THURSDAY, NOVEMBER 20, 1913.

MODERN PHYSICAL IDEAS AND RESEARCHES.

(1) *Modern Electrical Theory.* By Dr. N. R. Campbell. Second edition. Pp. xii + 400. (Cambridge: University Press, 1913.) Price 9*s.* net.

(2) *Les Idées Modernes sur la Constitution de la Matière. Conférences Faites en* 1912. By E. Bauer, A. Blanc, E. Bloch, Mme. P. Curie, A. Debierne, and others. Pp. 370. (Paris: Gauthier-Villars, 1913.) Price 12 francs.

(3) *Researches in Physical Optics, with especial reference to the Radiation of Electrons.* Part i. By Prof. R. W. Wood. Pp. vii + 134 + x plates. (New York: Columbia University Press, 1913.)

(1) THE second edition of Dr. Norman Campbell's "Modern Electrical Theory," reviewed first in NATURE, May 28, 1908, is practically a new book. The work of Barkla and Bragg, and the theories of Einstein and Planck have rendered necessary a fresh treatment of part ii., dealing with radiation. The principle of relativity and Stark's work on valency alter completely part iii., which deals with electricity and matter, a field in which second thoughts have proved notoriously less ambitious than the first, whilst the first part, which deals with the electron theory proper, has also been entirely re-written.

It must have been a task of no ordinary magnitude to attempt to present to-day the changing theories of modern physics. Speaking of the subject of radiation, the author claims it is the best attempt in the English language to deal generally with the matter, because "so far as I know there is no other." Again, in the references to the literature at the end of chapter i., after a mention of Lorentz's "Theory of Electrons," we read: "I know of no other English treatise which can be recommended with confidence," and the remark will be generally endorsed.

The book deals with the whole of the large legitimate field of the electron theory, electro-magnetism, metallic and electrolytic conduction, optics, radiation, and the chemical as well as physical properties of matter. It is in welcome contrast to the earlier more or less popular presentations of the subject which have appeared in our language, in that as much attention is given to the failures as to the successes of the theory, and in that, in the absence of any experimental evidence of positive electricity apart from matter, it does not trespass unduly into the region which many people have been led to regard as the chief object of the electron theory, the explanation of matter in terms of the electron.

Physical theories at the present moment are so shaky at the foundations that the doubt arises sometimes whether the superstructure is not being built up too rapidly. The difficulties, now ten years old, in reconciling the undulatory and corpuscular types of radiation in one theory, the hopeless confusion that prevails as to the necessity for the existence of an ether, and the modern discrete or quantum theory of energy, seem to call for a more drastic reconsideration than we find here of many of the simplest physical conceptions and their experimental basis. Take, for example, the view that has been universally held of the uniform propagation of radiation in all directions through space. There seems to be really no evidence for this. All that experiment and observation justify is its propagation between portions of space occupied by matter. Elsewhere it may not be propagated at all. Recent suggestions that it is propagated along "Faraday tubes" which, starting from the radiator, must necessarily end "somewhere," seem vaguely to imply something of the kind. But what a different complexion would be assumed by some of the larger generalisations of science, in the field, for example, of the maintenance of solar and cosmical energy, not to mention problems in wireless telegraphy connected with the curvature of the waves round the earth, and all of the topics dealt with in the present book, if it were frankly confessed at the outset that we are really in complete ignorance as to the answer to this simplest first question about the nature of radiation.

In the concluding chapters the author permits himself to wander beyond the strict boundary of his subject to discuss the principle of relativity and the changes in current ideas required from this new point of view. It is at least instructive to try to follow a British author attempting to reproduce these abstruse conceptions, which as yet scarcely anyone in this country professes to understand, or at least to appreciate. But the exposition is marred by too great an anxiety to defend the view from possible objections, and it cannot be said that the fundamental or primary significance of the principle is made out, or that it has been duly correlated with other physical conceptions. One remains in doubt whether, if not metaphysical, it is not of subjective rather than objective importance, a mathematical correction to render consistent observations in which the velocity of light enters, and which would be, if not actually false, at least inoperative were gravitational action, for example, instead of light em-

ployed to transmit the intelligence of an event to a distant place.

It may be true that it is impossible to conceive of a body moving relatively to an observer with velocity greater than that of light. But we can, and do, work with β-particles of radium, and we can imagine two of these expelled in opposite directions from a source of radium at rest relatively to the earth, and therefore, in ordinary parlance, having a velocity relatively to one another nearly twice that of light. This, of course, in no way questions or minimises the importance of the principle of the great German mathematical physicist in its own field, but science is ever sceptical of restrictions which it is told must necessarily and for all time limit its power of disentangling the phenomenon from the appearance of the phenomenon. In any case the author deserves success in thus including in this conscientious review of modern electrical theory some of the modern conceptions which are at once the most foreign to our habits of thought and the most difficult to appreciate at their true worth. Successful the volume undoubtedly is in its purpose of providing serious students acquainted with the older physics an introduction to the newer theories.

(2) This collection of ten lectures by as many authorities treats in simple and clear fashion with some of the special departments of physical science now most to the fore. Brownian movement, the subject of high vacua or ultra-rarefied gases, and the relations between matter and the ether are the only three topics which can claim even thirty years of history. Three more deal with the electron in one or other aspect—electro-magnetic dynamics, the electronic theory of metals, and ionisation by collision and the electric spark—and two with radioactivity, the radiations of the radioactive substances, and their successive transformations. Lastly, two of the newest conceptions, the quantum theory of energy and the magneton theory, complete the volume, which will prove as useful and interesting as earlier publications on similar lines by the Société française de Physique.

(3) The third volume is a collection of some of the most interesting and beautiful discoveries of Prof. R. W. Wood, issued by the Columbia University under the E. K. Adams fund for physical research. They include the notable contributions to resonance spectra and radiations, first with iodine, then from mercury vapour, which have enabled the vapour arising from a cold surface of mercury to be photographed, and going on to experiments with heat waves of more than 0·1 mm. wave-length, analogous to those with Herzian waves, in which a "dew" of condensed mercury globules deposited on quartz was employed for the resonator. This in turn leads to some extraordinary, still incomplete, observations on the electric conductivity of ruled silvered glass gratings, in spite of the complete severance of the silver film by the diamond.

Lastly must be mentioned some attempts to photograph the lunar surface through screens transmitting only yellow, violet, and ultra-violet light respectively. These photographs reveal the presence of a remarkable deposit round the crater of Aristarchus, which very probably may be sulphur, and foreshadow a method for carrying out a limited petrological survey of the lunar surface. It is a pity that the volume does not appear to be for sale, for many no doubt would be glad to secure this well-illustrated collection of modern experimental researches by one of its greatest masters. FREDERICK SODDY.

THE THRESHOLD OF SCIENCE—AND BEYOND.

(1) *Zoology*. By Prof. E. Brucker. Pp. xiii + 219. (London: Constable and Co., Ltd., 1913.) Price 2*s*. net.

(2) *Some Secrets of Nature*. Short Studies in Field and Wood. With an introduction by W. J. P. Burton. Pp. xiv + 144 + plates. (London: Methuen and Co., Ltd., n.d.) Price 1*s*. 6*d*.

(3) *The Romance of Nature*. Studies of the Earth and its Life. With a preface by the Rev. A. Thornley. Pp. xix + 164 + x plates. (London: Methuen and Co., Ltd., n.d.) Price 2*s*.

(4) *In the Lap of the Lammermoors*. By W. McConachie. Pp. xii + 315. (Edinburgh and London: William Blackwood and Sons, 1913.) Price 5*s*. net.

(1) ONE of the many ways of beginning the study of zoology is to take a survey of the whole animal kingdom, working from the simple to the complex, never going very deeply into anything, but using now this, now that, to illustrate a principle. That is what Prof. Brucker has done, and it is a feat to have done it so clearly and in such simple language. If the reader, young or old, is able to touch and handle, as well as read about, even a tenth of the creatures discussed, he will have got far across the threshold of the science—to use the phrase which gives its name to this new series. To our thinking there is far too much in the book for an introduction, but that is largely a matter of opinion, and it is doubtless what students say of most courses of elementary instruction which their professors after much thought on the subject decide to deliver. Be this as it may, the author of this little book is evi-

dently an experienced teacher, and he has been successful in working out the method he has adopted. His avoidance of the unnecessarily technical is most praiseworthy, even if it leads to difficulties of its own, such as that one, more or less happily circumvented, that the squids are "molluscs with the foot surrounding the head." That is rather a stiff one on the threshold!

(2) A very different kind of introduction is supplied by "Some Secrets of Nature," a book showing real educational insight on the part of the anonymous author. Why should we not know who this is, who sets these quite admirable "problems for consideration," sometimes just a little conundrumoid, at the end of each short study; who reveals a very intimate knowledge of what really goes on in field and wood and some other places too; who knows how to awaken the scientific spirit? As a guide to the embarrassed teacher and an aid to the eager pupil, where rural nature-study (plants and animals) is concerned, we would very strongly recommend this book. We venture to suggest that the note *personnel*—natural in a talk—becomes a little fatiguing in this book. The author is no egotist, but he must have impoverished the printer's stock of one letter.

(3) "The Romance of Nature" is meant to be a "Nature Reader for Senior Scholars," but it is not, in our opinion, very successful. The first chapter discloses what the rest of the book confirms, that the writers are ignorant of the psychology of the normal senior scholar. From the earth's beginnings to the establishment of land and sea; the story of rock and fossil; the life-cycle of a plant and the life-history of a frog; birds and insects; and so on—the general idea and intention of the book is good enough, but the outcome seems to us unattractive. The writers know a great deal; their book is full of useful information; the outlook is wholesome; the inculcation of reverence and independent research is admirable: yet, somehow, this "Nature Reader" does not grip, and we are afraid that it will not lead many senior scholars to appreciate the "Romance of Nature." For one thing, the style is not good enough.

(4) It is not quite fair to bring in Mr. McConachie's book along with the foregoing, for it is a work of art. They are helps across the threshold, but he has got to the hearthstone. Yet there may be justification for what we have had to do. For while the first three books follow different methods, is not their aim one—that of seeing, understanding, enjoying, and learning from what we call Nature? And it is our conviction that unless "Nature Study"—helped or hindered by books—makes for, or at least towards, that cultured outlook which Mr. McConachie's past and present work reveals, then it has in great part missed its mark. The first book reminds us that we must see widely and at the same time precisely; the second book rouses the curious questioning spirit; the third book suggests reverence before the wonderfulness of things; in the fourth book we have the harvest of a clear, searching, well-informed, and loving eye.

Mr. McConachie tells us of his walks in a Border parish, but his gift to us is independent of geography—the suggestion of how much there is in that which lies closest to our feet. Of course, he could not do what he does in these sketches—to be ranked beside those of Richard Jefferies and John Burroughs—unless he knew his birds and flowers and more besides really well, and unless he had a rare gift of style. But beyond that, in these pictures of the Border Parish, the Golden Glen, the Drifting Mist, the Woodpecker's Nest, the Wilderness, the Meadow Burn, the Lonesome Moor, the Summer Shielings, the Southward Flight—to name just a few—there is "a feeling for Nature," which, while in part doubtless the gift of the gods, is also the reward of those who sojourn with nature in sunshine and in storm, and who discipline themselves to hear her voices. And this is the chief end of "Nature-study."

J. ARTHUR THOMSON.

PRACTICAL MATHEMATICS.

(1) *Practical Mathematics: First Year.* By A. E. Young. Pp. vii+124. (London: George Routledge and Sons, Ltd., 1913.) Price 1*s.* 6*d.* net.

(2) *An Elementary Treatise on Calculus.* A Textbook for Colleges and Technical Schools. By W. S. Franklin, B. MacNutt, and R. L. Charles. Pp. ix+253+41. (South Bethlehem, Pa: Lehigh University, 1913.) Price $2.00.

(3) *Problèmes de Mécanique et cours de Cinématique.* By Prof. C. Guichard. Rédaction de MM. Dautry et Deschamps. Pp. 156. (Paris: A. Herman et Fils, 1913.) Price 6 francs.

(4) *Further Problems in the Theory and Design of Structures.* By E. S. Andrews. Pp. viii+236. (London: Chapman and Hall, Ltd., 1913.) Price 7*s.* 6*d.* net.

(1) THE author has covered a wide range of topics within the small compass of a hundred pages. He opens by explaining the use of the vernier calliper and the micrometer screw-gauge, and this leads naturally to an exposition of contracted methods. There is an excellent chapter on graphical work, which includes applications to statics; and there are also sections on the

practical use of logarithms, the meaning of the trigonometric functions, the mensuration of plane and solid figures, and variation. The concluding chapter introduces the reader to Cartesian geometry.

(2) The lines on which this text-book is written show that the authors are convinced, and in our opinion rightly, that a knowledge of the ideas and methods of the calculus can be obtained without any severe algebraic manipulation. They have wisely omitted all purely formal developments of the subject, and have introduced integration at an early stage. The explanations are given in a clear and simple style, and a variety of applications are made which should secure the interest of the reader. In a work such as this a rigorous treatment is out of place, but it is well to warn the student of this, and we disagree with the authors in their suggestion that the proof given of Maclaurin's theorem is complete, and secure against criticism. The subject-matter includes ordinary and partial differential equations and an excellent account of vector analysis. It is curious and regrettable that this is generally omitted by English writers.

(3) The first half of this volume is occupied with the solution of rather a miscellaneous set of problems on the motion of plane and solid bodies and systems of bodies, with special reference to envelopes and roulettes. The remainder falls into three sections: (1) particle dynamics; (2) rigid dynamics; (3) a brief account of relative motion, and the composition of motions of translation and rotation. Each of these is taken in far less detail than would be the case in a similar English treatise, and no exercises are included. Many students, however, might profitably read a course of this kind to supplement their ordinary text-book.

(4) This is a sequel to the author's former work on structures, forming a supplementary volume dealing with recent developments of the subject. The first eighty pages give a clear and full account of the method of influence lines, which, although suggested in Germany forty years ago, has until quite recently received little attention in this country. The next sixty pages deal with the principle of work and its application to the deflection of framed structures, redundant frames, and rigid or elastic arches; and the remainder to portals, wind bracings, and secondary stresses.

The mathematical work is set out at full length, and so clearly that it should offer few difficulties. The diagrams are excellent; and the problems chosen for discussion are of real practical interest; their selection and treatment is evidently the work of a thoroughly experienced teacher.

LABORATORY EXPERIMENTS IN AERONAUTICS.

The Resistance of the Air and Aviation. Experiments conducted at the Champ de Mars Laboratory. By G. Eiffel. Second edition, revised and enlarged. Translated by J. C. Hunsaker. Pp. xvi+242+xxvii plates. (London: Constable and Co., Ltd.; Boston and New York: Houghton Mifflin Co., 1913.) Price 42*s.* net.

AN English edition of this work will be welcomed by the large and increasing circle of scientific and engineering men who are desirous of obtaining accurate experimental data in aeronautics from which to direct their work. It need not be said that the experimental work of M. Eiffel repays study, for whether the reader seeks to gain information regarding the difficult and perplexing problems met with in this branch of physics, or practical "tips" for designing aerofoils, he will not be disappointed. Though the contents of this book, based as they are upon experiments made at the laboratory at the Champ de Mars, have passed into the category of established experimental facts, they are not so well known as they deserve to be.

The great new Auteuil laboratory[1] is described in the volume, from which in the future we may expect great things; nevertheless, the results obtained at the Champ de Mars with the smaller wind tunnel to which the volume before us is devoted, will pass the most critical examination for painstaking experimental work. From time to time we are met with suggestions that capable mathematicians should be entrusted with problems of stability and like questions, but the mathematical investigator must be provided with carefully ascertained facts if his conclusions are to be worth anything at all.

From such experiments as these, and from those made at the National Physical Laboratory, the mathematician must derive the grain for his logical mill. That good use will be made of them there cannot be any reason to doubt. As aeroplane wing sections are capable of indefinite variation, and no two experimenters have adopted similar sections, comparison of the work of different experimenters becomes difficult, hence the conflicting results which are quoted by those who have not taken into account the many independent variables entering into the experiments.

Perhaps the most striking result in this series of experiments on aeroplane wings is the effect of the "negative" angle at the leading edge as increasing the efficiency. After considering the

[1] See NATURE, February 20, 1913, p. 677, *et seq.*

results on the eighteen types of wing which formed the models experimented on, there is no special type which can be said to be the most advantageous from the aeroplane constructor's point of view, and the choice of the most advantageous depends upon the conditions of the particular problem in each case. In the case of wings with reverse curvature it was found that the reaction was no longer proportional to the square of the velocities. The wings tested had sections similar to those employed by the principal designers of aeroplanes.

Propellers were tested by driving them by an electric motor in the wind tunnel; thus the results obtained more closely conform to the conditions of flight, and the "dynamic" instead of the "static" thrust is obtained. The conclusions to be drawn from the experiments are that the reaction upon a propeller cannot be assumed exactly proportional to the square of the relative velocity, and from a study of the model it is possible to predict all the elements of propeller action provided that the model be tested with the same relative velocity, both in magnitude and direction, that the full-sized propeller is expected to use. This requires for the same velocity of translation a speed of rotation inversely proportional to the diameters of model and propeller. The distortion of the propeller at high velocities is mentioned as a cause of some variations observed in the results. Velocities of 5 to 18 metres per second were used, and the propellers were driven at speeds from 400 to 1600 revolutions per minute.

By such experiments facts are being brought to light which already have had a great influence on aeroplane construction in France, and the experiments on models offer a safe guide to the behaviour of the air upon aeroplane wings by the use of appropriate constants. From the results of the experiments the minimum effective power that can sustain flight is obtained for a given wing section. Thus a Blériot machine with a supporting area of 25 sq. metres, weight in service with pilot 588 kg., and an angle of attack of 9°, was found by the model to require a minimum effective power of 24 h.p. This, it is stated, is practically the power used. The effect of superposed planes is also studied; also the effect of aspect ratio upon the reaction. In this connection it may be mentioned that the author first observed the curious variations for a square plate with the Eiffel Tower dropping apparatus. The reaction on a square plate inclined 37° is nearly one and one-half times the reaction when normal to the wind. With good judgment the translator has retained the metric units.

R. S. B.

OUR BOOKSHELF.

Ulster Folklore. By Elizabeth Andrews. Pp. xiii + 121 + xii plates. (London: Elliot Stock, 1913.) Price 5*s.* net.

THIS dainty volume is made up of a collection of papers communicated to various societies and journals. As much of the information was collected at first hand, the book is a valuable contribution to the literature of Irish folklore. The expressed purpose kept in view was to find, and show, some correspondence between the description of Irish fairies and that of actual pigmies found, dead and alive, in various parts of the world, and that purpose gives unity to the work, which is more of a monograph than a folklore drag-net. The correspondence made out is certainly very striking. There are also rare pigmies to be met with in Ireland as well as elsewhere. But of the actual existence of pigmy communities in Ireland no evidence is given. The fairies there, as elsewhere, haunt "raths and souterrains." They occupy Neolithic megalithic structures. The photographs, plans, and descriptions of some fairy souterrains give the work special value. One recognises the invariably oriented creepway. Only on one plan the north point is marked, that of Knockdhu (p. 30). If the true north is given, the cove, which is 87 ft. long, is oriented 70° N.W.–S.E. The entrance is south-east; and assuming a sky-line elevation of one degree, the star Antares is indicated about 1700 B.C., a date by no means late for a Neolithic culture in the north of Ireland.

There is some evidence to show "that Palæolithic man lived and worked in Ireland" (pp. 99–100). "It is difficult to exterminate a people, and they could not be driven further west" (p. 104). One may add that the pigmy of folklore is much more ancient than the Irish Neolithic men. In the case of Ireland, however, what may be said with tolerable certainty is that the fairies are the Neolithic builders, and the case is well stated in a quoted statement of the late Mr. John Gray. "The stature of these primitive Danes and Pechts is five feet three inches, and they must have looked very small men to the later Teutonic invaders of an average stature of five feet eight and a half inches" (p. 102). The souterrains of Ardtole and Maghera are 5 ft. 3 in. high.

JOHN GRIFFITH.

Chemistry: Inorganic and Organic, with Experiments. By C. L. Bloxam. Tenth edition, Rewritten and Revised by A. G. Bloxam and Dr. S. J. Lewis. Pp. xii + 878. (London. J. and A. Churchill, 1913.) Price 21*s.* net.

THE first edition of this well-known treatise appeared in 1867, and consisted of 630 pages which, as the preface of the present issue points out, sufficed to give a fuller account of the science of chemistry than the tenth edition can pretend to offer. The development of physical chemistry has rendered necessary a recasting of the first portion of the book. The periodic classification

is followed more closely than in previous editions, and the inorganic portion of the volume rather than the organic has been developed in accordance with the increased attention which, the editors say, has been directed to inorganic chemistry of late years. Precise details from original memoirs, outside the scope of the ordinary text-book, have been included and will increase the value of the work for more advanced students.

LETTERS TO THE EDITOR.

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

Distance of the Visible Horizon.

THE subject of terrestrial refraction and its effect on the distance of the visible horizon, about which Mr. Backhouse inquires in NATURE of September 25, is very fully discussed in the second volume of Jordan's "Handbuch der Vermessungskunde." The formula there proved is

$$a = \sqrt{\frac{2r}{1-k}h}$$

where a = distance of visible horizon.
r = earth's radius.
k = coefficient of refraction (mean value 0·13).
h = height of observer.

This formula reduces to

Distance in statute miles = $1{\cdot}312\sqrt{\text{height in feet}}$.

The subject is also discussed in Gillespie's "Higher Surveying," where, using a slightly different coefficient of refraction, the formula arrived at is very nearly the same, viz. :—

Distance in statute miles = $1{\cdot}317\sqrt{\text{height in feet}}$.

It is easy to construct a table from either of these formulæ which will give the distance of the visible horizon at any height under average atmospheric conditions.

The method of reducing trigonometric heights described by Capt. Tizard, where the refraction-angle is taken at 5″ for each nautical mile of distance, is equivalent to using a refraction-coefficient of 0·18 in place of Jordan's 0·13. My own experience in the Red Sea and Gulf of Suez is that Jordan's value is tolerably correct near midday in winter and spring; this would imply that 4″ per nautical mile of distance is a nearer value than Capt. Tizard's 5″ under those conditions, and as a matter of fact the substitution of the lesser value leads to a rather better agreement for the height of Jebel Hooswah than that shown in Capt. Tizard's table.

Abnormalities of refraction, such as Capt. Tizard notes, are tolerably frequent over tropical seas, and one naturally avoids making measurements of altitude when the conditions are palpably abnormal. The variation of 18° in the altitude of the horizon in the Arctic regions, quoted by Capt. Tizard, is doubtless a misprint for 18′ or 18″; but in any case such a figure is meaningless unless the height of the observation-point is given.

It is not temperature *per se* which affects refraction, so much as the vertical temperature-gradient in the air; this varies very rapidly in the early morning hours, but becomes more steady about noon. I have found that at fair altitudes the refraction is in general wonderfully constant in the middle of the day, say between 11.30 a.m. and 3 p.m.; and by restricting observations for level to this time of the day I have obtained very much more concordant results than those quoted by Capt. Tizard. If the object is only visible in the early morning or late evening, an evening observation is much to be preferred to a morning one.

The table given by Capt. Tizard is liable to give an exaggerated impression of the range of refraction. The differences of height found for the same point by his various observations probably depend not so much on variations in refraction, as on the roughness of the angular observations; in all cases except two, his depression-angles are only given to minutes, and a minute of arc at a distance of fifty-eight nautical miles subtends more than 100 ft. It is easy nowadays to measure the vertical angles well within 5″ of the truth, using only a 6-in. micrometer-theodolite; but perhaps in 1871 the instruments available were of a less accurate nature, and one must not be too critical of the results obtained. I would, however, venture to point out that it is incorrect to take the arithmetic mean of the heights from a number of observations at different distances when the least certain factor in the height (the correction to the height due to refraction) varies as the square of the distance; and it is scarcely scientific to correct for refraction to single seconds when the observations themselves are only taken to the nearest minute, or to calculate heights to four significant figures from distances given only to three.

JOHN BALL.

Survey Department, Cairo, October 2.

WITH reference to the remarks of Dr. John Ball, I am much obliged to him for directing my attention to Jordan's "Handbuch der Vermessungskunde" and Gillespie's "Higher Surveying," two works with which I was previously unacquainted.

The coefficient for refraction given by Jordan is the mean of a number of results by different observers in different countries, the originals varying from 0·105 to 0·167.

These results show that the refraction is a very variable quantity, and that the results inland are different from those near the sea. In Gillespie's work he shows how the refraction varies at different hours in the day on the coast of California (*a*) from a height of 57 metres, and (*b*) from a height of 1173 metres, being least near noon, and greatest in the morning and evening. From the height of 57 metres the coefficient varied from 0·14 to 0·10, whilst from the height of 1173 metres it varied from 0·09 to 0·06.

Gillespie publishes curves showing the results obtained. But he points out that the refraction is a very variable quantity, and it is doubtful whether the same curves would be obtained at all seasons at the same place. These are the very observations that are required.

It is quite true, as Dr. Ball points out, that if at Jebel Hooswah a refraction of 4 seconds instead of 5 per mile was used the results would be in closer accordance, but he does not appear to have seen that if a refraction of 6 seconds instead of 5 per mile was used for the Jebel Serbal observations they would be still more in accordance with each other. Therefore on different days and from different heights the results in the one case would be closer if the coefficient for refraction was decreased, and in the other if it was increased. Abnormal refractions are more common in high than in low latitudes; the greatest I have seen personally was in the Baltic Sea.

With reference to Dr. Ball's observations on the table given by me I reply as follows :—

(1) The observations were obtained by a 5-in. theodolite reading to 30″ of arc.

(2) That the results given from angles of depression from Jebel Serbal to points nearly 180° apart show (*a*) that the theodolite was in perfect adjustment, and that the height obtained from a distance of fifty-eight miles on the north side differed only 116 ft. from the height obtained at a distance of 24·9 miles on the south side.

(3) Although observations obtained with imperfect instruments—and what instrument is perfect?—may give results not perfectly accurate, I cannot admit that the corrections applied should not be as accurate as they can be.

(4) Dr. Ball is correct in stating that a distance of fifty-eight miles an error of one minute in the angle of depression means a difference of about 100 ft. in the result.

(5) He is also correct in his surmise that the variation in altitude of the horizon in the Arctic should be 18 minutes and not 18 degrees. This is a printer's error.

T. H. TIZARD.

The Piltdown Skull and Brain Cast.

THE excellent figure of the Piltdown brain cast which accompanied Prof. Elliot Smith's last letter (NATURE, November 13, p. 318) brings out clearly the differences which separate him and me. His figure represents a brain with approximately symmetrical right and left hemispheres, so far as these are viewed from the hinder or occipital aspect. If, then, the anatomical parts occupy corresponding positions on the two sides, he has solved the problem of how to reconstruct the Piltdown skull so as to obtain a considerably smaller brain than I had postulated. I have made a tracing of his reconstruction in order to fill in with some details the exact relationship of parts represented by his drawing. It will be seen he has obtained symmetry by the most simple means. In the original brain cast the right hemisphere of the brain measured only 555 cubic centimetres, the left half 645 c.c.; this difference of 90 c.c. referred only to the hinder part of each hemisphere. In Prof. Elliot Smith's reconstruction the hemispheres have been balanced by moving the left hemisphere towards or beyond the middle line and enlarging the left hemisphere. The middle line which Prof. Elliot Smith has selected is exactly that used by Dr. Smith Woodward in the reconstruction of the skull, not that which he employed when building up the brain cast; in building up the brain he employed another middle-line altogether.

In the accompanying tracing of Prof. Elliot Smith's reconstruction I have indicated the longitudinal blood sinus which sweeps widely (10 mm.) to the right as it passes between the occipital poles of the brain. The left pole exceeds the right to a degree which is seldom seen in even the highest forms of modern human brains. Seven years ago Prof. Elliot Smith published a short paper (*Anat. Anz.*, 1907, vol. xxx., p. 574), which is justly regarded as authoritative. He directed attention to the preponderance of the left occipital pole of the brain, and attributed that preponderance to the specialisation of the right hand; only the slightest degree of asymmetry is observable in anthropoid apes. Indeed, at that time Prof. Elliot Smith definitely stated that he regarded symmetry of the occipital poles—in my opinion an absolutely just deduction—as a simian character. He will, therefore, if he retains the present reconstruction, have to modify to some extent the opinion he has expressed of the brain of Piltdown man—that it is "the most primitive and simian brain yet recorded." As regards the asymmetry of the occipital poles, it is, in my opinion, ultra-modern.

Prof. Elliot Smith has frankly stated that his reconstruction is not, in the strict sense of the word, a cranial cast—a cast taken from the interior of a reconstructed skull; it is a reconstruction built up—as the original brain cast must have been—from impressions taken from the inner or cerebral aspect of the cranial bones. To test such a brain reconstruction

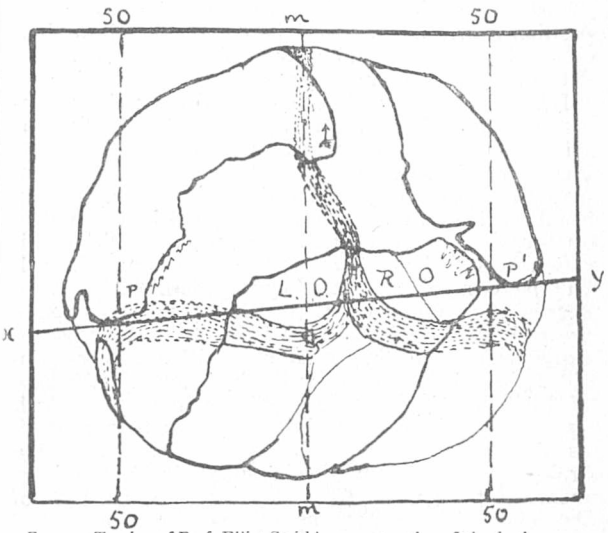


FIG. 1.—Tracing of Prof. Elliot Smith's reconstruction of the brain-cast with certa in additions. (Half nat. size.)

the actual fragments of the skull must be placed over the corresponding parts of the brain cast. When that is done it is at once seen that in securing a symmetry of the brain hemispheres the corresponding parts of the skull are thrown somewhat out of position. On the tracing of the reconstruction (Fig. 1) I have drawn a line, *x*—*y*, across corresponding angles of the parietal bones. That of the right side is a centimetre higher than on the left; on the right side the lamb-

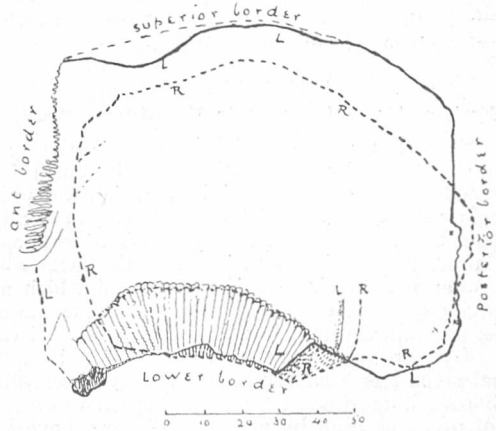


FIG. 2.—Tracing of the right fragment of the parietal (Piltdown) fragment (broken line) superimposed on the right bone (continuous line). (Half nat. size.)

doid suture passes outside the 50 mm. vertical line; on the left it stops short of that line.

It may be questioned if the hinder, lower angle of the parietal bones do correspond. That was the very first point I set out to determine when I found there was such a discrepancy between the size of the Piltdown cranial fragments and the brain capacity which Dr. Smith Woodward had ascribed to this earliest known form of man. That is the first step which has to be taken. In Fig. 2

I give drawings representing the corresponding parts of these two bones. The determination is not difficult; in each bone, enough of the lower border is preserved to guide one with certainty to the identification of right and left parts. In both sides the lower hinder angle of the parietal bone is broken away, but although not fractured in exactly the same manner, the lowest point in both cases may be taken as in strict correspondence. In this reconstruction then the lower border of the right parietal occupies a position nearly half an inch higher on the right than on the left side. I think that discrepancy must be due to an error in reconstruction.

I have not entered into a discussion on the markings which indicate the middle line of the skull for this reason. A very considerable experience in attempting to reconstruct ancient and modern skulls from fragments has convinced me that if a wrong bearing is taken—if one misidentifies any point in the middle line—unless it be a very slight error, that misidentification will find the reconstructor out, and his task will be brought to a halt by the development of a degree of asymmetry. If, on the other hand, points are rightly recognised—often it has to be by repeated experiment—then the parts fit easily together, provided there is a sufficiency of them, and in the case of Piltdown there is an ample sufficiency. I look upon the problem of rightly reconstructing a skull as similar to that of replacing the fragments of a broken vase of symmetrical design. Given the fragments of the greater part of one half and a part of the other, there cannot be two reconstructions. All the parts may be got together except one fragment. The remaining fragment is evidence that the task has not been accomplished. I know very well that my friend Prof. Elliot Smith is searching for a true representation of the brain-state of the very earliest human form that can claim any direct relationship to modern men; I hope I may claim the same spirit for myself. I also admit that he has gone a considerable way towards what, in my opinion, must have been the original form. The points on which we disagree are now apparent, and I am content, having had an opportunity of presenting my case, to leave the final decision to the future. ARTHUR KEITH.

Royal College of Surgeons, W.C.

Work of Natural Forces in Relation to Time.

IN the notice of the "Origin and Antiquity of Man" (NATURE, October 9), the remark that I have "returned to the manner of thinking which was prevalent before the days of Lyell" calls for some comment. It would be nearer correct to say that I have adopted the manner of thinking occasioned by the facts which have come to light since Lyell's day, and which may be succinctly described as that of regarding nature, not as a "uniformity," but an "evolution." Lyell's habit of regarding nature as a progression by infinitesimal steps has been corrected by later observations which reveal, at times certainly, a much more rapid rate of progress than he and his followers have been wont to admit. Lyell certainly failed to appreciate the activity even of the present forces of nature.

For example, in 1842, after a cursory examination of Niagara Falls, he put forth the estimate that their recession could not have amounted to more than one foot a year, and probably one foot in three years, thus making the age of the cataract at least 35,000 years, and probably 100,000. But at his suggestion Dr. John Hall made a trigonometrical survey of the front of the falls and set up monuments so that the rate could be eventually determined by actual measurements. After seventy years, surveys show that the falls have receded, during the entire period, at a rate of about five feet a year.

Again, Darwin, adopting Sir Charles Lyell's methods in the first edition of his "Origin of Species," estimated that the erosion of the Wealden deposits in England required the work of 306,662,400 years, which he called "a mere trifle of geological time." But on having his attention directed to the activity of sub-aërial erosive agencies acting over the entire surface at all times, concerning which a great mass of evidence had recently been gathered, he confessed in a second edition that he had made a rash statement, and in subsequent editions withdrew it entirely. The facts accumulated concerning the activity of present eroding forces show that instead of the immense period originally assumed by Darwin, the whole removal of the Wealden strata would be accomplished in a few million years.

But it is in respect to the rapidity of glacial movements that the slow rates assumed by Lyell and his followers are pre-eminently misleading. Those whose studies of glaciers have been limited mainly to the Alps, have not readily appreciated the facts concerning the movement of glaciers in North America. For example, it was in 1886 that I made the first extended observations upon the great Muir Glacier in Alaska. This glacier presented a water front one mile in width, rising 300 ft. above the water, and descending 700 ft. below the water. From examination of various lines of evidence I was able to show that, when Vancouver surveyed the region 100 years before, the Muir Glacier with various others coming in to Glacier Bay had united to project the ice twenty miles farther south, with a thickness of two or three thousand feet. The correctness of this inference has been abundantly corroborated by subsequent observers.

But now comes the confirmatory evidence in the fact that the Muir Glacier has receded seven miles and a half in the twenty-five years that have elapsed since my first observations. Moreover, the ablation from the surface has been such as to lower it 700 ft. In short, we have here from actual observation in a glacial field larger than that of the Alps, evidence of greater changes in twenty-five years than some of those for which Prof. Penck has demanded many thousand years.

The word uniformity as applied to the action of natural forces, both in geology and biology, is unfortunate and misleading. There is, indeed, continuity. But this permits varying rates of movement according to evolutionary laws, so that, as Huxley observed, all that Darwin had to do to adjust his theory to the recent moderate estimates of geological time was to assume a more rapid rate of variation. Neither need the Darwinian be afraid of recognising paroxysms in nature, since they naturally follow the slow accumulations of strain which finally culminate in some sort of fracture or interruption of the ordinary course of events. I am not a pre-Lyellian, but a post-Lyellian. G. FREDERICK WRIGHT.

Oberlin, Ohio, October 23.

The United States Territory of Hawaii.

DR. J. STANLEY GARDINER, in his appreciative notice of "Fauna Hawaiiensis," in NATURE of September 25, just received, has used a name against which I must enter protest. I thought it a possible misprint, but it appears several times as Hawaiia.

We shall probably have to bear Cook's name, Sandwich Islands, from our conservative English friends for some years longer, although the Hawaiian kingdom was independent many years, and never officially used that name, although having diplomatic and com-

mercial agents in England as elsewhere. Its successor, the United States territory of Hawaii, now administers the affairs of the late kingdom. Neither kingdom nor republican territory has ever sanctioned such a barbarous name as your reviewer gives—Hawaiia.

WM. T. BRIGHAM.

Bernice Pauahi Bishop Museum, Honolulu, H.I., October 24.

THE first article in the "Fauna Hawaiiensis" is entitled "Introduction, being a Review of the Land-Fauna of Hawaiia." Dr. Brigham's quarrel is hence with the writer of that article, and with the editor of the fauna, not with me. I should have expected "Hawaiia" to meet with his approval as against the rather cumbrous title, "United States Territory of Hawaii," a title taken from the name of the largest island. The islands from Niihau to Hawaii stand on an isolated plateau in the ocean, and represent a geographical group; the name "Hawaiia," I consider, may quite usefully be applied to them. A name will also have to be adopted for the islands between Nihoa and Lisiansky, which form a similar group; these I frequently find in maps included in the Hawaiian Islands.

Presumably the aboriginal inhabitants had no name for the islands in question, as they knew no other lands, and certainly the Spanish navigators established no name for them. Cook's name, "Sandwich Islands," dates from 1778, and clearly has priority, a fact which should appeal to American—I hope Dr. Brigham will pardon this incorrect adjective being applied to his countrymen—biologists.

J. STANLEY GARDINER.

November 14.

INTERNATIONAL CONFERENCE ON THE STRUCTURE OF MATTER.

THE first International Conference in Brussels on the Theory of Radiation in 1911 (see NATURE, vol. lxxxviii., p. 82) owed its inception to Mr. Ernest Solvay, and proved a great success. Shortly afterwards, Mr. Solvay generously gave the sum of one million francs to form an International Physical Institute (NATURE, vol. xc., p. 545), part of the proceeds to be devoted to assistance of researches in physics and chemistry, and part to defray the expenditure of an occasional scientific conference between men of all nations to discuss scientific problems of special interest. In pursuance of this aim the second International Conference or Conseil International de Physique Solvay, was held in Brussels this year on October 27–31, under the able presidency of Prof. Lorentz. On this occasion the general subjects of discussion were confined to the structure of the atom, the structure of crystals, and the molecular theory of solid bodies.

Reports were presented by the following:—The structure of the atom, Sir J. J. Thomson; Intereferenzerscheinungen an Röntgenstrahlen hervorgerufen durch das Raumgitter der Kristalle, Prof. Laue; the relation between crystalline structure and chemical constitution, W. Barlow and Prof. Pope; some considerations on the structure of crystals, Prof. Brillouin; and Molekulartheorie der Festen Korper, Prof. Gruneisen.

Among those present at the meeting were Prof. Lorentz, Kamerlingh Onnes, Sir J. J. Thomson, Barlow, Pope, Jeans, Bragg, Rutherford, Mme. Curie, Gouy, Brillouin, Langevin, Voigt, Warburg, Nernst, Rubens, Wien, Einstein, Laue, Sommerfeld, Gruneisen, Weiss, Knudsen, Hasenöhrl, Wood, Goldschmidt, Verschaffelt, Lindemann, and De Broglie.

An interesting and vigorous discussion followed on all the papers presented to the congress. Special interest was taken in the report of Laue on the interference phenomena observed in crystals with *x*-rays. A valuable contribution was made by Prof. Bragg on selective reflection of *x*-rays by crystals, and on the information afforded by this new method of research on crystalline structure. The report of Mr. Barlow and Prof. Pope on the relation between crystalline structure and chemical constitution was illustrated by a number of models, and was followed with much interest. A report on the papers and discussions at the Conference will be published as promptly as possible.

The arrangements for the meeting, which was successful in every way, were admirably made by Dr. Goldschmidt. All the members stayed at the same hotel, and thus were afforded the best of opportunities for social intercourse and for the interchange of views on scientific questions. During the meeting, the members were very hospitably entertained by Mr. Solvay and Dr. Goldschmidt, while a visit was made to the splendid private wireless station of the latter, which is one of the largest in the world, capable of transmitting messages to the Congo and Burmah.

The committee of the International Physical Institute, who were present at the conference, held meetings to consider the applications for grants in aid of research, made possible by the sum set aside for this purpose by Mr. Solvay at the foundation of the institute.

It was arranged that the next meeting of the Conseil de Physique should be held in three years' time at Brussels, when there will be a new programme of subjects for discussion. In order to extend the scope of the congress, and to make it as representative as possible, it has been arranged that the original members will retire automatically at intervals, while their place will be taken by new members, who will be specially invited to take part in discussion of definite scientific topics.

E. RUTHERFORD.

ALFRED RUSSEL WALLACE.

THE last link with the great evolutionary writers of the mid-nineteenth century—the men who transformed the thought of the world—is broken. How can I best speak of the long, happy, hard-working, many-sided life that has just come to a close? The history of Wallace's contributions to science and the details of his career have been long known, and are now rewritten and epitomised in the Press of the world. I propose to speak of the man himself as he was revealed to his friends.

I first saw Wallace about twenty-five years ago, introduced by a dear common friend and fellow-worker at the problems of evolution. We were on a short walking-tour, and our road lay through Godalming, where Wallace was then living. From that time I have been happy in his friendship and his kind encouragement and help.

Wallace possessed, like Charles Darwin, a charming personality. He was tall, with a magnificent head, a strong, clear, and pleasant voice, a hearty laugh, a keen sense of humour, an intense and vivid interest in the most varied subjects. But the central secret of his personal magnetism lay in his wide and unselfish sympathy.

It might be thought by those who did not know Wallace that the noble generosity which will always stand as an example before the world was something special—called forth by the illustrious man with whom he was brought into contact. This would be a great mistake. Wallace's attitude was characteristic, and remained characteristic to the end of his life.

A keen young naturalist in the north of England, taking part in an excursion to the New Forest, had called on Wallace and confided to him the dream of his life—a first-hand knowledge of tropical nature. When I visited Old Orchard in the summer of 1903, I found that Wallace was intently interested in two things: his garden, and the means by which his young friend's dream might best be realised. He then, and later on in many a letter, eagerly discussed the most favourable localities, the scientific memoirs to be carried, the means by which the journey could be undertaken, the disposal of collections, and every circumstance that would be likely to affect the success of the expedition. The subject was referred to in seventeen letters to the present writer: it formed the sole topic of some of them. It was a grand and inspiring thing to see this great man identifying himself heart and soul with the interests of one—till then a stranger—in whom he recognised the passionate longings of his own youth. By the force of sympathy he re-lived in the life of another the splendid years of early manhood.

In 1889, when the degree of D.C.L. was conferred upon him, Wallace stayed with us, and I was anxious to show him something of Oxford; but, with all that there is to be seen, one subject alone absorbed the whole of his interest. He was intensely anxious to find the rooms where Grant Allen had lived. He had received from Grant Allen's father a manuscript poem giving a picture of the ancient city dimly seen at midnight from an undergraduate's rooms. With the help of Grant Allen's college friends we were able to visit every house in which he had lived, but were forced to conclude that the poem was written in the rooms of a friend or from an imaginary point of view.

Of Wallace's energy and love of work much might be written. About ten years ago, at the age of eighty, he moved from Parkstone to Old Orchard, Broadstone, having himself superintended the building of the house and the laying out of the garden. In a letter written May 31, 1903, he speaks of "the charming 'lodge in the wilderness' I have got here in which to end my days on earth. I assure you I am enjoying it, perhaps more than I should ever have done at an earlier period." How entirely this happy anticipation was fulfilled is well shown by the following words written March 13, 1911, when Wallace was more than eighty-eight:—

> But what I am mainly at work (or at *play*) upon now is my garden, and I have suddenly developed a sad *mania* for Alpine plants, more especially for my old favourites, the genus Primula, which has received such wonderful additions lately from the Himalayas, but more particularly from N. China. My resuscitated hobby is due to my having now, the very *first* time in my life, a bit of ground really *suitable* for them, combining *shelter*, good aspects, a moist (even *boggy* in parts) subsoil, a moister atmosphere, and a good and varied soil. The new Primulas introduced by Veitch, Bees, and several others are so grand and charming that I have raised some from seed, and have applied for others (and for Alpines generally) to Kew, Edinburgh, Cambridge, and Dublin Botanical Gardens, and have already got such a fine lot of plants—about 20 species of Primulas and 150 of Alpines generally—with promises of more, that I am laying out a regular Alpine and bog garden, on a quite small scale, buying stone and stone chippings by the ton or truck-load, collecting sand and road scrapings, protecting against rabbits, &c., which all give me very interesting occupation, so filling up my time and powers of work that I have little time or energy for reading anything but newspapers, novels, and the regular supply of scientific or political periodicals.

And Wallace invoked for his friends the power which brought youth and happiness to his old age. "Many happy returns (and lots of work)," were his birthday wishes to the writer in 1909.

With the love of work we must above all associate the enthusiasm which Wallace put into all that he did—the bright, boyish spirit which shone in him as it did in Darwin. "I've enjoyed every minute of the time. Why, he has the spirit of a boy of eighteen!" was my daughter's comment on an afternoon spent at Old Orchard in the autumn of 1906. No youth gazing for the first time on the wonders of nature in the tropics could feel more enthusiasm than is expressed in Wallace's words describing a visit to the Natural History Museum on the morning after his Friday evening lecture at the Royal Institution in January, 1909:—

> I had a delightful two hours at the museum on Saturday morning, as Mr. Rothschild brought from Tring several of his glass-bottomed drawers with his finest New Guinea butterflies. They *were* a treat! I never saw anything more lovely and interesting!

The history of that Friday evening lecture—Wallace's last appearance before the scientific public—is given in the following passage, which is of interest in many ways, and recalls especially the famous 1858 essay—thought out in two hours and completed in three evenings. When the promise to the Royal Institution was made known, I addressed a friendly remonstrance to Wallace

for having refused to lecture in Oxford. He replied November 6, 1908:—

I am a believer in *inspiration*. All my best ideas have come to me *suddenly*. I had quite determined to decline *this* one [invitation] when, lying on my couch, an *idea* suddenly came to me! I saw that the subject had *never* been treated from *that* point of view—I felt that I *could* and should *like* so to treat it, and that it would suit the audience and *do good*. So I accepted. I hope I shall be able to do it justice.

The late Aubrey Moore, in a remarkable address delivered thirty years ago to the Church Congress in Reading—an address noticed in the columns of NATURE—spoke with disparagement of a mind "built like a modern ironclad in watertight compartments." But the criticism does not apply when the sliding doors are kept in good working order by constant use.

Wallace was keenly interested in many subjects—psychical, political, and economic—that would not attract the majority of the readers of NATURE. With those who met him in the field of biological and especially of evolutionary inquiry, the whole of the intercourse was filled to overflowing with the give-and-take of friendly discussion. The opportunities that came all too rarely would have been wasted in argument over fundamental differences or in the vain attempt to reconcile divergent tastes. All such subjects were therefore shut out.

"I am still very busy," he wrote, February 23, 1903, "and all the time I can spare from the garden I give to a new book I am writing—a kind of pot-boiler—though one that I am *immensely* interested in, but that you will not care about."

Many will doubtless be inclined to think, with the writer of the article last week (NATURE, p. 322), that Wallace's views on Mendelism were a product of the intellectual rigidity of old age. The facts here brought forward, to which numbers more might have been added, prove, however, that he retained his vitality and elasticity and keenness to a degree that was perfectly marvellous. With regard to Mendelism, he felt, as many far younger men feel, that it is both interesting and important, but that from the first it has been put in a wrong light, and erroneously used as a weapon of attack upon other subjects to which it is not in any way antagonistic.

His attitude towards "Mutation" was different; for here he knew that all the essential facts had been long pondered over by a greater mind than that of any living naturalist. Thus he wrote, July 27, 1907:—

Mutation as a theory is absolutely nothing new—only the assertion that new species originate *always* in sports—for which the evidence adduced is the most meagre and inconclusive of any ever set forth with such pretentious claims!

And again on March 1, 1909, he used words with which a firm believer in natural selection as the motive cause of evolution may fitly conclude:—

I have no doubt, however, it will all come right in the *end*—though the end may be far off, and in the meantime we must simply go on, and show, at every opportunity, that Darwinism actually *does explain* whole fields of phenomena that they [Mutationists] do not even attempt to deal with, or even to approach. E. B. P.

DR. S. J. P. THEARLE.

DR. S. J. P. THEARLE, whose death is announced, was born in the year 1846, and was thus at the time of his death sixty-seven years of age. He was born in Portsmouth, and entered as an apprentice at Devonport Dockyard in 1860. From this, as the result of competitive examination, he passed into the Royal School of Naval Architecture, South Kensington, in the year 1865, and after three years' study was graduated as a Fellow of the Royal School. He spent eight years in government service as a naval constructor, and then resigned his appointment to become surveyor to Lloyd's Register, in which Society he ultimately rose in the year 1909, after passing several stages, to the position of chief ship surveyor on the retirement of Mr. H. J. Cornish.

One of his most notable achievements was the preparation of several text-books on naval architecture, which became standard books for students for many years, and were so used by teachers in the Science and Art evening classes. Many naval architects feel themselves indebted to Dr. Thearle for their earliest introduction to scientific shipbuilding. These works not only dealt with scientific naval architecture, but also practical ship laying off and ship construction. As a surveyor of Lloyd's Register, he was notable for the independent action in connection with the ships under his survey, while always at the same time being loyal to his Society, and in the carrying out of its rules. His promotion to the senior position in his society was hailed as an excellent appointment, and a merited recognition of his life work.

Latterly the calls upon his time had been exceedingly onerous; he having been appointed on the committee formed to investigate subdivision of ships, under the presidency of Sir Archibald Denny, and on the committee created by the Government to investigate the question of suitable load lines for steamers, on both of which committees he proved himself a most active and useful member. Apart from this, he was in frequent request as a representative of his society. He was also on the Board of Trade Advisory Committee, which since the loss of the *Titanic* has been in more or less constant session.

Dr. Thearle had thus been for the last forty-five years closely identified as an individual and as an official with the progress made in naval architecture, and his contribution to that advance as an official and as a scientific naval architect have been of no mean order. Probably his best-known work during the last years was the reorganisation of Lloyd's rules for the construction of ships, bringing them up to their present position, in which they are abreast of the latest advances in scientific naval architecture.

NOTES.

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received the King's approval:—The Copley medal to Sir Ray Lankester, on the ground of the high scientific value of the researches in zoology carried out by him, and of the researches inspired and suggested by him and carried out by his pupils. A Royal medal to Prof. H. B. Dixon, F.R.S., for his researches in physical chemistry, especially in connection with explosions in gases. A Royal medal to Prof. E. H. Starling, F.R.S., for his contributions to the advancement of physiology. The Davy medal to Prof. R. Meldola, F.R.S., for his work in synthetic chemistry. The Hughes medal to Dr. Alexander Graham Bell, on the ground of his share in the invention of the telephone and more especially the construction of the telephone receiver. The Sylvester medal to Dr. J. W. L. Glaisher, F.R.S., for his mathematical researches.

PROF. J. N. LANGLEY, F.R.S., professor of physiology in the University of Cambridge, has been elected a corresponding member of the Academy of Sciences at Munich.

THE Mary Kingsley medal of the Liverpool School of Tropical Medicine was presented on November 14 to Prof. F. V. Theobald, Vice-Principal and zoologist of the South-Eastern Agricultural College, Wye.

WE regret to see the announcement of the death on November 10, at sixty-four years of age, of Colonel St. George C. Gore, R.E., Surveyor-General of India in the years 1899–1904.

WE notice with regret the death, at fifty-six years of age, of Mr. A. J. Wallis, fellow and bursar of Corpus Christi College, Cambridge. Mr. Wallis was bracketed fourth wrangler in the tripos of 1879, and was also bracketed equal with Prof. M. J. M. Hill, now of University College, London, for the Smith's prizes in that year.

THE death is announced of Dr. R. L. Bowles, at seventy-nine years of age. Dr. Bowles was a fellow of the Royal Society of Medicine, and was for some time president of the south-eastern branch of the British Medical Association. He was the author of a number of papers, including the article "Stertor" in "Quain's Dictionary of Medicine," and articles on the treatment of certain diseases of the heart at Bad Nauheim, the influence of light on the skin, and other subjects.

THE mounted head of an Indian rhinoceros (*Rhinoceros unicornis*), shot in the Nepalese Tarai by the King in 1911, and presented by his Majesty, has been placed on exhibition in the corridor leading to the upper mammal gallery, in the Natural History Museum, South Kensington. This trophy, which has been mounted by Messrs. Rowland Ward, Ltd., is in juxtaposition to the Nepalese tiger presented by the King some month ago, and faces the Hume bequest of Indian big-game heads.

THE authorities of the Natural History Museum, South Kensington, have in preparation an exhibition of a representative series of specimens selected from the collections made by the Scott Antarctic Expedition. The specimens, chiefly marine invertebrates, have been selected by Mr. D. G. Lillie, a member of the scientific staff on board the *Terra Nova*, who is engaged at present in sorting out the collections preparatory to their being sent to specialists to be worked out and described in the monumental report on the scientific results of the expedition, the publication of which has been undertaken by the trustees of the British Museum. The specimens, which are being arranged for exhibition by Dr. W. G. Ridewood, form, of course, only a very small portion of the collections brought home by the *Terra Nova*, but they will serve to show the public some of the more striking and interesting species obtained in southern waters. Two cases in the central hall are being set apart for the purpose.

A SEVERE earthquake is reported to have occurred at Abancay, in Peru, on November 7. According to the meagre accounts which have reached this country two hundred people were killed and many villages were destroyed. Abancay lies about 250 miles east-south-east of Lima, but, so far as known, it seems to have been free from disastrous earthquakes in the past. On November 13 another earthquake, the third since the beginning of October, occurred in the isthmus of Panama, but again without causing any damage to the canal structures.

THE annual conversazione of the Selborne Society will be held on November 21 in the theatre and halls of the Civil Service Commission, Burlington Gardens; as usual, there will be a large display of microscopes, and in the hall devoted to general exhibits an effort will be made to show by means of skins and feathers how wild species of birds and mammals are being saved from extinction by rearing them in captivity, as in the case of the ostrich and the silver fox, by protecting them, and by using the products of truly domesticated species in their place.

AT the anniversary meeting of the Mineralogical Society, held on November 11, the following officers and members of council were elected:—*President*, Dr. A. E. H. Tutton, F.R.S.; *Vice-Presidents*, Prof. H. L. Bowman and Dr. A. Hutchinson; *Treasurer*, Sir William P. Beale, Bart., K.C., M.P.; *General Secretary*, Dr. G. T. Prior, F.R.S.; *Foreign Secretary*, Prof. W. W. Watts, F.R.S.; *Editor of the Journal*, Mr. L. J. Spencer; *Members of Council*, Mr. W. Barlow, F.R.S., Mr. T. Crook, Sir Thomas H. Holland, K.C.I.E., F.R.S., Dr. G. F. H. Smith, Mr. F. H. Butler, Mr. J. P. De Castro, Mr. B. Kitto, Prof. A. Liversidge, F.R.S., Dr. J. J. H. Teall, F.R.S., Mr. F. N. A. Fleischmann, Mr. H. Hilton, and Mr. A. Russell.

MR. AUSTEN CHAMBERLAIN presided at a meeting at the London Chamber of Commerce on November 13 for the purpose of dissolving the subcommittee which had been formed for the purpose of raising funds for the London School of Tropical Medicine. The amount of the fund to date is 71,444*l.*, which, after deducting

expenses, leaves a balance of 70,431*l.* available for the purposes of the school. Mr. Otto Beit and the Government of the Federated Malay States each contributed 5000*l.*, and Sir William Bennet allocated the Wandsworth bequest of 10,000*l.* to the fund for purposes of research. After deducting the last-named, together with 15,000*l.* spent on new laboratories and hostel and an endowment for certain beds for tropical cases (to be named the "Chamberlain Ward"), there remain 39,000*l.* to form an endowment for the general purposes of the school.

THE death is announced of Dr. W. J. Ansorge, the well-known African explorer and natural history collector, at Loanda, Angola, on October 31. Dr. Ansorge was born in Bengal, in 1850, and educated at Pembroke College, Cambridge. His collections, which included mammals, birds, and fishes, were very extensive, and obtained from such widely sundered districts as Angola, Nigeria, Uganda, and British and German East Africa. A large proportion of the collection of birds is in Mr. Rothschild's museum at Tring, but there is also a considerable series in the British Museum, inclusive of 258 skins from Benguela and Uganda, purchased in 1895–6. At least one mammal—*Lophuromys ansorgei*—bears the name of the deceased collector, and in the first two volumes of the British Museum Catalogue of the Fresh-water Fishes of Africa there are eight species named in his honour. A few years ago he presented to the museum several skulls and horns of East African antelopes and rhinoceroses. Dr. Ansorge was the author of "Under the African Sun," published in 1899.

THE annual Huxley Memorial Lecture of the Royal Anthropological Institute was delivered on November 14 by Prof. W. J. Sollas, upon the subject of Paviland Cave. The Cave of Paviland, which opens on the face of a steep limestone cave about a mile east of Rhossili, on the coast of Gower (Wales), provided an almost ideal hunting lodge to Palæolithic man. The discovery by Buckland, in the kitchen midden which forms its floor, of a painted skeleton long known as the "Red Lady," rendered it famous. Recent investigation has shown that this skeleton is the remains of a man belonging to the tall Crô-Magnon race, which occupied the greater part of habitable Europe in the Aurignacian age (Upper Palæolithic). The bone of the animals, most of them extinct, found in the cave are in agreement with this conclusion. The associated implements are also Aurignacian. Paviland Cave is thus the most westerly outpost of the Crô-Magnon race, and at the same time the first Aurignacian station yet discovered in Britain.—At the conclusion of the lecture the president presented Prof. Sollas with the Huxley memorial medal for 1913.

A FEW months ago *The Scientific American* offered prizes for the three best essays on the ten greatest patentable inventions of the past twenty-five years. The results were announced in the issue of our contemporary for November 1. No two competitors selected the same set of inventions. In fact, only one invention, that of wireless telegraphy, was conceded unanimously to belong to the group of the ten greatest. The vote on aëroplanes was almost unanimous. But beyond that there was no unanimity. The conditions of the contest stated that greatness would be measured in terms of practical success and general usefulness to mankind; the competitors were limited to machines, devices, and discoveries commercially introduced in the last twenty-five years, and special emphasis was laid on the fact that the inventions must be patentable, although not necessarily patented. A dozen essays were afterwards picked out at random, and these were found to contain forty different subjects. The list of these subjects was published, and readers of *The Scientific American* were invited to vote upon it The result shows that the vote was not unanimous even on wireless telegraphy. The following twelve inventions secured the highest number of votes, the number printed after each representing a percentage of the votes given:—Wireless telegraphy, 97; aëroplane, 75; X-ray machine, 74; automobile, 66; motion pictures, 63; reinforced concrete, 37; phonograph, 37; incandescent electric lamp, 35; steam turbine, 34; electric car, 34; calculating machine, 33; internal-combustion engine, 33.

A CONFERENCE of members of the Museums Association and others interested in museum work was held at Warrington on October 30, on the invitation of the committee of the Municipal Museum. Representatives attended of the museums of Liverpool, Manchester, Hull, Bolton, Salford, Leicester, Stoke-on-Trent, and other towns. Mr. P. Entwistle (Liverpool Museum) raised the question how far it was allowable to go in the restoration of imperfect specimens, maintaining the view, with which the meeting generally agreed, that such restoration as was required to give a clear impression of the form of the object was desirable, provided that the extent of the restoration were obvious on close examination. Dr. Tattersall (Manchester Museum), in a paper on museums and local collections, with the outlines of a scheme for the compilation of a fauna of Lancashire, said that the first duty of a provincial museum was to collect and preserve specimens illustrating the natural history of the surrounding district, and proposed that an organisation should be formed to link up the existing museums in Lancashire with the various natural science societies, and specialists in various zoological groups. The museums would receive the specimens collected locally and forward them to appointed centres, where they would be named and recorded, and returned when dealt with to the same museums for permanent preservation. A committee was appointed, with Dr. Tattersall as convener, to take preliminary steps to carry out the scheme. Mr. Madeley (Warrington Museum) announced that it was proposed, provided a sufficient number of museums agreed to subscribe, to prepare and distribute a series of casts of, say twenty, typical British stone implements from the British Museum collections. The selection would be made by Sir Hercules Read, who had also kindly consented to prepare a description to accompany the casts.

PROF. A. KEITH, in the November issue of *Man*, describes two ancient crania found by the Rev. H. Mason in an old deposit at Wanganui, New Zealand. They belong to the Moriori race, now confined—a mere remnant—to the Chatham Islands. They inhabited New Zealand before the arrival of the Maori, and their crania differ in a remarkable degree from those of the latter race. The Moriori skulls are devoid of negroid characteristics, the stock to which the Maori are more closely allied. The Moriori are evidently related to some of the Polynesian and South American races; at least it is among these peoples that we find cranial forms which are comparable with them.

WE have received from the Land Agents' Society a copy of the seventh annual report of the honorary consulting biologist, in which Mr. W. E. Collinge, after referring to the spell of wet in 1912 as having been favourable to animal pests and inimical to game-birds, mentions some of the most serious cases of damage by insects and other pests which occurred during the year, with the best remedial measures for such infestations.

IN the October number of *The American Naturalist* Prof. W. S. Anderson insists on the importance of the study of the inheritance of coat-colour in horses. "If," he remarks, "there is a law governing the transmission of colour, may we not infer that a law of somewhat like nature will govern the transmission of the more essential qualities of the horse? If it can be proved that colours are unit characters and their inheritance obeys the Mendelian law of dominants and recessives, I believe one very important step will have been taken to solve the whole problem of breeding horses." Very noteworthy is the fact that when chestnut horses are mated with one another the progeny all seem to inherit the (recessive) colour of their parents, the recorded exceptions of one per cent. being probably due to error.

IN the current number of *The Journal of Agricultural Science* (vol. v., part 4) Messrs. W. A. Davis and A. J. Daish contribute a study of the methods of estimation of carbohydrates, especially in plant extracts. Certain sources of error encountered in the estimation of sugars in plant extracts, particularly of cane-sugar and maltose, are dealt with. A new method of estimating maltose, based on the use of pure cultures of maltase-free yeasts, such as *Saccharomyces marxianus* and *S. exiguus* has been devised. This is the only one available in such cases, as the ordinary method, using dilute hydrochloric acid for the hydrolysis of maltose, leads to destruction of much lævulose and to quite erroneous results. A scheme for the analysis of the complex mixtures of sugars, namely pentoses, dextrose, lævulose, cane-sugar, and maltose, occurring in plant extracts is appended. Mr. Davis also describes, in a separate paper, a simple laboratory apparatus for the continuous evaporation *in vacuo* of large volumes of liquids, such as plant extracts, which under the ordinary conditions froth badly and thus present difficulties.

The Journal of Economic Biology for September contains a valuable "General Survey of the Insect Fauna of the Soil," by Mr. A. E. Cameron, of the department of agricultural zoology in the University of Manchester. The researches described have been carried out in the grounds at Fallowfield attached to the economic laboratory, and from this small area a wonderful amount of interesting information has been obtained. The author gives a catalogue of more than 150 species of Apterygota, Coleoptera, Lepidoptera, Diptera, and Hymenoptera found in the soil at least during some stage of their life-history, together with the depth and nature of their habitat and observations on their food. He also discusses the effect exerted by these terrestrial insects on the soil as regards moisture, temperature, and ventilation—all factors of great cultural importance. It is regrettable that this excellent paper is disfigured by an abnormal number of misprints, and we do not understand why the explanations of some of the well-drawn figures of larvæ are given in German rather than in English.

THE October number of *The Journal of Genetics* (vol. iii., No. 2) contains papers of very varied interest. Prof. Punnett and Miss Pellew deal with gametic reduplication ("coupling") in sweet-peas and peas. Prof. Punnett gives evidence that when two dominant factors are introduced into a double heterozygote from different parents, the ratio of "repulsion" is the same as that of the coupling found when they are introduced from the same parent. When three factors are concerned together, the ratios between any two of them are modified, and he shows that the modification appears to agree with Trow's hypothesis of secondary reduplication. Mr. J. C. F. Fryer gives a preliminary account of Mendelian segregation in a sexually dimorphic Phasmid, in which the females differ in two pairs of characters; perhaps his most interesting observation is that typical Mendelian segregation may occur in parthenogenetic reproduction. Mr. E. N. Wentworth shows that strains of Drosophila (Diptera) of very different fecundity may arise by inbreeding from one pair, and suggests that loss of fecundity on inbreeding may be due simply to the segregation of such strains of low fertility. Pure strains of high fertility showed no loss in eight generations of inbreeding. Mr. C. Todd gives a lucid account of hæmolytic tests, showing that not only phylogenetic relationship may be tested in this way, but also that each individual has characteristic blood-corpuscles, the fate of which, when injected into another individual, can be followed. He gives indications of the hereditary transmission of these individual blood-characters. Mr. C. J. Bond shows that after apparently complete removal of the testicular tissue of birds, a full-sized testis may be regenerated, and suggests that the proportions of gametes bearing different hereditary characters may differ in the regenerated testis from those existing in the normal testis.

AN important investigation, entitled "Cloud and Sunshine of the Mediterranean Region," by Mr. J. Friedemann forms Part 2, vol. xxxv., of *Archiv der Deutschen Seewarte*. The area dealt with extends to

many parts beyond the Mediterranean district, and includes data from no fewer than twelve meteorological services. Many of the observations have been already published in widely scattered volumes; one of the merits of the present discussion is the bringing together of the separate data. The monthly, seasonal, and yearly distributions of the elements in question are shown in great detail; to obtain a satisfactory idea of these it will be necessary to refer to the original paper, which is accompanied by numerous tables and several coloured charts. One of the diagrams, however, consists of isopleths showing the variation of the yearly range of the amount of cloud on both sides of a line from Little St. Bernard to Beni Suef (Egypt). From this may be seen, *inter alia*, the peculiarities of the range at alpine stations, the rather cloudy condition of the Apennines, the decrease to the south-east, the small amount on the west of Greece, especially in summer, and the great differences in the Ægean Sea. A large part of this laborious work was prepared by the late Mr. F. Zillmann at the instigation of Prof. Partsch.

THE October number of the Journal of the Institution of Electrical Engineers is devoted almost exclusively to the subject of electric traction. At the joint meeting of the Institution and the Société Internationale des Electriciens, held in Paris in May, the question of the electrification of existing railways was widely discussed, and it seems evident that the problem is no longer a technical one but is now purely financial. The difficulties of construction and maintenance have been overcome, and direct-current and single and three-phase systems are all now in operation. While each of these three systems claims to be more economical than steam traction, there does not appear to be any certainty as to which of them is best. On the whole the papers read and the discussion which followed them tended to favour the continuous system with much higher voltages—*e.g.* 2400—than are usual at present, but it was evidently felt even by the advocates of such a system that there were circumstances under which the other two systems might be used with advantage.

AT a meeting of the Alchemical Society held on November 14, a paper was read by Mme. Isabelle de Steiger, entitled "The Hermetic Mystery," the chair being occupied by the acting president, Mr. H. Stanley Redgrove. Mme. Isabelle de Steiger's interpretation of the theories and aims of the ancient and medieval alchemists differs radically from that accepted by many students of the history of philosophy and science, her views in the main agreeing with those expressed in that well-known but exceedingly scarce work, "A Suggestive Enquiry into the Hermetic Mystery and Alchemy." According to the lecturer, the doctrines underlaying alchemy were the primitive doctrines at the heart of every ancient religion. Alchemy, she maintained, was not concerned with metals but with man, whom the alchemists endeavoured spiritually to perfect through a process analogous to that said to have been discovered by Mesmer. The alchemists, she said, formed a sort of free secret order, and their writings were crypto grammatic, being intended to be understood by one another only. They were couched in the language of chemistry to mislead the ignorant, this being necessary on account of the danger attendant upon any misuse of the processes with which they dealt. The full text of the lecture will be published in the November number of the society's Journal.

AN article by Mr. W. A. Caspari, entitled "British Chemistry and British Manufactures," is published in the November issue of *The British Review*. Mr. Caspari insists again upon the importance of the manufacturers of this country learning to appreciate the value to their industries of the services of highly qualified men of science. In the application of chemistry to industrial objects, Great Britain was the pioneer and undisputed leader during the earlier periods of the industrial revival. At present Germany stands easily supreme in all purely chemical manufactures, except possibly metallurgy and "heavy chemicals"; and the potency of German competition resides in clear-thinking German appreciation of applied science. Mr. Caspari asks: What is wrong? Too many of our manufacturers prefer to run their works with clerks, engineers, and "practical" men; in Germany, the chemical element in the *personnel* of the factory is strong, not only numerically, but also as regards rank. The British manufacturer's mind seldom soars beyond the conception that a chemist is a person who analyses things. He too often fails to realise that the scientific man, far from being merely a useful background accessory like the works' plumber, holds the key to the whole of his manufacture. Mr. Caspari makes some wise suggestions for the more suitable training of chemists in universities and colleges, and maintains that once the suitable type of chemist is produced and planted in our factories, our industrial system will evolve almost imperceptibly in the right direction, and our captains of industry with it.

MESSRS. H. F. ANGUS AND CO., 83 Wigmore Street, London, W., have issued a catalogue of second-hand microscopes, objectives, and accessories, which they have for sale or hire. In addition to second-hand instruments, Messrs. Angus have in stock some forty or more different patterns in microscopes and an equal variety in accessory apparatus, which include specimens of English, American, Austrian, German, Italian, and Swedish manufacture. It should prove a great convenience to purchasers to be able easily to compare instruments of varied character and range.

THE following books are announced, as in the press or in preparation, by the Cambridge University Press:—In the "Cambridge Psychological Library": "Psychology," Prof. J. Ward; "The Nervous System," Prof. C. S. Sherrington, F.R.S.; "The Structure of the Nervous System and the Sense Organs," Prof. G. Elliot Smith, F.R.S.; "Prolegomena to Psychology," Prof. G. Dawes Hicks; "Psychology in Relation to Theory of Knowledge," Prof. G. F. Stout; "Mental Measurement," Dr. W. Brown; "The Psychology of Mental Differences,"

C. Burt; "Collective Psychology," W. McDougall, F.R.S.; "The Psychology of Personality and Suggestion," T. W. Mitchell; "The Psychology of Dreams," T. H. Pear. In the "Cambridge Technical Series":—"Automobile Engineering," A. Graham Clark; "Electro-Technical Measurements," A. E. Moore; "Applied Mechanics," E. S. Andrews; "Alternating Currents," W. H. N. James; "Chemistry and Technology of Oils and Fats," F. E. Weston; "Paper, its Uses and Testing," S. Leicester; "Mining Geology," Prof. G. Knox; "Textile Calculations—Materials, Yarns, and Fabrics," A. M. Bell; "Domestic Science," C. W. Hale; "Business Methods," Thomas Hart, jun.; "Electrical Engineering," T. C. Baillie; "Applied Mechanics and Heat Engines," F. Boulden; "Elements of Applied Optics," W. R. Bower; "Physics for Engineers," J. F. Yorke; "English Building Construction," C. F. Innocent; "Sculpture in Relation to Architecture," T. P. Bennett; "Electric Installations," C. W. Hill; "Accounting," J. B. Wardaugh; "The Theory and Practice of Commerce," J. C. Stephenson. In the "Cambridge Health Series": "The Bacteriological Analysis of Water, Sewage and Foods," Dr. W. G. Savage; "Isolation Hospitals," Dr. H. F. Parsons. In the "Provincial Geographies of India": "Bengal and Orissa," L. S. S. O'Malley; "The Punjab, N.W. Frontier Province, and Kashmir," Sir J. McC. Douie.

OUR ASTRONOMICAL COLUMN.

COMET NEWS.—Miss Anna R. Kidder, of the Berkeley Astronomical Observatory, communicates to the Lick Observatory Bulletin, No. 245, the elliptic elements and ephemeris of comet 1913*e* (Zinner). The elements she has computed correspond so closely to those of comet 1900 III. (Giacobini) that she concludes that both comets are identical. The two sets of elements are as follows:—

Comet 1900 III. (Giacobini)		Comet 1913*e* (Zinner)	
T = 1900, Nov. 28·17		1913, Nov. 2·1047 G.M.T.	
ω = 171° 29′	1900·0	171° 29·1′	1913·0
Ω = 196 32		195 27·3	
i = 29 52		31 01·1	
q = 0·9342		0·97787	
e = 0·74168		0·72968	

The average period derived from the dates of perihelion passage in 1900 and 1913 is 6·464 years.

Two publications, namely the Lick Observatory Bulletin, No. 239, and the Lowell Observatory Bulletin, No. 57, contain accounts of photographs secured at the respective observatories. In the former, Dr. C. C. Kiess describes the observations made on comet 1911*c* (Brooks) and illustrates his descriptions with ten excellent reproductions. In the latter communication Mr. C. O. Lampland describes fully the photographs secured at the Lowell Observatory of the fine comet 1910*a*. A large series of most striking photographs is also reproduced. In the addenda to the paper he discusses the heliographic positions of this comet, and adds some remarks in connection with the heliographic latitudes of Donati's comet (1858 VI.), and Chéseaux's comet (1744 I.) when near perihelion.

MAGNIFYING POWERS USED BY DOUBLE-STAR OBSERVERS.—Mr. T. Lewis, writing in *The Observatory* for November, brings together some very interesting facts relating to the magnifying powers used by double-star observers. The object of the inquiry was to answer the question, "What is the best magnifying power of a telescope in actual practice?" and, in the hope of arriving at some definite result, he made counts of thousands of observations all over the world by various observers. The result of the investigation was to produce a formula—

$$\text{Magnifying power} = 140\sqrt{A},$$

where A is the diameter of the aperture, in inches, and this formula gives an excellent representation of the values derived from the discussion of the actual observational data. Thus the formula, as Mr. Lewis says, "may safely be taken as representing the consensus of opinion among experienced observers in their choice of the best magnification for a given telescope; and it may, therefore, be useful as a guide to others in selecting the eyepieces which will best suit their particular telescope."

STELLAR CLASSIFICATION.—At the Lick Observatory much work has recently been accomplished in the classification of stellar spectra. Bulletins 237 and 243 contain two researches in this subject, both of which have been carried through by candidates for the degree of doctor of philosophy in the University of California, a fact which indicates the increased attention now being devoted to this section of astrophysics. The first of these papers deals with "Class B Stars whose Spectra Contain Brignt Hydrogen Lines," and is the work of Mr. Paul W. Merrill.

By using plates stained with Wallace's three-dye stain the spectrograms included Hα. Five slit-prism spectrographs giving dispersions ranging from 8·7 A per mm. at Hγ, and one grating spectrograph giving in the second order at Hα (with that line central) 10·9 A per mm. were employed, attached to the 36-in. refractor.

The survey included nearly all the stars of the above description north of $-40°$, and some related stars; also some stars included either because on three-prism spectrograms Hβ was peculiar, or the lines were weak and diffuse in order to see whether Hα might be bright. The bright components of the Hβ line of γ Cassiopeiæ and b_2 Cygni were tested, with negative results, for polarisation. The author confirms the presence of the chromospheric lines $\lambda\lambda$4924 and 5018 in these stars, first pointed out by Sir Norman Lockyer and Mr. Baxandall in 1905. With regard to the doubling of the bright hydrogen lines, complex self-reversal is suggested as the explanation most in accord with the facts. Finally, Mr. Merrill divides these stars into four groups, of which the types are γ Cassiopeiæ, b^2 Cygni, Electra, and ϕ Persei. The groups contain fourteen, nineteen, two, and three stars respectively, whilst six stars remain unclassified. The variability and distribution of these stars also receives attention.

Bulletin 243 contains a photographic study of the visual region of the spectra of the brighter Class A stars, by Miss E. Phœbe Waterman. The line of greatest wave-length measured was λ6517, of unknown origin. Miss Cannon's proposal to rearrange the classification of these stars is supported; the stars now classified as A would thus be divided between classes Ao to A2. In the summary it is stated that the metal lines present are the enhanced or spark lines of the elements represented. They coincide throughout in wave-length and intensity with the stronger lines of the solar chromosphere. The peculiarity of the spectrum of α Cygni is found to consist in the great intensity of some of the iron lines, and in the narrow and well-defined character of all the lines rather than in the presence of lines foreign to stars of Class A. Miss Waterman finds that some stars perhaps show bright borders to the absorption lines.

INTERNATIONAL CONFERENCE ON THE SAFETY OF LIFE AT SEA.

THE International Conference on the Safety of Life at Sea was opened by the President of the Board of Trade on November 12, at the Foreign Office, in the presence of delegates from Germany, the United States of America, Australia, Austria-Hungary, Belgium, Canada, Denmark, Spain, France, Great Britain, Italy, Norway, Netherlands, Russia, Sweden, and New Zealand.

After offering a warm welcome to the delegates on behalf of the British Government, and an expression of their gratification at the cordial manner their invitation to the conference had been accepted, Mr. Buxton alluded to the importance of the task before them, and ventured on the opinion that few international conferences had had a greater and nobler work entrusted to them.

With regard to the questions to be discussed, he considered that they could be divided broadly into five heads. These may be summarised as follow:—(1) Is it possible to eliminate the liability to founder by constructional arrangements? (2) In the event of collision, fire, and other accidents, what life apparatus are required to minimise disaster and to save life? (3) What organisations are best to ensure the effective and expeditious handling of life-saving appliances on board the ship herself and the rescuing ship? (4) How can assistance from another ship or from shore be most quickly and effectively invoked and obtained? (5) What measures can be taken on behalf of the ships to avert or diminish the risk of accident, under which head come the observation and reporting of ice and derelicts, storm and fog signals, and warnings, &c.?

The President of the Board of Trade then read a message of cordial welcome to the delegates from the King, in which his Majesty referred to his personal experience as a sailor of many of the matters that would be considered by the conference, and to the special interest he took in the questions they were about to consider, affecting as they did the lives of so vast a number of his subjects.

An interesting speech from Dr. von Koerner, the chief German delegate, followed.

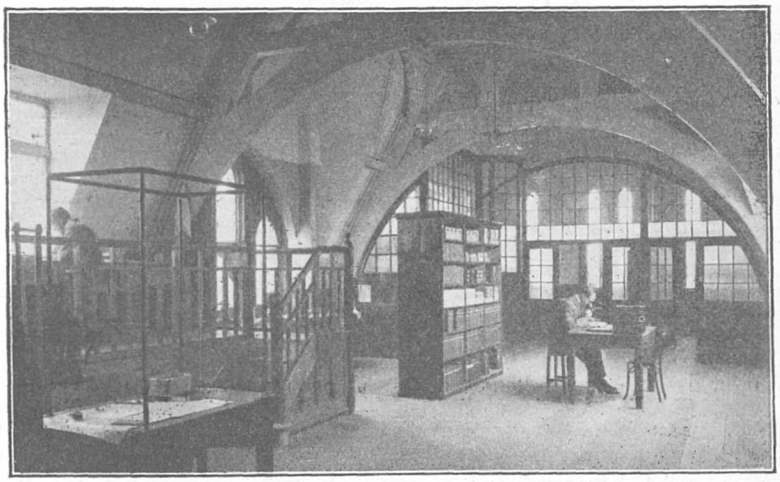
Lord Mersey, who was unanimously elected president, after thanking the delegates for the honour they had conferred upon him, pointed out that while means have to be taken to secure comparative immunity from risk, the practical requirements of business must be borne in mind. "Perfection," he said, "can sometimes be reached at too great a cost. But while remembering these two considerations, I would suggest that where doubt exists, the tendency should always lean towards the line of safety rather than towards the line of economy." Lord Mersey went on to say that increased cost incurred in the interest of safety will be cheerfully met by the public, who, after all, are those who have to pay.

After luncheon at the Foreign Office, Sir Edward Grey and M. Guernier, the chief French delegate, were the principal speakers. The former remarked that, though international, the conference caused no anxiety diplomatically, because, unlike some which arouse the rivalry of nations, it sprang from one of those human tragedies in history which only cause sympathy among the nations.

AGRICULTURAL ENTOMOLOGY IN THE UNIVERSITY OF MANCHESTER.

THE new laboratory for research work in agricultural entomology in the University of Manchester is situated at the top of the north-east corner of the University buildings in Oxford Road. Its position gives easy access to the general zoological laboratories on the floor below and to the collections of the Manchester Museum in the same building. It is a lofty room, 58 ft. in length by 28 ft. wide, with accommodation for five or six persons engaged in original investigations. The windows under which the working benches are placed face due north, and two large skylights in the sloping roof give illumination on the south side of the room. Leading out of the main laboratory there is a private room for the reader in agricultural entomology, 17 ft. by 17 ft., with a staircase leading to a working place raised above the floor level.

At a distance of about a mile from the University and on the main tram route, there is an experimental field with glass houses and a small laboratory, where the insectaria can be erected, trees planted, and other arrangements made for breeding and observing insect life. The University, moreover, is working in cooperation with the Cheshire County Council, and facilities will be offered for entomological work on the farm lands connected with the Agricultural College at Holmes Chapel. The scheme of work has been approved by the Board of Agriculture and Fisheries, and the expenses will be met by a grant of one-third of the total amount by the council of the University and two-thirds from the Development Fund.



[*Photo. C. Ireland, Manchester.*

Laboratory for Agricultural Entomology in the University of Manchester.

The University has appointed Dr. A. D. Imms, formerly forest entomologist to the Government of India, to be the first reader in agricultural entomology, and he will conduct researches and superintend the work of research students in the laboratory.

The reader in agricultural entomology will give occasional lectures in the University on the subject of the researches conducted in the department, and may give advice or assistance to students reading for the honours school of zoology who are taking the Insecta as a special subject; but the department will not be concerned in the ordinary course with instruction given to students for the degree examinations of the University. It is anticipated, however, that a certain number of post-graduate students will be offered facilities for the conduct of original research in the University, and such students will be eligible to apply

for the M.Sc. degree after a course of two years' research work in the University.

The new laboratory was opened on November 13 by Sir Sydney Olivier, the Permanent Secretary of the Board of Agriculture and Fisheries, in the absence of Mr. Walter Runciman, the President of the Board, who was detained in London by a meeting of the Cabinet Council. At the opening ceremony, Dr. Imms gave a short sketch of the aims and scope of agricultural entomology, and Sir Sydney Olivier, in declaring the laboratory open, explained the policy of the Board as regards the endowment of the universities and agricultural institutions for research work in agricultural science.

At the conclusion of the ceremony a number of exhibits of the research work done in the department and of the apparatus used in entomological investigations was shown to the visitors in the zoological laboratories and museum. S. J. HICKSON.

THE PASSIVITY OF METALS.

A GROUP of eight papers brought together with the view of setting forth every aspect of "passivity" as it presents itself to those now actively engaged in working out a satisfactory explanation of this most difficult and elusive subject, was discussed at the meeting of the Faraday Society on November 12.

The theoretical importance of passivity lies in the fact that it is in all probability so closely bound up with the fundamental mechanism of electrolytic action that a proper understanding of its cause will go far towards clearing away many of the difficulties which still surround the simple processes of anodic solution and kathodic deposition. It has further an important practical bearing on corrosion, for if this be an electrolytic action, a non-corrodible metal and a passive metal are, anyhow within certain limits, synonymous terms. The very idea of the connection suggests a line of research on non-corrodible alloys that may lead to most fruitful results. But if the subject is important, it is no less perplexing. At present two theories, in many respects diametrically opposed to one another, would appear to hold the field, one of which, broadly speaking, ascribes passivity to the presence of oxygen in some form or another, and the other to hydrogen. It may be added that the advocates of each theory point to an *experimentum crucis* claimed to prove the impossibility of its rival as a satisfactory explanation of all the phenomena which have been observed.

While attention was concentrated on the original observation made in 1790 by Keir, that iron became "passive" or indissoluble after plunging into strong nitric acid, the simple mechanical explanation that the change of state was due to a close film of protective oxide no doubt seemed all-sufficient. It was only when passivity was studied as an electrolytic phenomenon, as an example of anodic polarisation by which the passive metal rises higher in the electrolytic scale towards the "noble" metals than it was in its active state, that a broader interpretation was called for, and hence was put forward Le Blanc's fruitful conception that the retarded anodic action was chemical and not mechanical in its origin, and that it must be explained as arising from the diminished reaction-velocity of some chemical process taking place at the anode. This conception is now universally adopted in the consideration of passivity phenomena; the only question arising is, What is the reaction the velocity of which is diminished when metals become passive?

To this question the following answers were given in the papers presented for discussion.

(1) Adopting the current view of Nernst that electrode potential is a result of the formation of metallic ions when the electrode is placed into an electrolyte, Dr. G. Grube supposes this action to be retarded under conditions known as passive by the formation of an alloy of anode surface and oxygen, which has a lower solution pressure than the pure metal. Such retardation of anodic action is known to take place when a platinum anode is used in the electrolysis of halogen salts, and for the self-same reason, and analogous kathodic retardation was likewise shown to exist by Dr. Grube; for example, when zinc and hydrogen are deposited simultaneously with iron. Much the same theory was developed by Dr. D. Reichinstein direct from the Nernst formula, and experimental support was given to the theory by Dr. H. S. Allen, who showed that the photo-electric behaviour of iron—its property of losing negative electricity under the action of light—which from considerations of "fatigue" is believed also to be due to the state of the gaseous film on the metal, increases or diminishes in intensity according as the iron is in the active or passive state.

(2) In order to take into consideration the specific properties of the electrolyte anion some investigators are now reverting to the old Grotthus view of electrolysis that the primary action at the anode is not the formation of metallic ions, but a discharge of negative ions (anions). Prof. Leblanc, however, further supposes that the anion is hydrated, and that passivity is merely the retardation of the reversible reaction, ion−hydrate⇌ion+water. Prof. E. Schoch also adopts the theory of primary anion discharge, but impressed by Dr. Günther Schulze's experiments on the structure of aluminium anode-films, he considers that under certain conditions of current density, temperature, &c., there will be a diminished rate of reaction between anions and electrode owing to the formation on the latter of a film of oxide or oxygen. Neither of these theories, which seem to make gratuitous and unnecessary assumptions, were received with much favour.

(3) More attractive is the hydrogen theory stated in the paper presented by Prof. G. Schmidt, and supported by some ingenious and striking experiments. This supposes that the passive condition is normal, and that metals like iron and chromium are only rendered active by the diffusion through them of hydrogen, which acts as a catalyst and sets up local action. Possibly this is often the case, but it is doubtful whether the "hydrogen-activation" theory will explain all cases of passivity. In the end it may be found, as Dr. G. Senter said in the course of the discussion, that no one theory will cover every case of passivity, but the sense of the meeting was certainly in favour of either an oxygen-film or an oxygen surface alloy as offering in most cases a satisfactory working hypothesis of the passive state.

UNIVERSITY EDUCATION IN LONDON

THE President of the Board of Education has sent to the Vice-Chancellor of London University an important letter in which he announces that the Government accepts in general the recommendations of the Royal Commission on University Education in London, and is prepared to act upon them. The letter is as follows:—

Board of Education, Whitehall, S.W.,
Nov. 12, 1913.

DEAR MR. HERRINGHAM,—1. I am very anxious that the position of the Government in regard to the proposed reconstitution of the University should be generally realised, and that discussion should not be

obscured by any misunderstanding on the subject. I am, therefore, venturing to set out in the form of a letter to yourself as Vice-Chancellor of the University the substance of what I said at the Mansion House the other day.

2. As you are aware, I have appointed a Departmental Committee to consult the bodies and persons concerned and to recommend the special arrangements and provisions which may be immediately adopted for the purpose of giving effect to the scheme of the report and as the basis of the necessary legislation. The committee will not attempt to go again over the ground covered by the Royal Commission. The Government, after careful consideration, have decided that the scheme of the report is calculated to produce a University of London worthy of the name. Starting from this point it will be the business of the Departmental Committee to discover how far the numerous bodies and persons concerned are prepared to cooperate on the basis of the principles underlying the scheme.

3. Those principles are in themselves simple. They may be shortly stated as follows:—

(1) That the Government of the University, and particularly its financial administration, shall be entrusted to a small Senate predominantly lay in its composition and not representative of special interests; and

(2) That on the other hand the control of the teaching and the examinations of students in colleges of the University shall be in the hands of the teachers;

(3) That the educational and financial control of the constituent colleges shall be vested in the University; and

(4) That as much of the University work as possible, together with the University administration, should be concentrated in a central University quarter. (The question of the particular site to be selected is one on which the Departmental Committee will be able to advise the Government after they have considered the various alternatives that have been proposed);

(5) The scheme of reconstruction should provide effectively for continuance of access to University examinations by external students—*i.e.*, by those who are not attached to any college or school of the University.

4. As regards the future of the Imperial College, I may say that it has never been proposed that the college should be moved from its present site. It is, however, an essential part of the scheme that it should become a constituent college of the new University under "the educational and financial control" of the Senate. I ought to explain that the word "incorporation," which is sometimes used as a convenient term to describe the position of a constituent college under such control, does not imply any such vesting of the property of the constituent college in the University as would preclude the earmarking of capital or income by donors and benefactors for particular institutions or specific purposes. This applies to past no less than to future gifts. Such a restriction is not contemplated by the Government, and, speaking for myself, it would be contrary to the views which I have more than once expressed as to the value of local and private munificence in maintaining the highest standard of educational development.

5. On the conclusion of the necessary negotiations the Government hope to introduce legislation in due course to give effect to these principles, and I see no reason why sufficient agreement should not be arrived at to secure the acceptance of the Bill in Parliament as a non-contentious measure.

6. I trust that this statement, which I have already made in public, will be of assistance to all who are from whatever point of view interested in the work of reconstruction by defining the area within which amendments and modifications of the scheme of the committee are admissible. Particularly would I ask of them that they should not reject the scheme because in this point or in that it may fall short of their ideals or is even contrary to what they think best. Some acquiescence or even sacrifice on individual points will be necessary for all concerned if a scheme worth having is to be carried out. It must be remembered that the scheme of the Royal Commission is the only one in the field and that if it fails of accomplishment all chance of reform and progressive development may be gone for many years. In these circumstances and with a definite statement of principles before them I trust that they will not hesitate to make some mutual surrender of views and opinions which perhaps owe their origin in large measure to the uncertainty which has so long prevailed even as to the main lines of reconstruction.

7. The Government will be prepared, in the event of the scheme taking shape in legislation, to make substantial new contributions to the resources of the University, and they are confident that the establishment of a University worthy of the capital of the Empire will be regarded by the citizens, Livery Companies, and corporate bodies of London equally with the Government as an object deserving of their interest and support.

8. I am sending a copy of this letter to the Press.

Yours faithfully,

JOSEPH A. PEASE.

W. P. Herringham, Esq., M.D., &c.

THE PREPARATION OF EYE-PRESERVING GLASS FOR SPECTACLES.[1]

Since March, 1909—in connection with the Glass Workers' Cataract Committee of the Royal Society—I have been experimenting on the effect of adding various metallic oxides to the constituents of glass in order to cut off the invisible rays at the infra-red end of the spectrum, and thus to prepare a glass which will cut off those rays from highly heated molten glass which damage the eyes of workmen, without obscuring too much light or materially affecting the colours of objects seen through the glass when fashioned into spectacles.

Single metals were at first tried in varying quantities to see if from the colour and properties communicated to the glass they were worth further examination. Each specimen is cut and polished into a plate 2 mm. thick. The plate so prepared is first put into the radiometer balance to find the percentage of heat cut off. It is then tested in the spectrum apparatus to ascertain the upper limit of transmission of the ultra-violet rays; next it is tested in Chapman Jones's opacity meter to estimate the percentage of luminous rays transmitted, and finally the colour is registered in a Lovibond's tintometer.

The following elements were selected as likely to be worthy of further experimentation by combining the metals, two, three, or four at a time in one glass so as to enable the advantages of one to make up for the shortcomings of another:—Cerium, chromium, cobalt, copper, iron, lead, manganese, neodymium, nickel, praseodymium, and uranium.

Whilst bearing in mind that the chief object of

[1] Summary of a paper read before the Royal Society on November 13 by Sir William Crookes, O.M., F.R.S.

this research is to find a glass that will cut off as much as possible of the heat radiation, I have also attacked the problem from the ultra-violet and the transparency points of view. Taking each of these desiderata by itself, I have succeeded in preparing glasses which cut off more than 90 per cent. of heat radiation, which are opaque to the invisible ultra-violet rays, and are sufficiently free from colour to be capable of use as spectacles. But I have not been able to combine in one specimen of glass these three desiderata in the highest degree. The ideal glass which will transmit all the colours of the spectrum, cutting off the invisible rays at each end, is still to be discovered.

So far as transparency, however, is concerned, it will not be an unmixed advantage for the sought-for glass to be quite clear and colourless. The glare of a strong light on white cliffs, expanses of snow, electric light, &c., is known to be injurious to the eye, and therefore a tinted glass combining good obstruction to the heat radiation and ultra-violet rays is the best to aim for.

For ordinary use, when no special protection against heat radiation is needed, the choice will depend on whether the ultra-violet or the luminous rays are most to be suppressed, or whether the two together are to be toned down. Ordinarily the visible spectrum is assumed to end at the Fraunhofer line K, λ 3933, but light can easily be distinguished some distance beyond by the naked eye. It may therefore be considered that the ultra-violet rays which are to be cut off on account of their possible injurious action are those of shorter wave-lengths than, say, λ 3700. Many glasses have been prepared for this purpose, all of which are opaque to rays shorter than λ 3700. The colours are pale green, yellow, and neutral; they transmit ample light so that a choice of tints is available to suit individual taste.

Glasses which are restful to the eyes in the glare of the sun on chalk cliffs, expanses of snow, or reflected from the sea, of yellow, green, and neutral tints, have also been prepared which have the advantage of cutting off practically all the ultra-violet rays and also a considerable amount of the heat radiation.

GEOLOGY AT THE BRITISH ASSOCIATION.

ON the conclusion of Prof. E. J. Garwood's presidential address, which has been published in full in a previous issue, Prof. Lapworth gave an address on the geology and physical geography of the country round Birmingham, which was supplemented by a description of the igneous rocks of the district by Prof. W. W. Watts. Prof. Lapworth's address dealt with the broad features of the topography and stratigraphy of the area, special reference being made to some of the places to be visited on the field excursions.

Mr. George Barrow described the typical Spirorbis Limestone of North Warwickshire as a rather compact rock, usually grey, and containing *Spirorbis carbonarius*. Two main beds occur, the Index Limestone about 100 ft. down in the Halesowen group, and another less persistent bed close to the base of the Keele group. There are other less continuous bands, and also lenticles and scattered nodules. He attributed the formation of the limestone to the evaporation of shallow sheets of lime-bearing water, a view which is supported by the structure of the rock, during a dry epoch, subject to sudden or periodical floods.

The stream-courses of the Black Country plateau formed the subject of a communication by Mr. Henry Kay. The area was described as including the anticline of the South Staffordshire Coalfield *plus* the north-western parts of Cannock Chase and the Warley-Barr area. The chief physical feature is the midland watershed which runs across the plateau from Wolverhampton to the Lickeys. The Trent drains the larger part of the area, but the southward marginal drainage flows into the Severn. The Trent drainage area has been subjected to excessive piracy and has steadily suffered loss. The northern drainage is consequent on the formation of the South Staffordshire anticline, regarding the age of which it bears notable evidence. The author states that the uplift is, in part at least, post-Tertiary.

Prof. Sollas exhibited a number of flints showing outlines similar to those described as "rostro-carinate," and supposed to be of human workmanship. He described the conditions under which they were found, and expressed his firm belief in their formation by the action of surf upon nodules of flint partially embedded in the deposits of the beach, the curved keel being produced by the intersection of two conchoidal fracture-surfaces.

In a paper on the structure of the Lias Ironstone of South Warwickshire and Oxfordshire Mr. E. A. Walford inferred that the sea-floor of the Middle Lias was a tangle of crinoid growth, stage above stage. He described beds of the Middle Lias stone as packed with curved and interlacing stems lying upon the bedding plane, with other beds of the fine pentangular and smaller ossicles of crinoids between.

Mr. T. C. Cantrill described the occurrence of *Estheria*, cf. *minuta*, in the Bunter pebble bed of Ogley Hay, near Walsall. The fossils were found in two thin bands of red marl in a disused sand-quarry.

The flora and fauna of the Upper Keuper Sandstones of Warwickshire and Worcestershire formed the subject of a communication by Messrs. L. J. Wills and W. Campbell Smith. They described for the first time from the English Trias examples of the foliage and scales of the female cone of a Voltzia, closely resembling *V. heterophylla*, of the Bunter of the Vosges, and recorded new occurrences of Voltzia, Schizonema, Carpolithus, and, possibly, Yuccites, The fauna includes *Phaebodus brodiei*, Semionotus, and Ceratodus, also the lamellibranch *Thracia? brodiei*, and the authors conclude "that we are not dealing with a pre-Rhætic incursion of the sea, but with a littoral facies of the Keuper Marls, formed where the water was at times sufficiently fresh to support a small fish-fauna and in sufficient motion to move coarse sediments."

Nodules from the Basal Ordovician conglomerate at Bryn Glas, Ffestiniog, were exhibited by Prof. W. G. Fearnsides, and some discussion as to their nature and origin took place.

Dr. A. Vaughan made a communication on the division between the Lower and Upper Avonian with a view to the discussion of several important questions of nomenclature.

Mr. F. G. Meachem contributed a paper on the progress of the coal-mining industry of the South Midlands since the year 1836, from which the following figures are quoted:—

Areas of the Known Coalfields of the Area in Square Miles.

	1836	1913
South Staffs	70 ...	360
Leicester	20 ...	88
Warwick	10 ...	222
Salop	20 ...	96
Total	120 ...	766

Output in Millions of Tons.

	1865	1912
South Staffs	10 ...	$7\frac{1}{2}$
Leicester	$1\frac{1}{2}$ ...	$2\frac{3}{4}$
Warwick	$\frac{1}{2}$ ...	$4\frac{1}{2}$
Salop	$1\frac{1}{2}$ ...	$\frac{3}{4}$
Total	$13\frac{3}{4}$ ...	$15\frac{1}{2}$

Dr. E. A. Newell Arber gave a preliminary note on the fossil floras of the South Staffordshire Coalfield, which include both petrifications and impressions, and expressed the hope that in course of time it will be possible to trace the floras systematically from the lowest to the highest beds of the Coal Measures of this coalfield.

In a paper on the correlation of the Leicestershire Coalfield, Mr. R. D. Vernon stated that it had been found impossible to use either the sandstones or the seams of coal in the correlation even of the eastern and western portions of the Leicestershire Coalfield itself, and that fossil plants had also proved of relatively little value, and the fresh-water lamellibranchiata were equally unsatisfactory. For these reasons a search was made for marine beds. The thickest marine bed occurs about 260 yards above the Moira Main coal, and its outcrop has been mapped on the it is comparable with the Gin Mine marine bed of that in stratigraphical position and in faunal contents it is comparable with the Gine Mine marine bed of North Staffs, the Mansfield marine bed of the Yorkshire and Nottinghamshire field, and the Pennystone Ironstone marine bed of Coalbrookdale, and therefore serves as a means of correlating the Measures of Leicestershire with those of neighbouring areas.

On systems of folding in the Palæozoic and newer rocks, by G. Barrow. The author is of opinion that many so-called systems of folding are due to series of resisting masses with parallel margins, and cites as examples the great lenticular masses of thermally altered rocks of the Highlands.

In a paper on the Harlow Boulder Clay and its place in the glacial sequence of eastern England, Dr. A. Irving dealt with the sequence of the various deposits of Pleistocene age in the eastern counties of England.

The discovery of Lower Carboniferous Grits at Lye, in South Staffordshire, was recorded by Mr. W. W. King and Mr. W. J. Lewis.

Mr. E. A. Walford read a paper on some of the basement beds of the Great Oolite and the Crinoid beds, and suggested the following subdivision of the Great Oolite:—

UPPER GREAT OOLITE.—(1) *Terebratula maxillata* beds; (2) *Calcaire à Echinodermes.*

LOWER GREAT OOLITE.—(1) Striped Limestones; (2) *Rhynchonella concinna* beds; (3) Stonesfield Slate.

SUB-BATHONIAN.—(1) Striped Limestone and Crinoid beds; (2) Neæran series; (3) Striped Crinoid Marls; (4) Chipping Norton Limestones.

Mr. A. R. Horwood directed attention to the value of a knowledge of the rock soil distribution of plants in tracing geological boundaries, and pointed out the consequent importance of the new ecological surveys to the geologist.

The geology of the district between Abereiddy Bay and Pen Caer, Pembrokeshire, formed the subject of a paper presented by Dr. A. H. Cox and Prof. O. T. Jones, in which it was shown that not only Llandeilo and Bala rocks, as previously supposed, but Arenig and even Cambrian rocks form large areas on the coast. The authors propose to map the area in detail.

"The Relation of the Rhiwlas and Bala Limestones at Bala," by Dr. Gertrude L. Elles. The Rhiwlas Limestone is an impersistent limestone at the base of the Hirnant Series, and is found only in the northern part of the area. The Bala Limestone is not developed as a calcareous bed in the northern part of the area. The true relation of these horizons to each other is seen at Gelli Grin, where the Bala Limestone at its maximum thickness is overlain by light-coloured, pasty mudstones, containing a typical Rhiwlas Limestone fauna.

The work of excavation of critical sections in the Cambrian rocks of Shropshire has been continued, and has furnished palæontological proofs of the prolongation of the Lower and Middle Cambrian rocks of Comley into the Cwms area to the south, and a description of excavations Nos. 53, 54, 55, and 56 formed the subject-matter of a communication by Mr. E. S. Cobbold, who has been carrying on the work.

Dr. A. Irving furnished a contribution to the much-discussed question of "Flint and its Genesis." Silicification of calcareous fossils can be understood as a "mass-reaction" of the alkaline silicates in the presence of a large excess of water:—

$$n\mathrm{H_2O} + \mathrm{CaCO_3} + \mathrm{K_2SiO_3} = \mathrm{K_2CO_3} + \underset{\text{(dissolved)}}{\mathrm{Ca(OH)_2}} + \underset{\text{(precipitated)}}{\mathrm{SiO_2}} + (n-1)\mathrm{H_2O}.$$

Plant petrifactions in chert and their bearing on the origin of fresh-water cherts was discussed by Dr. Marie C. Stopes, who directed attention to the recent "sapropel" observed by Potonie, and the likeness it has to the débris in certain cherts from Asia Minor, and concluded that the chert may be taken as practically pure petrified "sapronel."

Dr. Vaughan Cornish directed attention to the conditions which govern the transport and accumulation of detritus by wind and water.

In a communication on the shelly and graptolitic faunas of the British Ordovician, Dr. Gertrude L. Elles showed that there are two main types of "shelly" faunas of Ordovician age in the British Isles, and that each of these can be further subdivided into a number of subfaunas, which can be correlated by reference to associated graptolite-bearing beds. The main shelly types were described as (*a*) Asaphid-Trinucleid-Calymenid fauna; (*b*) Cheirurid-Lichad-Encrinurid fauna. It was suggested that fauna (*b*) is an exotic fauna, possibly southern in origin, which migrated into the British area. Becoming early established in south Scotland, it soon spread west into Ireland, but did not dominate the whole British area until Ashgillian times. Correlation tables were given showing the relations of the various faunas of the groups (*a*) and (*b*) to the graptolite zones of the series.

"A First Revision of the British Ordovician Brachiopoda, by Clara E. Sylvester. The author gave a summary of the present stage of her researches among the British Ordovician Brachiopoda, and presented a table of the known species, with their range and geological and geographical distribution. The species in each genus were grouped around well-known forms selected as types.

Mr. W. D. Matthew gave a paper on discoveries in the American Eocene.

In further notes on Palæoxyris and other allied fossils, with special reference to some new features found in Vetacapsula, Mr. L. Moysey directed attention to several features which had been found in certain new material collected since the publication of his paper in the Quart. Journ. Geol. Soc., vol. lxvi., 1910.

Mr. Frank Raw gave a paper on the occurrence of a wind-worn rock surface at Lilleshall Hill, Salop.

The author directed attention to certain surfaces of Uriconian rocks which have been ground smooth, and where hardest highly polished.

Mr. V. C. Illing directed attention to certain recent discoveries in the Stockingford Shales near Nuneaton, which tend to show that the Cambrian succession in that area is almost, if not quite, complete. The author correlates the beds as follows :—

Merevale Shales.	Lower Tremadoc.
Oldbury Shales	Dolgelly.
	Ffestiniog.
	Maentwrog.
	Menevian.
Upper Purley Shales Middle Purley Shales	Menevian?
Lower Purley Shales Hartshill Quartzite	Taconian.

The same author, under the title of "Notes on certain Trilobites found in the Stockingford Shales," described numerous forms, representing young stages in the development of certain trilobite genera, including Liostracus, Holocephalina, and Paradoxides, together with certain new forms of Agnostus.

The classification of igneous rocks formed the subject of a communication by Dr. H. Warth. The classification proposed was a chemical one, and was based, not upon the proportions of individual bases, but upon the respective sums of bases of equal valency. Tables and diagrams were shown in illustration of the paper.

Copper in the sandstones of Exmouth was recorded by Mr. C. Carus-Wilson. Copper-carbonate was found in certain sandstones between the Exmouth golf links and the High Lands of Orcombe. Its presence is due to copper pyrites, which is one of the constituents of the sandstone, and is undergoing decomposition.

Dr. A. Hubert Cox and Prof. O. T. Jones described several occurrences of pillow lavas in Wales. The lavas were in some cases associated with chert and jasper.

Dr. A. Hubert Cox described certain igneous rocks of Ordovician age, and suggested that the Ordovician igneous rocks would appear to afford a favourable ground for ascertaining whether the connection between rock-types and types of earth-movement holds good to a greater extent than has been hitherto suggested, and we may perhaps expect that further research will show some constant difference between the facies of the igneous rocks in areas where subsidence was continuous, and the facies in areas where subsidence was interrupted by uplift.

Prof. W. S. Boulton described and exhibited a new form of machine for cutting thin sections of rocks. The machine is electrically-driven, and can be connected with any ordinary incandescent lamp-carrier on the house circuit. A special arrangement for automatic lubrication of the cutting edge is provided, and also a new device for arming the disc.

Mr. C. H. Cunnington read a paper on the Carboniferous Limestone at the head of the Vale of Neath, South Wales.

A special series of Excursions was organised by Prof. Lapworth, Prof. Boulton, and Mr. Frank Raw, and many places of geological interest were thus thrown open to the members. The excursions included the Licky Hills and the Clents, under the leadership of Prof. Lapworth; Nuneaton and Atherstone, Prof. Watts and Mr. Illing; The Wrekin, Prof. W. S. Boulton; and Witley and the Lutley Valley, Mr. H. Kay and Mr. W. H. Foxall. There was also an excursion to Cheltenham in conjunction with the Cheltenham Natural Science Society, under the leadership of Mr. L. Richardson.

At the conclusion of the meeting, Prof. Lapworth conducted a three days' excursion into South Shropshire, and a number of members availed themselves of the opportunity of visiting this classic district under the guidance of one who has done so much to elucidate its complex structure and the relationship of its older sediments. A. R. D.

PALÆOBOTANY: ITS PAST AND ITS FUTURE.[1]

PALÆOBOTANY has already passed through three main phases of its development: the first, when fossil plants were supposed to be the spontaneous ornamentations of stones by an exuberant nature which blindly disported itself. The second, when they were realised as being the remains of extinct life, but were described without the light of a fundamental and unifying hypothesis; and the third, when a scientific knowledge of their structure made comparison with recent plants possible, and it was realised that they threw light on the evolution both of the living plants and the existing continents. In this phase we are now at work.

Even at a time when the true nature of animal fossils was realised, and their occurrence causing much discussion, references to plants were few. John Ray wrote in 1693 :—"Yet I must not dissemble, that there is a Phænomen in nature, which doth somewhat puzzle me to reconcile with the prudence observable in all its works, and seems strongly to prove, that nature doth sometimes *ludere*, and delineate Figures, for no other end but for the Ornamentation of some Stones, to entertain and gratifie our Curiositie or exercise our Wits. That is, those elegant Impressione of the Leaves of Plants upon Cole-Slate."

The lecturer read quotations from a number of little-known books written between 1693 and 1781, illustrating the importance of fossil plants to those authors who took the flood as a fact, and were puzzled to account for the existence of plants at all on the earth—for only the animals had been preserved in Noah's Ark. Among pioneers of Palæobotany, it is interesting to discover the mystic Swedenborg, who published the first plates of fossil plants in Sweden, a country now famous in palæobotany through Prof. Nathorst's work.

At the beginning of the nineteenth century, palæobotany suddenly became scientific. The works of Brongniart, Sternberg, Schlotheim, and others created a new epoch in the science. In 1828 Sprengel described silicified fern stems from their anatomical structure. In 1833 Witham published his book on "The Internal Structure of Fossil Vegetables," and this was shortly followed by a large work giving beautiful drawings of the anatomy of Psaronius and other fossils by Corda.

As a forerunner of the newer type of work which crystallised round Williamson, one may here place Sir Joseph Hooker, who was much interested in and published several valuable papers on the structure of fossil plants, and who held from 1846 to 1848 the official post of botanist to the Geological Survey. The post has lapsed for all these years, and to-day, when the surveys of other civilised countries have their official palæobotanists, it would be interesting to know why England, the first to originate the post, and the premier coal-producing country in the world, should be minus so valuable a servant. Concerning the extreme value and originality of Prof. Williamson's work, little need be said. He may justly

[1] From an inaugural lecture delivered at University College (University of London) on October 17, by Dr. Marie C. Stopes.

be described as the father of botanical palæobotany. It was Williamson who, in face of the opposition of every living botanist of his day, propounded the fact that the lower vascular plants could develop secondary wood without, as the French school of palæobotanists maintained, thereby qualifying for inclusion among the Angiosperms. Writing on Williamson's work on Cambium, Solms Laubach said:—"This is a general botanical result of the greatest importance and the widest bearing. In this conclusion palæontology has, for the first time, spoken the decisive word in a purely botanical question."

The anatomical structure of plants was also receiving attention at the hands of other brilliant men, about the same time, chief among whom were Renault and Solms Laubach.

The more geological side of palæobotany was at that time growing rapidly as a result of the researches of Saporta, Heer, Ettingshausen, Lesquereux, and others. Heer in particular was doing work of world-wide fame in his discoveries of Arctic floras which indicated a once warmer climate for those now frozen zones. Nevertheless to some of Heer's work, and to many monographs published at the end of the nineteenth century, one might apply the following words, which, curiously enough, were published a hundred years before such work appeared. In 1784 Francis-Xavier Burtin said:—"Malheureusement ceux qui découvrent un fossile, s'empressent trop de le nommer, et le mot je *l'ignore* paroit avoir été de tout temps dur à prononcer. De là cette quantité de noms absurdes, dont la science oryctologique parvient si difficultment à se débarrasser."

To-day palæobotany has three sides; or rather, the new science slowly reaching out from the shelter of its step-parents botany and geology, is already a growth with three main branches, each of which bears fruits of value to three sections of the community.

First, to botanists. Reference has been made to some of the recent work of palæobotany as being indispensable to the science of modern botany. This is now recognised by every leading botanist, and Sir Joseph Hooker in a letter to Dr. Scott in 1906 wrote of our "knowledge of botany as it advances by strides under a study of its fossil representatives." From the student of the fossils one learns not only of whole genera, and even families of extinct plants, which help us to comprehend the relationships of existing types, but often the fossils exhibit complexities and novelties of character which not the most vivid imagination could have foreseen. For instance, what modern botanist, even in a delirious dream, could have conceived of a cone for the Lower Carboniferous Pteridophytes so complex as Cheirostrobus, the demonstration of the actual structure of which we owe to Dr. Scott? Then the existence in the past of the Pteridosperms, demonstrated by Prof. Oliver and Dr. Scott, is of profound importance to all botanists.

The modern botanist's conceptions of morphology, his definitions even of an organ like the seed, have undergone profound modification through the introduction of ideas based on fossils. *Only from the fossils can we learn the actual facts of evolution.* Connecting the botanist with the geologist is the plant-geographer. The history of Ginkgo, now an isolated species only found native in Japan and eastern China, but in Tertiary to Oolitic times widely distributed over Europe and America, illustrates with a single instance, the importance of the palæobotanical record for those who deal with the distribution of modern plants.

Asa Gray said:—"Fossil plants are the thermometers of the ages, by which climatic extremes and climate in general through long periods are best measured"; and Charles Darwin, in 1881, wrote to Hooker:—"The extreme importance of the Arctic fossil plants is self-evident."

Through the palæogeographer we come to the geologist. To what extent is he indebted to palæobotany? In this country, it has been so arranged by nature that there are no immense tracts of land composed of strata in which the only fossils are plants; had there been, possibly that survey post held by Hooker in 1846 would not have lapsed. If our geologists think they can get along without palæobotanists, let us hear what the Americans have to say.

There are twelve palæontologists altogether in the United States Geological Survey, and of these four are palæobotanists. Take the record of one of these geological palæobotanists, Dr. Knowlton; he says:—"For the past five years I have annually studied and reported on from 500 to 700 collections, each of which embraced from one to hundreds of individuals, and with them have helped the geologists to fix perhaps fifty horizons in a dozen states."

Now let us turn to the third branch of my science. This is the practical side, and deals specially with coal-mining. In their rough and ready way, miners have "muddled along" without much help from palæobotanists. But with a collaboration between the two great advantages to both would accrue, and are to be looked for in the future. Palæobotanical information, to be of any value to the miner, must be very detailed and accurate. It represents the ultimate refinement of the stratigraphical work just mentioned as being the province of geological palæobotany. Fine and accurate zoning by plants has already been successfully carried on, however, particularly in France, where Prof. Zeiller, of Paris, or M. Grand' Eury, is called in consultation before most mining operations of importance are undertaken. Palæobotany is an intricate and independent science, which is now much vaster than is realised by more than a few people. To illustrate the enormous mass of detail with which a conscientious palæobotanist has to cope, it is only necessary to turn to Dr. Jongmans's *résumé* of the publications for the year on the subject. It is 569 pages long, and on each page are, on an average, twenty-one entries. But this invaluable work has only been published for the last three years. For everything before that we have no centralisation of results.

What will the palæobotanist of the future demand?

That in at least *one* institution in each civilised country there shall be a recognition of his science and adequate accommodation for it. This institution would form the headquarters, the centralising bureau, for all the branches of work in which the individual palæobotanists may be specialising whether as geological palæobotanists, botanical palæobotanists, or practical miners. In this central department should be kept standardised collections of fossil plants. In this central department also should be available herbariums and immense series of sections of modern plants with which to compare the fossils while working on the botanical elucidation of their structure. As things are to-day in any new branch of palæobotany, the modern botanists do not provide exactly the kind of data wanted for comparison by the palæobotanist. This is noticeably the case, for instance, in the study of early fossil Angiosperms. No modern botanist can show us the preparations of living Angiosperms that are essential for our researches.

Then, too, in this central department of the science would be collected together, not only all the literature on palæobotany, but this literature would all be indexed, analysed, and made available on several

series of card catalogues. The work done by Dr. Jongmans for the last three years must be done for the last 150 years, and put in the handiest form for reference, which is, of course, a card catalogue. Then there must be a complete card index of all the names ever given to fossil plants. At present, most palæobotanists, all indeed, save a very few, tend to despise questions of nomenclature, but our science is in a very bad way owing to the immense numbers of names given on insufficient or wrong grounds. One cannot emphasise too strongly the urgent necessity for palæobotanists to reduce order from the chaos of their present nomenclature, and this can only be done by some centralising institution or committee, who are sufficiently grounded in the science to realise the special needs of palæobotany.

Beyond all this it must not be forgotten that the collections of fossil plants at present made are trivial in comparison with those which will have to be made from all parts of the earth before we can completely unravel the histories of the ancient continents, solve questions of past climates, restore the details of innumerable extinct floras, and reconstruct the tree of plant evolution through the ages.

In spite of all the discoveries of palæobotany immense problems still lie unsolved. Darwin said, in a letter to Hooker, "The rapid development, so far as we can judge, of all the higher plants within recent geological times is an abominable mystery." To-day it is an abominable mystery still, and an abominable mystery it will remain until palæobotany is recognised as an independent science, and housed, endowed, and equipped so that she has the tools she needs for her work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Board of Agricultural Studies reports that the number of students receiving instruction in the school of agriculture is 320. The number of senior students, exclusive of members of the staff, engaged in research during the past year was nineteen. In view of the large number of research students working in the school of agriculture, the University has constituted a degree committee of the Board of Agricultural Studies, which has already recommended one research student for the B.A. degree. The extension of the school of agriculture is now practically completed, and will be fully occupied during the present term by the transference of most of the research work from the original building. In this way more laboratory accommodation is provided for teaching.

Under a general scheme for research work in forestry, the Board of Agriculture in July, 1912, offered a grant to the University to enable investigations to be undertaken on questions relating to the structure of timber, &c. The forestry committee appointed Mr. Burdon as investigator, and Mr. A. P. Long as assistant-investigator. The work commenced on January 1, and rapid progress has been made. In addition to two interim "progress reports," a bulletin, the first of a series, on "Scots Pine in Great Britain," has already been issued by the University Press, while a second bulletin is now in the press. In addition to field investigations of the nature dealt with in the bulletin issued, several investigations and experiments of a different nature have also been started. In April last, the Great Northern Railway Company asked the investigator to undertake certain inquiries relative to the preservation of sleepers, and their subsequent immunity from fungal attacks. An experiment with some thirty sleepers is now in progress. Under the grant of 500*l.* a year from the Board of Agriculture for advisory work the committee has, in accordance with the conditions of the grant, appointed Mr. C. Hankins, who took up duties on April 1 of this year. There has already been a large demand for advice on the management of woodlands, from landowners in the eastern counties.

BY the will of the late Mr. G. W. Palmer, of Reading, a bequest of 10,000*l.* is made to University College, Reading.

MR. ALEXANDER MCKENZIE, head of the chemistry department of Birkbeck College, London, has been appointed professor of chemistry in University College, Dundee, in succession to the late Prof. Hugh Marshall.

IT is announced that a large bequest, stated to be approximately 250,000*l.*, is made in the will of the late Mr. W. Gibson, of London and Belfast, to institute a scheme for providing sons of farmers of counties Down and Antrim with educational advantages. No details of the scheme are yet available.

A REUTER message from Cape Town on November 14 announces that Prof. John Perry, F.R.S., has been appointed a member of the University Commission which is to investigate matters connected with higher education and to consider the conditions under which the Wernher and Beit donations and bequests for the purposes of the proposed University of South Africa may best be utilised. The other members of the Commission are Sir Perceval M. Laurence, formerly Judge President of the Supreme Court of South Africa, who is the chairman, ex-Justice Melius de Villiers, and the Rev. Mr. Bosman. Prof. Perry's views upon university education were stated by him clearly in an address delivered at Oxford just ten years ago and published in full in NATURE of December 31, 1903 (vol. lxix., p. 207); and in many papers and addresses he has described the useful functions of great schools of science and technology.

THE annual general meeting of the Association of teachers in Technical Institutions was held on November 15, at St. Bride's Foundation Institute, London, E.C., when the retiring president, Mr. P. Coleman, was in the chair. The annual report of the council was adopted; it shows that the association has continued to progress in strength and influence, and has maintained the reputation it has earned for energy and activity. The increase in membership continues to be satisfactory, and is now about 1200. Two new branches were formed during the year, namely the Leicester Branch and the South of Ireland Branch. National councils have now been formed in Scotland and Ireland, and the organisation and development of these will engage the attention of the council during the present session. In the early part of the year the council had under consideration the situation which has been created by the abandonment of certain examinations of the Board of Education and the general adoption of internal examinations. The council finally determined to urge local authorities to form advisory boards in various localities for the purpose of assisting in the coordination of examinations within a district. The council feels that the present position with regard to the salaries of technical teachers is unsatisfactory. Although the cost of living has increased considerably, the salaries of teachers have not appreciably increased. The council hopes that in a very short time it will be able to report that important steps have been taken to obtain a satisfactory solution of this matter. The desire for cooperation between the different associations of teachers continues to increase, and this association, as representing technical teachers, has, during the past year, lost no opportunity of joint action with other professional bodies. Mr. P. Abbott, Regent

Street Polytechnic, was elected president, Mr. J. Paley Yorke honorary secretary, and Mr. C. Harrap honorary treasurer.

ON November 15 Dr. David Starr Jordan, president of the Leland Stanford Junior University, delivered a lecture at Birkbeck College on the American university. He said that the words of Emerson, "America means opportunity," supplies the basal idea of the American university. American university institutions are not intended to maintain any kind of tradition or system; they are intended to meet the people's needs. What is best for one may not be best for another, and it is not for any educational board to say that this study is more valuable than that. It is for the student to find out which things are worth most to him. Scholarship, he said, depends on the thoroughness of our knowledge in its relation to the affairs of human life. In tracing the development of the universities in the United States, Dr. Jordan said that about 1868 the Act was passed which allowed for the gift to every State of a large amount of land on condition that a university was established, which was to teach, among other subjects, agriculture and the mechanic arts, and that brought engineering and agriculture into the very centre of their university system. The work of the university is to bring scholars together, and if he were to offer a word to London upon the university question he would say: "Above everything bring together all the fragments that are scattered over the City." The university is not the place for men who neglect work, and in the United States they are moving more and more towards testing a man's work as he goes on and sending him home to think about it if it was unsatisfactory. Dr. Jordan himself once sent away 131 men in one day. American authorities have generally agreed that prizes do not help scholarship, and most American institutions have discarded honours for the same reason. He thought, he said, that the abuse of fellowships and scholarships has been greater on the whole than the good results. In most American universities, if those under the old influences are excepted, men and women are admitted on the same terms, and nothing will induce the Western institutions to change that system. One result of reaching out for all kinds of talent is an enormous increase of students. In California, where the population numbers 2,000,000, there are 8000 university students.

SOCIETIES AND ACADEMIES.

LONDON

Royal Society, November 13.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir William **Crookes**: The preparation of eye-preserving glass for spectacles (see p. 356).—Prof. A. W. **Porter**: An inversion point for liquid carbon dioxide in regard to the Joule-Thomson effect.—Prof. A. W. **Porter** and Dr. F. W. **Edridge-Green**: Negative after-images and successive contrast with pure spectral colours. This paper is a rejoinder to the criticisms made by Prof. Burch to a previous paper. The authors have repeated their experiments, taking the most minute precautions to avoid all stray light, with the same results as before. The most important result is that a negative after-image of an approximately complementary colour is obtained in the total absence of stimuli which would cause such colour.—Prof. O. W. **Richardson**: The positive ions from hot metals.—G. W. **Walker**: The diurnal variation of terrestrial magnetism. The paper deals with observational data with regard to the diurnal variation of terrestrial magnetism collected from nine observatories. The data are presented in terms of the Fourier coefficients of the 24-hour and 12-hour terms for the geographical components to north, west, and vertical (downwards). It is noted that the data give strong support to Dr. Schuster's formulæ (Phil. Trans., 1908) for the magnetic potential of diurnal variation as derived from the west component; but the magnetic potential so determined does not give the proper numerical values for the north component as observed. The data for vertical force are shown to be in general agreement with Schuster's conclusion that the primary source of variation is of epigene origin.—G. W. **Walker**: A suggestion as to the origin of black-body radiation. The paper first shows that a function of dynamical form can represent the data with regard to radiation quite as well as the formula proposed by Planck.

Royal Anthropological Institute, November 4.—Prof. Arthur Keith, F.R.S., in the chair.—J. Reid **Moir**: The striation of flint surfaces. The paper dealt with the scratches to be observed upon flints found upon the present land surface. Flint was shown to be a material of variable hardness, the black unchanged variety being the most resistant. Specimens from the surface which had been "patinated" were much softer, and it was shown how these can be scratched by passing a flint point over their surfaces under pressure. It was also demonstrated that a *hardened steel* point will also have this effect. The depth and nature of a scratch depend largely upon the hardness of the surface to be scratched. Examples of scratched glass found upon the surface of the fields were exhibited, and the scratches upon them shown to be of various kinds and similar to those developed upon surface flints. The specimens of scratched glass demonstrated that certain movements, such as would be brought into play by agricultural operations on the present land surface, were sufficient to imprint scratches upon scratchable objects lying on that surface, and as it has been demonstrated that some flints can be scratched by steel it seems probable that certain of the scratches seen upon surface flints can be assigned to the same cause. The "weathering out" of scratches upon flints was next dealt with. It was shown that when a moving point passed over a flint under pressure the area upon which the point impinged was shattered, and small plates of flint formed along the line of movement. These plates of flint in time weather out and leave a clean-cut groove behind. If the theory of the weathering out of scratches was correct, then what in many cases had been looked upon as deep glacial stria might possibly be simply weathered-out "shattered" scratches, the initial stage of which would not require any very great pressure to produce.

Geological Society, November 5.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—J. A. **Douglas**: Geological sections through the Andes of Peru and Bolivia. The geological structure is dealt with of the South American Andes, as illustrated by a horizontal section from the port of Arica in the north of Chile across the "Cordilleras" to the forested region of the Amazon slopes, following the route of the Arica-La Paz railway. The general physiography of the Peruvian Andes and the topographical features of the country traversed by the railway are discussed. Its geological structure is described under three headings:—(1) The Mesozoic sediments of the coastal region with their contemporaneous igneous rocks; (2) the volcanic rocks of the Mauri River, the Mesozoic and Palæozoic sediments of the "Altaplanicie" and the Titicaca district; (3) The Palæozoic rocks and granitic core of the eastern Cordillera and the Amazon slopes. The Mesozoic stratified rocks are well exposed in the "Morro de

Arica," where fossils occur which indicate an Upper Jurassic (Callovian) age. They are interbedded with thick sheets of basic enstatite-andesite. The erosion of the river-valleys that has brought to light the Jurassic sediments has also laid bare the underlying plutonic mass of granodiorite, which may be regarded as the deep-seated core of the western "Cordillera." The western Cordillera is essentially a volcanic range. The enormous amount of volcanic material emitted has almost completely concealed the underlying rocks. The lavas can be resolved into three main groups, characterised by their dominant ferromagnesian mineral, succeeding one another in age according to a law of increasing basicity. The "Altaplanicie," is almost entirely covered by horizontal sheets of volcanic ash, tuff, and pumiceous lava, described as the Mauri Volcanic Series. The occurrence in an interbedded layer of gravel, of a fragment of a jaw of "Nesodon," almost identical with specimens from the Miocene beds of Santa Cruz, affords a clue for an estimation of their age. They are overlain on the east by gravel-deposits of the Desaguadero River, the highest terrace of which was found to contain remains of Mastodon, Megatherium, Scelidotherium, and other Pleistocene vertebrates. From beneath these superficial deposits crops out a series of unfossiliferous red sandstones and conglomerates. These are divided into two groups—a younger series of Cretaceous age resting with pseudoconformity on an older Permo-Carboniferous group. The Carboniferous formation is nowhere exposed along the line of section. The eastern Cordillera is composed chiefly of steeply-dipping Devonian slates and quartzites.

Linnean Society, November 6.—Prof. E. B. Poulton, F.R.S., president, in the chair.—H. Hamshaw **Thomas** and Miss Nellie **Bancroft**: The cuticles of some recent and fossil Cycadean fronds. The investigation was undertaken with the view of determining the probable relationships of the modern group to the Mesozoic Cycadophyta.—Prof. W. A. **Herdman**: Spolia Runiana II. Results of the past season's dredging. The author described the course taken by the yacht off the west coast of Scotland, and showed a long series of slides displaying the scenery and bird-life of the unfrequented regions visited.

Mineralogical Society, November 11.—Anniversary meeting.—Dr. A. E. H. Tutton, F.R.S., president, in the chair.—A. **Hutchinson** and A. M. **MacGregor**: A crystalline basic copper phosphate from Rhodesia. The mineral occurs at the Bwana M'Kubwa copper mines as a crust of minute, brilliant, peacock-blue, orthorhombic crystals, associated with malachite. Axial ratios $a:b:c=0{\cdot}394:1:1{\cdot}01$; forms 110, 011; hardness 4–5; specific gravity 4·1. Chemical composition, determined by an analysis of a small quantity of carefully selected material, approximates to the formula $2Cu_3(PO_4)_2.7Cu(OH)_2$; no water is lost on heating to 190°. Although it has much the same composition as some minerals included in the pseudomalachite family, it differs widely in its physical characters from dihydrite, the only well-defined crystalline member of the group, and is probably a new species.—Dr. G. T. **Prior**: The meteoric stone of Wittekrantz, South Africa. The stone, which fell on December 9, 1880, at the farm, Wittekrantz, Beaufort West, Cape Colony, is slightly chondritic, and consists of the usual aggregate of olivine and bronzite, with particles of nickeliferous iron and troilite. In chemical and mineral composition it is very similar to the Baroti meteorite previously described.—Dr. G. T. **Prior**: The remarkable similarity in chemical and mineral composition of chondritic meteoric stones. The close similarity presented by most chondritic meteoric stones, although generally recognised, has to some extent been obscured by the unduly elaborate classifications which have been devised. A review of the quantitative mineral composition of forty-two chondritic stones and a critical examination of the published analyses of others lead to the conclusion that almost all those at present known are, except for some variation in the amount of nickeliferous iron, practically identical in chemical and mineral composition, the identity extending even to the chemical composition of the individual constituents. They approximate to the type with the following percentage mineral composition:—Nickel-iron (Fe : Ni = 10), 9; troilite, 6; olivine (Mg : Fe = 3), 44; bronzite (Mg : Fe = 4), 30; felspar, 10; chromite, &c., 1.—Arthur **Russell**: Notes on the minerals occurring in the neighbourhood of Meldon, near Okehampton, Devonshire. The principal species are datolite, in crystals sometimes $2\frac{1}{2}$ cm. in length, sea-green in colour, and nearly transparent, polysynthetically developed, and showing a cleavage parallel to 001; apophyllite, in three types—square, tabular, and pyramidal; pyrrhotite, in thin hexagonal plates; tourmaline, in black, brown, green, blue, and pink crystals, sometimes zoned; garnet, in colourless cubo-dodecahedra, and trapezohedra, sometimes including wollastonite hairs; wollastonite, abundantly in pure white, fibrous masses.—J. B. **Scrivenor**: A calcium-iron-garnet from China. It is interesting on account of its unusually easy solubility in hydrochloric acid without ignition.

Mathematical Society, November 13.—G. T. **Bennett**: The skew-isogram mechanism.—G. H. **Hardy** and J. E. **Littlewood**: Tauberian theorems concerning power series the coefficients of which are positive.—G. H. **Hardy**: Lambert's theorem.—J. E. **Campbell**: (1) The connection between surfaces the lines of curvature of which are spherical and surfaces the inflectional tangents of which belong to linear complexes. (2) Surfaces the systems of inflectional tangents of which belong to systems of linear complexes.—W. H. **Young**: Integration with respect to a function of bounded variation.—W. W. **Johnson**: The computation of Cotes's numbers, and their values up to $n=20$.—S. G. **Soal**: Some ruler constructions for the covariants of a binary quantic.—T. C. **Lewis**: Analogues of orthocentric tetrahedra in higher space.

PARIS.

Academy of Sciences, November 10.—M. F. Guyon in the chair.—Emile **Picard**: Remarks concerning an integral equation considered by M. Charlier.—H. **Deslandres** and L. **d'Azambuja**: The action of a magnetic field on the ultra-violet band spectrum of water vapour. A new property of the regular series of lines forming the band. The third group of the nitrogen bands shows the Zeeman effect; under similar conditions the water vapour band is not doubled by the magnetic field, but all the lines constituting the band are displaced.—Armand **Gautier**: Fluorine as a constant element in the emanations from the earth's crust. Fluorine (probably as hydrofluoric acid) has been detected and estimated in the gases from a fumerolle at Vesuvius, in the proportion of about one part in 10,000. Fluorine has also been found in the fumerolles of Tuscany.—E. **Jungfleisch** and Ph. **Landrieu**: Researches on the acid salts of dibasic acids. The dextrorotatory camphorates: the potassium camphorates.—C. V. L. **Charlier**: Terrestrial refraction and the constitution of the atmosphere.—M. **Fessenkoff**: The equatorial acceleration of the sun.—MM. **Chipart** and **Liénard**: The sign of the real part of the roots of an algebraic equation.—Georges **Pólya**: An algorithm always convergent to obtain polynomials with the best approximation of Tcheby-

chef for any continuous function.—E. **Goursat**: Some singular integral equations.—R. **Boulouch**: Homographical relations between systems of centred spherical dioptres. Singular stigmatic points.—Emile **Baud**: Relation between the heat of formation of binary liquid mixtures and their composition. For mixtures of *cyclo*hexane and ethylene bromide the relation $q=kx(1-x)$ is shown to hold good, in which q is the quantity of heat evolved, x and $(1-x)$ are the fractions of the gram-molecule of each constituent for a gram-molecule of the mixture. k varies only from 1·30 to 1·35.—L. C. **Maillard**: The origin of the cyclic bases of coal tar. Amino-acids combine with sugars giving humus bodies which yield pyridine bases on dry distillation. These facts are applied to the formation of coal and to explain the products of its pyrogenic decomposition.—Marcel **Sommelet**: A mode of decomposition of the halogen alkylates of hexamethylene-tetramine. An aqueous solution of the chlorbenzylate of hexamethylene-tetramine when boiled gives benzaldehyde as the main product of its decomposition. The homologous toluic aldehydes are formed in a similar manner. The course of the reaction cannot be readily followed.—C. **Gaudefroy**: The dehydration figures of potassium oxalate.—G. **André**: The displacement of potassium contained in certain felspathic rocks by some substances employed as manure. Various salts, triturated in aqueous solution with felspar, bring into solution notably larger quantities of potassium than would be obtained with water alone, ammonium sulphate, and calcium acid phosphate producing the greatest effect.—A. **Maublanc** and E. **Rangel**: *Stilbum flavidum*, a parasite of the coffee plant, and its place in classification.—G. **Barthelat**: The fruit of Mesembryanthemum and its dehiscence.—P. **Chaussé**: The determination of the minimum infectious dose in tuberculosis by inhalation.—C. **Levaditi**: Presence of the treponeme in the blood in general paralysis. The living organism was definitely proved to be circulating in the blood of patients suffering from general paralysis. The blood in these cases gave a positive Wassermann reaction.—Y. **Manouélian**: The existence of Negri's corpuscles in the nerve ganglia of the salivary glands in animals suffering from rabies. Sections of the salivary glands showed large numbers of Negri's corpuscles in the cytoplasm of the nerve cells only; no other constituent of these glands showed the corpuscles.—Maxime **Ménard**: A certain means of avoiding Röntgen-ray burns. A description of special screens and gauntlets, together with a proof of the real immunity from X-ray burns obtained by their use.—M. **Dantan**: The fecundity of *Ostrea edulis*.—A. **Trillat** and M. **Fouassier**: The conditions of transport of micro-organisms by the air. Experiments leading to the conclusion that micro-organisms can be transported by air without the intervention of mechanical projection. This view is opposed to ideas currently held.—Charles **Lepierre**: The uselessness of zinc for the culture of *Aspergillus niger*. The mould grows and reaches a normal weight when zinc is absent from the culture medium.—J. **Stoklasa**: The influence of radio-activity on nitrogen fixing micro-organisms, or on those transforming nitrogenous materials.—Sabba **Stefanescu**: The ramification of the dental tubercles of the molars of Elephas, Stegodon, and Mastodon.

BOOKS RECEIVED.

Die Wissenschaft. Band 48. Die Entwicklung des Temperaturbegriffs im Laufe der Zeiten. By K. Meyer. Uebersetzt aus dem Dänischen by I. Kolde. Pp. 160. Band 49. Das Leuchten der Gase und Dämpfe. By Dr. H. Konen. Pp. xiv+384. (Braunschweig: F. Vieweg und Sohn.) 4 and 12.50 marks respectively.

Lehrbuch der Meteorologie. By Dr. J. Hann. Unter Mitwirkung von Prof. R. Süring. 3 Auflage. Lief. 1. (Leipzig: C. H. Tauchnitz.) 3.60 marks.

Memoirs of the Geological Survey, Scotland. The Geology of the Fannich Mountains and the Country around Upper Loch Maree and Strath Broom. (Explanation of Sheet 92.) By B. N. Peach and others, and Petrological Notes by Dr. J. J. H. Teall. Pp. 127+vi plates. Also Sheet 92. (London: H.M.S.O.; E. Stanford, Ltd.) 2*s*. 6*d*. each.

Elemente der exakten Erblichkeitslehre mit Grundzügen der biologischen Variationsstatistik. By Dr. W. Johannsen. Zweite Deutsche Ausgabe in 30 Vorlesungen. Pp. xi+723. (Jena: G. Fischer.) 13 marks.

The Holiday Nature-Book. By S. N. Sedgwick. Pp. 355. (London: C. H. Kelly.) 3*s*. 6*d*.

The Courtship of Animals. By W. P. Pycraft. Pp. xvi+318+40 plates. (London: Hutchinson and Co.) 6*s*. net.

Farm Gas Engines. By Prof. C. F. Hirshfeld and T. C. Ulbricht. Pp. vii+239. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

Underground Waters for Commercial Purposes. By Dr. F. L. Rector. Pp. iv+98. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

The Government of Man: an Introduction to Ethics and Politics. By G. S. Brett. Pp. xiv+318. (London G. Bell and Sons, Ltd.) 3*s*. 6*d*. net.

British and Colonial Dairying for School, Farm, and Factory. By G. S. Thomson. Pp. xi+464. (London: Crosby Lockwood and Son.) 5*s*.

Transactions of the Rochdale Literary and Scientific Society. Vol. xi., 1912–13. Pp. 134+xxii. (Rochdale.)

Vorlesungen über landwirtschaftliche Bakteriologie. By Dr. F. Lohnis. Pp. viii+398+plates. (Berlin: Gebrüder Borntraeger.) 16 marks.

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104. Oceanographische en Meteorologische Waarnemingen in den Indischen Oceaan. December, January, February (1856–1910). Tabellen. Pp. 222. Kaarten. Plates 25. (Utrecht: Kemink aand Zoon.) 6.50 florins.

Regenwaarnemingen in Nederlandsch-Indië. Drie en Dertigste Jahrgang 1911. Deel ii. Uitkomsten. Pp. xi+214. (Batavia: Landsdrukkerij.)

Desert and Water Gardens of the Red Sea. By C. Crossland. Pp. xv+158+plates. (Cambridge University Press.) 10*s*. 6*d*. net.

The "Wellcome" Photographic Exposure Record and Diary, 1914. Pp. 280. (London: Burroughs, Wellcome and Co.)

Mildews, Rusts, and Smuts. By G. Massee, assisted by I. Massee. Pp. iii+229+iv plates. (London: Dulau and Co., Ltd.) 7*s*. 6*d*. net.

Popular Natural History. By H. Scherren. New edition. Pp. vii+376+13 plates. (London: Cassell and Co., Ltd.) 3*s*. 6*d*.

Camping in Crete, with Notes upon the Animal and Plant Life of the Island. By A. Trevor-Battye. Including a Description of Certain Caves and their Ancient Deposits. By D. M. A. Bate. Pp. xxi+308+plates and map. (London: Witherby and Co.) 10*s*. 6*d*. net.

Spencer's Philosophy of Science. The Herbert

Spencer Lecture. By Prof. C. Lloyd Morgan. Pp. 53. (Oxford: Clarendon Press.) 2s. net.

The Celebration of the Two Hundred and Fiftieth Anniversary of the Royal Society of London, July 15–19, 1912. Pp. 128. (London: The Royal Society; Oxford University Press.) 5s. net.

The British Bird Book. Edited by F. B. Kirkman. Section xii. Pp. 405 to 692+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10s. 6d. net.

How to Enter the Civil Service. By E. A. Carr. New edition. Pp. xii+260. (London: A. Moring, Ltd.) 2s. 6d. net.

The Progress of Scientific Chemistry in Our Own Times. By Sir W. Tilden. Second edition. Pp. xii+366. (London: Longmans and Co.) 7s. 6d. net.

A Laboratory Manual in Physics. To accompany Black and Davis's Practical Physics for Secondary Schools. By N. H. Black. Pp. x+117. (London: Macmillan and Co., Ltd.) 1s. 8d. net.

Physics: an Elementary Text-Book for University Classes. By Dr. C. G. Knott. Third edition, revised and amplified. Pp. vi+370. (London and Edinburgh: W. and R. Chambers, Ltd.) 7s. 6d.

Die Natur als Künstlerin. By Ernst Haeckel. Together with Formenschatz der Schöpfung, by Dr. W. Breitenbach. Pp. 114. (Berlin: Vita Deutsches Verlagshaus.)

A Description of the Imperial Bacteriological Laboratory, Muktesar: its Work and Products. By Major J. D. E. Holmes. Pp. 47+plates. (Calcutta: Superintendent, Government Printing, India.) 8 annas, or 9d.

Index Kewensis Plantarum Phanerogamarum. Supplementum Quartum. Pp. 252. (Oxford: Clarendon Press.) 36s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—*Medullosa Pusilla*: Dr. D. H. Scott.—Neuromuscular Structures in the Heart: Prof. A. F. S. Kent.—The Alleged Excretion of Creatine in Carbohydrate Starvation: G. Graham and E. P. Poulton.—The Origin and Destiny of Cholesterol in the Animal Organism. XI. The Cholesterol Content of Growing Chickens under Different Diets: J. A. Gardner and P. E. Lander.—Contributions to the Biochemistry of Growth—The Lipoids of Transplantable Tumours of the Mouse and the Rat: W. E. Bullock and W. Cramer.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Treatment of Tin Ores in Cornwall: A Description of the Geevor Mill: H. G. Nichols.—The Occurrence of Gold in Ontario: J. B. Tyrrell.

LINNEAN SOCIETY, at 8.—The Travels of Sir Joseph Hooker in the Sikkim Himalaya: H. J. Elwes.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Cutting Power of Lathe Turning Tools: Prof. W. Ripper and G. W. Burley.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Electrical Maintenance: T. A. St. Johnston.

MONDAY, NOVEMBER 24.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations on the Eastern Karakoram: Mrs. Bullock Workman and Dr. Hunter Workman.

INSTITUTE OF ACTUARIES, at 5.—Approximate Valuation of Endowment Assurances: W. P. Elderton.

TUESDAY, NOVEMBER 25.

ZOOLOGICAL SOCIETY, at 8.30.—The External Characters and Biology of Bryde's Whale, a New Rorqual from the Coast of South Africa: Ørjan Olsen.—A New Species of Trematodes of the Genus Lechriorchis from the Dark Green Snake (*Zamenis gemonensis*): Miss M. V. Lebour.—Cirripedes from the Cenomanian Chalk Marl of Cambridge: T. H. Withers.—The Peroneal Muscles in Birds: Dr. P. Chalmers Mitchell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Construction of the "White Star" Dock and adjoining Quays at Southampton: F. E. Wentworth-Sheilds.

WEDNESDAY, NOVEMBER 26.

ROYAL SOCIETY OF ARTS, at 8.—Zoological Gardens: Dr. P. Chalmers Mitchell.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Tuareg: M. Fr. de Zeltner.

INSTITUTE OF CHEMISTRY (Imperial College of Science, South Kensington), at 8.—The Research Chemist in the Works, with Special Reference to the Textile Industry: W. P. Dreaper.

THURSDAY, NOVEMBER 27.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: A Method of Measuring the Pressure Produced in the Detonation of High Explosives or by the Impact of Bullets: Prof. B. Hopkinson.—Gravitational Instability and the Nebular Hypothesis: J. H. Jeans.—The Diffraction of Light by Particles comparable with the Wave-length: B. A. Keen and Prof. A. W. Porter.—Note on the Colour of Zircons, and its Radio-active Origin: Prof. R. J. Strutt.—The Influence of the Constituents of the Crystal on the Form of the Spectrum in the X-ray Spectrometer: Prof. W. H. Bragg.—The Analysis of Crystals by the X-ray Spectrometer: W. L. Bragg.—*And other Papers*.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Characteristics of Insulation Resistance: S. Evershed.

CONCRETE INSTITUTE, at 7.30.—Steel and Reinforced Concrete Chimneys: H. Cane.

FRIDAY, NOVEMBER 28.

JUNIOR INSTITUTION OF ENGINEERS, at 8. Patent Protection: A. Abbey.

PHYSICAL SOCIETY, at 5.—The Expansion of Silica: Prof. H. L. Callendar.—The Thermal Expansion of Mercury and Fused Silica: F. J. Harlow.—An Experimental Method for the Production of Vibrations on Strings. Prof. J. A. Fleming.—A Double-fibre String Galvanometer: W. Apthorpe.

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