or strutting performance upon all important occasions; as, when he awakes in the morning, when he goes to roost at night, when he joins the flock, when he meets another male to fight, when he meets a female to court, etc.

The utility of these pigeon performances is the same as that of ceremony in primitive man—social control. There is a prevalent notion that animals which form societies, especially the ants, bees and wasps, are so mechanically bound together as to be free from that conflict between individuality and sociality which is so marked in human life. This notion is erroneous: it is probably erroneous even with regard to ants, bees and wasps; it is certainly erroneous if applied to pigeons; the pigeon is a true free individual, hence social ends among pigeons can be secured only by some means of social control. The social life of pigeons is chiefly family life of a highly complex and specialized nature: the numerous details of this family life are regulated by social control; the actions of the different individuals in the family are connected and socialized through control by ceremonial observances.

Occurrence of the Cysticercus of Tænia solium in Sheep: B. H. Ransom, U. S. Department of Agriculture.

A number of cases of the occurrence of cysticerci in the muscles of sheep have been reported by various authors. In most cases the data given are not sufficient to show definitely whether the cysticerci in question belong to *Tænia solium,* the armed tapeworm of man, as some authors have believed, or whether they belong to *Tænia hydatigena,* the marginate tapeworm of the dog, as maintained by other authors. Bongert (1899), however, has described a cysticercus found in the muscles of a sheep, which is evidently the cysticercus of *Tænia solium,* and that the sheep may act as the intermediate host of this tapeworm of man seems therefore to be pretty well established.

Dr. L. E. Day, in charge of the branch pathological laboratory of the Bureau of Animal Industry at Chicago, recently sent into the Zoological Laboratory of this bureau specimens of the muscles of a sheep extensively infested with small cysticerci. These cysticerci when removed from the capsule surrounding them measure 2 to 3 mm. in diameter and are slightly oval in shape. The head process projects into the bladder from one side, as is the case in the cysticercus of *Tænia solium*. In the cysticercus of *Tænia hydatigena* the head process is invaginated from one end of the bladder instead of from the side. Possibly, however, the position of the head depends upon the location of the parasite rather than upon specific peculiarities. Accordingly, it might happen that the head process would develop from the side of the cysticercus of *Tænia hydatigena* instead of the end if the parasite were located in muscle tissue, and the fact that in the mutton cysticerci found by Dr. Day the position of the head process is different from that in the cysticerci of *Tænia hydatigena* when located in relation with the serous cavities of the host, the usual location, can not be considered absolute proof that the mutton cysticerci in question do not belong to *Tænia hydatigena*. The hooks of these cysticerci number from 24 to 32 in different specimens. The large hooks measure 135 to 160 μ in length, and the small hooks 100 to 120 μ. The roots of the hooks are only slightly developed, and the hooks, therefore, do not present all of the characters to be found in fully grown hooks, so that on the basis of the hooks alone it would be difficult to determine whether these cysticerci belong to *Tænia solium* or to *Tænia hydatigena*. Since, however, they possess a prominent characteristic of *Tænia solium* which is not shared by *Tænia hydatigena*, that is, the outer surface of the bladder is marked with numerous small tubercle-like projections, and since also, in other particulars of structure as well as in location (in the muscles) they agree more closely with the former than with the latter species, they have been identified as *Tænia solium*.

Further Results of Heterotransplantations of Blood-vessels: C. C. Guthrie, Washington University.

Continuity of divided carotid arteries in dogs was reestablished by interposing segments of blood-vessels from cat and rabbit. Good function was observed after more than eight months.

On the Ovary and Ova of the Cuban Cave-fishes: Henry H. Lane, University of Oklahoma.

The viviparous blind-fishes (*Lucifuga* and *Stygicola*, family Brotulidæ) living in the subterranean streams of Cuba have a Y-shaped ovary which consists of a mass of stroma containing numerous sinuses filled with lymph and adipose tissue, and the whole covered with an epithelium continuous with that lining the surrounding ovisac. This epithelium is quite unique in that it frequently contains numerous blood-capillaries. The ova arise in "nests" or masses of several hundred each, deep within the substance of the stroma and in the adult ovaries have at that time an average diameter of about ten micra. Only one ovum from such a nest usually develops to maturity, the other ova of the nest undergoing a rapid degeneration and being ultimately absorbed into the substance of the growing ovum. In many instances whole nests fail to mature a single ovum, in which case all the ova of such nests undergo a slow, pigmented degeneration *in situ*. This destruction of so many ova at an early stage is an adaptation to the viviparous habit of these fishes. The whole ovary as just described is enclosed within a Y-shaped ovisac which is continued to the urogenital pore as the oviduct. The young fishes, which are but few in number, only two to ten in any case as yet observed, are not developed in separate sacs, but lie within the lumen of the ovisac, gradually compressing the ovarian stroma as they develop. They attain a length of 20 to 25 millimeters before birth, while the adults may be as much as 100 millimeters long. Viviparity is apparently a comparatively recent acquirement of these fishes, though probably attained before they left the deep-sea for the fresh-water cave streams.

Notes on Diplosis sorghicola Coq.: Carleton R. Ball, U. S. Department of Agriculture.

The frequent failure of sorghums to produce seeds in our southern states has long been noted. Many theories regarding the cause have been advanced: fungi, insects and unfavorable meteorological conditions, such as excessive precipitation, high humidity. Severe drouth or hot winds are the causal agencies most commonly assigned. Among the growers this trouble is known as "blast" and is usually held to be caused by excessive rainfall and the consequent washing away of pollen during the blooming period. Experiments made during the past season proved conclusively that the injury results from the attacks of a small fly, which has been identified as *Diplosis sorghicola* Coq., for which the name sorghum midge is here proposed. The eggs are laid within the spikelet and the larya absorbs the juices of the ovary through its body walls, causing the death of the ovary and sterility of the infested heads. The insect is prolific; the life cycle is short; and the crop is totally destroyed in badly infested areas. Two parasites are known. Relief may also be found through breeding immune varieties.

Mechanics of Orientation in Lower Organisms: S. O. Mast, Johns Hopkins University.

Orientation in lower organisms stimulated by light may be classified as direct and indirect. In direct orientation the organism turns directly toward or away from the source of stimulation, *e. g., Volvox, Arenicola* larvæ, etc.

In indirect orientation the organism makes preliminary random movements, which bear no definite relation to the apparent point of stimulation, until it reaches a position in which the stimulation is reduced to a minimum. This position it retains in moving forward and thus becomes oriented.

The random movements resulting in orientation may be restricted to motion toward a structurally defined side, as in *Euglena, Stentor,* etc.; or they may not be thus restricted, as in some of the worms.

A detailed study of the structure and light reactions of *Euglena,* which orients indirectly, and *Volvox* and *Arenicola* larvæ which orient directly, shows that the reactions of these three forms, apparently so different, are fundamentally the same. There does, however, not appear to be any definite relation between the reactions of organisms which orient by means of unrestricted preliminary random movements and the reactions of those in which the random movements are restricted to motion toward a structurally defined surface.

No theory of reaction yet formulated covers all cases. The theory of Sachs, formulated for light reactions in plants and accepted by Loeb, who applied it to animals, is not in accord with the observed reactions in any of the organisms studied.

On some Isopods of the Family Dajidæ from the Northwest Pacific Ocean, with Descriptions of a New Species and a New Genus: Harriet Richardson, Smithsonian Institution.

During the cruise of the U. S. Bureau of Fisheries Steamer *Albatross* to the

Northwest Pacific Ocean, some new Dajidæ were collected, one being the type of a new genus, *Arthrophryxus,* and the other the type of a new species of *Holophryxus, H. giardi.* An immature stage of *Holophryxus giardi* was also obtained and is of interest in being a stage not heretofore recorded in the development of the female from the cryptoniscian larva to the adult form. Both of these parasites are attached to the dorsal side of the carapace of the host with the head directed posteriorly. The male *Holophryxus alascensis* Richardson is also described for the first time from a specimen obtained at Monterey Bay.

Leidya distorta (*Leidy*) *Found on a New Host:* HARRIET RICHARDSON, Smithsonian Institution.

Specimens of *Leidya distorta* (Leidy) found in the branchial cavity of *Pachygrapsus transversus* Gibbes, from the Bermudas, were recently sent me by Professor A. E. Verrill. This species has been recorded as found in the branchial cavity of *Uca pugilator.* The fact that this parasite has been found on a new host gives evidence that this genus and species is not confined to one genus and species of host. As no descriptions or figures of this form have been given since those published by Leidy, the parasite is again described and figured, as well as the young female, which is described and figured for the first time.

The following demonstrations were exhibited:

L. B. Walton: (1) The ideal dissecting tray; (2) early stages of *Eurypauropus spinosus* Ryder; (3) museum cataloguing; accession and department catalogue cards.

Henry F. Nachtrieb: (1) Early stages in the development of the thymus of the pied-billed grebe—reconstruction of one stage; (2) the sensory ridges of the lateral line and the primitive pores of *Polyodon spathula.*

R. M. Strong: A litter of short-tailed and tailless puppies.

Thomas G. Lee: Early stages in the development of *Dipodomys* and other rodents.

F. R. Lillie: Karyokinetic figures of centrifuged eggs.

S. O. Mast: An electric thermo-regulator.

Charles Brookover: Ganglion cells on Pinkus's nerve of *Amia* and *Lepidosteus.*

R. S. Sheldon: Medullated nerve fibers in the olfactory mucous membrane of fishes.

W. L. Tower: (1) Demonstration case to illustrate the evolution of the *lineata* group of the genus *Leptinotarsa,* showing forms that have been produced in experiment and sports occurring in nature; (2) demonstration case to illustrate the results obtained in the production of sports experimentally—arranged to show the results produced in the stimulated germ-cells and the results from those not stimulated in the case of the same parent; (3) demonstration case to show the results obtained in the transplantation of *Leptinotarsas* from one habitat into another and the proof that they are different in the new habitat as demonstrated by the behavior of the modified and unmodified form when crossed with a third species; (4) demonstration cases to illustrate results obtained in the study of variability of dominance in crossing.

C. R. Bardeen: Abnormal toad and frog larvæ from eggs fertilized by spermatozoa exposed to the Roentgen rays.

W. J. Baumgartner: A cheap sharp microtome knife.

Section F of the American Association for the Advancement of Science was organized at the Chicago meeting with the following officers:

Vice-president and Chairman of the Section—E. B. Wilson, Columbia University.

Secretary—C. Judson Herrick, University of Chicago.

Member of the Council—C. H. Eigenmann, Indiana University.

Member of the General Committee—G. E. Coghill, Denison University.

Sectional Committee—E. B. Wilson, vice-president, 1908; E. G. Conklin, vice-president, 1907; C. Judson Herrick, secretary; Frank Smith, one year; W. E. Ritter, two years; A. W. Bleile, three years; A. L. Treadwell, four years; C. C. Nutting, five years.

At the business session of the Central Branch of Zoologists the following officers were elected:

President—E. A. Birge, University of Wisconsin.

Vice-president—M. F. Guyer, University of Cincinnati.

Secretary-Treasurer—H. H. Newman, University of Michigan.

Member of the Executive Committee for Three Years—C. M. Child, University of Chicago.

The following were elected to membership in the Central Branch: Oscar Riddle, V. E. Shelford, W. S. Miller, A. W. Meyer, James A. Nelson, C. J. Herrick.

Thomas G. Lee,
Secretary

University of Minnesota

SCIENTIFIC BOOKS

A First Course in the Differential and Integral Calculus. By William F. Osgood, Professor of Mathematics in Harvard University. Pp. xv + 423. New York, The Macmillan Company. 1907.

First Course in Calculus. By E. J. Townsend, Professor of Mathematics in the University of Illinois, and G. A. Goodenough, Associate Professor of Mechanical Engineering in the University of Illinois. Pp. x + 466. New York, Henry Holt and Company. 1908.

A Course in Mathematics for Students of Engineering and Applied Science. By Frederick S. Woods and Frederick H. Bailey, Professors of Mathematics in the Massachusetts Institute of Technology. Vol. I. Pp. xii + 385. Boston, Ginn and Company. 1907.

Graphic Algebra. By Arthur Schultze, Assistant Professor of Mathematics, New York University, and Head of the Department of Mathematics, High School of Commerce, New York. Pp. viii + 93. New York, The Macmillan Company. 1908.

A Treatise on the Integral Calculus founded on the Method of Rates. By William Woolsey Johnson, Professor of Mathematics at the United States Naval Academy, Annapolis, Maryland. Pp. v + 440. New York, John Wiley and Sons. 1907.

People who have to do with mathematics fall temperamentally into three classes. There are the theorists. These are interested in doctrines as doctrines. They find their joy in the construction and the understanding of them, and have but little personal interest in applications and utilities, or none at all. The theorist is a lover of logic, of the abstract and the recondite, of pure creations of the intellect. For him a mathematical doctrine is a work of art, of art that is supersensuous, and a theory is valuable in proportion as it is beautiful. In sharpest contrast with the theorists stand the practicians. These despise theory as such, sometimes denying the fact, sometimes admitting it and occasionally avowing it even boastfully. They look upon mathematics as a mere tool, as a spade or a wheelbarrow. The practician is not a man of science, strictly speaking, and he is not an artist. He is an artisan, not an artisan of high type, indeed, nor yet entirely useless. He is allied to the theorist very much as the splitter of rails or the painter of a barn is allied to a sculptor, a creative musician or a master of color and design. The theorist and the practician are organically antagonistic in temperament. The former comprehends the latter as the greater includes the less. The theorist contemns mere practise and avoids it, but he does so deliberately from a knowledge of values and relative worths. The practician hates theory and avoids it, but he does so from necessity, by the "virtue of impotence." The differences between them, being organic and fundamental, can be neither composed nor annulled. Fortunately for an age that glories in possessing and is bent on advancing a material civilization that theorists never would and that practicians never could produce, there is a third class among those who have to do with mathematics, a class composed of two groups of men: a group interested primarily in theory, in mathematics as a science, yet having a strong secondary interest in applications, in practise, in mathematics as a tool; and another group chiefly interested in practise that involves applications of mathematics, but having at the same time a potent secondary interest in the subject as a science, as a body of consistencies, an ensemble of coherent doctrines. The latter group, the engineers, tend to keep mathematics sane, serviceable, attached to reality, adapted to the needs of the surveyor, the miner, the excavator, the bridge-builder, and the rest; the former group, comprising most of the professional mathematicians and the teachers of mathematics, serve to save the science from degenerating into a mere drudge, and by extending its structures far above the conscious needs of man, make it an everlasting monument to his dignity and an honor to his spirit. Thus the interests of these two groups, unlike those of the theorist and the practician, intersect; and as there is the need of better cooperation between the groups, there is also, by virtue of their community of temperament, the possibility of securing it. The engineer says to the teacher of mathematics: "Make your science more serviceable, lay bare its instrumental significance, teach us how to use it." The teacher replies: "Your demand is just and reasonable, but you should understand that the application of a difficult doctrine to a difficult concrete problem presupposes an understanding of the doctrine as a doctrine and that such understanding requires native ability and prolonged study." As a reasonable man, the engineer must admit that the teacher, too, is right. What, then, is to be done? The answer is: compromise.

How to effect the compromise to the best advantage of all the interests involved—the integrity of the science itself, the insistent claims of the technologist, the indubitable rights of those who pursue the study of mathematics solely as a discipline and especially of those rarer spirits who hope to make it the object of a life's devotion—that is the question that presses upon the teachers of mathematics in our day and that, owing to the familiar rapid multiplication of technological schools, presses especially hard upon teachers of the calculus. In Professor Osgood's book culminate the efforts of nearly a generation of mathematicians to produce a beginner's calculus that shall be both rigorous and understandable, theoretic enough to be scientific and sufficiently practical for the student of engineering, not too spiritless for those whose aim is liberality of culture and yet adequate as a preparation for the intending student of still higher disciplines. For directness and simplicity of presentation, clearness and correctness of statement, judicious accentuation and ordering of topics, and for the happy mingling of the concrete and particular with the abstract and general, this work attains a level of excellence not likely to be soon surpassed. The author estimates that the time required for covering the matter of the book corresponds roughly to a five-hour course throughout one year. The estimate is based, however, upon the lecture method of presentation. In the case of lectures adapted to undergraduates, this method, whatever be its compensatory advantages, is undoubtedly less rapid than that of assigning definite lessons and requiring recitations upon them. By employing the latter method of instruction and by omitting the chapter of about forty pages devoted to mechanics—an omission entirely practicable in a considerable number of institutions that provide a separate course in elementary mechanics to follow the calculus—it would seem to be possible to cover the remainder of the matter fairly well in a three-hour year course or even in a five-hour half-year course. Indeed, if one make the mentioned omission, the remainder of the book, owing to wider margins and other physical features, only appears to contain more reading matter than such a book, for example, as Osborne's revised "Calculus," and this last, as experience has shown, can be mastered in a three-hour course of one year. In view of the high excellence of the book one hesitates to note so minor an infelicity as the recurring phrase, tangent *in* a point; or to query why the notion of limit is not defined instead of being presupposed; or to question the scientific or the didactic value of the cautionary note (p. 5), for while it is true that two coincident points of a curve do not determine a secant, is it not also true that, if P be a point of a curve admitting a tangent T at P and if P' be a second point of the curve, the secant PP', if P' move along the curve into coincidence with P, at the same time rotates about P into the definite position of coincidence with T? The tangent T is not, indeed, then determined by the mere coincidence of P and P', but by that *coincidence regarded as having resulted from P' moving along the curve.*

Professors Townsend and Goodenough's "Course" is a notable contribution to the text-book literature of the calculus. It is too large by a hundred pages to admit of the satisfactory presentation of the whole of it in the time usually allotted to the subject even in the best schools. The thickness of the volume is partly due, however, to the presence of a chapter dealing with ordinary differential equations, an excellent table of integrals, a table of answers, and a good index that renders the book a convenient work of reference. The method of limits is employed exclusively. The notion of integration is introduced at an early stage, and topics are in general arranged in the order of increasing difficulty, such topics as infinite series, expansion of functions, singularities of plane curves, envelopes and the like being reserved for treatment when the reader shall have had time to confirm his grasp of fundamentals. It is especially noteworthy that the book is a joint product of a professional mathematician, who is chiefly responsible for the theory, and a professional teacher of mechanical engineering, who is largely responsible for the practical aspects of the work. Indeed, the applications of the subject are about equally distributed between geometry and mechanics, a fact that should be of interest to the student of engineering, though the book is by no means written for him alone.

Professors Woods and Bailey's book is the first volume of a work in course of preparation which is designed to present together—that is, in a single course—so much of algebra, analytical geometry, calculus and differential equations as is usually required of engineering students in the first two years of their professional study. The attempt represents a wholesome reaction against the long-prevailing practise of presenting these subjects in as many separate courses, and of thus incidentally giving the student the impression that the several doctrines are essentially insulated and independent, instead of being, as in fact they are, but different parts of one complicate instrument or different organs of a single body of doctrine. The experiment sufficiently commends itself *a priori* to deserve a fair trial, though this will not be easy in view of the readjustment of programs and schedules necessarily involved. The danger of the reaction lies, of course, in the opposite extreme, namely, of so presenting a group of interpenetrating disciplines that they shall produce the effect of a mere *mélange.*

Professor Schultze's "Graphic Algebra" is an excellent introduction to the plotting of equations and therewith to the graphical representation of functional dependence in general. The method is illustrated in connection with equations of the first four degrees in two variables. An appendix extends the method to other than equational relationships, and furnishes for practise some tables of data drawn from a considerable variety of fields. The book is timely and should be interesting to many, for this is indeed the age of coordinates and graphical depiction, the method long familiar in analytical geometry having proved its availability in almost every field of study, including even the critical study of biblical literature.

Professor Johnson's "Integral Calculus" treats more fully than his earlier one on the same subject of reduction formulæ and of multiple integrals. It contains, besides, new chapters dealing with mean values, probability, definite integrals (including the Eulerian), Fourier's series and other topics, including functions of the complex variable. There are numerous references to the author's "Differential Calculus" which is essential to the reading of the present work. Both treatises are based on the method of rates and both enjoy both the advantages and the disadvantages that attend adherence to that method. The work will serve, too, as a welcome auxiliary to Professor Johnson's well known and widely used "Differential Equations."

C. J. KEYSER
COLUMBIA UNIVERSITY

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for April is devoted to a symposium on "Aspects of the Species Question," being the papers presented at the January meeting of the Botanical Society of America, by Charles E. Bessey and others. The aspects are taxonomic, physiological and ecological and the views of the various authors are naturally more or less colored by the nature of their work. Many will thank C. L. Bristol for his quotation showing the origin of the "Otter Sheep," as information of this kind is most difficult to lay hands on. One may know the general facts and yet be unable to give a definite reference to them.

BIBLIOGRAPHIES are always welcome, and the "Index to Hull (England) Museum Publications, Nos. 1–47," will be of much service in facilitating reference to the many objects in the Hull Museum described during the past six years.

The Museums Journal of Great Britain has a description, by E. Howarth, of "The School Museum System of Sheffield" with details of the circulating collections, stereoscopic views and lantern slides for loan to public schools. The cost of the individual "cabinets" in these collections was stated to be from $25 to $75 each, which must be regarded as a pretty liberal sum.

THE *Reports relating to Alaskan Seal Fisheries*, recently issued by the Department of Commerce and Labor, contain much interesting information in regard to the seals of the Pribilofs, and the Arctic fox. The seal herd has steadily decreased, owing to pelagic sealing and the total number in 1907 was only about 172,000 as against 400,000 in 1897. The greatest destruction is now wrought by the Japanese, who are not bound by any agreement, seal up to the three-mile limit (sometimes within it) and use shot-guns which cause great loss and waste. Owing to the adoption of certain restrictions proposed by the government agents the proportion of active young bulls has increased.

THE *First Biennial Report* of the Louisiana State Museum, covering the period December 10, 1906 to April 1, 1908, has just been issued. It gives a brief account of the origin of the museum and includes a general catalogue of the exhibits of the various departments. These include a fair representation of the fauna of the state, a considerable proportion of commercial products and some extremely valuable and interesting historical material. It is to be hoped that this museum may receive substantial support from the state.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 205th meeting of the society, on April 22, 1908, specimens of "coal bombs" from Walsenburg, Colo.; Las Cerillos, N. M., and the Pennsylvania anthracites were exhibited by David White, who remarked that these nodule-like masses from the midst of coal beds often show a combination of slickensiding and concentricity of structure suggesting tension in one plane rather than pressure in all directions. Such nodules or bombs, found in coals of varying age and kind, are probably more frequent than would be supposed from their rare mention in the literature.

Regular Program

Mineral Deposits of the Cerbat Range and Black Mountains, Mojave County, Arizona: Mr. F. C. SCHRADER.

The Cerbat Range and Black Mountains are two desert ranges situated about twelve miles apart in the northwestern part of Arizona, southeast of the Big Bend of the Colorado River and between the river and the Colorado Plateau. They represent the southward continuation of the Virgin and Muddy Mountains of the Great Basin on the north. The principal distributing point for the mining districts is Kingman, situated on the main line of the Atchison, Topeka and Santa Fe Railway.

The deposits, concerning which little has hitherto been known, occur principally in two regions: One in the Cerbat Mountains, where the deposits are distributed over an area that extends from about nine miles north of Kingman to twenty miles north, embraces the Chloride, Mineral Park, Stockton Hill and Cerbat districts. The other region is in the southern part of the Black Mountains, where it embraces the well-known Gold Road and Vivian districts, situated about twenty-four miles southwest of Kingman. Both regions contain numerous mines, many of which have produced from about $1,000,000 to $3,000,000 each; the production of the Gold Road mine being about $1,000,000 in the two years 1905 and 1906.

The deposits are of two very distinct types. The first, which is confined chiefly to the Cerbat Range, consists of quartz fissure veins, usually in the pre-Cambrian complex of granitoid-gneiss-schist rocks. The veins usually are not deeply oxidized. They contain the sulphides, pyrite, galena, zinc blende and arseno-pyrite, which yield silver chiefly, but with minor amounts of gold.

The second group comprises the deposits of the Black Mountains. They differ markedly from those of the Cerbat Range, just described, in several important respects. First, they occur chiefly in Tertiary volcanic rocks, principally andesite, and are younger than the Cerbat veins. Second, the veins seem to have originally contained a calcite gangue, which is still present in many of them. In the most valuable deposits, however, a mineralogical change has taken place, by which the calcite has been replaced by quartz and adularia. Third, the values are almost exclusively gold. Fourth, the oxidation extends to the depth of 600 or 700 feet, and, as a rule, no sulphides or base metals are found.

The deposits of both types are believed to owe their origin to the circulation of mineralized, aqueous solutions probably at high temperatures through the fissures in which the values are now found.

Recent Work on the Illinois Coal Field: Mr. Frank W. De Wolf.

The Illinois Coal Field covers an area exceeding 36,000 square miles and supports over four hundred commercial mines scattered through fifty counties. The preliminary estimates place the production for 1907 in excess of forty-nine million tons, and thus indicate an increase during the year of over twenty per cent.

While the general features of the stratigraphy and structure have been presented in earlier reports, the problem remains to divide the stratigraphic column into appropriate formations and to carry the correlation of the sixteen or more coals through the state. This work is going forward by cooperative investigations of the State and U. S. Geological Surveys.

Certain chemical problems have been investigated, also; one refers to variations in the quality of coal seams from place to place; another, to the relation between analyses of mine samples and commercial samples, with especial regard to the deterioration of coal during storage. Another consideration of vital importance refers to the selection of some "pure coal" unit which may serve as a basis for comparing samples of varying composition.

Detailed reports are finished for parts of Saline, Gallatin and Williamson Counties. The explored rocks include some fifteen hundred feet of carboniferous sediments, and these include two widely persistent coals of approximately five feet in thickness and of excellent quality, besides numerous local beds. The dip of the rocks is essentially northward toward the center of the basin, but is interrupted locally by dome-like features which suggest block-faulting on a small scale. The structural relief, as shown, is four hundred and twenty-five feet. In some cases the coals are cut by igneous dikes which produce natural coke along the contacts and which contain occasional crystals of sphalerite, thus suggesting relationship to near-by counties which produce lead and zinc.

Panama Stratigraphy: Mr. ERNEST HOWE.

Following andesitic breccias that are supposed to be of early Eocene age, sedimentary rocks belonging to three epochs have been recognized in the section exposed on the Isthmus of Panama. The oldest, the Bohio formation, has conglomerates associated with volcanic breccias near the base, but consists for the most part of fine calcareous sandstones and shales. An abundant fauna contains species characteristic of the Claiborne Eocene and some common to the Upper Tejon. Separated from this by an unconformity are the Peña Blanca marls rich in foraminifera that, from the characteristic species *Orbitoides fortisi,* Dr. Dall considers of Lower Oligocene age corresponding to the Vicksburg. The youngest sedimentary rocks are those of the Monkey Hill formation consisting of fine calcareous and argillaceous sandstones and marls. From abundant fossils contained in these beds they are regarded as equivalent to the Chipola Oligocene. Of these three formations the oldest only, represented by the Culebra beds, has been observed on the Pacific side of the isthmus.

Eruptions of rhyolitic rocks, both massive and fragmental, occurred at some time between the close of the Bohio epoch and the beginning of the Monkey Hill, while all the rocks in the central and southern portions of the isthmus were invaded in the Miocene by pyroxene-andesites and basalt.

RALPH ARNOLD,
Secretary

DISCUSSION AND CORRESPONDENCE

THE CHAIR OF PHILOSOPHY AT THE UNIVERSITY OF CINCINNATI

TO THE EDITOR OF SCIENCE: I beg permission to make a statement relative to my deposition from the University of Cincinnati.

First, I should like to say that the three reasons assigned for declaring my chair vacant are either inadequate grounds for such action or are false in fact. Furthermore they are not the reasons stated in private by the president.

The three grounds assigned were (1) The suppression of the real reasons for my leaving Vassar when I applied for the position at Cincinnati. I agree with the president on this point that this was not fair to him and so informed him before his request for my resignation. But is this an adequate basis for deposing an officer whose work is admittedly satisfactory?

The second ground was that I held views destructive of society which affected my teaching and my life. The testimony of my students both here and at Vassar College refutes the charge that my views on certain ethical topics had entered the classroom. The testimony of my wife and of those who know me must intimately is sufficient reply to the charge of baneful effects of my alleged sinful views upon my life and character. The objection that now, at least, I have taught my views by their publication in the newspapers is certainly met by replying that a man has a right to state his views on any subject in this age and country as long as he does it in a dignified and decent way. And since I was asked to resign on account of my views (which fact is significantly omitted from the formal statement issued by the president) I maintain that I had a right to vindicate myself before the public by stating the views for which I was to be ejected. If it be objected that I did not choose the proper place and manner of publicity in stating my views, it is replied that the only statements authorized by me were given to the Cincinnati *Times-Star* with the understanding that they were to be printed just as I wrote them or not at all. They were so printed in that paper. Additions and embellishments by reporters unhappily have been taken as expressing my views, instead of my own carefully prepared statement of them.

The third ground assigned by the president for my dismissal, that I threatened him, did not exist.

I made this stand here at Cincinnati in the hope that I might be dealt with on the basis of the merits of the case. The three grounds assigned evade the real issue of my views which was privately stated by the president to be the basis of his action. And this real issue, which is not frankly stated, but set aside by the interposition of an unjustifiable personal attack, is a violation of the principle of *Lehrfreiheit*.

H. Heath Bawden
University of Cincinnati,
May 31, 1908

SPECIAL ARTICLES

A METHOD OF SENDING PURE CULTURES OF FUNGI

For several years the writer has had occasion to receive cultures of moulds from different parts of this country and from abroad and has learned to expect a large percentage of contaminations even when the cultures are pure when shipped. The usual method is to send a pure culture of the mould in a fresh slant tube of nutrient which has been hardened with either gelatin or agar. During transit the nutrient generally becomes shaken up against the cotton plug and there results an infection of bacteria or of moulds like *Penicillium* and *Aspergillus*, the spores of which are usually present on the outside of the cotton plugs but which germinate and grow down into the tubes when the plugs are wet or the surrounding air is rendered moist by rubber caps or even by paper wrappings which more or less completely seal the tubes. Recently the writer received a shipment of a considerable number of tubes from Utrecht, Holland, from the fungus collection of the Association Internationale des Botanistes. They were apparently fresh cultures and a very large proportion were thus irredeemable from contamination with weed fungi. It seems not undesirable, therefore, to describe in some detail a method of shipping cultures which experience has shown to be free from the objectionable features already mentioned, although it is a method which might naturally occur to any one having spores to send.

If cultures are to be sent in test-tubes it is advisable to avoid gelatin and to use rather stiffer agar than usual, which should be allowed to dry out and thus fasten itself against the sides of the tubes before packing. For stock cultures, which are to be kept a year or so, the writer has successfully used as much as 30 and even 35 grams of agar to the liter, and agar of this degree of hardness might be used for shipping. While with proper precautions pure cultures may be sent in test-tubes yet the possibility of breakage or of infection already pointed out, as well as the possible inconvenience of custom-house inspection when packages are received from foreign correspondents, are objections to this method.

These disadvantages have led the writer to use small paper envelopes such as are made by druggists in putting up powders or by botanists in preserving fungi in exsiccati. A mass of the fungus filaments containing spores are taken with a sterilized instrument from a pure culture of the species desired, together with some of the substratum, and put into the envelopes, where it is allowed to dry. Several of these culture envelopes may be sent with little inconvenience in an ordinary letter. It has been the writer's practise as a matter of precaution to sterilize the envelopes either in an autoclav or in a dry oven at 140° C. before using them. The danger of infection is probably not very great if the culture envelopes, although unsterilized, are made up of clean paper that has not been unduly exposed to contamination since the few spores of *Penicillium* or other fungus weeds that may be present have little opportunity of germinating and spreading if the material used in the transfer be rapidly dried and kept in a dry condition. In making up the dry cultures it seems desirable to include some of the substratum mixed with the spores. In this way even such bacteria as *Bacillus prodigiosus* have been successfully sent through the mail and moulds have been received in good condition from as distant countries as the Philippines. Naturally with those fungi that fail to fruit well in captivity and to form spores or other reproductive bodies which retain their vitality, recourse must be had to test-tube cultures with hard agar. The envelope method has been used for several years by the writer and by several of his correspondents, and for the forms most generally cultivated seems to meet all the requirements of convenience and freedom from contamination.

A. F. Blakeslee
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BOTANICAL NOTES

SANE AND SCIENTIFIC FREE-SEED DISTRIBUTION

In these days when we hear so much in very proper denunciation of the continuation of the congressional free-seed distribution which the United States Department of Agriculture is annually compelled to make, it is well to call attention to some work now quietly carried on by the Bureau of Plant Industry which is not only not open to such criticism, but, on the contrary, very much to be commended. Through inquiries made by a representative of Science the following authoritative statements have been elicited, and are here published in order to show the nature and scope of a legitimate seed and plant distribution, in contrast with the annual farce which is enacted at the imperious command of a majority of the congressmen. It is due the department to say that in these statements only a few of the lines of work conducted under the appropriations for "the purchase and distribution of valuable seeds" are mentioned.

FORAGE CROP WORK

Introduction and Extension of Alfalfa.—This work includes the extension of the present range of alfalfa culture in the east and the introduction of new varieties in the west. Special attention is being given to the development of varieties which will resist cold and drought, as well as varieties which will give greater yields than those ordinarily grown. Arabian alfalfa, secured by exploration in 1905, has proved to be by far the heaviest yielder in the southwest. Twelve cuttings were obtained at Mecca, Cal., during the past year as compared with eight cuttings of ordinary alfalfa. This is the most remarkable alfalfa yet found for rapidity of growth.

Propaganda Work with New and Standard Grasses.—This work has for its objects the wider utilization of the standard grasses and the introduction and extension of the culture of new and improved varieties. Experiments with improved varieties of timothy, with meadow and pasture mixtures, and with several new grasses, such as Para grass, Guinea grass, and Natal grass, are being made. During the past year seed has been distributed of the two improved timothies developed by Dr. A. D. Hopkins, both of which possess very superior merit. One of these ripens with red clover and the other is a large yielder.

Cowpea Investigations.—The chief object of this work is to secure cheaper and better cowpea seed, so as to bring about a great increase in cowpea culture. The need is for good varieties producing small, hard seeds that will not crack and that retain their vitality for more than one year. The cowpea is to the south what clover is to the north, and the lessening of the cost of the seed and the improvement of varieties are important problems. Much attention is being given to the study and development of harvesting machinery.

Work with Vetches in the South.—This work consists of the introduction and encouragement of the growing of vetches throughout the south. The vetch is an exceedingly important plant and its much wider use is greatly to be desired. The development of varieties that will mature in time for cotton-planting, and the distribution of seed of desirable varieties are features of the work. About sixty varieties and species of vetch have been tested for two years. One of these, *Vicia dasycarpa,* is of especial promise, resembling hairy vetch, but being so early that it can be used as a winter crop in rotation with cotton. Seed is being grown in quantity. Extensive cooperative experiments with farmers, especially in the south, with common vetch and hairy vetch have been conducted during the past two years, resulting in great interest in the crop and a greatly increased culture. This work is being continued.

Tests of New Forage Crops.—Among the new forage plants under test are the Tangier pea and guar, an East Indian forage plant.

Extensive tests of these plants are being made in various parts of the country, and their culture in promising localities is being encouraged. These tests are being carried on at Arlington, Va.; Chico, Cal.; Pullman, Wash.; and Chillicothe, Tex. Among the most valuable new things so far tested are the Tangier pea, moth bean, and snail clover, all of which are of sufficient promise to warrant distribution. Seed of the first two has been grown in quantity for distribution in 1908.

IMPROVED COTTON SEED

This work consists of the sending out on congressional and other order of trial packages of seed of the improved varieties of cotton developed by the plant breeders of the Bureau of Plant Industry for boll-weevil districts. Each congressman from the cotton states is assigned a regular quota of eighty packages of this select seed, each package containing one peck. The seed is also sent to cooperators and others.

IMPROVED TOBACCO SEED

This work is conducted on the same plan as the cotton-seed distribution, the improved varieties of tobacco being sent out on both congressional and other request. The Bureau of Plant Industry has developed several improved tobaccos, and the seed secured in the breeding work is distributed each season.

IMPROVED MELON SEED, CITRUS HYBRIDS, ETC.

The Bureau of Plant Industry also distributes each year seed of improved wilt-resistant melons, which are being developed in connection with the pathological work; and also young trees of improved and new citrus fruits, such as citranges, tangelos, etc.

AGRICULTURAL EXPLORATIONS

The Bureau of Plant Industry conducts systematic agricultural exploration work in foreign countries. Purchases are made in all parts of the world, including seeds and plants for trial by the experiment stations and others, and the shipments arrive at the rate of eight or nine a day. One of its explorers has completed a year of search through Manchuria and North China for hardy fruits, vegetables, grains and forage crops. He has secured and shipped in over 1,000 things, among them promising new alfalfas, seedless persimmons four inches in diameter, hardy Chinese pears, the Shantung peach for the dry southwest, new North China grapes, the seedless Chinese date, timber bamboos, new cowpeas, new soy beans, a new rose, a new sand cherry, a remarkable series of new shade trees and sorghums, etc. These things are now being tested in those portions of this country which have a climate like that of North China, where the thermometer goes down to 15 or 20 degrees below zero.

DATE INTRODUCTIONS AND DATE GARDENS

A large collection of the remarkable date varieties from the upper Tigris River in the region of Bagdad is now being gotten together by the American consul, and these will be sent to this country next spring. Large purchases of date seeds and fruit of the Morocco varieties have been made this season. Two date gardens are being maintained in California, one at Mecca and the other at Indio. In the Mecca garden are assembled 394 palms imported from foreign countries. They occupy fifteen acres of land and are without doubt the largest ever gotten together in any country. It has been demonstrated that the date palm can be grown successfully in California and Arizona as a result of this work during the last eight years.

MATTING PLANT INTRODUCTION

The floor-matting industry costs the United States four million dollars in imports every year. There are perfected looms in America which are fed by the imported material—rush and sedge straw. The Americans are being shut out of the Japanese market by the Japanese manufacturers and must get their raw material in this country or take their machines to Japan and operate them there. An explorer was sent to Japan by the Department of Agriculture and secured, notwithstanding the opposition of the Japanese matting guilds, 75,000 plants of the Japanese rush and 380,000 plants of the Japanese sedge. It was found necessary to increase these quantities by propagation, but car-load lots have now been sent to points in Texas, Louisiana, South Carolina and California, where contracts have been made for the planting of trial areas under normal field conditions.

BAMBOO INTRODUCTION

THE timber bamboos of the Orient are among the most profitable plant cultures of the orientals. Scattering groves of these plants in America have demonstrated that they can be grown profitably on land that is not now occupied by crops, such as the "canebrake" lands of the south. The uses in this country to which bamboos can be put are being studied. Early introductions into the plant introduction garden at Chico, Cal., have been growing successfully and an explorer has been appointed to get up a shipment of the best timber forms and import them the coming spring. Hardier forms than the Japanese have been found in China, drought resistant forms are being ordered from India, and the tropical giant forms will be secured from the planters in Porto Rico.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

THE NATIONAL EDUCATIONAL ASSOCIATION

THE National Educational Association meets at Cleveland Ohio, from June 29 to July 3, under the presidency of Mr. Edwin G. Cooley, of Chicago. The program of the general sessions is as follows:

Monday Afternoon, June 29

Addresses of welcome by Hon. Tom L. Johnson, mayor of city of Cleveland, Ohio, and by Dr. Charles S. Howe, president of Chamber of Commerce, Cleveland Ohio.

Response by William O. Thompson, president of Ohio State University, Columbus, Ohio.

Report of Educational Progress for the Year, by Charles F. Thwing, president of Western Reserve University, Cleveland, Ohio.

Monday Evening, June 29

Annual address of the president, Joseph Swain, president of Swarthmore College.

"Compulsory Education in Industries in the Schools of London," by Cloudesley S. H. Brereton, divisional inspector for the London Council, London. (Appointment provisional.)

"Adaptation of the Public School to Industrial Ends," by Andrew S. Draper, commissioner of education for the state of New York, Albany, N. Y.

Tuesday Evening, June 30

"The Rein and Spur," by J. C. Willis, president of Louisville University, Louisville, Ky.

"Negro Education and the Nation," by Booker T. Washington, president of Tuskegee Institute, Tuskegee, Ala.

"The Function of Education in a Democracy," by Martin G. Brumbaugh, superintendent of schools, Philadelphia, Pa.

Wednesday Afternoon, July 1

"Reconcilement of Cross Purposes in Education of Women" by Sarah Louise Arnold, dean of Simmons College, Boston, Mass.

"The School and the Immigrant Child," by Jane Addams, Hull House, Chicago, Ill.

"The School and the Practise of Ethics," by Ella Flagg Young, principal of Chicago Normal School, Chicago, Ill.

Friday Morning, July 3

"The Personal Touch in Teaching," by Andrew F. West, dean of the Graduate School, Princeton University, Princeton, N. J.

"Personal Power of the Teacher in Public School Work," by William H. Maxwell, superintendent of schools, New York City.

Those announced to read papers before the department of higher education are the president of the department, Dr. Oscar J. Craig, and Professors R. J. Alley, Charles Fordyce, David S. Snedden, W. H. Crawford and W. N. Stearns. Those announced to read papers before the department of science instruction are Messrs. R. H. Whitbeck, N. M. Fenniman, Robert A. Millikan and Miss Martha K. Genthe. An evening session will be addressed by Professor L. H. Bailey and Mr. Gifford Pinchot.

THE HANOVER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

WITH the issue of SCIENCE for May 29 there was distributed the preliminary announcement of the special summer meeting of the association to be held on the invitation of Dartmouth College, at Hanover, N. H., from June 29 to July 3. The American Physical Society and the Geological Society of America meet in affiliation with the association, and good programs of scientific papers may be expected in physics and in geology. In the other sciences there will be no regular programs, though there may be informal conferences. The special feature of the meeting will be the opportunity of meeting colleagues and friends amid the pleasant surroundings of a New England College and the interesting excursions that have been arranged. Those who were able to attend the summer meeting at Cornell University two years ago remember it with special pleasure, and there is every reason to believe that the meeting at Dartmouth College this year will prove equally attractive.

The association is performing an important service for scientific men and for those interested in science by arranging not only great winter meetings in our cities where the attendance runs into the thousands and where the collective strength of the science of the country is exhibited, but also in providing less formal meetings in the summer for those able to attend them. Our scientific men are so many, the country is so large and interests are so diversified that there is ample room for two meetings in different regions and of different character. There is indeed nothing quixotic in looking forward to the time when the association will make arrangements for a dozen meetings in the course of a year. It is an advantage to have a well-organized central office which will serve scientific men and scientific interests whenever and wherever this is possible. Our national societies devoted to the different sciences, and our local academies must be the units of organization; and their complete autonomy must be respected. But each of these societies can not maintain salaried officers and have at its disposal the information and the experience which are needed to arrange a meeting efficiently and economically.

In arranging the Hanover meeting the officers of the association have served the physicists and the geologists, who wish to hold sessions, and have provided a center where scientific men can meet individually and in conferences and committees. They have also performed a function which has been somewhat neglected in recent years, and which has never been so well performed here as in Great Britain, namely, the diffusion of science and the awakening of the interest of those not professionally engaged in scientific work. It should always be remembered that science depends on the intelligent public for recruits and for support, and scientific men should encourage general interest in science in so far as this can be done without sacrifice of their research work. A meeting such as this at Hanover should attract men and women who wish to become acquainted with the work of scientific men. Relatively more attention can and should be paid to their interests than is possible in the crowded winter meetings. Lectures, meetings and excursions have been arranged at Hanover which are of general interest, and this fact should be brought by scientific men to the attention of others.

While the Hanover meeting may interest directly only a small proportion of the scientific men of the country, it certainly does not interfere with those who do not attend. On the contrary, it is of some service to all by what it does accomplish. Next summer the British Association meets in Winnipeg, and has courteously invited all members of the American Association to become members for the meeting. An invitation of this character could only be extended to a national association. For the following summer the officers of the association are planning an excursion to Hawaii and a meeting there. The association in thus serving the interests of scientific men and of those interested in science in both summer and winter deserves the support of all, and this can be best given at present by attending the Hanover meeting. Each one who goes will add to the pleasure of others, and will find himself amply repaid.

SCIENTIFIC NOTES AND NEWS

FOLLOWING the conference of the governors at the White House, President Roosevelt has appointed a National Conservation Commission, divided into sections for waters, forests, lands and minerals. Mr. Gifford Pinchot, chief forester, is chairman of the commission, which, in addition to senators and representatives, includes Dr. W J McGee, Mr. F. H. Newell, Professor George F. Swain, Professor Henry S. Graves, Mr. Overton W. Price, Mr. Charles McDonald, President Charles R. Van Hise, Mr. John Hays Hammond, Professor Irving Fisher and Mr. J. A. Holmes.

PROFESSOR LIBERTY H. BAILEY, director of the College of Agriculture at Cornell University, has been given the degree of doctor of laws by Alfred University, where he made a commencement address.

THE University of Cincinnati has conferred its doctorate of laws on Dr. F. C. Shattuck, Jackson professor of clinical medicine in the Harvard Medical School.

THE University of Arizona conferred the degree of LL.D. on Professor William Phipps Blake, at its annual commencement on June 3, in recognition of his achievements in exploration and geology. Professor Blake began his work in the southwest as a member of the Williamson expedition which traversed southern California and the Colorado desert in 1852, discovering the San Gorgonio Pass and making clear the nature of the Salton Basin.

SIR GEORGE DARWIN, K.C.B., F.R.S., and Professor E. B. Tylor, F.R.S., have been elected corresponding members of the Vienna Academy of Sciences.

AN expedition, under the combined auspices of the American Museum of Natural History and the Geological Survey of Canada, is now on its way to the mouth of the Mackenzie River and adjacent country to collect ethnological and zoological material. The party is being conducted by Mr. V. Stefánsson, who is well acquainted with the Eskimos of the region, having wintered with them in 1906, and Mr. R. M. Anderson, a well-known naturalist. The expedition was organized for the purpose of making scientific studies of the Eskimos of the country, of procuring as exhaustive collections as possible illustrating not only the material cultures of the uncivilized tribes of the region, but also of the zoological conditions which prevail there, and of increasing our knowledge of the geological formation of that portion of the world. The expedition will commence its return journey during the summer of 1909.

MR. FRANK M. CHAPMAN on his recent ornithological expedition for the American Museum of Natural History procured material for a "habitat group" illustrating the rookery bird life, at one time so characteristic a feature of Florida. He succeeded in reaching doubtless the last general rookery of the region. The museum group will contain large and small White Egrets, Roseate Spoonbills, Louisiana and Blue Herons and White Ibises. Mr. Chapman also secured a series of moving pictures of pelicans on Pelican Island, showing the habits of the birds during the nesting period. These pictures will be of especial interest, as evidencing the results of the protection which has been accorded the birds for the past five years.

IN compliance with a request of the secretary of the interior, Dr. J. Walter Fewkes, of the Bureau of American Ethnology of the Smithsonian Institution, has gone to the Mesa Verde National Park, Mancos, Colorado, to take charge of the excavation and preservation of the cliff dwellings there. His work for the present will be directed toward the so-called Spruce Tree House, which he will restore, before attempting the preservation of the Cliff Palace. The Cliff Palace is not only the finest but also the largest example of cliff house architecture in our southwest. In the Cliff Palace, Dr. Fewkes plans to excavate all the rooms and plazas to their floors, remove accumulated débris, repair the walls that are in danger of falling, and put the ruin in such a condition that a visitor may walk through the courts and rooms without obstruction. Dr. Fewkes has gone to the Mesa Verde Park from the Casa Grande ruin, Pinal County, Arizona, where he has been at work during the winter season unearthing the remains of an extensive prehistoric city.

Professor C. J. Chamberlain visited Mexico during March and April to continue his studies upon the Mexican cycads. Besides securing abundant material and numerous photographs of *Dioon edule* and *D. spinulosum*, he found at Santa Catarina in the state of Oaxaca a new species of *Dioon* which is clearly intermediate between the other two species, having the habit of *D. edule* with the spinulose leaf of *D. spinulosum*. The leaf is not so spinulose, however, as in *D. spinulosum*. Further observations were also made upon *Ceratozamia*.

Professor E. D. Campbell, director of the chemical laboratories of the University of Michigan, recently visited the University of Wisconsin and delivered an address to the faculty and students of the chemistry department on "Technical Chemistry." Sigma Xi, the honorary scientific society, entertained Professor Campbell at a banquet at which he gave a second address on "The Effect of Free Magnesia on Cements." Through an accident in 1891 Professor Campbell lost his sight; but in spite of the fact he has risen to his present high position, doing considerable valuable original research work, especially on the chemistry of cement and iron. Many of his pupils now occupy responsible positions in university faculties, among them Professor E. B. Hart, head of the department of agricultural chemistry and Professor Richard Fischer, of the chemistry department of the University of Wisconsin.

An effort is being made to erect at Montpellier, France, on the grounds of the National School of Agriculture, a monument to the late Gustave Foëx, the French horticulturist whose work on the grapevine *Phylloxera* and other viticultural questions is so well known to the horticultural world. A considerable amount of money has been raised in Europe, and the committee hopes to obtain something in America between the present date and the end of next September. Americans desirous of contributing any sum, large or small, may do so by addressing the Comité d'Organisation, Monument Gustave Foëx, Montpellier, France, or the American representative of the Committee, Dr. L. O. Howard, U. S. Department of Agriculture, Washington, D. C.

A statue of Liebig is to be erected in Darmstadt, where he was born in 1803. The corporation of Darmstadt has contributed 3,000 Marks towards the expenses.

Sir John Evans, K.C.B., F.R.S., the eminent British archeologist, past president of the British Association for the Advancement of Science, died at his residence, Britwell, Berkhampsted, on May 31, in his eighty-fifth year.

Dr. Oskar Langendorf, professor of physiology at Rostock, has died at the age of fifty-five years.

The deaths are also announced of Dr. A. Belohoubek, professor of pharmaceutical chemistry in Prague, of Dr. Hermann Wedding, professor of mining at Berlin, and of Dr. Ulrich Behn, docent for physics at Berlin.

There will be a New York State civil service examination for the chief of division of Trade Schools in the Educational Department at a salary which may be $3,000, and for vice-director of the New York Library School, at a salary which may be $2,500. The latter position is open to both men and women. Applications for these two positions will be received until July 1, 1908. A special circular of requirements will be sent on request.

CONGRESS has made an appropriation of $35,000 to pay the expenses of a delegation from the United States to the fourth Latin-American Scientific Congress, which will be held in Santiago, Chile, in December, 1908. The United States is entitled to nine delegates, who will be probably selected from the universities of the country during the present summer. The program divides the work of the congress into the following sections: (1) pure and applied mathematics, including engineering; (2) physical sciences; (3) natural sciences; (4) medicine and hygiene; (5) jurisprudence, political and social science; (6) history, languages and fine arts; (7) pedagogy; (8) agriculture and animal husbandry; (9) industrial processes.

A CABLEGRAM has been received at the Harvard College Observatory from the Astronomische Centrale at Kiel, stating that Encke's comet was observed by Woodgale (Woodgate) at the Cape of Good Hope on May 27, 1908. 691 Gr. M. T. in R. A. 2^h 59^m 16^s. Dec., 7° 29′.

THE *Journal of the American Medical Association* says: "From the outset the Chicago session demonstrated that it would be all that had been expected of it. Registration began the first thing on Monday morning and kept up in a steady stream all day, so that by the time the registration bureau closed 2,210 had registered, a number exceeding the phenomenal Monday's registration at Boston in 1906 by 663. As we go to press (Wednesday noon) the registration has reached a total of 5,944. In point of attendance, therefore, the Chicago session of 1908 has set a fresh standard for the annual sessions. Last year the total registration reached 3,713, and the Boston session, which had the largest attendance of any preceding the present one, was 4,722. The section meetings are wonderfully well attended, and the meeting places are proving decidedly satisfactory. It is not too much to say that the fifty-ninth annual session of the American Medical Association, held in its home city, will go on record as a permanent milestone in the onward and irresistible march of American medicine."

REPRESENTATIVES of twenty of the state geological surveys meeting in Washington on May 13 organized an Association of American State Geologists. Provision was made for an annual meeting and the appointment of various committees for the transaction of the business of the association. H. B. Kümmel, of New Jersey, was made president, H. F. Bain, of Illinois, secretary, and J. H. Pratt, of North Carolina, was appointed to act with them, forming an executive committee. Messrs. W. B. Clark, of Maryland; I. C. White, of West Virginia, and J. H. Pratt were appointed a committee to investigate the distribution of documents by the various surveys. J. M. Clarke, of New York, was appointed to represent the state geologists on the general committee on nomenclature now being organized, with Samuel Calvin, of Iowa, and E. A. Smith, of Alabama, as associates. The following resolution was unanimously adopted:

Washington, D. C., May 12, 1908.

WHEREAS, our country and the sovereign states composing it now face serious problems relating to the preservation of our national resources, and,

WHEREAS, these problems—of wisely administering our forests, our minerals, our soils, our water resources—are to-morrow to be the subject of a conference between the Governors of the various states and the President of the United States, and,

WHEREAS, we deem a contour-topographic map of our country so necessary to the intelligent solution of these and equally important problems,

Be it *Resolved*, that we most earnestly ask of the state and federal authorities in conference assembled their support in securing such a map, and, since the state and national interests are here so closely one, we most respectfully suggest: That state and federal appropriations for topographic surveys be increased, and that more immediately the federal appropriation be increased for this work to meet the state appropriations now available.

Be it *Resolved*, also, that a copy of these resolutions be presented to said conference of the Governors with President Roosevelt with our greetings and respect.

THE *Journal of the American Medical Association* quotes an announcement to the effect that the German authorities have organized a central institute at Hamburg to train officials for the German colonies and protectorates, and to centralize all the scientific and economic efforts on behalf of the colonies. In order to keep the institution in close touch with commercial interests, three members of the chamber of commerce are delegated to act as an advisory board in all questions that may arise, and as the intermediary between the institute and the senate commission. Chairs are to be organized for astronomy, botany, geography, geology, history, jurisprudence, tropical medicine, ethnology, political economy and zoology in their relations to the colonies, with all the practical branches of these sciences. The Imperial Colonial Office is to send to the institute at least 20 officials each year for an annual course of instruction, and pay for each about $45 the semester. The lectures are open to merchants and others, and a special diploma is given to all those who complete the course. The city of Hamburg at present bears the cost of maintenance, but state aid is guaranteed in case the scope of the institute is enlarged or it develops beyond the present facilities. The term commences on October 1, 1908.

The Athens correspondent of the London *Times* reports that two archeological discoveries of considerable importance have been made. The excavations carried out in the Altis or sacred precincts of Olympia, near the great altar of Zeus, under the superintendence of Professor Dorpfeld, have resulted in the discovery of interesting remains of the Neolithic period, including house-vessels and implements. Thus it is evident that Olympia was a place of human habitation more than two thousand years before Christ. In Sparta the members of the British School have brought to light a large number of interesting terra-cotta figurines of the fifth century before Christ.

UNIVERSITY AND EDUCATIONAL NEWS

The University of Rochester has practically completed a fund of $100,000; thus entitling it to the additional gift of an equal sum from Mr. Andrew Carnegie. Half of the money is to be used for the erection of a building of applied science, and the other half for its endowment.

The department of physics of the University of Cincinnati has been granted $500 by the Bache Fund for the purchase of apparatus for research.

Dr. John S. Stahr has resigned the presidency of Franklin and Marshall College, Lancaster, Pa., which he has held for the past eighteen years.

Dr. Horatio H. Newman has recently resigned an assistant professorship of zoology at the University of Michigan in order to accept the professorship of zoology at the University of Texas, vacant by the removal of Dr. T. H. Montgomery, Jr., to the University of Pennsylvania. Dr. J. T. Paterson, of the University of Chicago, has been appointed instructor in zoology in the same department.

The following changes have been made at the Iowa State College, Ames: Professor S. W. Beyer is made vice-dean of the division of engineering; Associate Professor M. L. Bowman is made professor of farm crops; Assistant Professor M. P. Cleghorn is made associate professor of mechanical engineering; Assistant Professor R. E. Buchanan is made associate professor of general bacteriology; Professor Maria Boberts is made vice-dean of the junior college; M. I. Evinger is promoted from instructor to assistant professor in civil engineering; H. S. Bell and B. W. Crossley are made assistant professors in farm crops; H. C. Pierce is made assistant professor in animal husbandry in charge of the poultry department.

Mr. R. N. Rudmose Brown, B.Sc., has been appointed at Sheffield to the newly-instituted lectureship in geography. Mr. Brown accompanied the Scottish Antarctic Expedition in 1902 as naturalist. He acted in 1906 as special commissioner under the Indian government for the investigation of the pearl oyster fisheries.

Gonville and Caius College, Cambridge, has established a new fellowship, to be called the Monro Fellowship, and Mr. T. B. Wood, M.A., Draper's professor of agriculture, has been elected to it.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JUNE 26, 1908

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DEDICATION OF THE CHEMISTRY BUILDING OF THE COLLEGE OF THE CITY OF NEW YORK, MAY 14, 1908

IN taking the chair, Professor Baskerville, the director of the laboratory, said:—

Ladies and Gentlemen:

In the name of the honorable board of trustees, the president and the staff of the department of chemistry, I bid you hearty welcome. We are here to-day, because

First, honor is to be done to two teachers of chemistry, each distinguished in his own way as a scientist and as a citizen; and

Second, a building is to be formally opened and set aside for the study of chemistry.

It is not appropriate on this occasion to dwell upon the multitude of details incorporated in plans for a laboratory constructed to accommodate more than a thousand students. My colleagues hold themselves in readiness to show those particularly interested over the unfinished building at the close of these exercises. Papers have appeared and others will soon appear in print which call attention to the principles involved and some of the incidental details. The building is not perfect. No structure devised by the human mind or constructed by the human hand is ever perfect. Many ideas have been borrowed from other laboratories in this country and Europe. Some have been incorporated which are original. Some are good, and others not so good.

More important than all these facilities, however, is the spirit which dominates the teachers and students alike. I assure you, your presence to-day inspires us and its effect will be most lasting.

In the lecture theater of the department of chemistry in the University of Pennsylvania, where a laboratory was first opened to students in this country, is a frieze. Inscribed upon that border are these names: Priestley, Scheele, Lavoisier, Dalton, Gay-Lussac, Avogadro, Berzelius, Wöhler, Liebig, Graham, Bunsen, Hoffman, Cannizzaro and Wolcott Gibbs.

These names were placed by Dr. Edgar F. Smith, the present professor of chemistry. Electro-analysis is the most modern and the neatest means for analysis. Wolcott Gibbs was the father of electro-chemistry and Edgar F. Smith is now the world's authority on that subject. It is a great happiness to me, personally, that my dear friend Edgar F. Smith, is here today, a pioneer to speak of a pioneer, for it is his spirit I would establish in this department. I have the honor of presenting Vice-Provost Smith, who will speak to us of

A PIONEER OF CHEMISTRY

I am glad to be here on this red-letter day in the history of the College of the City of New York. I am sure that the hearts of all persons intimately connected with the college are at this moment overflowing with gladness and deepest gratitude on the completion of this splendid laboratory, which, in equipment and appointments for every kind of chemical work and investigation, stands in the first rank of laboratories designed for similar purposes.

In appearing before this happy and joyous company, it is my portion first of all, as well as my great pleasure, to offer you, President Finley and the honorable board of trustees, as well as your faculty and especially those members of it whose business it is to be in closest contact with the teaching and experimentation now being done here and which, as the years go by, shall continue to be done here—the heartiest, warmest congratulations and best wishes of the University of Pennsylvania—first of our American institutions to create a chair devoted to the science of chemistry, first also to open to its students a laboratory for practical instruction in that science.

Permit me also to extend my felicitations to the student body upon the extremely liberal and generous provisions made for them to acquire and perfect themselves in the methods of a science which has done so much for the comfort, happiness and welfare of mankind.

We see, surrounding us on all sides, innumerable evidences of a tender and deep-seated interest in those who shall come here to equip themselves for the great struggle of life. How grateful then all should be to that nation, that state or that city which has provided so munificently of its means that we may profit thereby. Indeed, it seems to me that it should create in us a great overwhelming national or civic pride—yes, more—a burning patriotism that will ever be uplifting, constructive in every respect.

However, I am not come here to read a dissertation. Not at all. I have come here to spend a few short hours with you, and to behold with my own eyes how supremely happy your beloved professor and my friend, Dr. Baskerville, is at this moment in the realization of his dream of many long years. This is his laboratory! And that reminds me that as professor of chemistry he is the successor of a brilliant line of chemists whose names shed lasting glory upon the college, and if you will bear with me, I should like to trace for a few minutes the activities of your first professor of chemistry—Wolcott Gibbs, who still lives, at the advanced age of eighty-six years, and who, though absent in body, must surely at this moment be present with us in spirit.

When we pause to read the record of his life, or his activities in the cause of chemistry here in America, we stand entranced, as it were, and freely admit that it is worthy of the highest praise and the most careful, thoughtful consideration, for there is scarcely a contribution that has emanated from his hand which does not fairly teem with suggestive thoughts.

As a junior in Columbia College when but nineteen years of age, Wolcott Gibbs gave to the scientific public a new form of voltaic battery in which, for the first time, carbon was used as the negative electrode. In his dissertation of 1845, upon a natural system of chemical classification, there is evinced a power of discrimination and understanding of analogies in crystalline form in relations of combinations and types of compounds that betrays the superb order of chemical intellect.

Beginning here in your laboratory with the analysis of the dust of a sirocco, there followed at a close interval a series of contributions upon analytical chemistry which demonstrated his acumen in devising new methods for the determination of various metals as well as separating them with the finest accuracy when associated in complicated mixtures. Though simple, it was Wolcott Gibbs who showed how simple lead dioxide might be or was in the separation of manganese from a series of allied metals, and cerium from its almost constant associates, lanthanum and the two didymiums.

This early attention to things analytical no doubt paved the way for later contributions upon the use of sodium thiosulphate as a reagent of separation; of hypophosphorous acid as a quantitative precipitant of copper, and of others too numerous to mention.

And then in 1857, in conjunction with my own chief and honored predecessor, Dr. Genth, there appeared the first of a series of contributions upon the cobaltamines—those fascinating bodies which taxed to the utmost the analytical skill of both Gibbs and Genth. In their hands the number of these compounds in which cobalt is differently combined from what it is in its ordinary salts, was greatly multiplied; but the complete interpretation of their constitution was not given by them. The solution of that problem was reserved for Werner of Zurich. And here at least is one instance where a discovery made by Americans arrested the attention of European minds to such a degree that from following the studies of Werner we are obliged to radically modify our long-cherished views upon the doctrine of valency.

It may also be said that Gibbs remarked, "very numerous and carefully made analyses of the salts of the cobaltamines, executed in my laboratory, indicate 59 as the true atomic value of cobalt." This and other published data make certain that as early as 1858 your first professor of chemistry was wide awake to the importance of the atomic numbers and to their methods of determination—problems of deepest interest to chemists of the present time.

There is scarcely an element that Dr. Gibbs did not follow in its many combinations. He knew them all. He knew them well.

And there in your early laboratory he also carried out an exhaustive study of platinum ore, patiently reviewing the many suggestions made for the separation of the several metals of the platinum group, and then, venturing forth on his own initiative to find new and better processes, met with the most abundant success. His research made in 1860 upon osmium bases stands to-day unfinished. Wolcott Gibbs opened the door. Who will enter and reap the rich harvest apparent there?

But it was not only in the field of analysis or in synthetic inorganic chemistry that your first professor was busy, for under date of October 27, 1857, we find him writing from the Free Academy in New York "On the Rational Constitution of Certain Organic Compounds" and concluding with this observation: "I conclude with the expression of my conviction that every complex molecule is built up, not directly of the elements which it contains, but of simpler organic molecules, which are more or less perfectly fused together but which may yet in the majority be distinctly traced in the complex whole." And then he called attention to the preparation of methyl and ethyl derivatives of silicon, as well as to the theoretic interest attaching to their vapor density determination. Though of historic value alone at this moment his study of the "Molecular Structure of Uric Acid and its Derivatives" reveals a deep appreciation of the intricacies of that great problem, the solution of which has only been made possible by such efforts as he and others put forth for its realization.

Wolcott Gibbs is the father of electro-analysis, that branch of gravimetric practise which to-day is widening its applications and winning for itself a distinct and permanent place in the great domain of analytical chemistry. But the great crowning study, perhaps, of your first professor of chemistry was that relating to complex inorganic acids—compounds in which several acid radicals unite to form a nucleus with functions like a single radical. Such derivatives have been greatly increased in number in recent years. They offer stupendous analytical problems. Their constitution is barely known. Here and there hints have been obtained as to the same. The future must disclose the methods to be pursued in unraveling their enigmatical structure, and when that is once accomplished perhaps then the constitution of the great host of silicates will also be made clear.

And now I must pause. Inadequately, superficially have I traced the activities of your first professor of chemistry. Time forbids anything more elaborate, more exhaustive. But reflect for a moment upon the cobaltamines—the amines of the platinum metals—the beginnings of electro-chemistry—the beginning and development of complex inorganic acids—and all that these represent in the way of philosophic treatment and generalization, and I think you will agree with me that it is the work of a master mind. And yet some years ago when discussing these matters with our honored and beloved Nestor of chemical research in America, he said, "I have only been a pioneer in this work, nothing more!" He has indeed been a pioneer, but better still, he inspired hosts of young men to enter these fields of inquiry and rich indeed has been their reward.

And now in conclusion let me express the wish that under the guidance and inspiration of the present occupant of the chair of chemistry, there may be trained in this palatial laboratory many young men who will pursue not only the science of chemistry, but all other sciences, in the spirit of Wolcott Gibbs, the pioneer, and like him serve well their day and generation.

The following letter from Professor Gibbs was then read:

Gibbs Avenue, Newport, R. I.,
April 6, 1908.

My dear Mr. Baskerville:

I received with pleasure your kind letter of March 28 and it gratifies me very much to have the library named after me.

I should very much like to see the new college, but at my advanced age I can not hope to be able to do so.

I recall with pleasure and interest my connections with the old institution and send heartiest good wishes to the new.

With kindest regards, I am,

Very sincerely yours,

(Signed) WOLCOTT GIBBS

Prof. Charles Baskerville.

In unveiling the portrait of Professor Wolcott Gibbs, Professor Baskerville said:

Handsome bronze doors will soon grace the main west entrance of the capitol in Washington. On one of the eight panels, four being on each side of the door, is a scene depicting science. On the sides of this panel are two figures, one of Joseph Henry, the physicist, and the other is Oliver Wolcott Gibbs, the chemist, and founder of the Union League Club of New York. There he stands, a model to all Americans, as a scientist and a citizen, and here we have his memory and likeness as a constant inspiration and a stimulus to those who follow in our footsteps.

Addressing the audience, Professor Baskerville continued:

We know from the press that there is a three days' gubernatorial picnic in progress at Washington. This is an unusual proceeding, but our distinguished president in establishing this precedent has displayed unusual common sense. This conference looking toward the conservation of our natural resources is not to become a mere speech-fest, but is intended to be really productive. To insure that, Mr. Roosevelt has commanded the presidents of the various scientific organizations of our country to be present. For that reason, and solely for that reason, we are deprived of the pleasant and happy company of Dr. Ira Remsen, of the class of 1865, president of Johns Hopkins University, and president of the National Academy of Sciences. President Remsen, however, has written of his keen regret in being absent, and has forwarded his address on "Some Changes in Chemistry in Fifty Years," which will be presented by my colleague, Professor Herbert R. Moody.

SOME CHANGES IN CHEMISTRY IN FIFTY YEARS

What changes have taken place in chemistry since this college was founded? It would be a bold and foolish man who would attempt to answer this question in fifteen minutes. As the writer does not claim to be especially bold and does not wish to be regarded as especially foolish, he will not make the attempt, but will confine himself to a few reflections of a general character, to some extent in keeping with this occasion.

First, it may be of interest to note that I had the pleasure of hearing the lectures of Professor Wolcott Gibbs in the years 1861–2. At that time there was no laboratory for students. We did not have even a text-book wherewith to cram. Once a week, as nearly as I can remember, Professor Gibbs gave us a lecture and showed us a few specimens. In another place I have recorded the interesting fact that all that I can now remember of that course of lectures is the word "sesquioxide." That stands out in bold relief. It is a great satisfaction to me to recall the fact that I had the opportunity to come in contact, though not in close contact, with Professor Gibbs at that early period. In later years we became intimate friends and have often talked over these early efforts. There were rumors then among the boys that he was a man of wide reputation. One of the older boys to whom I looked up said to me one day, "Dr. Gibbs is a remarkable man. He would be recognized as such by all the world if he would only publish his results." Well, that boy did not, of course, know what he was talking about, but his words made an impression. Here was a man who, according to the statement quoted, was actually doing things of value to the world. Whether I learned anything from his lectures or not was a secondary matter. It was worth much to be permitted to see him and to hear him talk.

Dr. Doremus did not teach chemistry at the college in my day, but shortly afterward he gave some popular lectures on chemistry at the Cooper Institute, in the course of which he performed extremely striking experiments, many of which I can remember as clearly as if they had been performed yesterday. In fact, I have never seen more brilliant chemical lecture experiments. The hall was crowded and I am sure the lectures set many to thinking. I have always felt that my own interest in chemistry, which soon became absorbing, was due to what I saw and heard in these lectures.

With this brief reference to chemistry at the college nearly fifty years ago let me pass to chemistry as it was in the world at large at that time. We often hear the statement that chemistry has been completely revolutionized within a comparatively brief period. I have been hearing that statement ever since I have known anything about chemistry. After all, progress in chemistry has not been by revolution, but by evolution. Probably the nearest to a revolution was that which happened during the last quarter of the eighteenth century when Priestley and Scheele and Lavoisier explained the nature of combustion and paved the way to the overthrow of the theory of phlogiston which had so long controlled the views of chemists. But that theory was not overthrown in a day or in a year. Priestley and Scheele, whose discovery of oxygen led to Lavoisier's work on combustion, both remained phlogisticians to the end of their days, as did most of their contemporaries.

Within the last half century the change that has made the most impression on the outside world and has led to the common belief that the older views have been completely given up and that radically new ones have taken their place, is that which is due to the gradual acceptance of what is generally known as the law of Avogadro. The conception embodied in this law is very simple. It is that the number of molecules contained in a given volume of a gas or vapor is the same, no matter what the gas or vapor may be, provided only that the temperature and pressure are the same. That it is difficult to prove the truth of this statement is evident from the fact that it was nearly a half century after it was propounded by Avogadro before it came to be generally accepted. Few, if any, accepted it at the time it was first put forward. The leaders tried to apply it to well-known facts and gave it up. And yet, in the light of facts discovered later, it came to be recognized as a fundamental truth of great value.

When Gibbs was teaching chemistry in the old Free Academy, Avogadro's law was not taught in this country and only a few of the younger teachers were beginning to teach it and to use it in Italy and Germany. It was a most confusing time for the student. According to the prevailing system, to take an example, the atomic weight or the combining weight or the equivalent of oxygen was 8, whereas, according to Avogadro, it was 16. And yet it was the same old oxygen that had been discovered by Priestley and Scheele, and it supported combustion in exactly the same way whether we assigned to it the atomic weight 8 or 16. How could both be true? I remember in 1867, when I finally decided to give up medicine and study chemistry, meeting a man who knew a very little more chemistry than I did, who asked me what I thought of "the new chemistry." Not being willing at that time to confess my ignorance, I believe I said I thought very well of it, and in the silent watches of the night I often found myself wondering what was meant by "the new chemistry." Arriving in Germany, I found that the old masters like Liebig and Wöhler would have nothing to do with the new chemistry, while the younger teachers in the same universities used the new system. In the end the law of Avogadro prevailed, and now it is generally, I fear, taught dogmatically, and the evidence upon which it rests is lost sight of.

The conception that proved to be most fruitful during the period immediately following the acceptance of the law of Avogadro was that of the constitution of compounds as first clearly set forth by Kekulé in his great "Handbook of Organic Chemistry." Soon after the appearance of this book the majority of the younger chemists were ardently engaged in trying to determine the constitution of chemical compounds. Results came rapidly. The determination of constitution led, further, to efforts to build up natural substances artificially in the laboratory and factory. One of the first great successes in this line was the artificial preparation of the coloring matter of madder, known as turkey red, or alizarin. Since then achievements in synthetical chemistry have been innumerable. Great industries have been developed in the wake of these efforts and there seems to be no end to the possibilities. Perhaps the most sensational of the successes in synthetical chemistry is that which has culminated in the artificial preparation of indigo. It took about a quarter of a century to work out that problem—a problem that is of great interest not only to the chemist, but to the agriculturist, the political economist and the anthropologist.

Let us not forget that, while Kekulé's clearly expressed views gave the principal impetus to the work on constitution that led in turn to the work in synthetical chemistry, the way had been prepared by a long line of predecessors, among whom should be especially remembered Berzelius, Gay-Lussac, Laurent, Liebig, Wöhler, Dumas, Williamson and Frankland. Kekulé did not lead a revolution, he helped an evolution. The work in the field of synthetical chemistry is still progressing, and results as valuable as ever are being obtained. The problems under investigation are in general more difficult of solution than those that have already been solved. I need only mention in this connection the magnificent researches of Emil Fischer, of Berlin, on the synthesis of proteins, the complex substances that enter so largely into the composition of living things. It is of the highest importance that the chemistry of these substances should be worked out. The more we know about them, the better shall we be able to understand the mechanism of the living organism.

Within the last twenty-five or thirty years that branch of science which is called physical chemistry, and sometimes chemical physics, has been largely developed, and this has contributed to the advance of chemistry in many ways. The beginnings of physical chemistry are to be found, however, in the very beginning of the last century. Bertholet's work on "Chemical Statics," which appeared in 1801, may fairly be regarded as an important contribution to the subject, but more important, because more fruitful, was the work of Guldberg and Waage on the law of mass action which appeared in 1867. Since then, through the labors of Ostwald, Van't Hoff, Arrhenius and a host of others, physical chemistry has taken an independent position, and it may now be regarded as a new branch of science, occupying a field midway between chemistry and physics, and helpful to both. We are in the era of ions. It took chemists many years to learn to use the words atom and molecule in a rational way. Now that they have learned this lesson fairly well, the ion has come in to plague them and—to help them. Here again it must be remembered that the ion is no new thing. Indeed we owe the word and the first conception to Faraday. But Arrhenius has emphasized its importance in connection with reactions that take place in solution and we have fallen captive. So thoroughly have we yielded to its influence that we are now using the ion as food for babes. It is an exception now-a-days to find one who has studied chemistry a few weeks who will not discourse at length on ions. Do not misunderstand me. I acknowledge gladly the great impetus that has come to chemistry through the conceptions of dissociation and ions, but I do question the desirability of attempting to introduce these conceptions at too early a period in the teaching of chemistry. The result must inevitably be dogmatic teaching and dogmatic teaching is not scientific teaching.

The development of physical chemistry has not interfered with the study of constitutional chemistry or of any other branch of chemistry, but has made it possible to interpret many phenomena more satisfactorily than formerly. The result of the application of physical methods to the study of chemical phenomena has been to give us more refined views and deeper insight. It is idle to claim that one method of investigation is higher than another. As Professor Nernst has recently said: "The question whether chemistry has profited most by the atomic theory or by thermodynamics is a foolish one. It is like the question whether Goethe or Schiller is the greater poet. Let us rejoice that we have two such poets. Let us rejoice that we have two such valuable methods of chemical research. We need all the aid we can possibly get and even with this aid progress will be relatively slow."

The latest developments in chemistry are in some respects the most remarkable of all. A recent writer has said: "The ideas which guide chemists when they use the molecular and atomic theory, when they apply the periodic law, when they deduce composition from crystalline form, when they use the hypothesis of ionization, when they discuss certain aspects of chemical affinity, when they connect changes of composition with changes of energy; these and many other guiding ideas are the gifts of the physicist to the chemist. The measure has been returned by the chemist 'pressed down and running over.' By the discovery of radium the chemist has called a new world into being; and, with a fine generosity, he has given it to the physicist to investigate." The study of radium and similar elements has led to most unexpected results of fundamental importance which have already thrown much needed light on the constitution of matter and have made it appear probable that electric charges, whatever they may be, are responsible for all forms of matter as well as for some forms of energy. But the statement that matter is made up of electric charges, however soothing it may be, raises the question what is an electric charge?—a question as difficult to answer as the older one, what is matter? Everything then resolves itself into electricity. Truly, "The old order changeth, yielding place to new." But not so fast. What we call matter still exists and the old phenomena presented by it still call for study, and will through eternity.

Let us finally return to the earth for a moment. Leaving out of consideration the theories that have grown out of the study of radioactivity, let us note the conclusion that has been forced upon us that the atom is a changing system, that it is an aggregate of much smaller particles called corpuscles or electrons. This carries with it the thought that it may be possible to change one of the so-called elementary forms of matter into another, and some observations have already been recorded that seem to show that this possibility can in fact be realized. Sir William Ramsay has shown that, in the course of the decomposition which radium naturally undergoes, one of the products is another element, helium, and, further, it appears that, by allowing the emanation from radium to act upon copper, he has obtained a minute quantity of the element lithium. These observations have interested the chemical world profoundly. We are anxiously awaiting confirmation and further developments.

It has been suggested that, because some, and perhaps all, atoms are changing, the atomic theory, which for a century has been the principal theory of chemistry, is no longer tenable, that we must revise our entire terminology. It is hardly necessary to say to this audience that this is an extreme view. The atomic theory is as useful as it ever was. Under the conditions which surround us on the earth most atoms do not undergo change that can be discovered in any ordinary way. The atomic theory is based upon innumerable weighings. Now, the changes in weight which atoms undergo are not such as can be detected, so that we have as much evidence in favor of the atomic theory as we ever had, though we must supplement it by the conception of corpuscles or particles much smaller than atoms which can be given off from the atoms.

While chemistry is making rapid advances the great mass of knowledge of chemical phenomena that has been collected needs study now as in the past. No discoveries will ever make it possible to ignore oxygen and hydrogen and the other chemical elements and the compounds which they form with one another. I fear, however, that in our zeal for the new, we do not always give as much attention to the old as it deserves. I know that to talk in this way is furnishing evidence of my advancing years, yet, even at the risk of this, I wish to leave with you the thought that the new is built upon the old and includes the old. Chemistry was a great science fifty years ago. It is a greater science in the year 1908.

The presiding officer then said:

Fifty years is a long time. President Remsen has depicted the many and rapid changes that have come about in our science during that period. In 1852 Robert Ogden Doremus assumed the professorship of natural history in this college. Two years previous to this, while connected with the New York Medical School, he opened the first chemical laboratory for medical students in this country. The students of the College of Pharmacy, then without a home of its own, were allowed similar advantages in that laboratory. He soon extended this method of instruction to the Bellevue and Long Island Hospital Medical Colleges.

With a member of the faculty, who had already demonstrated unique activity in teaching chemistry, it was the natural and only thing to do, when Gibbs was called to the Rumford Professorship at Harvard in 1863, to ask Professor Doremus to transfer his activity to the chair of chemistry.

Then in unveiling the portrait of the late Professor R. Ogden Doremus, Professor Baskerville said:

This ardent devotee of science, this impressive teacher, this lover of art, poetry and all learning, occupied the chair for forty years, retiring in 1903.

In that time he was unremitting in his efforts to secure laboratory facilities for the students. The crowning of his labors in that direction came when the honorable board of trustees, as the result of his insistence, decided upon making one of this magnificent group of buildings a laboratory for the teaching of chemistry.

Professor Doremus, who never did anything on a small scale, was an eloquent and brilliant experimental lecturer. When I recall his charm of manner and courteous hospitality, his tremendous influence over the students of the college is easily understood, and it has been attested by Professor Remsen to-day.

It is fitting that his portrait be in this room, but for reasons familiar to chemists only a reproduction will remain here, but the name on the doors will serve ever to remind those who come of this successful expounder of the principles of our science through two generations.

Professor Baskerville then addressed the audience:

If, when Wolcott Gibbs was first professor in this college, he had told his students that we should soon read the history of the stars, he would have been said to be very erratic. Yet while he was still here, Bunsen and Kirchoff invented the spectroscope. While he was here mauve was discovered by Perkin and the coal-tar color industry started. While here oil was found in Pennsylvania and the great petroleum industry begun. If Gibbs, who was professor of physics and chemistry, had early said that nations would soon communicate across the depths of the ocean by cables, he would have spoken to incredulous listeners. Yet, as he left this institution, Cyrus Field laid the cable and William Thomson made its operation practicable.

If Doremus in the sixties had said that within a score of years the human voice would be recognized after transmission by wire for hundreds of miles, he would have been laughed at. Yet Graham Bell convinced the Emperor of Brazil and a distinguished group of interested scientific people in Philadelphia that it was an actuality.

If in the eighties Doremus, for he also was professor of physics and chemistry, had said in those remarkable and instructive lectures of his, that we should soon see through the human body, that nations would communicate across land and sea without connecting wires; if he had said that chemical elements would be found devoid of their characteristic property of chemical affinity; if he had said that chemical elements would be discovered which spontaneously and without chemical change produce vastly more energy than that evidenced in the most violent chemical reactions known—he would have been thought of as a man of delusions. Yet knowledge of all these things is common property at present.

In this day when a professor of chemistry publicly states that light and electricity are the same and that it is nearly proved (one of our distinguished speakers has done this and I believe he is right) he is greeted with a tolerant smile. So what of the "future in chemistry" in our day and generation? No one is better qualified to speak upon that subject than Professor Wilder D. Bancroft, whose esteemed and diplomatic grandfather epitomized the past. Dr. Bancroft, having drawn inspiration from the spirit of Gibbs at Harvard, is a daring and far-seeing investigator, whose vivid imagination visualizes the realms of the unknown, ever, however, holding it within reason.

Professor Bancroft then spoke upon

THE FUTURE IN CHEMISTRY

The future in chemistry! No two people agree as to what the future development of chemistry is to be, and it is probable that any one man would give you a different answer if the question were put to him at an interval of five years. Depending on whom you ask, you will be told that the really important thing is: organic chemistry, inorganic chemistry, physical chemistry, electrochemistry, photochemistry, physiological chemistry, industrial chemistry, or what not. I could even name one man who has believed all these things at one time or another. It is easy to see that predictions like these are the results of opinion that exists. The same diversity of opinion as to what is fundamentally important appears very clearly when we remember that the Carnegie Institution is not making any large grant to chemistry, for the simple reason that the chemists of the country can not agree as to what problem or group of problems should be attacked. My task to-day is to point out to you what the real future of chemistry will be and to make you see that my prophecy is the one that will come true.

We shall reach our goal most quickly by what is at first sight an indirect way. At the dedication of a chemical, physical, engineering, geological, biological or medical laboratory, it is customary to have addresses, even as now; and it is the orthodox thing to say that the most important of all the sciences is the science to be studied in that laboratory, whether it be chemistry, physics, engineering, geology, biology, medicine or something else. I sympathize fully with the practise and I intend to do the same thing myself to-day. You will admit, however, that the people who make addresses of this type at the dedication of laboratories, can not all be right when they talk like that. Some of them must be exaggerating just a little, and in order to acquit the chemist of any such a charge, we must first consider the relation of chemistry to the other sciences.

We will define chemistry as a study of all properties and changes of matter depending on the nature of the substances concerned. This definition is wider than the usual one. It is one that I have used for years and it is one which Sir William Ramsay suggested but did not make in his "Introduction to the Study of Physical Chemistry." It follows from this definition that physics is a subdivision of chemistry; an important and interesting subdivision, it is true, but only a subdivision. Chemistry includes all of what is known as physics except the law of gravitation, the laws of motion, and a few other abstract formulations. Everything else that gives life and interest to physics is chemistry pure and simple. I admit that this point of view is not popular among my colleagues, the physicists, but their objections are natural enough without being valid. Physics was a flourishing science at the time when chemistry, in the narrower sense of the word, was of very little importance. In the case of anything that is expanding and developing, it seems to me axiomatic that you must have the part before we have the whole, and that in the first stages the part will seem the whole. In 1600 the men of Great Britain were the whole of the Anglo-Saxon race. To-day they are only a part of it; an important part, it is true, but only a part. Let us try another illustration. As children we were told that "great oaks from little acorns grow." If you only have the acorn, of course, it is the important thing; but later one sees that the acorn is merely an interesting subdivision or product of the oak and that is all it is. We may, therefore, class physics as a subdivision of chemistry.

When we come to engineering, it is clear that we are dealing with applied chemistry. If it were not for the specific properties of iron, copper, concrete, brick, etc., and of all the other materials of engineering, there would be no such subject as engineering. Speaking in a broad sense we may say that engineering is the art of making the structural properties of matter useful to man.

Geology is the study of the chemistry of the earth. This has been recognized for a long time, and though we speak of the Geophysical Laboratory at Washington, its work is geochemical in fact though not in name.

In biology of the present and future we are interested in the chemical changes in the living organisms due to heredity and environment. Growth is a chemical change. The internal and external structures of plants and animals are the result of a series of chemical changes. After the first stage of identification, enumeration and classification has been passed, the interests of the biologist are essentially chemical and the quality of his work is likely to increase as his methods become chemical. The work of Loeb in California is a striking instance of what may happen when a biologist realizes that his subject is a subdivision of chemistry.

In curative medicine we are dealing largely with the action of drugs. In preventive medicine we are dealing with inoculations, diet, exercise and fresh air. In the first case we are checking and eliminating an abnormal process, sickness, by the action of one set of chemicals on the system. In the second case we are preventing the occurrence of a disturbing chemical process, sickness, by the action of another set of chemicals on the system. Owing to the difficulties involved and to the number of variables concerned, our knowledge of the chemistry of medicine is not yet what it should be; but it is clear that real progress will be made just in so far as we study physiology and medicine as subdivisions of chemistry. I cite as an instance the brilliant work of Arrhenius in the field of immuno-chemistry.

I have tried to show you that physics, engineering, geology, biology and medicine are all subdivisions of chemistry. My task is over. The future in chemistry will consist in the change from chemistry as a coordinate science to chemistry as the dominant science. With this in mind can you wonder at the fascination which chemistry has for the chemist? Now you will see why I rejoice that to-day the world is to be the better for a well-equipped laboratory in the hands of a well-equipped staff.

In introducing the next speaker, Professor Baskerville said:

Dean Swift said a certain university was a learned place; most persons took some learning there, few brought any away, hence there was accumulation. This caustic arraignment is probably true of some institutions. Yet in my humble opinion, a college should not be regarded merely as a place of learning. I like to fancy it as a machine which grasps the refined, but still raw, metal of mentality and turns it out a tool fit for efficient citizenship.

M. Leroy-Beaulieu, who has shown a robust faith in the United States, has said that we are fast approaching undisputed leadership in practical things. According to Professor Munroe, and he is qualified to speak, in 1840 the coal production and consumption was one quarter ton per person in the United States; in 1860 it was one half; in 1880 one ton, and 1890 five tons. These figures show the increasing energy demands of a growing manufacturing country. The colleges must produce the men who utilize and direct these great forces.

We are peculiarly fortunate to-day in having as one of our speakers a man, a college man, the man whose successful constructive ability is seen in several powerful, but legitimate, morally legitimate, corporations, one bearing his name. His gratitude to the college course, his appreciation of its relation to the manufacturing world, have been evidenced in large generosity and his willingness to serve as chairman of the board of trustees of a great Polytechnic School in Brooklyn. I refer to Dr. W. H. Nichols, who will address us upon

THE COLLEGE COURSE AND PRACTICAL AFFAIRS

The dedication to the cause of higher education of this magnificient group of buildings on this superb site, marks an epoch in the history of our city. It is one of the glories of this country that the schoolhouse has always followed closely after the axe of the pioneer. Government by the people is not practicable where ignorance is the rule, or even the state of a considerable minority, and this fact was recognized by the fathers. A good common-school education has always been obtainable by a large majority of white children, outside of that neglected and almost unknown region in the Appalachian mountain belt. This city justly prides itself on its public school system, in spite of the criticism of those who do not make sufficient allowance for the difficulty of keeping pace with the tremendous growth in population; especially of that class in which a tendency towards "race suicide" is not noticeable, and whose children must be educated at the public expense, if at all. No one would venture to raise the question of the value as an investment of that portion of our taxes which goes into our common-school fund. All realize that we have here a plain instance of duty and self interest running concurrently.

A step upward in the development of our educational system brings us to the high school. Many scholars are so fortunately situated that they are not obliged to earn their own living on leaving the grammar school, and the city has provided for them a system of high schools which is exceedingly creditable. These turn out a goodly number of boys and girls who have much more than the rudiments of education, and are qualified to fill positions of considerable importance. It was found, however, that many of these were worth the cost of still higher education, and financially able to undertake the work. Hence the College of the City of New York, which to-day, after many years of experience in unsatisfactory quarters, dedicates this great plant to this purpose. I suspect that our city fathers in making the investment were not actuated solely by motives of altruism, but were looking for returns in better citizenship. The students and graduates of this institution must realize that their education has cost the city a large sum, which they should repay with usury in one or more of the many ways of usefulness open to cultured men.

It is a truism which few will question, that life, from conscious infancy to old age, is a school in which all who will take advantage of experience and mistakes as they occur will receive an education of a certain sort. Only the very stupid fail to profit in this way. It is astonishing to note how much may be daily added to one's store of knowledge by observation, if only we mean business, and "Knowledge is power." After all, is not one of the principal objects of the college course the training of the mind so that it may more surely and logically appropriate knowledge thus offered? The great rank and file of our fellow citizens possess a large share of the total stock of that rare gift—common sense—and it is a fortunate thing for the country that it is not confined to what is sometimes called the "ruling class." It seems to be more inborn than acquired and I have never heard of a chair having been founded in any of our institutions of learning for instruction in this subject. It is one of the elements of wisdom, and wisdom is not necessarily learning. Knowledge is a fine foundation for wisdom, but it is not the only one. It is indeed power, but it may be a power for harm, which is not true of wisdom. Solomon said: "Wisdom is the principal thing. Therefore get wisdom." How to get it and how to keep it are very different questions, and are questions which every one must settle for himself. If Solomon be right, time can not be better spent than in seeking it, even if the quest occupy a lifetime. In all practical affairs, it is a most valuable asset.

I am asked to discuss briefly "The College Course and Practical Affairs." Now what are practical affairs? I suppose the comprehensive answer to this is that nearly all affairs are or should be practical. The mechanic, the farmer, the teacher, the merchant, the chemist, the engineer, in fact nearly everybody excepting possibly the pure theorist, and the impure loafer of both the corner and the society sort, is engaged in some kind of practical occupation. We even hear of practical politics. The measure of success or reward depends on fitness and application, not often on luck, unsuccessful ones to the contrary notwithstanding. Of course, allowance must be made for ill health or accident; but all other things being equal, the man who is best qualified by training, and does not neglect his opportunities, will come out ahead. The best training to make a good bricklayer is, of course, different from that needed to produce a good merchant, and both are totally unlike the preparation for a good chemist or a good lawyer. But the principle is the same. No one should neglect or omit a single step necessary to perfect himself in the trade, occupation or profession he seeks. And just here is where the rub comes in so many instances. The boy may not be qualified, or his parents may not help him intelligently to decide on the career for which he is best suited, and hence so many sad misfits and failures. One of the most important decisions a young man has to make is frequently postponed over and over again, or left altogether to chance, so that when the necessity for action arrives he is quite unprepared and hopelessly confused. Some may find themselves even at that late stage, and struggle out and up, but the majority will follow the line of least resistance, and drift down with the current, to an aimless and more or less useless existence.

It is then immensely important that as early as possible every boy should decide on the calling he feels best qualified to follow, and do all in his power to fit himself to make good in it. It must not be assumed that his success in life will be measured by the money he accumulates. We are all glad to acknowledge that the contrary view is becoming more and more generally accepted, and we are really beginning to feel a healthy contempt for the man who has nothing but money or other tangible property to recommend him. In fact even great learning will be found not to be sufficient. The man to receive universal respect and approval to-day must have character; and if he have this, and yet is without wealth or learning, even, he has the essential element of true manhood.

While I believe all this to be true, there is, of course, no doubt that the better education a man has, the better he is qualified to enjoy his own life, and be of use to his fellow men. As the beauties of nature, of art and of literature, are better comprehended by him, his nature broadens, and his life grows fuller and richer. Whatever may be the ordinary grind of his daily existence, he moves on higher and ascending planes, and has for his more or less intimate companions the great of all ages. He has at his disposal fountains of pleasure and profit which the uneducated man knows not of.

As I said a while ago, life is a school in which all may be educated by hard knocks and experience. It is, however, not the only school, and the man who boasts that he is self-educated does not often have to prove the assertion. It is generally self-evident. I am aware that there are and have been many men who without the advantages of college training have become eminent in the fields of science and art and even literature. But they never boast of what they have accomplished under adverse conditions, but rather repine because they have been prevented from reaching far higher levels which would have been attainable if only they had been able to command a college education. The college, the university, the engineering school need no apologist. Their output of educated men and women is their sufficient answer to any heterodox critic who questions whether they are worth what they have cost in lives and means.

In order, however, that the college education may contribute all it should to the formation of the wisdom which we all seek, and which has so much to do with the satisfactory working out of practical affairs. care must be taken that it shall not turn out deformed men; that is men who are over-developed on some sides, and under-developed on others. We frequently hear that this is an age of specialists, and success in any field depends largely on specializing in that field. There is a good deal of truth in this, and yet it is not the whole truth. Specialization should not be carried to the point of deformity, if we want to qualify a man to be a practical success. I have known excellent engineers who could not write an intelligible report in good English, not because they did not understand the subject, but because they had not been taught to express themselves properly. No scientific student should be denied a thorough education in culture studies. Neither should an arts course man neglect chemistry, mathematics or the sciences in general. The course should be designed and arranged to turn out good all-round scholars, while at the same time paying due attention to specialization.

But however the course may be arranged, or whatever may be its shortcomings, no young man who has the chance should fail to take it, whatever kind of practical affairs he expects to engage in, unless, perhaps, he intends to learn a trade. But even in this case, a college course would be a luxury if not a necessity, and make him all the better artisan and citizen. We have only got one life to live, and one brain and body to carry us through it. Let us, therefore, do what in us lies—fit both brain and body for their tasks. This is indeed the beginning of wisdom.

Professor Baskerville then introduced the Honorable Herman A. Metz as follows:

When the trustees of our educational institutions tired of the theological fad, they looked to the departments of chemistry for managers of the corporations for which they were held responsible. In seeing some of the most distinguished of these gentlemen before me, I hesitate to call the roll, but realize how unfortunate it has been for our science, but how fortunate for those institutions that professors of chemical economics have become their presidents. A more recent movement in the selection of college and university presidents has shown a favoritism to political economists. Perhaps a combination may prove the best solution. A live wire carries energy; if insulated it is safe. Professional modesty forbids me from mentioning which is the wire.

A physical chemist sits as a member of the privy council of Great Britain and is helping in the readjustment of its politico-economic policy. A plain, but distinguished, chemist was for years a senator and member of the cabinet of France during its trying period of recovery from disastrous conflicts without and within. Our nation has been so blessed in natural resources that it has achieved a reputation for extravagance, national, communal and personal. "In times of affluence prepare for depression," is a trite rendering of an expression usually enunciated in simpler words. In recent times no chemist has had a voting voice in affairs at Washington. It was fortunate for our city that in a time of the fullest prosperity it should place in charge of its finances a chemist who had known the needs of laboratory economy and the benefits of earned prosperity. For he successfully applied those principles to the municipality in times of stress, and perhaps will yet apply them for the welfare of the nation. I have the honor of presenting the Comptroller of the City of New York.

Mr. Metz spoke of the important part the chemist plays in the control of structural work, the purchase of supplies, health and happiness of the community, and emphasized the reliance a large municipality should place in the chemical profession. He called attention to the immense saving to the City of New York which had come about through his establishing a chemical laboratory in conjunction with the department of finance. He expressed his obligation to his course in chemistry in the Cooper Union, and the gratification of the city officials at present in power in having had a part in completing the handsome buildings of the college of the city where the high and low alike might secure adequate preparation for their life work.

In presenting the Honorable James W. Hyde, the secretary of the board of trustees, Professor Baskerville referred to Mr. Hyde's reluctance to appearing too prominently at public functions where such striking evidence of his remarkable executive capacity was to be seen on every hand. After thanking those who had come for their presence, Dr. Baskerville said: "Come again. This college and its every department is yours. It belongs to you, to me, to every man, woman or child of our great city, who pays taxes or rent, and you have a right to know whether we keep the faith."

Mr. Hyde then formally opened the building and declared it fit for the use for which it was devised.

At the conclusion of the exercises, an informal reception was held by the speakers and the laboratory was inspected by parties under the direction of the various members of the staff.

SCIENTIFIC BOOKS

Conductivity and Viscosity in Mixed Solvents. By Harry C. Jones, Professor of Physical Chemistry in the Johns Hopkins University, and C. F. Lindsay, C. G. Carroll, H. P. Bassett, E. C. Bingham, C. A. Rouiller, L. McMaster and W. R. Veazey. Carnegie Institution of Washington, Publication No. 80. Pp. v + 235.

In this volume are presented the results of an extended series of investigations on the electrical conductivity and viscosity of solutions of certain electrolytes in water, methyl alcohol, ethyl alcohol and acetone; and in binary mixtures of these solvents.

The conductivity measurements have brought to light a bewildering range of behavior on the part of the solutions studied. In the first place, it appears that in practically all mixtures into which water enters as one of the constituents of the solvent, the molecular conductivities show a minimum value for a certain composition of the solvent. In the second place it is shown that in mixtures of the alcohols, the conductivity follows the law of averages, that is, the conductivity of solutions in such mixtures is usually approximately the mean calculated from the conductivities of equimolecular solutions in the pure solvents. Finally, in mixtures of the alcohols with acetone, the molecular conductivities generally show a maximum value for certain mixtures.

These relations, however, hold only in broadest outline; so complex indeed are the observations that it would be useless to attempt an account of them in the limits of a review.

As the result of a long series of measurements of viscosity of mixed solvents and their solutions, there has been shown to exist a parallelism between the fluidity—that is, the reciprocal of the viscosity—of a solvent and the conductivity of its solutions, whence it is concluded that electrical conductivity is largely dependent upon the fluidity of the solvent. The parallelism between fluidity and conductivity is shown to be only approximate, however, for upon the effect of fluidity on conductivity is superimposed the effect of the degree of dissociation of the solute and also the size of the sphere of solute which is assumed to be in combination with the ion and to affect the speed with which it travels through the solution.

The experimental results are discussed at length and hypotheses are offered in explanation of the diminished fluidity of the solvent mixtures containing water; of the increased fluidity of certain mixtures of the alcohols and acetone; of the approximately normal behavior of mixtures of the alcohols with respect to fluidity; of the obvious dependence of electrical conductivity on fluidity; of the observed deviations of the conductivity curves from the fluidity curves; of the effect of temperature on the conditions prevailing in solutions in mixed solvents; of the effect of the presence of ions of high atomic volume on the viscosity of solvents; and of what seems to be the greater ionizing power of certain mixed solvents over that of either constituent of the mixture.

Altogether a very extended series of relationships have been discovered and a number of ingenious hypotheses have been offered which are certainly of the greatest importance as contributions to our knowledge of solutions.

E. C. Franklin

Elementary Experiments in Psychology. By Carl F. Seashore, of the University of Iowa. Pp. 218. New York, Henry Holt & Co. 1908.

Had this very valuable manual appeared a few weeks earlier, a notice of it would have been incorporated in the review of Professor Judd's handbooks of psychology (Science, May 15, 1908). Like the Judd volumes it testifies to the increasing need of serviceable handbooks for the presentation of the experimental attitude to students of mental processes. Like the Witmer handbook, Professor Seashore's manual contains within its own covers (with the aid of a few simple properties to be found in every household) a considerable range of experiments illustrative of psychological principles. Unlike the Witmer volume, it is not at the same time a text, but merely a companion manual to any text or course. It should be said with the brevity as well as with the emphasis characteristic of the book itself that it accomplishes its purpose with exceptional skill. Its appeal is to a very general clientele. There is hardly a course in psychology so brief or elementary as not to make possible the introduction of the experimental method on the scale provided by Professor Seashore. Let it also be said that while the scope of the work is elementary, its spirit and discernment are sufficiently advanced to arouse in all disposed thereto a proper "student" psychological reaction. Always direct, terse, clear, explicit, the directions lead unmistakably to the illustration of principles. No more suitable treatment for the purpose in view could be wished for. Its only fault is freely admitted: the selection of experiments in part for their ease of execution without facilities, and hence a rather uneven range of importance and significance. For beginners' courses in psychology of modest scope the manual may be warmly recommended.

J. J.

SOCIETIES AND ACADEMIES

THE IOWA ACADEMY OF SCIENCE

The twenty-second annual meeting of the Iowa Academy of Science was held at the State Normal School at Cedar Falls on Friday and Saturday, May 1 and 2, with twenty-seven members in attendance.

The president of the academy, Professor John L. Tilton, of Simpson College, gave the presidential address on the subject, "Science required for a General Education." The evening lecture was given by Professor Moulton, of Chicago University, on "Old and New Theories of the Formation of the Earth." The lecture was a critical comparison of theories and was illustrated by most excellent stereopticon slides.

Friday afternoon and Saturday forenoon were devoted to the reading and discussion of papers. A few of the papers were read by title while the others were read in full and quite thoroughly discussed.

Resolutions were adopted with reference to the death of Lord Kelvin, and also with reference to the use of the metric system of weights and measures. The latter resolution is as follows:

Whereas, the metric system possesses great advantages over the system now in common use and is being adopted more and more throughout the world, and is used without difficulty, with facility and satisfaction, in American shops upon foreign work, be it

Resolved, That the Iowa Academy of Science again express its conviction that the exclusive use of this system for all public transactions is highly desirable, and be it

Resolved, That Congress be urged to pass legislation looking towards the introduction of the metric system for general use in the United States at as early a date as possible.

Officers elected for the ensuing year are:

President—Samuel Calvin, State University of Iowa.

First Vice-president—Frank F. Almy, Iowa College.

Second Vice-president—S. W. Beyer, Iowa State College.

Secretary—L. S. Ross, Drake University.

Treasurer—H. E. Summers, Iowa State College.

Elective Executive Committee—D. W. Morehouse, Drake University; R. B. Wiley, State University of Iowa; Louis Begeman, Iowa State Normal School.

The program as presented is given below. The brief abstracts accompanied the papers at time of presentation.

Review of Solar Observations made at Alta, Iowa, during the Past Five Years: David E. Hadden.

A brief review of sunspot observations during the years 1903 to 1907.

The Vitality of Weed Seeds under Different Conditions of Treatment and a Study of their Dormant Periods: H. S. Fawcett.

The object of the investigation recorded in this paper is to make a comparison of viability of different species of weed seeds, especially those found in cultivated fields and pastures, and to study their dormant periods in order to determine possible means of destroying these weeds. Plantings were made under out-door and in-door conditions. Conclusions: that seeds require a rest period; that natural conditions shorten this dormant period; that best germination indicates fall and spring as the two natural periods; that in general, percentage of germination was low. The paper is accompanied by tables summarizing the experiment.

Some Seeds of the Genus Pyrus: L. H. Pammel.

A brief study of the minute morphology of the seeds of the more common cultivated apples along with the specific gravity. The differences in some of the forms is quite marked, the seeds consisting of the testa of from four to six differentiated layers and the perisperm, endosperm and embryo.

The Genesis of the Loess, a Problem in Plant Ecology: B. SHIMEK.

The influence of plants in building up sand-dunes, soils, etc. The probable readvance of the flora after the recession of the ice sheets, viewed in the light of modern ecological observations. Evidence of the presence of an abundant flora during the deposition of the loess; snails, etc. Root-marks, iron tubules and calcareous nodules of no value, as they were formed after the loess was in place. Comparison of the distribution of modern plants and of the loess. The probable mode of loess accumulation: chiefly by wind; water deposition relatively insignificant. Comparison of the loess of the Missouri, the Mississippi and the Iowan border made on ecologic grounds. Illustrated by slides.

A Hybrid Oak: B. SHIMEK.

A description of a probable hybrid oak, *Quercus imbricaria palustris* from Johnson County.

Notes on Peronosporales for 1907: GUY WEST WILSON.

The meteorological conditions of the season are reviewed briefly and notes given on the occurrence and abundance of both conidia and oospores of sixteen species of the order.

A Key to the Families of Ferns and Flowering Plants of Washington: T. C. FRYE.

The Forestry Problem of the Prairies of the Middle West: HUGH P. BAKER.

Notes on the Routine Diphtheria Determination in the Laboratory: L. S. ROSS.

A brief comparison of work in a few laboratories.

Isolation of Diphtheria Bacilli from Serous Fluid of a Cadaver: L. S. ROSS.

A recent case of such an isolation is reported.

The Uric Acid Ferments: E. W. ROCKWOOD.

The Determination of Ferrous Iron: NICHOLAS KNIGHT.

The ferric iron was determined in siderite in the form of a coarse powder and again when very finely powdered. The fine powder gave a higher percentage of ferric iron. The heat produced by finely grinding the mineral in the agate mortar changes a small quantity of ferrous to ferric oxide.

The Decomposition of Dolomite: NICHOLAS KNIGHT.

In many localities the top layer of the Niagara dolomites, to the depth of a few inches, appears to be decomposed and presents a mealy appearance. Chemical analyses were made of this to compare its composition with the normal rock. A still more highly decomposed portion appearing like a ferruginous clay was likewise investigated.

The Life of Portland Cement: G. G. WHEAT.

The Loess of the Paha and the River-ridge: B. SHIMEK.

A review of the accounts of distribution, structure, composition and contents of the paha and river-ridges (with special reference to the loess) of McGee, Norton and others, supplemented by the writer's observations. The age and genesis of this loess are discussed, the conclusion being that the loess is in part post-Kansan, but largely post-Iowan, in the latter case being often closely associated with old sand-dunes. Illustrated by slides.

Some Peculiarities in the Elastic Properties of Certain Metals: K. E. GUTHE.

An Experimental Determination of the Charge of an Electron by Wilson's Method, using Radium: L. BEGEMAN.

Nucleation According to Barus: L. BEGEMAN.

Evaporation from Water Surfaces exposed to the Sun: A. G. SMITH.

The Protozoa of Fayette, Iowa: GUY WEST WILSON.

During the fall term of 1908 a number of cultures were brought into the laboratory for class use and as the Protozoa were rather abundant notes were made on the abundance and sequence of species in cultures from various sources. These data are presented in the form of an annotated list of species.

Exhibit of Photographs of Delicate Marine Animals taken from Life in Sea Water: C. C. NUTTING.

A Study in Wing Venation, Family Aphididæ: C. E. Bartholomew.

Protective Adaptations in the Nesting Habits of Some Central American Birds: M. E. Peck.

Revival of an Old Method of Brain Dissection: H. J. Hoeve.

Myxomycetes of Iowa: T. H. McBride.

Stratigraphic Position of Red-Beds: Charles R. Keyes.

The possible significance of the Fort Dodge gypsum beds is discussed on the theory that they are Carbonic in age, recent data bearing upon the Red-Beds problem as obtained in southwestern United States being correlated with the Iowa section.

Some Relations of the Older and Younger Tectonics of the Great Basin Region: Charles R. Keyes.

The moot questions regarding the origin of the basin ranges of western America are discussed in the light of the latest observations in the region. Two distinct periods of mountain building are recognized, the older of which is not considered as having any influence on the genesis of the present mountains. The present aspect of the existing ranges is chiefly due to erosive action of eolian character and under the peculiar conditions of an arid climate.

Eolian Origin of Certain Lake Basins of the Mexican Tableland: Charles R. Keyes.

Extensive lake basins in the various bolson plains of the northern part of the Mexican tableland are shown to occur under conditions that indicate clearly that the basins were hollowed out by wind action, under conditions of extreme aridity. The phenomenon is believed to be one of the minor and temporary results of general desert leveling in an arid region.

L. S. Ross,
Secretary

THE NORTH CAROLINA ACADEMY OF SCIENCE

The North Carolina Academy of Science held its seventh annual meeting at the State Normal College, Greensboro, N. C., on Friday and Saturday, May 1 and 2, 1908.

The academy was called to order at 3:30 p.m., May 1, by the president, T. Gilbert Pearson. A letter of welcome to the academy from President J. I. Foust, of the college, was read. A response to this welcome was made by the retiring president, Collier Cobb, of the academy.

At 8:30 p.m. the academy met in the auditorium of the Students' Building and the presidential address, "An Historic Sketch of Ornithology in North Carolina" (illustrated by lantern slides), was delivered by President T. Gilbert Pearson. Following this address, a reception was tendered the members of the academy by the faculty and students of the senior and junior classes of the college in the dining-room of Spencer Building.

At 9 a.m. Saturday, May 2, the academy convened for a business meeting. Reports of various committees were heard. The report of the treasurer showed a balance of $119.60. Seven new members were elected. The following officers were chosen for the ensuing year:

President—Tait Butler, Department of Agriculture, Raleigh, N. C.

Vice-President—J. J. Wolfe, Trinity College, Durham, N. C.

Secretary-Treasurer—E. W. Gudger, State Normal College, Greensboro, N. C.

Executive Committee—Chas. H. Herty, University of North Carolina, Chapel Hill, N. C.; John F. Lanneau, Wake Forest College, Wake Forest, N. C.; W. H. Pegram, Trinity College, Durham, N. C.

The next meeting of the academy will be held at Trinity College, Durham, N. C., May, 1909.

The following papers were presented:

The Amanitas of the Asheville Plateau: H. C. Beardslee, of Asheville, N. C.

The following list of species was reported: *Amanita cæsarea* Scop., *A. virosa, A. phalloides* Fr., *A. muscaria* Linn., *A. pantherina* DC., *A. junquillea* Quel., *A. strobiliformis* Paul., *A. solitaria* Bul., *A. echinocephala* Vitt., *A. rubescens, A. cinerea* Bres., *A. nitida* Fr., *A. vaginata* Fr., *A. volvata* Pk., *A. farinosa* Sohw., *A. mappa* Fr.

The species *A. verna, virosa,* and *phalloides* were considered as not distinct.

Amanita junquillea Quel. was illustrated by photographs and specimens and compared with the European forms. The American *A. russuloides* Pk. was referred here, also the European species *A. amici, adnata,* and *vernalis.* Photographs and specimens had been seen by Bresadola and Boudier, who verify this conclusion. Specimens of the European form had also been examined.

Amanita cinerea Bres. was shown to include *A. spreta* Pk. *A. volvata* was shown to be the plant referred by Quelet and Bataille to *A. coccola* Scop. It was also considered the true *A. agglutinata* of Curtis, and *A. baccata* as understood by Bresadola.

Photographs of many forms of *A. solitaria* and its allies were shown illustrating the difficulty of successfully defining species in this much-confused group.

Distribution and Migration of Warblers at Raleigh: C. S. BRIMLEY, of Raleigh. (No abstract furnished.)

An Adjustable Armillary Sphere—Newly Designed: J. F. LANNEAU, of Wake Forest College, N. C.

This paper dealt with a unique piece of apparatus—a light, symmetrical mechanism, built by Wm. Gaertner & Co., Chicago, after Professor Lanneau's design—for class-room use in Wake Forest College.

Its special feature is the placing of the horizon plane and vertical circles *within* the celestial circles, and the two concentric systems, mechanically *independent,* allowing of the real eastward rotation of the former, or of the apparent westward rotation of the latter.

Some Illustrations.—1. An aluminum ball at the center represents the sun; and by a simple device a smaller ball revolves around it eastward in the plane of the ecliptic, representing the earth's annual motion.

2. With central ball representing the earth, to it is securely attached the horizon plane and vertical circles for, say, an observer in latitude 36° north. Clamping the celestial circles in fixed position, the earth-ball with its horizon system is easily rotated eastward, showing sunrise and sunset and the rising and setting of moon, stars and planets—these objects being suitably indicated, for any given date, in their apparent places on the celestial framework. Or clamping the horizon in its seemingly fixed position, the celestial circles and objects in place are readily rotated westward in accord with familiar appearances.

3. Altering in latitude the attachment of the horizon plane to the earth-ball, the apparatus shows in turn the reality and the appearances to an observer at the equator; or, again, to an observer at the north pole during his six-months' day and his six-months' night.

4. Some circles and the celestial objects may be variously adjusted and placed for an indefinite number of astronomical illustrations.

5. Selected circles and objects may be duly disposed to facilitate apprehension and solution of numerous celestial problems—and, of problems also in geodesy and navigation which involve the ever-recurring "astronomical triangle."

Question and Answer.—Are the earth and sun at the center? They are not held to be at the center of the myriad stars of the visible universe. They are at the center of the "celestial sphere," conceived of as everywhere equidistant from the earth; so distant as to be beyond the remotest star. Its quasi reality is that vast shell of void space beyond the stars, upon which as a dark, spherical background all the stars appear fixed as viewed from the central earth. So measureless its remoteness, any point within the earth's comparatively little orbit, including the sun, is virtually its center. This "celestial sphere," with sun or earth as center, is the basis of practical astronomy. Its standard circles in miniature are part of our armillary sphere.

Concerning Sclerotinose of Lettuce: F. L. STEVENS and J. G. HALL, of the North Carolina Experiment Station, Raleigh.

The term sclerotinose was proposed as a designation for diseases caused by *Sclerotinia,* and sclerotinose of lettuce was characterized as one form of lettuce drop caused by *S. libertiana.*

As the result of two years' study the authors conclude that the only part of the fungus that lives through the quiescent period of the disease is the sclerotium and that each season's infection is by wind-borne ascospores produced from these sclerotia. They recommend that the formation of sclerotia be prevented by early removal and destruction (incineration or burial) of infected plants. This course followed for a few years, accompanied by the exhaustion of all sclerotia originally in the soils by germination, seems promising as a means of ridding infected regions of the pest.

The Origin of Certain Topographic Features along the Sand-hills Border of the Atlantic Coastal Plain: Collier Cobb, of the University of North Carolina. (No abstract furnished.)

Notes on the Life Zones in North Carolina: C. S. Brimley and Franklin Sherman, Jr., of Raleigh, N. C.

The authors, having made a detailed study of all available records of the occurrence and distribution of animals in the state, present their conclusions as to the probable boundaries of the different life zones. The groups of animals chiefly relied upon are mammals, reptiles and batrachians. Birds and insects have been used mainly to confirm ideas otherwise originated.

It is found that four distinct life zones are represented in the state as follows:

1. *The Canadian Zone,* including only the tops of the higher mountains, usually above 4,500 feet elevation. The following places are placed in this zone: Black Mountain, Roan Mountain, Grandfather Mountain, Bald Mountain in Yancey County, and the higher mountains in Macon County near Highlands.

2. *The Alleghenian Zone* includes practically all between the elevations of 2,500 feet and 4,500 feet. This includes most of the Blue Ridge, Smoky Mountains, Nantahala Mountains, Balsams, Pisgah Ridge, and the lower elevations of Black Mountain and others mentioned as belonging to the Canadian zone.

3. *The Upper Austral Zone* includes all of the state north and west of a line drawn from Suffolk, Va., to Raleigh, thence to Charlotte, thence to the South Carolina line near Tryon in Polk County; except that portion already assigned to the Canadian and Alleghenian zones.

4. *The Lower Austral Zone* includes all of the state to the south and east of the line just mentioned.

Lists are given of the characteristic animals known in each of these zones, and mention is made of a number of exceptional records, where animals have been taken beyond the limits of what their range would supposedly be.

The counties in the extreme northwest part of the state have not yet been zoologically explored, and are therefore not yet assigned to any zone, awaiting the accumulation of more records.

The Relation of Bovine Tuberculosis to the Public Health: Tait Butler, of the Department of Agriculture, Raleigh. (No abstract furnished.)

The Twenty-seven Lines upon a Cubic Surface: Archibald Henderson, of the University of North Carolina.

In his paper Dr. Henderson explains that by the selection of a highly symmetrical equation of a cubic surface:

$$\left(\frac{x}{x_2}+\frac{y}{y_2}+\frac{z}{z_2}+\frac{w}{w_2}\right)\left(\frac{xz}{x_1z_1}-\frac{yw}{y_1w_1}\right) - \left(\frac{x}{x_1}+\frac{y}{y_1}+\frac{z}{z_1}+\frac{w}{w_1}\right)\left(\frac{xz}{x_2z_2}-\frac{yw}{y_2w_2}\right)=0;$$

by a proper choice of constants x_1, y_1, z_1, w_1; x_2, y_2, z_2, w_2; and finally by employing a regular tetrahedron as tetrahedron of reference, that it was not difficult to derive very simple and symmetrical equations of the twenty-seven lines upon the cubic surface, and therefore to construct a string model of the configuration, showing the fundamental tetrahedron and the twenty-seven lines in proper relation to each other and to the fundamental tetrahedron. Instead of a string or wire model, he exhibited a beautiful perspective drawing in colors of the configuration.

The Scope and Function of Science: WM. LOUIS POTEAT, of Wake Forest College. (Read by title.)

Some Trials of a Museum Curator: H. H. BRIMLEY, State Museum, Raleigh. (Read by title.)

The Oral Gestation of the Gaff Topsail Catfish, Felichthys marinus: E. W. GUDGER, of the State Normal and Industrial College.

This paper was given by permission of the Commissioner of Fisheries and will later be published in the *Bulletin* of the bureau.

The Proximate Constituents of the Oleoresins of Pinus palustris and Pinus heterophylla: CHAS. H. HERTY, of the University of North Carolina. (No abstract furnished.)

The San José Scale: FRANKLIN SHERMAN, Jr., entomologist, North Carolina Department of Agriculture, Raleigh, N. C.

The paper opens with an apology and explanation for presenting so threadbare a subject before the academy—stating, however, the author's belief that popular presentation of subjects of economic interest to the state should have a conspicuous place on the program.

A brief account of the history and general distribution of the San José scale (*Aspidiotus perniciosus,* Comst.) is given, and mention is made of the principal food-plants and methods of spread of the insect.

Referring to conditions within the state of North Carolina it is shown that present records indicate the pest in 65 counties, at 145 different post-office localities, and on at least 423 different premises. It is a *safe presumption* that it is in many localities in addition to those on record. It is a *reasonable presumption* that it is in every county in the state, but it *can not be presumed* that it is in every locality—and there is every reason to believe that many individual premises are not yet infested by it.

In at least seventeen communities it is generally distributed, having been found in a number of the orchards and perhaps in all. In the west it is known in the counties of Cherokee, Haywood, Mitchell, and Watauga—and in the east in the counties of Brunswick, New Hanover, Carteret and Pasquotank. It is found only a few feet above sea-level, and at an elevation of 4,000 feet.

According to present records the worst-infested counties are as follows in order of infestation: Catawba, Surry, Guilford, Moore, Gaston, Wade, and Polk.

Concerning the Difference of Behavior of Soil Organisms when in Solutions and when in Soils: F. L. STEVENS and W. A. WITHERS, of the North Carolina Experiment Station, Raleigh. A preliminary report of work done by F. L. Stevens and W. A. Withers, assisted by W. A. Syme and J. C. Temple.

Results of numerous experiments were adduced to show that the activities of ammonifying, nitrifying, denitrifying, and nitrogen-gathering bacteria are different in soils from what they are in solutions and that no adequate knowledge of the efficiency of these various soil organisms in effecting chemical change can be attained by tests conducted in solutions. Even the relative powers of different organisms or of different soils is largely affected by the conditions of the test. It seems, therefore, that in the study of soil bacteria the work must be done with soils rather than with solutions, or at least that frequent controls or checks in soil must be made.

How to Study the Common Rocks: COLLIER COBB, of the University of North Carolina. (No abstract furnished.)

E. W. GUDGER,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 650th meeting was held on May 9, 1908, President Bauer in the chair.

Professor Harry Fielding Reid, of Johns Hopkins University, presented, by invitation, an interesting paper on the "Mechanics of the Californian Earthquake" (1906).

The surveys of the United States Coast and Geodetic Survey during 1874–91 and 1906–7 as discussed by Dr. Hayford show that between these dates the earth on opposite sides and at some distance from the great fault was relatively displaced about six feet. At the time of the rupture on April 18, 1906, the opposite side of the fault plane shifted about twenty feet and the displacement diminished as the distance from the fault plane increased. A consideration of the origin of the forces which produced the break shows that they must have been the result of an elastic strain set up in the rocks by the slow movement of the ground at a distance from the fault, and that the strain was of the nature of a shear, and did not consist of compressions and extensions, such as accompany the ordinary bending of beams. The difference in the amount of the displacement at the fault end and at a distance shows that about two thirds of this strain must have existed already at the time of the earlier survey. An analysis of the forces which produced this slow displacement shows that they must have been applied at the under surface of the displaced area, and not at its boundaries, and that they must have been applied in a definite way. The force at the fault plane at the time of the rupture must have been 2,000 pounds to the square inch, and it is probable that the rock in an uninjured condition was too strong to break under this force. It seems probable, therefore, that the old break along the fault plane had not become completely consolidated, and broke under a smaller force than was necessary to break the fresh rock. By analogy with the underground flows which the theory of isostasy has shown exist, it was suggested as a possibility that underground flows might cause dragging forces on the rock above and thus set up the strain which caused the rupture along the fault plane.

Mr. C. K. Wead presented a brief paper on "Efficiency." The word had come down through the medieval Latin with the loose popular meanings which it still retains. But in 1854 Rankine seized it, stamped on it a technical meaning and gave it currency where it was greatly needed. The definition he gave, in the course of his studies on the steam engine, was, "*The efficiency of a machine is the ratio of the useful work performed by it to the whole work expended on it.*" This test of efficiency, which is applied everywhere in mechanical engineering, is coming to be applied in almost every line of human activity, even though the quantities to be compared are not always commensurable. For illustration, reference was made to manufacturing, transportation, administration, the so-called trusts, philanthropies, war, scientific terminology and so on.

R. L. Faris
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 206th meeting of the society, held on Wednesday evening, May 13, in the Cosmos Club, the following papers were presented:

Regular Program

The Unconformity between the Mississippian and Pennsylvanian Rocks in Western Pennsylvania, and its bearing on Questions of Geologic Correlation: Chas. Butts.

In the anthracite basins the Pottsville is 1,200 feet thick, the Mauch Chunk, 2,000 and the Pocono, 1,000. On the Allegheny front, in Blair County, the Pottsville is 130 feet thick, the Mauch Chunk, 180, and the Pocono, 1,100. The Connoquenessing sandstone near the top is the oldest Pottsville present. In Allegheny Valley, at Kittanning, the section is the same as the last, except that the Mauch Chunk is missing. The top, 400 to 500 feet, of the Pocono is a sandstone, unbroken in the Allegheny front but more or less broken by beds of shale in Allegheny Valley. This is the Burgoon sandstone of the U. S. Geological Survey, the "Big Injun" sand of the oil-well drillers, and the Logan and Black Hand formations of the Ohio geologists. In Lawrence County the Burgoon is absent, and the lowest Pottsville rests on middle Pocono beds. The Burgoon forms the lower part of the Allegheny Valley walls. The Kittanning region north to Tionesta, where it is eroded off, and the Connoquenessing rests on middle Pocono. At Warren the whole Pocono is eroded and the Pottsville (Olean or Sharon conglomerate) rests on the underlying rocks. These facts indicate an uplift of west and central Pennsylvania at the close of Mauch Chunk time, with the erosion of all the Mauch Chunk and part, or all, of the Pocono along a strip extending from Newcastle to Warren, the axis of the uplift lying along that line.

The submergence of this area proceeded from the west, the axial part being overlain by Olean conglomerate, while the part of the area from Allegheny Valley to the Allegheny front received only the Connoquenessing sediment of later age than the Olean. The correlations following from the conditions described are as follows: The Pocono equals the Waverly, the Burgoon at the top being the same as the Logan group of Orton; the beds immediately below the Olean conglomerate in western New York and Pennsylvania are the equivalent of the top of the Erie shale in Ohio; the Salamanca conglomerate is the same as the Venango third oil sand instead of the first oil sand, as supposed by the Pennsylvania geologists; and the Berea sandstone is the first oil sand of Venango County and the 100-foot sand of southwestern Pennsylvania.

The Grand Gulf and Lafayette Formations in Northern Florida: Frederick G. Clapp.

Overlying the Tertiary formations of northern Florida are three types of surface deposits, similar in sequence and character to the Grand Gulf, Lafayette and Columbian formations of adjacent states. The most recent of the Florida deposits (Columbian) is a fine-grained, quartz sand, a few feet in thickness, largely wind-blown and covering nearly the entire state. This sand overlies the so-called Lafayette beds with a marked unconformity. The Lafayette is distinguished from the Columbian by its coarser nature, its abundant water-worn quartz pebbles, its deep surface oxidation, its greater thickness, and its older topography. Below it is a series of quartz sands interstratified with beds of plastic clay (correlating with the Grand Gulf formation of Dr. E. A. Smith in Alabama), the whole ranging in thickness from a few feet in northeastern Florida to 500 feet or more in northwestern Florida. This formation is of estuarine origin. In northwestern Florida numerous flat-topped hills have an average elevation of 250 feet, and are capped by Lafayette. They appear to be remnants of a once extensive terrace of probable Grand Gulf age. At Pensacola the records of deep borings from which fossil shells have been brought up corroborate Smith's evidence at Mobile that his Grand Gulf formation is of late Pliocene or early Pleistocene age.

The deposits hitherto classed as Lafayette in northwestern Florida are complex and consist of parts of several formations. What is presumably the true Lafayette form a mantle covering a wide range of topographic conditions from the top of the 250-foot terraces to the bottom of many valleys. These deposits are believed to be largely of fluvio-terrestrial origin, and were presumably formed during a considerable period of denudation succeeding the Grand Gulf deposition. Hence where the Lafayette beds are of highest elevation they are nearly or quite conformable with the Grand Gulf and were formed early in the Lafayette epoch; while similar deposits in the valleys show strong unconformities and are much more recent.

Brief Discussion of the Copper Deposits of Kasaan Peninsula, Southeastern Alaska: C. W. Wright. (No abstract.)

Ralph Arnold,
Secretary

ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

The 178th meeting was held in the main lecture hall of the Chemical Laboratory, April 28, 1908, 7:30 p.m. The program was as follows:

"Stresses in Masonry Dams," by Professor William Cain.

"Pathologic Effect of Alcohol on Animals," by Professor W. DeB. MacNider.

A. S. Wheeler,
Recording Secretary

THE ORAL OPENING OF THE NASAL CAVITY IN ASTROSCOPUS

Any communication between the nasal cavities and oral cavity is rare among the fishes, being found in the case of the Dipnoi and hagfishes.

While studying the electric organ of *Astroscopus guttatus* the writer found well-developed posterior nostrils opening into the oral cavity from each nasal cavity. A brief study of the organs in action showed them to be used as intakes for water during inspiration. They are used in this way both while the mouth is so used and also when it is closed tightly. Each of these two internal openings is provided with an independent valve which automatically prevents the regurgitation of water.

Besides these openings the nasal cavity is also provided with the usual anterior and posterior nares. A fuller account of this structure will appear shortly in another journal.

Ulric Dahlgren

SPECIAL ARTICLES

BLACKHEAD, A COCCIDIAL DISEASE OF TURKEYS [1]

In many districts of the United States, and in Rhode Island in particular, there has been known to exist since about 1894 a highly infectious disease affecting the ceca and liver of turkeys and, to a less extent, of fowls. It is characterized, in the ceca, by inflammation, thickening, occasional perforation of the walls and denudation of the epithelium; in the liver by enlargement and by the formation of cream-yellow spots.

Since the investigations of Theobald Smith, published in 1895, it has been commonly believed that the disease is due to an ameba, *Amœba meleagridis* Smith. The present writers believe they have demonstrated, however, that the disease is caused by a *Coccidium,* which, according to the nomenclature adopted, may be a variety of *Coccidium cuniculi,* and that *Amœba meleagridis* Smith is probably the schizont stage in the development of the *Coccidium.*

The stages of the *Coccidium* most commonly found were the schizonts and the macrogametes or oocytes. The former were first discovered in smears by means of a rose-analin-violet and methylene-blue stain. Later they were recognized in fresh preparations, both within and without the epithelial cells. The macrogametes were most common in the cecal and the intestinal content below the junction of the ceca, and were often present when the cyst stage was absent. Besides these stages the microgametocytes, the microgametes, the merozoites and the sporozoites were recognized both in fresh preparations and in sections stained with hematoxylin and eosin.

By placing the cecal content containing macrogametes in a solution of 10 per cent. potassium bichromate, the growth of bacteria was stopped and the development into cysts and then into sporozoites could be watched. The cysts are commonly oval, and have an average size of 21 by 14 micra. Cultures containing cysts were also made to develop in 2 per cent. formalin, saturated solution of thymol, 4 per cent. boracic acid, 1 per cent. lysol and 2 per cent. carbolic acid. The organism is common in the soil and is frequently found in apparently normal fowls, which do not appear to be so susceptible as turkeys to this form of the disease.

By means of feeding portions of cecal content or parts of ceca of diseased birds, the disease was produced experimentally in turkeys, chicks and sparrows, but not in guinea-pigs, kittens or in rabbits. In young turkeys the disease is almost certainly fatal; older birds may recover. It is doubtful if death is caused directly by the *Coccidium* in the majority of cases; whether there is a specific accompanying organism pathogenic to turkeys under these conditions, and less so to chickens, has not yet been determined. In cases of perforation of the cecum, death soon follows from acute peritonitis. No method of treatment is at present recognized.

The investigations reported above were made at the Rhode Island Agricultural Experiment Station, in cooperation with the Bureau of Animal Industry, U. S. Department of Agriculture, during the year 1906–7.

Leon J. Cole
Philip B. Hadley

[1] Abstract of paper read before the Zoologists' meeting at New Haven, December, 1907.

THE NATIONAL CONSERVATION COMMISSION

Pursuant to the recent Conference of Governors in the White House on the conservation of our natural resources, the President on June 8 appointed a National Conservation Commission, comprising Senators and Representatives in Congress, scientific and technical experts, and citizens of the several sections of the country.

The instructions to the Commissioners are as follows:

THE WHITE HOUSE,
WASHINGTON, June 8, 1908.

The recent Conference of Governors in the White House confirmed and strengthened in the minds of our people the conviction that our natural resources are being consumed, wasted and destroyed at a rate which threatens them with exhaustion. It was demonstrated that the inevitable result of our present course toward these resources, if we should persist in following it, would ultimately be the impoverishment of our people. The Governors present adopted unanimously a Declaration reciting the necessity for a more careful conservation of the foundations of our national prosperity, and recommending a more effective cooperation to this end among the States and between the States and the Nation. A copy of this Declaration is enclosed.

One of the most useful among the many useful recommendations in the admirable Declaration of the Governors relates to the creation of State commissions on the conservation of resources, to cooperate with a Federal Commission. This action of the Governors can not be disregarded. It is obviously the duty of the Federal Government to accept this invitation to cooperate with the States in order to conserve the natural resources of our whole country. It is no less clearly the duty of the President to lay before the Federal Congress information as to the state of the Union in relation to the natural resources, and to recommend to their consideration such measures as he shall judge necessary and expedient. In order to make such recommendations the President must procure the necessary information. Accordingly, I have decided to appoint a Commission to inquire into and advise me as to the condition of our natural resources, and to cooperate with other bodies created for a similar purpose by the States.

The Inland Waterways Commission, appointed March 14, 1907, which suggested the Conference of Governors, was asked to consider the other natural resources related to our inland waterways, and it has done so. But the two subjects together have grown too large to be dealt with by the original body. The creation of a Commission on the Conservation of Natural Resources will thus promote the special work for which the Inland Waterways Commission was created, and for which it has just been continued and enlarged, by enabling it to concentrate on its principal task.

The Commission on the Conservation of Natural Resources will be organized in four sections to consider the four great classes of water resources, forest resources, resources of the land and mineral resources. I am asking the members of the Inland Waterways Commission to form the Section of Waters of the National Conservation Commission. In view of the lateness of the season and the difficulty of assembling the members of the sections at this time, a Chairman and a Secretary for each Section have been designated, and the Chairman and Secretaries of the Sections will act as the Executive Committee, with a Chairman who will also be Chairman of the entire Commission. I earnestly hope that you will consent to act as a member of the Commission, in common with the following gentlemen:

Waters

Hon. Theodore E. Burton, Ohio, *Chairman.*
Senator William B. Allison, Iowa.
Senator Francis G. Newlands, Nevada.
Senator William Warner, Missouri.
Senator John H. Bankhead, Alabama.
Mr. W J McGee, Bureau of Soils, *Secretary.*
Mr. F. H. Newell, Reclamation Service.
Mr. Gifford Pinchot, Forest Service.
Mr. Herbert Knox Smith, Bureau of Corporations.
Hon. Joseph E. Ransdell, Louisiana.
Prof. George F. Swain, Institute of Technology, Mass.
The Chief of Engineers, U. S. Army.

Forests

Senator Reed Smoot, Utah, *Chairman.*
Senator Albert J. Beveridge, Indiana.
Senator Charles A. Culberson, Texas.
Hon. Charles F. Scott, Kansas.
Hon. Champ Clark, Missouri.
Mr. J. B. White, Missouri.
Prof. Henry S. Graves, Yale Forest School, Connecticut.
Mr. William Irvine, Wisconsin.
Ex-Governor Newton C. Blanchard, Louisiana.
Mr. Charles L. Pack, New Jersey.
Mr. Gustav Schwab, National Council of Commerce, New York.
Mr. Overton W. Price, Forest Service, *Secretary.*

Lands

Senator Knute Nelson, Minnesota, *Chairman.*
Senator Francis E. Warren, Wyoming.
Hon. John Sharp Williams, Mississippi.
Hon. Swager Sherley, Kentucky.
Hon. Herbert Parsons, New York.
Mr. James J. Hill, Minnesota.
Ex-Governor N. B. Broward, Florida.
Ex-Governor George C. Pardee, California.

Mr. Charles McDonald, American Society of Civil Engineers, New York.
Mr. Murdo Mackenzie, Colorado.
Mr. Frank C. Goudy, Colorado.
Mr. George W. Woodruff, *Secretary.*

Minerals

Hon. John Dalzell, Pennsylvania, *Chairman.*
Senator Joseph M. Dixon, Montana.
Senator Frank P. Flint, California.
Senator Lee S. Overman, North Carolina.
Hon. Philo Hall, South Dakota.
Hon. James L. Slayden, Texas.
Mr. Andrew Carnegie, New York.
Prof. Charles R. Van Hise, Wisconsin.
Mr. John Mitchell, Illinois.
Mr. John Hays Hammond, Massachusetts.
Dr. Irving Fisher, Yale University, Connecticut.
Mr. Joseph A. Holmes, Geological Survey, *Secretary.*

Executive Committee

Mr. Gifford Pinchot, *Chairman.*
Hon. Theodore E. Burton.
Senator Reed Smoot.
Senator Knute Nelson.
Hon. John Dalzell.
Mr. W J McGee.
Mr. Overton W. Price.
Mr. G. W. Woodruff.
Mr. Joseph A. Holmes.

One of the principal objects of the Federal Commission on the Conservation of Natural Resources will be to cooperate with corresponding commissions or other agencies appointed on behalf of the States, and it is hoped that the Governors and their appointees will join with the Federal Commission in working out and developing a plan whereby the needs of the Nation as a whole and of each State and Territory may be equitably met.

The work of the Commission should be conditioned upon keeping ever in mind the great fact that the life of the Nation depends absolutely on the material resources, which have already made the Nation great. Our object is to conserve the foundations of our prosperity. We intend to use these resources; but to so use them as to conserve them. No effort should be made to limit the wise and proper development and application of these resources; every effort should be made to prevent destruction, to reduce waste, and to distribute the enjoyment of our natural wealth in such a way as to promote the greatest good of the greatest number for the longest time.

The Commission must keep in mind the further fact that all the natural resources are so related that their use may be, and should be, coordinated. Thus, the development of water transportation, which requires less iron and less coal than rail transportation, will reduce the draft on mineral resources; the judicious development of forests will not only supply fuel and structural material, but increase the navigability of streams, and so promote water transportation; and the control of streams will reduce soil erosion, and permit American farms to increase in fertility and productiveness and so continue to feed the country and maintain a healthy and beneficial foreign commerce. The proper coordination of the use of our resources is a prime requisite for continued national prosperity.

The recent Conference of Governors, of the men who are the direct sponsors for the well-being of the States, was notable in many respects; in none more than in this, that the dignity, the autonomy, and yet the interdependence and mutual dependence of the several States were all emphasized and brought into clear relief, as rarely before in our history. There is no break between the interests of State and Nation, these interests are essentially one. Hearty cooperation between the State and the National agencies is essential to the permanent welfare of the people. You, on behalf of the Federal Government, will do your part to bring about this cooperation.

In order to make available to the National Conservation Commission all the information and assistance which it may desire from the Federal Departments, I shall issue an Executive order, directing them to give such help as the Commission may need.

The next session of Congress will end on March 4, 1909. Accordingly, I should be glad to have at least a preliminary report from the Commission not later than January 1 of next year.

Sincerely yours,
(Signed) Theodore Roosevelt

THE INLAND WATERWAYS COMMISSION

On June 5, 1908, the President reappointed the Inland Waterways Commission, with an increase in number and such extension of function as to authorize the correlation of the administrative Departments and Bureaus of the Federal Government in so far as their work is connected with waterways. The letter of appointment, addressed to the Chairman, Hon. Theodore E. Burton of Ohio, follows:

June 5, 1908.

The Inland Waterways Commission was appointed on March 14, 1907. It was appointed to meet the strongly expressed and reasonable demands of the people. Commercial organizations throughout the Mississippi Valley and elsewhere demanded then and still demand such improvement of waterways and development of navigation as will prevent traffic congestion and develop commerce. It is an unpleasant fact that although the Federal Government has in the last half-century spent more than a third of a billion dollars in waterway improvement, and although the demand for transportation has steadily increased, navigation on our rivers has not only not increased, but has actually greatly diminished. The method hitherto pursued has been thoroughly ineffective; money has been spent freely for improving navigation, but river navigation at least has not been improved; and there is a just and reasonable demand on the part of the people for the improvement of navigation in our rivers in some way which will yield practical results. It was for such reasons as these that the Commission of which you are Chairman was requested to consider and recommend a general plan of waterway improvement giving reasonable promise of effectiveness.

The preliminary report of the Inland Waterways Commission was excellent in every way. It outlines a general plan of waterway improvement which when adopted will give assurance that the improvements will yield practical results in the way of increased navigation and water transportation. In every essential feature the plan recommended by the Commission is new. In the principle of coordinating all uses of the waters and treating each waterway system as a unit; in the principle of correlating water traffic with rail and other land traffic; in the principle of expert initiation of projects in accordance with commercial foresight and the needs of a growing country; and in the principle of cooperation between States and the Federal Government in the administration and use of waterways, etc.; the general plan proposed by the Commission is new, and at the same time sane and simple. The plan deserves unqualified support. I regret that it has not yet been adopted by Congress, but I am confident that ultimately it will be adopted.

Pending further opportunity for action by Congress, the work of the Commission should be continued with the view of still further perfecting the general plan by additional investigations and by ascertaining definitely and specifically why the methods hitherto pursued have failed. To this end I ask that the present members of the Waterways Commission continue their most commendable public service. I am asking three others to join them, namely: Senator William B. Allison, of Iowa; Hon. Joseph E. Ransdell, of Louisiana, a member of the Rivers and Harbors Committee of the House of Representatives and President of the National Rivers and Harbors Congress; and Professor George F. Swain, of the Massachusetts Institute of Technology, a recognized authority on water power. When a Chief of Engineers is appointed to succeed General Alexander Mackenzie, retired, I shall also designate him a member, in lieu of General Mackenzie, whose retirement relieves him of further duty on the Commission. The Commission will thus be increased from nine members to twelve.

In order to facilitate the work of the Commission, I shall shortly issue an Executive order along the lines suggested by your findings and recommendations, directing the Executive Departments to give the Commission access to their records and all necessary and practicable assistance in securing information for submission to the President and to Congress.

An indirect but useful result of the work of the Commission was the recent Conference of Governors on the Conservation of our Natural Resources, held in the White House May 13–15. I take great pleasure in repeating my public expression of indebtedness and my congratulations to the Commission for their signal public service in connection with this great Conference; it was an event which is likely to exert a profound and lasting influence on the development and history of our country.

Copies of this letter are being sent to each of the twelve members of the Inland Waterways Commission.

Sincerely yours,
(Signed) Theodore Roosevelt

Hon. Theodore E. Burton, Chairman,
Inland Waterways Commission.

THE HANOVER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

From the preliminary announcement of the special summer meeting of the American Association, to be held at Hanover, N. H., from June 29 to July 3, distributed with the issue of Science for May 29, we repeat the following details:

The first general session will be held in Dartmouth Hall at 8 p.m., on Monday, the twenty-ninth. The registration will be open at the office of the permanent secretary at College Hall from 10 A.M. on that day.

The American Physical Society and the Geological Society of America meet on June 30 and on July 1 in affiliation with the corresponding sections of the association. On the evenings of these days there will be lectures on "The Spoliation of Niagara," and on "The American Bison."

On July 2 there will be an excursion to the Blue Mountain Forest Park, stocked with buffalo, moose and other game by the late Mr. Austin Corbin. Elaborate and interesting excursions, both preceding and following the meeting, have been arranged by the Section of Geology and Geography.

Professor Robert Fletcher is chairman and Professor H. H. Horn, secretary, of the local committee. The official headquarters and social rendezvous will be in College Hall. The hotel headquarters will be in Hanover Inn, and room accommodations will be provided in the dormitories, with meals in the large dining-room of College Hall.

Most of the railways have offered a rate of a fare and a third on the certificate plan.

SCIENTIFIC NOTES AND NEWS

Colonel W. C. Gorgas, eminent for his work on yellow fever at Havana and as chief sanitary officer of the Isthmian Canal Zone, has been elected president of the American Medical Association.

At the University of Maine, the degree of doctor of laws was conferred on Dr. A. A. Noyes, acting president of the Massachusetts Institute of Technology, and on M. C. Fernald, for forty years connected with the university, formerly as president, who retired this year from the professorship of philosophy. The degree of doctor of science was conferred on L. H. Merrill, professor of biological and agricultural chemistry and on J. N. Hart, professor of mathematics and astronomy and dean.

The University of Liverpool has conferred its doctorate of science on Mr. Francis Darwin and Professor J. L. Todd, and its doctorate of engineering on the Hon. C. A. Parsons.

The gold Karl Ritter medal of the Berlin Geographical Society has been conferred on Professor Hermann Wagner, of Göttingen.

Professor J. E. Sinclair, for the past thirty-nine years professor of mathematics at the Worcester Polytechnic Institute, has retired under the terms of the Carnegie Foundation.

Dr. George I. Adams, formerly in the U. S. Geological Survey and lately with the Corps of Engineers of Mines of Peru, has been appointed geologist in the Bureau of Mines of the Philippine Islands and will sail from San Francisco on the *Mongolia* on June 30. His address will be Bureau of Mines, Manila, P. I.

Dr. Pérot has been appointed physicist in the Astrophysical Observatory at Meudon.

Dr. Arthur Böhm has been appointed chemist in the Geological Bureau at Berlin.

Professors Bang and Fibiger, of the University of Copenhagen, and Dr. Roerdam, a noted military surgeon, have been appointed delegates from Denmark to the tuberculosis congress to be held in Washington in September.

Professor Charles Schuchert, curator of the geological collection in Peabody Museum, Yale University, started on May 30 on an exploring and collecting excursion for invertebrate fossils to Anticosti Island. Anticosti is an island 150 miles long by fifty miles wide, lying at the mouth of the St. Lawrence River, about twenty miles off the Labrador coast.

Dr. George P. Merrill, head of the department of geology of the United States National Museum, has returned from Meteor, Arizona, where he went several weeks ago for the Smithsonian Institution to make additional studies of a peculiar crater-form depression in the plain, about three quarters of a mile across and nearly six hundred feet deep. Dr. Merrill witnessed the boring of wells reaching a depth of 842 feet below the bottom of the depression. These and other studies have tended to confirm the conclusion, reached by him last year, that the crater was caused by a meteor.

Dr. W. D. Matthew, of The American Museum of Natural History has left New York to join the expedition to western Nebraska under the direction of Mr. Albert Thomson. The main object of the party is to obtain complete skeletons of the three-toed horses of the Miocene epoch. While it is Dr. Matthew's intention to return to the museum about August 1, the other members of the party will remain in the field during the entire season.

The American Museum of Natural History has sent Mr. Alanson Skinner to James Bay to make archeological and ethnological investigations among the Cree Indians. Dr. R. H. Lowie, of the anthropological department of the museum, who left New York City on May 5, has arrived at Fort Chippewyan on Lake Athabasca. Dr. Lowie plans to remain among the Athabascan Indians during the summer.

Dr. L. Cockayne has been instructed by the New Zealand government to undertake botanical surveys in different parts of the dominion. He has completed a survey of a kauri forest (*Agathis australis*) in the north island, and also of the Tongariro National Park, and he is now engaged on a survey of another large forest. His reports will be published by the government as parliamentary papers.

The memorial tablet in honor of Robert Henry Thurston, former director of Sibley College, Cornell University, who died in 1904, was unveiled on June 16. The tablet, which is a fine piece of work and bears a faithful likeness of the great engineering investigator and teacher, is the work of Herman MacNeil, a New York sculptor, who was formerly a student and instructor at Cornell. Professor R. C. Carpenter, one of Director Thurston's colleagues, presided. Addresses were delivered by President Schurman, Dr. Andrew D. White, Mr. John H. Barr, of Syracuse, and Director Albert W. Smith, of Sibley College. Mr. Henry Dubois presented the memorial on the part of the donors.

A monument in honor of Dr. Bernhardt Wartmann, the botanist, has been erected at St. Gallen.

Dr. Ludwig Mond has established a prize in honor of Professor Stanislao Cannizzaro, to be awarded by the Academy of Sciences at Rome.

Dr. Ferdinand Löwl, professor of geology at the University of Czernowitz, has died at the age of fifty-two years.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. Henry Phipps, of Pittsburg and New York, has made a large gift to the Johns Hopkins University for the founding of a Psychiatric Clinic. It provides for the construction of a hospital building on the Hopkins Hospital grounds to accommodate sixty patients, together with apparatus, and laboratories for the scientific investigation of mental abnormalities by pathological, chemical, and psychological methods. Mr. Phipps will provide for the maintenance of a medical and nursing staff, including salaries for a professor of psychiatry and assistants and other expenses for a period of ten years. The total amount of the gift is withheld in accordance with the wishes of Mr. Phipps, but it is understood that it will considerably exceed half a million dollars.

The corner stone of the Morley Chemical Laboratory was laid on the Adelbert College campus, June 11, when an address was delivered by the director, Olin Freeman Tower, Ph.D. The laboratory is to cost at least $120,000, and is expected to be ready for use in the fall of 1909.

Drown Memorial Hall, erected at Lehigh University, for the social purposes of the students, as a memorial to Thomas Messenger Drown, formerly president of the university and eminent as a chemist, was dedicated on June 9. Addresses were made by Dr. C. B. Dudley and by Dr. Rossiter W. Raymond.

The corner stone of the new agricultural building of the University of Maine was laid in connection with the commencement exercises last week. President S. E. Fellows presided. Dr. W. H. Jordan, director of the New York Experiment Station, Geneva, made the opening address. Hon. Payson Smith, state superintendent of public schools, spoke briefly, and was followed by Dean W. D.

Hurd, of the university. The corner stone was then laid by Hon. Augustus W. Gilman, state commissioner of agriculture.

At the University of Nevada, the new mining building and the statue of John W. Mackay, both the gift of Mr. Clarence H. Mackay and his mother, Mrs. John W. Mackay, were dedicated on commencement day. The building, erected at a cost of $75,000, is to house the departments of mining and metallurgy and of geology and mineralogy, ample accommodation being provided for all the work of these departments, besides a large museum room which occupies one wing. In addition to this, Mr. Mackay has promised other gifts of money to the university, for a part of the equipment and running expenses of the same departments, for extensive improvements of the campus, and for providing an athletic field and training quarters.

Ground has been broken for the School of Mines Building of the University of Pittsburg as the University of Pennsylvania is hereafter to be called. This building, which will cost $175,000, is the first of the group to be erected for the University opposite the Carnegie Institute and the Carnegie Technical School.

The first commencement exercises of the Carnegie Technical Schools, Pittsburg, was held on June 17. Dr. R. S. Woodward, president of the Carnegie Institution of Washington, delivered the address to the graduating class, which numbered fifty-nine.

Dr. G. Stanley Hall, president of Clark University, gave the address at the commencement exercises of the College of Physicians and Surgeons, Boston.

Dr. Edwin E. Sparks, professor of American History at the University of Chicago, was on June 17 installed as president of the Pennsylvania State College, succeeding Dr. George W. Atherton, who died in 1906. Dr. Alex. C. Humphreys, president of Stevens Institute of Technology, and Dr. Paul Shorey, professor of Greek in the University of Chicago, made addresses.

At Western Reserve University, Carl Byron James has been made assistant professor of biology in Adelbert College and the College for Women, and Roger Griswold Perkins, M.D., associate professor of pathology and hygiene in the medical school. George Trumball Ladd, LL.D., has been appointed lecturer on education in the College for Women.

Professor A. H. Patterson, of the University of Georgia, has been elected professor of physics at the University of North Carolina.

Dr. Chas. E. Cory has been appointed head of the department of philosophy in the Washington University, in the place of Professor A. E. Lovejoy, who, as we have already announced, has accepted a call to the University of Missouri.

Central University, Danville, Ky., has elected Professor Frank Lewis Rainey to the chair of biology. Mr. Rainey, who is spending the summer in England and on the continent, has been at the head of the same department in Parsons College, Fairfield, Iowa, for the past five years.

In the chemical department of the University of Illinois appointments have been made as follows: *Instructors*—Grinnell Jones, Ph.D. Harvard, '08; B. S. Lacy, Ph.D. Harvard, '06; Brainard Mears, Ph.D. Johns Hopkins University, '08. *Research Assistant*—E. E. Gorsline, Ph.D. Johns Hopkins University, '08. *Assistant.*—James Coss, Upper Iowa University. *Graduate Assistants*—J. E. Egan, DePauw University; Luther Knight, formerly assistant at Rose Polytechnic Institute; E. K. Strachan, Worcester Polytechnic Institute; Guy Conrey, University of Michigan; W. F. Washburn, formerly assistant, University of Maine.

Mr. William Bateson, F.R.S., has been elected to the chair of biology at Cambridge University, which has been established for five years, largely owing to an anonymous donor. Mr. Bateson, who was born in 1861, is a son of the late master of St. John's College and has been a fellow of this college since 1885.

During the present summer the address of the responsible editor of Science is Woods Hole, Mass.