THURSDAY, JULY 29, 1909.

HOW TO DIAGNOSE GENIUS: A STUDY OF HUMAN ENERGETICS.

Grosse Männer. By Prof. Wilhelm Ostwald. (Leipzig: Akademische Verlagsgesellschaft, 1909.)

THIS book is a study in comparative biography, and may be said to point the way to a new field of investigation. Prof. Ostwald was prompted to write it, as he tells us in his first sentence, by an ingenuous question put to him by one of his Japanese students as to how budding geniuses could be recognised. Much money, his student went on to say, is spent by various Governments in attempting to discover those people whose thorough education may be expected to bring in a return of value to the State, and the question how best to discover latent genius is an eminently practical one. After cogitation, Prof. Ostwald came to the conclusion that it is those students who cannot be kept on the rails—that is, who are not contented with methodical teaching—who have within them the seeds of genius; and the writer's experience would lead him to the same conclusion.

But in order to lay a basis for such a deduction, vague, to some extent, because derived only from personal impressions, a careful comparison has been made of the lives of six men, all of whom had a great influence on the thought of their time. These are:—Davy and Faraday; Julius Robert Mayer, who shares with Joule the honour of having shown the equivalence of heat and work; Liebig; Gerhardt, who, in his day, contributed to the revolution in chemical thought; and Helmholtz.

These names belong to men of science, exclusively; the reason for the choice is perhaps to be found in words penned by Liebig:—

"The history of the nations teaches us of the futile efforts of powers, political and ecclesiastical, to maintain spiritual and bodily slavery over mankind; future history will deal with the conquest of liberty, gained by the investigation of the reason of things, and of truth; a conquest gained by weapons unstained with blood, and on a field in which religion and morals take part only as feeble allies."

This, it may be remarked, is prophecy, and, as such, is at present beyond criticism; it may, however, be pointed out that to some of us, at least, the prospects held out by the remarkable conquests over what used to be called "the forces of nature" do not at present point to a speedy millennium. However, the retort is open that it is not the spread of the teachings of science, but a disregard for such teachings, which is the reason that our moral progress does not keep pace with our material progress.

Be that as it may, Prof. Ostwald has given, in his masterly style, delightful sketches of the lives of these undoubtedly distinguished men. The biographies differ somewhat from the usual "lives," inasmuch as the failings, as well as the virtues, of the subjects have been touched on. No character is perfect, and, without ample knowledge, it is impossible to attempt to draw just conclusions.

One notable characteristic of men of genius is that it is rare for them to have come from either a high or a low grade of society. Exceptions are confined practically to England and France, as witness Boyle, Cavendish, and Lavoisier; Faraday might perhaps be instanced as an example—almost the sole example—of the second class.

Another characteristic is the very early age at which such men develop. Goethe was twenty-four years old when he electrified the German nation by his "Sorrows of Werther"; Schiller was twenty-two when he published "The Robbers"; Newton had invented the calculus, discovered the law of gravitation, and had completed his analysis of light before his twenty-fifth year; Linnæus had evolved his sexual system of plants at the age of twenty-four; and the list might be extended indefinitely, to Carnot, Clausius, Scheele, Berzelius, Vesalius, the reformer of the science of anatomy, the physiologists Ludwig, Helmholtz, and Du Bois Reymond, to, last, though not least, Kelvin. Youths who make their mark at a later age, as already remarked, show a distaste for the formal instruction which is still given in the public schools of Germany and England. In this connection it is interesting to note the saying of a writer on English public schools, himself once a distinguished headmaster, that, while a classical or mathematical master does not fall off, indeed improves, with age, inasmuch as he perfects himself in methods of teaching practically unprogressive branches of learning, the science masters cannot but deteriorate, unless they keep abreast with the progress of science by increasing its bounds by their own efforts. Prof. Ostwald takes a strong view of the inutility of the training to be acquired from a linguistic, especially a classical, education, and believes that the usual duration of school life is far too great. In this the writer heartily concurs.

"Had Kelvin or Leibnitz been so unfortunate as to have come into the world in our days, and in Germany, their early development would have been of no avail; they would have sat on the school benches till their eighteenth year—an age at which they had gained a prominent position in science."

The temperaments of the men whose lives are chronicled may be divided under two heads, "Klassiker," or "phlegmatic," to quote an old classification, and "Romantiker," or "sanguine." To the former class belonged Faraday, Mayer, and Helmholtz; to the latter Davy, Liebig, and Gerhardt. These temperaments correspond to the rate of reaction to external stimulus. The romantic type is eager, alert, impatient, and impulsive; the classic type painstaking, conscientious to a fault, self-criticising, and accurate. It is remarked on as curious that most men who have achieved greatness belong to one or other of these classes; it would appear that average minds, who occupy a mean position, being neither very impulsive nor very critical, have not the qualities which raise them above their fellows.

The "yield" of such minds, to use an expression borrowed from chemical manufacture, depends, according to Ostwald, on their "economic coefficient." To transform one kind of energy into another implies the "degradation" of a portion; this is the second

law of thermodynamics. Born into the world with the usual amount of energy, *i.e.* capacity for work, some minds are so constituted as to transform a large portion of it so that it is of service to humanity, while a comparatively small portion is, as it were, wasted. The sum of the action of such minds constitutes human progress. It is necessary that the progress of the individual genius should be hindered as little as possible by artificial and unnecessary obstacles, and it would appear that in some countries the path is made easier than in others. Taking the membership of national academies as a test, if only a rough one, of scientific eminence, the proportion of distinguished men to the inhabitants, reckoned in millions, is in Saxony 0·2, in Baden and Norway 0·25, in Switzerland 0·33, in Holland and Bavaria 0·41, in England and Prussia 0·49, in France 0·79, in Italy 2·17, in Austria 2·7, in the United States 3·08, and in Russia 16·3; that is, for example, there is in Russia only one member of international academies to 16·3 million inhabitants. It can hardly be doubted that this low number is due to the hindrances which stand in the way of the progress of youths who might, in Russia, display genius, and enrich the world by their efforts.

It is impossible to review such a book as this satisfactorily in a short article. It teems with interest, not only on account of the intrinsic attractiveness of the subject, but also because of the masterly grasp of it displayed by the author. Whatever Prof. Ostwald writes is sure to interest, owing to the originality of his mind and his lucid and attractive method of presentment. On every page there occurs some saying which excites attention, even although the reader may sometimes be disposed to challenge the conclusions drawn. The questions discussed are well worth the most careful consideration of all who have the welfare of humanity at heart. The problem considered is an eminently practical one—perhaps the most practical problem which exists—and we owe the author a debt of gratitude for having introduced it to us in such a charming manner. W. R.

SOME MEN AND MATTERS IN CHEMISTRY. Essays, Biographical and Chemical. By Sir William Ramsay, K.C.B., F.R.S. Pp. vii+247. (London: Constable and Co., Ltd., 1908.) Price 7*s.* 6*d.* net.

IT is good to read about the pioneers of science, their trials and their triumphs. Even it is good for the student who has to "grind" up facts about scientific worthies and serve them up hot to a voracious examiner; albeit in such a case it smacks strongly of "turning old heroes into unworthy potions," as Sir Thomas Browne remarks in discussing the medicinal virtues of mummies. At any rate, such a student would get some of the facts about his heroes pleasantly enough in reading what Sir William Ramsay has to say in the present volume concerning Boyle and Cavendish, Davy and Graham, Black, Kelvin, and Berthelot.

The essays are a collection of lectures and magazine articles published, the author tells us, at various times during the last twenty-five years. It follows that they are of a popular character in the sense that little or no special knowledge on the part of the reader is assumed. They are somewhat unequal in scope and treatment, as may be inferred from the fact that the organs in which they first appeared included such diverse publications as the *Youth's Companion* and the Proceedings of the Royal Society.

Of the biographical essays, those upon Berthelot and Lord Kelvin seem to the present writer to show the author at his happiest. Perhaps that is because there is the personal note in them; for Sir William Ramsay was acquainted with the French *savant* as well as the English one. He gives us an attractive glimpse of the happy home life of the Berthelots. There was a touch of romance, too, about the meeting of young Marcellin Berthelot with his future wife, which is described in the essay, and which we may venture to quote almost in the author's words. Mademoiselle Breguet was beautiful and well-dowered, but presumably beyond Berthelot's reach. However, one day she was crossing the Pont Neuf in the face of a strong wind, wearing a charming Tuscan hat.

"Behind her walked her future husband; suddenly she turned round to avoid having her hat blown off, and practically ran into his arms. A case of love at first touch," says Sir William.

The stories of Boyle and of Cavendish will always appeal to chemists. The author describes and contrasts the work and character of the two men in an interesting little sketch. "Each was in advance of his age"; Boyle by reason of his calm philosophical spirit and clear judgment, Cavendish in his power of refined quantitative experiments and deductions. Neither was married; and the author, after reflecting that Boyle was too many-sided and Cavendish too reserved, remarks:—"It is perhaps legitimate to draw the conclusion that man's nature does not culminate in its best without the influence of a helpmeet." It may be so; but another conclusion, perhaps equally legitimate, is that if there had been a Mrs. Boyle and a Mrs. Cavendish there might have been no "Sceptical Chymist" and no "Experiments on Air." Black also, it may be noted, remained unmarried, though a particular favourite of the ladies. Perhaps they missed much, these three distinguished chemists, both in personal happiness and in perfection of character; but it may well be that their loss was mankind's gain, and that chemical science has cause to bless the circumstances which enabled them to pursue their researches with singleness of aim, undistracted by either the joys or the troubles of matrimony.

A sketch of the careers of Davy and Graham completes the essay on the "Great London Chemists." Space allows only a brief mention of the author's comparison of the four. Graham, with his philosophical mind, more resembled Boyle than Cavendish or Davy. While Cavendish carried his devotion to science so far that it deprived him of the ordinary pleasures of a human being, and while Davy, in relation to fashion, could not escape the accusation of playing to the gallery, Graham pursued a happy mean, beloved by his friends, esteemed by all. "Of him, as of Faraday, it might have been said with no shade of misgiving, 'He was a good and a true man.'"

The second half of the volume is devoted to essays on various chemical topics. A few titles will indicate their nature; thus there are "The Becquerel Rays," "What is an Element?" "Radium and its Products," and "The Aurora Borealis." This last is an interesting discussion of the evidence for regarding krypton as a noteworthy constituent of the aurora. An oration upon "The Functions of a University," delivered some eight years ago at University College, concludes the work, and ends with the remark:—

"As it exists at present, a University is a technical school for theology, law, medicine, and engineering. It ought to be also a place for the advancement of knowledge, for the training of philosophers, and of those who love wisdom for its own sake. . . ."

Surely; and if examples were wanted of men who loved wisdom for its own sake, who "scorned delights and lived laborious days" in pursuit of it, yet by whose labours was wrought incalculable material benefit to posterity, what better instances could be found than those of the pioneers of chemistry?

With two or three exceptions, neither the biographical nor the chemical essays pretend to be more than popular presentations of their several subjects, and if here and there they seem perhaps a trifle superficial and jejune, it is only fair to remember the circumstances of their production, and to recall the fact that some were written when their distinguished author's powers were less mature, by a quarter of a century's growth, than they are to-day.

C. SIMMONDS.

EXPERIMENTAL PSYCHOLOGY.

A Text-book of Experimental Psychology. By Prof. C. S. Myers. Pp. xvi+432. (London: Edward Arnold, 1909.) Price 8*s*. 6*d*. net.

THIS book supplies a want which has been long felt by both students and teachers. Until now there has been no text-book to meet the special needs of those attending a course of instruction in experimental psychology. There have been books on psychology written on an experimental basis which have differed little, if at all, from others not so characterised, and there have been handbooks for the laboratory, notably that of Titchener, but there has been no book which attempted to give in reasonable compass a general account of experimental methods and of the results which have been gained by the experimental movement in psychology. Such a book was needed for two classes of persons, for those definitely committed to the study of the subject, and for the large class of people who know that experimental psychology exists but do not know what it means.

It may be said at once that for each Prof. Myers's book will be of the greatest service. It gives a concise and yet clear account of what has been done by means of experiment in psychology, and it is surprising to find so vast an amount of information in a book of the size. At the same time, there has been admirable judgment in the selection of the material and in the discussion of the many thorny topics in which the science at present abounds. The only fault to be found is that its conciseness will make it difficult for the beginner, but this has been anticipated by the author, who has distinguished the more difficult parts by means of brackets to indicate that they should be left by the beginner for a second reading. Further, the last eighty pages are devoted to an illustrated description of laboratory exercises, and the performance of these will go far to remove any difficulty due to the conciseness of the main body of the text.

To pass to detail, the earlier chapters are devoted to the senses, and those on hearing are especially full. There is no other book in which a summary of the very important researches of recent years on this subject can be found. The accounts of the psychophysical and statistical methods, given under these titles and in the chapter on identity and difference, are admirably clear, though, perhaps, not enough stress has been laid on the use of the psychophysical methods for purposes other than threshold determination. These methods were devised with the idea that by their means sensation and other psychical states might be measured. They are, however, coming to be used more and more for the exact comparison of the effects of different conditions on mental processes in which there is no question of the actual determination of a threshold, either absolute or differential, and the attention of the student might have been more forcibly directed to this aspect of the use of the methods.

The subject of memory is very fully treated, it might be thought a little out of due proportion. The space devoted to it is, however, fully justified, for we have in this branch of the subject what is, perhaps, the greatest achievement of the experimental method in pure psychology apart from those advances which are rather physiological than psychological.

In a short chapter on muscular and mental work an excellent account is given of modes of research which are now taking a very important place in applied psychology and especially in pedagogy, and the author rightly insists on the difference between the mental work of laboratory methods and that of ordinary life. There is at present a great danger that the value of this line of work will suffer depreciation owing to premature application to practical problems. The last two chapters chiefly serve to show how little the experimental method has so far accomplished in the study of such subjects as attention and feeling.

It is to be regretted that want of space has not allowed the author to deal with the comparative and pathological sides of psychology so far as these can be studied by the methods of experimental psychology. The result of the perusal of this book, in which the accomplishments of the science have been so ably portrayed, is to confirm an impression that the experimental study of the developed mind will not take us very far, and that it is in the study of the developing mind and of the dissociations and destructions produced by disease that there lies the chief prospect of advance. It is to be hoped that the author will be able to deal with these subjects, either in another book or in a future expansion of the present volume.

Although this country has been very late in recognising the experimental movement in psychology, the

subject has at last succeeded in making a position for itself, and its existence is recognised in the chief universities of England and Scotland. Its further progress will certainly be assisted by this able account of the methods and accomplishments of the science.

SPEECH.

The Science of Speech, an Elementary Manual of English Phonetics for Teachers. By Benjamin Dumville. Pp. xii+207. (Cambridge: University Tutorial Press, Ltd., 1909.) Price 2*s.* 6*d.*

THIS is a concise, accurate, and interesting little manual, written by one who is evidently a master of the subject of phonetics, and knows how to communicate information. Nowhere have we seen so good an account of the muscular movements and the positions of the articulating apparatus. The book is intended for teachers, who often, in these days, are required to teach the elements of phonetics, or, at all events, to train children in the art of correct pronunciation and good reading. It is not a book to be read hastily. It requires a careful experimental study of the movements described, with the aid of a mirror, but the descriptions are so clear and the methods so simple and convincing that the accurate knowledge acquired will well repay all the trouble. The nature of vowels, consonants, diphthongs, digraphs, the distinction between voice and whispering, the various kinds of whispers, and the nature of the aspirate are fully explained.

There is an interesting chapter on the sounds in connected speech, such as accent, emphasis, intonation, assimilation, and variations in pitch. The author, perhaps, scarcely attaches the importance to pitch, or rather to variations in pitch in the words or syllables of a spoken sentence, which we are inclined to do, and which is brought out in a striking way when the vibrations of the sounds of a sentence are recorded on a rapidly moving surface. We are much interested in the chapter on "The Organic Basis of English," which must appeal to physiologists, the point being that, by repetition, during the early period when speech is acquired, a kind of habit is imposed on the articulating organs, and, we would add, on the nerve centres involved; this will be determined by the sounds the child imitates, or is taught to pronounce. There will thus be a kind of organic habit for each language, a consideration that may explain how difficult it is for one trained from early days in the English language to acquire, in later life, the true intonation of good French. The author gives a striking illustration, p. 141, of the difference between the English *t* and its French equivalent, so that an Englishman uttering the sentence *Ton thé t'a-t-il ôté ta toux?* (Has your tea taken away your cough?) would probably not give the *t* the peculiar softness or quality that can only be obtained by pronouncing the *t*, as the French do, by starting with the tip of the tongue from the back of the front teeth, instead of a little behind, as is done in English speech (see Fig. 27).

The last two chapters deal with spelling reform and with the important pædagogic question of whether a phonetic training is helpful to children who are learning to read. We will not follow the author here, but be content with stating that he presents his arguments forcibly but with fairness. Children must at first be taught by the ear alone, and by frequent repetition; sounds that are distinctly bad, like the peculiar tone of many resident in London or in the south, or the nasal drawl of the west of Scotland, must be got rid of; and the ear of the child must hear, at all events during school hours, the tones of pure English. In not a few cases, probably, the work of the teacher may be undone by the sounds of the child's home. The author refers briefly to the use of the phonograph. The intonation of the gramophone is far superior, and we would advise that the Gramophone Company should be induced to take, say, a dozen records from highly trained and correct voices, illustrating the tones of pure and undefiled English. These would be of immense service to teachers. The Gramophone Company has a record of the voice of the late Canon Fleming, uttering some of the prayers in the Morning Service of the Church of England, which fully illustrates what we mean.

It is a pity that a better set of symbols for phonetic speech sounds has not been invented. Some are very grotesque, but, still worse, with a weak eyesight, some of the symbols are difficult to discriminate. The symbols of Graham Bell seem to us to be better than those mostly in vogue, and it is only right to mention that these are used by so high an authority as Mr. Sweet in his "Primer of Phonetics." Mr. Dumville is to be congratulated on having produced an excellent book on what is truly the *science* of speech.

JOHN G. MCKENDRICK.

A TEXT-BOOK OF OTOLOGY.

Lehrbuch der Ohrenheilkunde für Ärzte und Studierende. By Dr. Paul Ostmann. Pp. viii+533. (Leipzig: Verlag von F. C. W. Vogel, 1909.) Price 18 marks.

THE name of Dr. Paul Ostmann is well known to otologists, not only in Europe, but in the British Islands and the United States. A text-book upon diseases of the ear from his pen is, therefore, welcome, even though it be disappointing. Like all text-books which hail from the German Empire, however, it is marked by that peculiar German conceit which, whilst giving ample prominence to the work of compatriots, ignores, or, at the most, dismisses with curt comment, that of equally prominent scientific labourers of other countries. Dr. Paul Ostmann's text-book abounds with references to German aural surgeons, but in all its 533 pages only some seventeen British or American otologists receive mention, and the names of some of these are spelled incorrectly. Picking out, from motives of curiosity, the names quoted from among those surgeons who belong to our own country, we find that Handfield Jones, Toynbee, Hinton, Ogston, Macewen, Walker Downie, Dundas Grant, and Yearsley alone receive acknowledgment for their work, whilst Cheatle, Pritchard, Barr, and many other names of equal lustre in the domain of diseases of the ear are ignored completely. In a work issued at the present time, when so much that is of lasting

value has been done for the advancement of otology, one expects to find mention at least of that which fairly may be described as epoch-making. Yet the pioneer work of Lake, Marriage, Armour, and Yearsley in operations upon the labyrinth for the relief of distressing and incurable vertigo and tinnitus receives no attention, whilst the still more recent researches of Bárány are barely noticed, and those of West, Scott, Crum-Brown, and Alexander are passed over in silence.

For the work as a text-book we can speak with moderate approbation. There is no dissertation upon anatomy to swell the book, but the author plunges straightway into methods of examination and diagnosis. This portion is not too much padded with unnecessary pictures of instruments, and the diagrams are adequate, with the exception of Fig. 13, which is exaggerated and wholly unnatural. A considerable number of pages is devoted to the functional testing of the ears, and this appears to be treated very fully and exhaustively. In dealing with anomalies of the hearing, a series of useful charts is given from actual cases. In treating of the various diseases of and operations upon the ear, we can find no mention of the use of the hand-gouge in place of the chisel and mallet in performing operations upon the mastoid, an improvement in technique which we owe to British surgery. We fully approve of the classification of otosclerosis with diseases of the bony labyrinthine capsule. This is a distinct advance upon those text-books which continue to describe it as a middle-ear condition.

An excellent section deals with the effects of general diseases upon the ear, and another is devoted to the toxic effects of quinine, the salicylates, iodide of potassium, arsenic, aspirin, chloroform, tobacco, alcohol, mercury, silver, carbon dioxide, and phosphorus. Sections such as these are so rarely met with in the works of specialists that they deserve unstinted praise.

It is disappointing to find so important a subject as deaf-mutism dismissed in four pages.

The volume is an average text-book, and deals with its subject in an average manner, but it does not add markedly to the now voluminous literature of otology. As a guide for the student and junior practitioner, it will, no doubt, find a useful place.

OUR BOOK SHELF.

Zenographical Fragments, II. The Motions and Changes of the Markings on Jupiter in 1888. By A. Stanley Williams. Pp. xiii+104; 9 plates. (London: Taylor and Francis, 1909.)

MR. WILLIAMS has been known for about thirty years as a very painstaking planetary observer, and, considering the small sizes of his telescopes (5¼-inch and 6¼-inch reflectors), his results have been remarkable in their comprehensiveness and importance. To Jupiter especially Mr. Williams has devoted attention, and, as a continuation or supplement to the "Zenographic Fragments" which he published twenty years ago, and dealing with his observations in 1887, has now issued a similar contribution for 1888. The individually observed transits of the various spots are given, and the periods of rotation are derived and compared with the results of 1887 and subsequent years. In 1888 the number of spots followed with sufficient fulness and accuracy to enable their rotation period to be well determined was 76. Of these, 48 were equatorial markings, and 15 were north tropical spots. The power used on the telescope was 150, and consisted of a single plano-convex lens. The planet was badly situated for observation, its meridian altitude only slightly exceeding 20° even in the south of England.

Notwithstanding the difficulties encountered, however, Mr. Williams succeeded in securing a mass of useful observations, the number of spot-transits recorded being 888. These are carefully discussed, and the results presented in a series of tables. The rotation periods deduced during the opposition of 1888 are included with many others by Mr. Williams and other observers in later years in summaries exhibiting the changes of relative velocity from year to year. It is by comparisons of this character extending over a long period of time that we may hope finally to unravel the problem offered by the changing scenery of Jupiter's vaporous envelope and by the remarkable series of different currents circulating in various latitudes. A number of painstaking observers, including Mr. Williams, Prof. Hough, Major Molesworth, Rev. T. E. R. Phillips, Mr. Bolton, and others, have accumulated extensive materials, to this end, during the past quarter of a century, but much more remains to be done.

The comparisons which Mr. Williams has instituted at the end of his volume are not so valuable as they might have been in consequence of omissions in quoting the results of various observers. Thus, in the table of rotations of spots in the south equatorial current, Mr. Phillips's values for 1898 and 1906–7 are given, but similar figures for the intervening years are not mentioned at all. Similarly the writer's rotation periods for 1905–6 (*Monthly Notices*, vol. lxvi., p. 434) are altogether omitted. On the whole, however, Mr. Williams's new contribution to zenographic study is very valuable and ably executed. There are few typographical errors, and the volume is well got up, while the illustrations are excellent, though the differences between the light and dark markings are intensified, perhaps purposely, to assist the eye in noting the details more readily.

W. F. D.

Introduzioni Teoriche ad Alcuni Esercizi Pratici di Fisica. By Alfonso Sella. Edited by A. Pochettino and F. Piola. Pp. viii+133. (Firenze: Successori Le Monnier, 1909.) Price 2.50 lire.

THIS is a short treatise on a few selected subjects of practical physics. They comprise the testing of a balance and calibration of a thermometer tube, the measurement of specific heat by the method of mixtures, the determination of the constants of a ruled grating, the measurement of magnetic field-intensity and its horizontal component, and the use of the Wheatstone bridge and the quadrant electrometer. The various problems involved are treated very fully, but in a purely theoretical manner, evidently intended to point out to the instructor the difficulties and limitations likely to be encountered. Thus, in the determination of a magnetic field, the lack of uniformity is dealt with at exceptional length, and the mathematical reasoning is given in full at every step. In the measurement of the magnetic quantities M and H, account is taken of such sources of error as the rigidity of the suspending fibre, and the variation of the magnetic moment and the moment of inertia with the temperature. In adding the dimensional equations, the author unfortunately adheres to the old practice of expressing them in terms of M, L, and T only. That $M/H=L^3$ (*recte* L^3) implies that it has something to

do with a volume, but conveys no information concerning the physical constitution of the quantities in question.

The whole of the work dealt with belongs to the second term of the physics course in the University of Rome. The author compiled it while yet Prof. Blaserna's assistant. His untimely death after succeeding to the chair prevented him from publishing it himself, but that duty has been admirably carried through by his two able disciples.

Azimuth. By G. L. Hosmer. Pp. v+73. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 4*s.* 6*d.* net.

THIS work is avowedly not a text-book; it is a handbook for the practical surveyor, and, as such, should prove very useful. Prof. Hosmer gives just the ordinary methods for checking the angles of a survey by observation of the sun and stars, but the book is removed from the commonplace by the conciseness of its instructions and the numerous practical hints given at all the necessary points. The tables for computing the results are given in the latter part of the book, and the examples are worked out on specimen forms calculated to obviate clerical errors.

The book is nicely printed, illustrated with useful diagrams, and well bound. These features, combined with its handy size, make it a very useful work for the practical surveyor to carry with him as a pocket-book for easy reference. W. E. R.

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.]*

Notes on a Stone Circle in County Cork.

IN view of several references made in NATURE lately to stone circles in Ireland (vol. lxxix., p. 488, February 25), the following notes on one situated at Drumbeg, near Glandore, County Cork, may prove of interest, especially as this circle contains the characteristic "recumbent stone" of the "Aberdeenshire" type in the south-western half of its circumference, a feature not hitherto met with outside that locality.

Drumbeg Circle. Recumbent stone and supporters, viewed from centre of circle, showing notch in hills (solstitial sunset line).

The accompanying photograph shows this stone and its supporters, of which the following dimensions may be given:—recumbent stone, 7 feet long, 1 foot 8 inches deep, 2 feet 6 inches high; right supporter, 4 feet 8 inches high, 1 foot 9 inches deep, 3 feet wide; left supporter, 5 feet high, 1 foot 6 inches deep, 3 feet wide.

The circle stands on a hill-side facing the sea, upon an artificial plateau with a well-defined edge, 160 feet long, on the southern (seaward) side. This edge, otherwise straight, is indented by a "cove" 20 feet in length, directed towards the centre of the circle, which it almost touches externally on its southern side.

A row of four small ovals, and mounds of stones (probably burial-sites), lie in a line a short way outside the plateau to the south-eastward. The remains of (?) a hut-circle of rough stones occur at a distance of 170 feet westward from the main circle, and there is a large solitary outlying boulder situated on a small eminence 100 feet to the north-eastward.

The following astronomical features (sight-lines) are observable in the above remains:—

(1) From the recumbent stone; solstitial summer sunrise over one of the two most important stones of the circle; sky-line elevated 3° 40′. (This line passes almost over the outlying boulder.)

(2) From the same position, May sunrise over the second of the two important stones; hill-line elevated 2° 20′.

(3) From same position (or from centre of circle, see photograph), solstitial winter sunset over a conspicuous gap in the hills, distant one mile.

(4) Edge of the plateau lies in the line of May sunrise or November sunset.

(5) Side of the cove is directed to the solstitial summer sunset over centre of circle, nearly.

(6) Line of stone ovals, outside plateau, is practically that of May-sunrise.

(7) From centre of (?) hut circle, over the northernmost stone of circle (a slab with a rounded profile, thus differing from the remainder, which are of "pillar" form), to the outlying boulder, is the May-sunrise line.

There are no indications of a burial-mound in the centre of the circle. BOYLE T. SOMERVILLE.

Admiralty Survey Office, Tenby, S. Wales.

Musical Sands in Chile.

THE interesting letter of Mr. Carus-Wilson, dealing with the existence of musical sands, suggests to me that some fact in my experience relating to this subject may be worth putting on record, and may, through the courtesy of your columns, possibly lead to the elucidation of an occurrence which has hitherto lacked explanation, at least in my mind.

Some few miles to the west of the town of Copiapo, in Chile, and, so far as my recollection of the locality carries me, about half a mile to the southward of the railway line, there is a tailing off of a ragged hill-range, which runs about north and south. In a ravine—it is too small to be called a valley—the sand which covers the greater part of that portion of Chile has, blown doubtless by the sea-breeze, been carried up the gully to which I refer, and lies there at a slope equal to the flowing angle of dry sand. The place is locally known by the name of "El Punto del Diabolo," as, given conditions of wind and weather, which time did not allow me to study, a low moaning sound, varying in intensity, can be heard for quite a quarter of a mile away. Amongst the superstitious natives the place is avoided. Thinking it worth a visit, I went there with the late Mr. Edwards, who was then the British Consul in that district. On our arrival we found that the sands were quite silent, but on making a glissade down the slope a gradually increasing "rumble" was heard, which increased in volume as the sand slid away before us. As the sound increased we were subjected to an undulatory movement, so decided that it was difficult

to keep one's balance, and as we both had heard that this sand had swept over an old silver mine, there was a clear impression on the minds of both that the vibration might break in the roof of the old workings. I write of this experience for what it is worth. I do not know whether the ground under the sand was hollow or solid, and although I have ventured to theorise on the subject, as yet I have found no satisfactory solution of this, to me, quite unique experience. M. H. GRAY.

Lessness Park, Abbey Wood, Kent.

The Æther of Space.

As one who has read with the greatest appreciation the work recently written by Sir Oliver Lodge on this subject, I take it that the following statements represent fairly well the condition of scientific opinion at the present time :—

(1) The fundamental units of which matter is composed are probably individualised regions of the universal æther, neither condensations nor rarefactions, but distinguished by some kinetic structure from the unmodified æther surrounding them.

(2) The æther, as a whole, is stationary, there being nothing of the nature of æther currents, but it possesses an exceedingly fine-grained circulation in closed curves, its elasticity being of kinetic origin.

(3) So far as the motion of a mass of matter is concerned, there is no ætherial viscosity, and, consequently, the earth carries no æther with it in its motion. We therefore live in an æther stream due solely to the earth's motion in space, and having the full value due to its velocity, the failure of Prof. Michelson's delicate experiment being due to a lessened cohesion (of electromagnetic origin) in any length of matter carried at right angles to the æther stream.

The question arises as to whether the æther which forms any mass of moving matter remains the same. Assuming the above statements, there appear to be two alternatives. Either the æther, distinguished by special structure, which composes the ultimate units of which matter is built up, has a bodily transfer through space, or the æther in the line of approach must be rapidly caught up in the advancing vortices (or whatever the structure may be), fused into their being, and as rapidly liberated along the line of recession.

If the former supposition be correct, there must be a region of slip in the æther surrounding the ultimate units (electrons); if the latter, we have the very interesting conception of matter being incessantly made and unmade as regards its fundamental units with a speed proportional to the velocity of motion. All the physical properties of a given mass of matter would remain constant, while the æther, the substratum of its existence, was changing.

If this reasoning be not in error, I shall be glad if Sir Oliver Lodge or any other physicist will indicate which of these views obtains acceptance.

CHARLES W. RAFFETY.

Wynnstay, Woodcote Valley Road, Purley, Surrey, July 15.

Botanical Surveys.

REFERRING to the review, in NATURE of July 15, of Mr. F. Morey's "Guide to the Natural History of the Isle of Wight," in which it is suggested that the Isle of Wight affords wide scope for a botanical survey on the lines followed by Dr. W. G. Smith and his school of plant-ecologists, it may be of interest to the reviewer and others to state that already the primary survey of the district has been completed and maps made by the writer, in association with the Central Committee for the Study of British Vegetation.

As suggested by "F. C.," a bare species list, even if complete, can do but scant justice to the variety of the vegetation of the Isle. Though in some types it is second in interest to the opposite mainland of South Hampshire, as, for example, in the calcareous grasslands and dry and wet heathlands, yet the almost full development of maritime associations and the diversity of the woodland formations do much to restore the balance.

The island has been under a long-continued civilisation, yet there still remain, almost untouched by man, several station-associations which, according to the plan of Prof. Conwentz, would be among the first to be scheduled as "natural monuments." In this last respect the island is but typical of much of Britain, and the regret expressed by your reviewer that the makers of county floras are not animated even by the spirit of Baker's "North Yorkshire" is shared by all who know the standing of British plant-ecology. To such it is sad that the period which saw the publication of Wheldon and Wilson's "West Lancashire" saw also the publication of the arid lists of many of the Victoria county histories, as of Lancashire itself. W. MUNN RANKIN.

Storey Institute, Lancaster, July 19.

The *Acarus Crossii*.

SOME months ago (NATURE, February 4) a correspondent directed attention to the account of Crosse's remarkable experiences when experimenting with electric currents, and the appearance of quantities of an acarus in the solutions treated, as fully narrated in Chambers's "Vestiges of the Footsteps of Creation," and the question was asked whether any explanation of such strange phenomena had ever been heard of. No reply seems to have been made, and, presumably, no recent attempts to investigate the mystery have taken place. It may be of interest to note that Chambers's account is fully corroborated in the "National Dictionary of Biography," and it appears that Crosse, though he did not make any suggestions as to "spontaneous generation," but merely related the facts and left explanations to others, found himself the victim of such a shower of abuse that he thenceforth entirely abandoned all research work and retired into obscurity. His experiments would probably have been forgotten but that they were repeated with complete success by another worker. Considering how much more easily prolonged electric action can nowadays be applied, would it not be well if someone would have the patience to repeat once more the exact conditions so amply described by Chambers, and so, if possible, clear up what is undoubtedly a very mysterious occurrence? CHARLES E. BENHAM.

28 Wellesley Road, Colchester, July 7.

Barisàl Guns in Australia.

IN NATURE of June 4, 1908 (vol. lxxviii., p. 101), under the title of "Barisàl Guns in Western Australia," you published a note from me describing a peculiar, loud detonation heard by my companions and myself while on the Strelley River, in the north-west of Australia. In reading Captain Sturt's "Two Expeditions into the Interior of Southern Australia during the Years 1828, 1829, 1830, and 1831," I find that, when camped on the newly discovered Darling River, near what is now the town of Bourke, in New South Wales, in February, 1829, a very similar sound was heard by the explorers. Sturt's words are as follows:—"About 3 p.m. on the 7th Mr. Hume and I were occupied tracing the chart upon the ground. The day had been remarkably fine, not a cloud was there in the heavens, nor a breath of air to be felt. On a sudden we heard what seemed to be the report of a gun fired at the distance of between five and six miles. It was not the hollow sound of an earthly explosion, or the sharp cracking noise of falling timber, but in every way resembled a discharge of a heavy piece of ordnance. On this all were agreed, but no one was certain whence the sound proceeded. Both Mr. Hume and myself had been too attentive to our occupation to form a satisfactory opinion; but we both thought it came from the N.W. I sent one of the men immediately up a tree, but he could observe nothing unusual. The country around him appeared to be equally flat on all sides, and to be thickly wooded: whatever occasioned the report, it made a strong impression on all of us; and to this day, the singularity of such a sound, in such a situation, is a matter of mystery to me" (2nd edition, 1834, vol. i., p. 98).

J. BURTON CLELAND.

Bureau of Microbiology, Sydney, New South Wales, June 19.

THE STONE CIRCLES OF KESWICK AND LONG MEG.[1]

IT has frequently been shown that the site on which a stone circle was erected was chosen with reference to the elevation of the northern horizon. At Keswick and Long Meg it appears that a further choice was exercised, in that, when possible, natural features were utilised in place of outlying stones or circles. In each case Arcturus rose in a well defined gap between two hills, whilst at Keswick, where the Pleiades were used for the May warning, the alignment passes over the crest of Great Mell Fell.

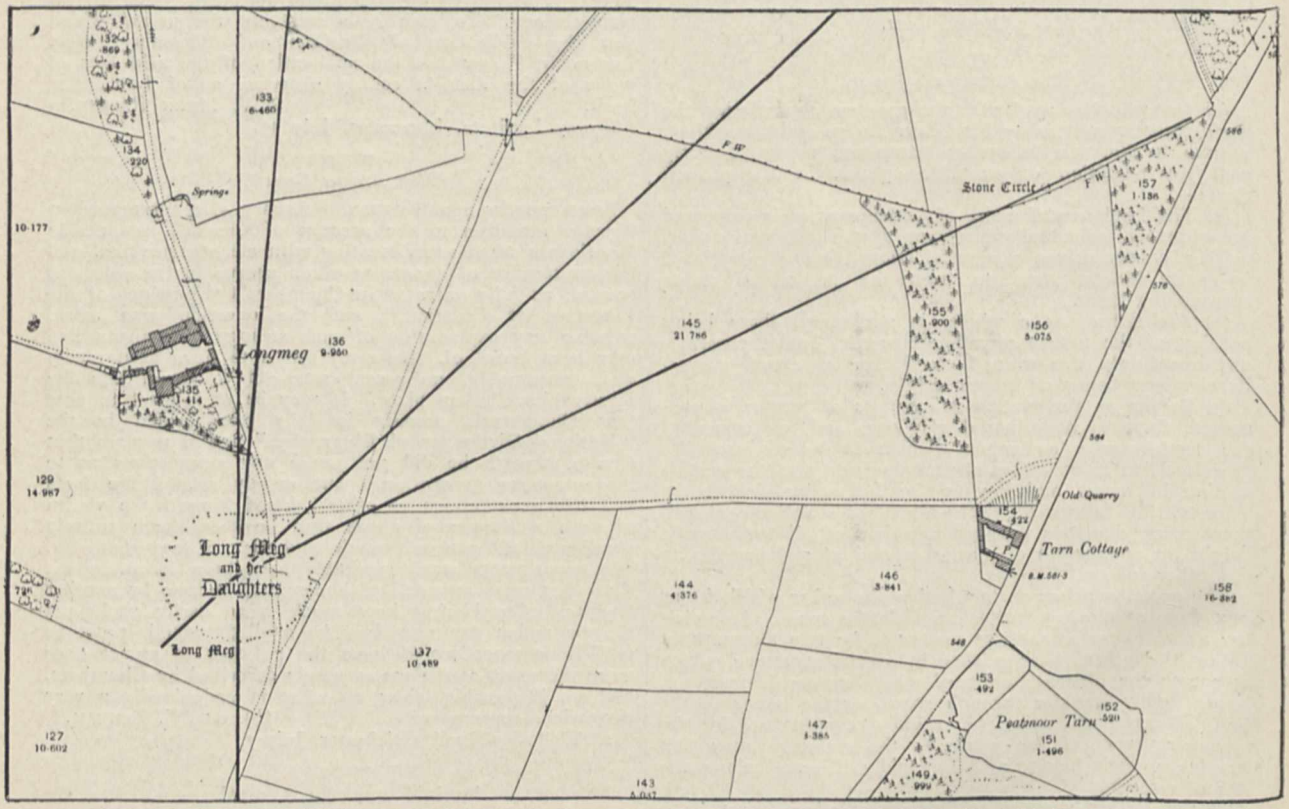

FIG. 1.—Portion of Ordnance Map—Long Meg. From the Proceedings of the University of Durham Philosophical Society.

FIG. 2.—The Chapel or Rectangle, Keswick Circle. From the Proceedings of the University of Durham Philosophical Society.

At Keswick the circle consists of thirty-eight unhewn stones with an internal diameter of about 50 feet. The rectangle or chapel involves ten additional stones, and there is a single outlying stone. These are all shown on the plan accompanying the paper, those which appear to have fallen being indicated by cross-hatching. The stones range from 2 to 7 feet in height.

As the result of a preliminary survey, the following alignments were carefully measured :—

(1) From the centre of the circle over the tip of the pointed stone, No. 1, to the gap on the horizon between Blencathra (Saddleback) and Skiddaw; (2) from the eccentric centre along the centre line of the chapel, over the tip of the pointed stone, No. 10, to the crest of Great Mell Fell; (3) from the outlying stone to the centre of the circle, proceeding along the valley of the Greta.

The observed altitudes and azimuths and the calculated declinations are given in Table I.

[1] Abstract of a paper on "Sun and Star Observations at the Stone Circles of Keswick and Long Meg," by Dr. John Morrow (Proceedings of the University of Durham Philosophical Society, vol. iii., part iii, 1908-9).

TABLE I.—*Keswick Circle* (*Lat.* 54° 36′).

Alignment	Altitude	Azimuth E. of N.	Decl. N.	Object
Circle to Gap (Saddleback-Skiddaw)	° ′ 2 38	° ′ 8 25½	° ′ 37 19	Arcturus rising.
Centre line of chapel to Great Mell Fell	1 42	79 38½	7 6	Pleiades rising.
Outlying stone to centre of circle	−0 29	64 45½	13 25	May and August Sun.

The Pleiades and Arcturus were the warning stars for the May and August festivals respectively. Of these, the Arcturus alignment is the better preserved, and this gives the date of erection of the circle as about 1400 B.C.

The stones known as "Long Meg and her Daughters" are in the neighbourhood of Little Salkeld, a few miles from Langwalby. There are sixty-eight stones in the circle, and at least one other is buried. The 25-inch Ordnance map gives a fairly accurate plan. The diameters are about 350 feet in an east and west direction, and 305 feet north and south.

Between six and seven hundred yards to the north-east there is a small circle of some 15 feet diameter composed of eleven good-sized stones.

The only shaped stone, Long Meg, is to the south-west of the main circle. It is more than 12 feet in height, and is deeply notched at the top.

The alignments taken were :—

(1) From the centre of the large circle, over a stone which is now recumbent, to a well defined gap on Newbeggin Fell (the only well defined gap on the horizon); (2) from the centre of the large circle to that of the small outlying circle; (3) from Long Meg to the centre of the large circle.

These are dealt with in Table II., and we here also get the date from the Arcturus alignment. This date is 1130 B.C., showing that Long Meg was probably erected after the Keswick circle had fallen into disuse.

TABLE II.—*Long Meg* (*Lat.* 54° 43′ 20″).

Alignment	Altitude	Azimuth E. of N.	Decl. N.	Object
Circle to Gap (Newbeggin Fell)	° ′ ″ 1 11 20	° ′ ″ 4 52 20	° ′ ″ 35 36 35	Arcturus rising.
Large circle to small circle	3 12 0	64 24 40	16 44 35	May and August Sun.
Long Meg to centre of large circle	2 40 0	49 37 20	23 53 40	Summer solstice.

Fuller descriptions of the circles, and details of the alignments and the degrees of accuracy to be expected, are given in the original paper in the Proceedings of the University of Durham Philosophical Society. An appendix contains the results of a geological examination of the stones made by Dr. Woolacott. These circles are now brought into line with, and render an additional verification (if such were needed) of, the theories first formulated by Sir Norman Lockyer.

THE FLORA OF SOUTH AFRICA.[1]

WHILE ostensibly forming a part of the scientific results of the *Valdivia* expedition of 1898–9, the present volume is in reality much more than this. Indeed, it represents the results of many years of work and experience of the flora of South Africa. For an account of this flora, the editor of these memoirs has been singularly fortunate in securing the cooperation of Dr. Marloth. The author has given to botanists an excellent and comprehensive survey, which for many years must form a standard reference work on the plant-geography of South Africa. The volume contains a full historical summary of the work of previous investigators and travellers, adds much that is new, and supplies a series of vivid descriptions of the peculiar vegetation of this quarter of the globe.

After giving an account (accompanied by a series of maps) of the various floral regions as suggested by earlier plant-geographers, the author proposes a scheme of his own. This resembles, on the whole, that proposed by Dr. Bolus in 1905, but differs in several essentials from any previous scheme. The following are the larger divisions now suggested :—

(A) The Cape Province of the South-west.

(B) The Southern Palæo-tropical Provinces, which include :—

(1) The grass steppes of Rhodesia, the Northern Transvaal, part of Natal, &c.

(2) The South-eastern Littoral.

(3) The forests of the South Coast.

(4) The Central Region, including the Karroo, the Karroid uplands, and Little Namaqualand.

(5) The Western Littoral.

The essential differences between Dr. Marloth's scheme and earlier ones consist in (*a*) the more accurate delimitation of the Cape Province, (*b*) the separation of the forest region of the South Coast from the Cape Province, and (*c*) the smaller subdivisions which he proposes for the above provinces. Though brief descriptions are given of the others, the only regions treated in detail in this volume are the Cape Province, the South Coast forests, and the Central Region. Each of these may now be briefly noticed.

The Cape Province.—The peculiar systematic character of the Cape flora is, of course, well known. It is exceedingly rich in species, many of which have a very limited range, and includes numerous endemic forms of the orders Proteaceæ, Thymelæaceæ, Ericaceæ, Restionaceæ, &c. The dominant vegetation is a "Macchia," composed of sclerophyllous evergreen shrubs, with small, entire, xerophytic leaves. Mixed with the shrubs, but subordinate to them, are many xerophytic dicotyledonous herbs, together with bulbous and succulent monocotyledons, and many Restionaceæ. This Macchia (see Fig. 1), which somewhat resembles that of the Mediterranean region, forms the real climatic type of vegetation of the Cape region. Other ecological types, *e.g.* those found in marshes, or on rocky ground, sand dunes, &c., are due to local edaphic influences. The Macchia is typical only where the original vegetation has not been destroyed, and Dr. Marloth is of opinion that if the land were freed from the influence of bush fires and of grazing herds of domestic animals, in fifty years' time it would become entirely covered with a dense, impenetrable Macchia.

Dr. Marloth has explored many of the mountains outside the area of the Cape Province proper, and finds that outliers of the Cape flora occur as "islands" on the higher mountain ridges, both in the Karroo and also in Little Namaqualand. The occurrence of these Cape "islands" is, he considers, largely due to the fact that the ridges are sufficiently high to experience the effects of the rainy south-east winds. Their climate thus more nearly resembles that of the Cape than that of the dry desert plains below them. Besides this, wherever edaphic and other factors permit, there is a reciprocal invasion between Cape and Karroid forms. For instance, even those parts of the Cape region which have the greatest rainfall are not entirely devoid of succulent immigrants from the Karroo. Comparatively few succulents, however, can survive the effects of an exceptionally rainy winter.

[1] "Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899." Edited by Prof. Carl Chun. Zweiter Band, Dritter Teil. Das Kapland, insonderheit das Reich der Kapflora, das Waldgebiet und die Karroo, pflanzengeographisch dargestellt. By Rudolf Marloth. Pp. 436; with 20 plates and 8 maps. (Jena: Gustav Fischer, 1908.) Prices 100 marks and 81.50 marks.

The Forests of the South Coast.—Though formerly more extensive, the true forests of South Africa are now practically confined to a small strip of coast-land in the Knysna district. Floristically, the Knysna forests are so distinct from the Cape Province that Dr. Marloth has classed them (for the first time) as a separate region. In this district, where the annual rainfall amounts to some 36 inches, the woodland has all the characters of a typical temperate rain-forest. Epiphytes are common, and lianes are not infrequent. Westwards the forests become more dwarfed, and finally pass into the Macchia of the Cape Province.

The Central Region.—Passing northwards from the South Coast the rainfall rapidly diminishes, and in consequence the country becomes increasingly arid and desert-like. Thus the Central Province (including the Karroo, the Karroid uplands, and Little Namaqualand) forms a vast area, over which semi-desert conditions prevail. But the only true desert in South Africa is the narrow strip of coast-line known as the Western Littoral. Elsewhere, the streams arising in the mountains somewhat lessen the severity of the conditions, and even in the "Gouph" we can only speak of a stony semi-desert. The term "Gouph," a word of Hottentot origin, signifying barren, empty, void, is employed to denote the most arid and desert-like part of the central Karroo. The vegetation, for the most part, consists of dwarfed, rounded shrubs, with reduced, often ericoid leaves, and numerous succulent herbs scattered between the shrubs. Here and there, one or the other type of plant is so dominant as to render it possible to distinguish a succulent steppe from a dwarf-shrub steppe, but in general they are mixed. Eastwards the Karroo passes into grass steppes, and to the south and west into the richer vegetation of the Cape Province.

The Karroid uplands, which occupy large tracts of the northern part of Cape Colony, are still comparatively little known botanically, except from the collections of Thunberg, Lichtenstein, and Burchall, made more than a hundred years ago. In fact, according to Dr. Marloth, many parts of this region have never yet been visited by botanists.

Ecology.—The chief value of Dr. Marloth's work is on the floristic side of plant geography. He has travelled extensively, and, although many parts of South Africa are still incompletely known botanically, he has considerably advanced our knowledge of plant distribution in this part of the world. But, in addition to this, Dr. Marloth has not lost sight of the ecological point of view. Throughout the work the dependence of vegetation on rainfall (which is nowhere better seen than in South Africa) is emphasised, and rainfall and temperature tables are introduced wherever possible. One very interesting point brought out is the importance, especially at higher altitudes, of moisture deposited on the vegetation from the thick clouds which so often cover and obscure the mountain tops. An apparatus for collecting the moisture precipitated from clouds has been employed on Table Mountain. On one occasion, during a period of six days, this instrument registered a precipitation of 152 mm., while an adjacent rain-gauge only recorded an actual rainfall of 4 mm. The author devotes a special section of more than fifty pages to the "General Ecology of South African Plants." Under this heading are discussed the various growth-forms found in different plant formations, such as annuals,

FIG. 1.—Macchia from the North side of Table Mountain, showing Protea, Leucadendron, Brunia, &c. Reproduced from "Das Kapland," by Dr. R. Marloth.

tuberous and bulbous plants, shrubs, &c. Epiphytes (as is to be expected in a climate of such general dryness) are few, but parasitic phanerogams are abundant. A good deal of attention is paid to the various contrivances for storing water and reducing transpiration. Other matters discussed are insects and birds as agents of pollination, the influence of wind, light, &c. Several curious instances are adduced, especially in the genus Mesembrianthemum, of so-called protective resemblance. Though supposed cases of mimicry in the plant kingdom should be received with caution, it must be admitted that the resemblance, both in colour and form, between some of these curious plants and the stones and rocks amongst which they grow is exceedingly striking.

The closing chapters of the volume are occupied by a useful discussion on the affinities and origin of the South African flora in general, and that of the Cape Province in particular. The older theories of Hooker and Wallace, as well as those of later authors, to account for the resemblances between the floras of South Africa, Australia, and temperate South America, are given at some length, and discussed in the light of what is known of geological and climatic changes since the Cretaceous period.

Not the least interesting feature of the volume is a series of short, posthumous sketches of the vegetation of various districts, by the late Prof. A. F. W. Schimper, who was botanist to the *Valdivia* expedition. These sketches, which are marked by Prof. Schimper's usual lucidity, supplement Dr. Marloth's descriptions in many respects.

On p. 188 is a photograph, taken in the Knysna forest district, in which both Prof. Schimper and Dr. Marloth appear. The latter, however, with characteristic modesty, has omitted his own name from the description of the figure. The volume is copiously illustrated by line drawings and photographs. Some of the latter take the form of particularly beautiful heliogravures. There are also a number of useful maps, illustrating the rainfall, geology, and phytogeographical regions of South Africa. Karte 6 would be improved by a clearer method of indicating the regional boundaries.

To sum up, the work presents a most useful account of the present position of geographical botany in South Africa. Its very limitations, particularly in the ecological sections, afford a graphic indication of the enormous (and in many directions practically untouched) field which awaits future investigators.

R. H. Y.

PALÆOLITHIC MAN.[1]

RECENT discoveries have filled up to a great extent the gaps in our knowledge of Palæolithic man. The skeleton find in the lower grotto of Le Moustier (Dordogne) in the main confirms Klaatsch's conclusions, based on a comparison of the face-skeleton of the Neanderthal race with that of the present Australians. *Homo mousteriensis* belongs to the older Diluvial race, that is, to the Neanderthal type, not to *Homo sapiens* found in more recent Diluvium. The subject was about sixteen years old probably a male. That *Homo mousteriensis* belongs to the Neanderthal type is further shown by the character of the femur and radius (of which the length is estimated at 195 mm., while the upper arm measures 210 mm.). The Neanderthal race had short extremities, in which fact Klaatsch sees an approximation to the present Arctic races of Mongoloid relationship.

[1] "Recently discovered Fossil Human Remains and their Bearing upon the History of the Human Race," by Moritz Alsberg (*Globus*, vol. xcv., No. 17, May 6, 1909).

Mention must also be made of the extraordinarily massive proportions of the absolutely chinless lower jaw. The knobs on the backs of the incisors recall the Krapina find. All the upper front teeth have much curved roots adapted to the round arching of the upper jaw-bone.

The position of the skeleton at Le Moustier, like that of the find at Grimaldi, proved that Diluvial man buried his dead with care. The posture is that of sleep, with the face turned to the right, and the right arm under the head, which was surrounded by flint flakes. Beside the skeleton were found, in addition to flint implements of the Mousterian type, some of the Acheulean type, among them a splendidly worked "hand-wedge." A mark on the right femur is traceable to burning, but there is no sign of the cannibalism ascribed by Kramberger to Krapina man.

Another important find in France is that of a male skeleton, brought to light by the Abbés A. and J. Bouyssonie and Bardon near La Chapelle-aux-Saints (Corrèze), in an absolutely undisturbed archæological stratum. The subject is an old man of about 1·60 m. in height. The skull is actually 208 mm. long by 156 mm. broad, that is to say, dolichocephalic, with an index of 75. The height from basion to bregma is only 116 mm. The breadth-height index is 62, far outside the variation in living man. The huge, almost round orbits and very wide nasal aperture agree with what has been noted as very remarkable in skulls of the Neanderthal type. Though the face is defective, its prognathous nature is clear. The mandible is of great dimensions, and in so far as senile atrophy has not produced changes, exhibits a formation which agrees in the main with those of lower jaws from Spy, Krapina, La Naulette, &c. Here, too, we have absence of chin, "negative chin-formation" (Klaatsch). The occipital and temporal regions have Neanderthal characteristics. The old man's grave contained no tools of the Acheulean stage. This fact, and the predominance of reindeer-bones in the grave, would lend some degree of probability to the supposition that La Chapelle man belongs to a rather later cultural phase than Le Moustier man. Both are to be taken as representatives of the Neanderthal type, and as belonging to the Middle Diluvium.

P. Adloff has in several publications dealt with the question as to whether the above physical characteristics comprised under the term "Neanderthal race" represent an absolutely fixed human type, or whether they were subject to variations. As regards differences of dentition in different specimens of the Neanderthal type, he comes to the conclusion that by no means insignificant differences do exist; Krapina man especially exhibits a form sharply distinguished from other representatives of the genus Homo. Obviously, in a type like the Neanderthal, scattered over a vast area, and doubtless existing for many thousands of years, certain variations must arise by way of adjustment to different climatic conditions, food, mode of life, &c.

Dr. O. Schoetensack has recently made a notable find at Mauer, near Heidelberg, of a fossil human lower jaw, which he has called *Homo heidelbergensis*. It unites two at first seemingly contradictory qualities: (1) massiveness of the body of the jaw, combined with entire absence of chin-projection, breadth and thickness, and special form of the ascending rami—phenomena usually taken as indicating a development little advanced, so-called pithecoid qualities; (2) a set of teeth agreeing with that of present man in all essentials, the size of the teeth not surpassing the scale of variation in some still extant primitive peoples (*e.g.* Australians). No doubt, as Adloff says, the teeth of man are in many respects more primitive than

those of anthropoids, and the pithecoid characteristics met with in human dentition are actually primitive features. A glance at the lower jaw of a young gorilla or of a South American howler shows a remarkable resemblance of the mandible to that of *Homo heidelbergensis*. Dr. W. Wright has given an account and illustrations of this jaw in NATURE of June 3, p. 398.

In determining the exact position of *Homo heidelbergensis* in the human pedigree, it must always be borne in mind that a huge difference in time exists between *H. heidelbergensis* and the members of the Neanderthal race. Fossil remains of Neanderthal man belong to the Middle Diluvium, coinciding in general with the Mousterian culture period; whereas the remains (of *Elephas antiquus, Rhinoceros etruscus*, Falc., and *Equus stenonis*, Cocchi) were found undisturbed in the same stratification with *H. heidelbergensis*, which points to earliest Diluvium or to the transition period from Diluvium to late Tertiary age (Pliocene). The long periods intervening between Neanderthal man and *H. heidelbergensis* are shown by Penck's climatic curve of the Glacial periods (Ice ages), mainly coinciding with the Quaternary age, with warmer inter-Glacial periods between and the Palæolithic culture periods introduced into his diagram. The culture epoch, called Mousterian by the French prehistorians, corresponds, according to Penck, together with the subsequent divisions of Palæolithic culture (Solutrean, and perhaps partly Magdalenian), to the Ice-age divisions, comprising the inter-Glacial epoch, which falls between the Riss- and Würmeiszeit. On the other hand, Penck makes the oldest divisions of Palæolithicum correspond: Acheulean and the preceding Chellean, to the warm intervening epoch of specially long duration between the Mindel- and Risseiszeit. Obviously, the late Palæolithic age (of successive Mousterian, Solutrean, and Magdalenian cultures) lies very much nearer to the present than that earlier division of the Palæolithic age (of Acheulean and Chellean cultures).

The supposition that a very long interval elapsed between Middle Diluvium (with Neanderthal man in Europe) and that earliest Diluvium (of *H. Heidelbergensis*) receives indirect confirmation from recent excavations by R. R. Schmidt (Tübingen). He devotes himself chiefly to later divisions of the Palæolithic age, and, working back from the Neolithic age, shows the relatively long duration of the culture-sections which he calls late, high, and early Magdalenian; later and earlier Solutrean; late, high, and early Aurignacian; and late Mousterian. However, the slow and gradual earliest cultural progress of the human race leads one to attribute to those oldest divisions of the Palæolithic age, commonly called Chellean or Acheulean, a still longer duration than to all those later divisions.

Thus an enormously long period must have elapsed between Neanderthal man (generally coinciding with Le Moustier culture) and *H. heidelbergensis* (of earliest Diluvium, or Pliocene-Diluvium transition). No fundamental objection stands against the view of Rutot, Klaatsch, Verworn, and others that the first beginnings of human cultural development reach far back beyond Diluvium into the middle division of the Tertiary period (Oligocene, according to Rutot), and that the much debated eolith is to be regarded as the primitive implement of man at the lowest cultural stage. It is obvious that an extremely long period of slow development must have preceded the production of the "hand-wedge," the characteristic implement of the Chellean age.

Neanderthal man, then, is of slight antiquity as compared with *H. heidelbergensis*. Klaatsch has for years upheld the theory that to discover the roots of the human race we must go very far back, perhaps even to the roots of the mammalian genealogical tree, and additional probability is lent to this idea by the Heidelberg find. The teeth of the Heidelberg jaw undoubtedly prove that no anthropoid stage preceded that to which the Heidelberg mandible belongs, so that to explain the similarity of human and anthropoid forms we must go back to the remote ancestor from which there branched off on the one side the genus Homo and on the other the genera of anthropoids and perhaps of other ape-species. The fact that the origin and development of anthropoids reaches back to the Middle Tertiary age (Miocene) prevents the assumption that the Heidelberg mandible is itself the stage of development at which the anthropoids branched off from the genus Homo; this is also rendered improbable by the discovery of eoliths in Middle Tertiary beds. There is nothing to preclude the supposition that the Heidelberg fossil, as regards formation, stood fairly near the point of separation. The line of descent Pithecanthropus–Neanderthal man–recent man has to a certain extent been shaken by the recent researches, which attribute less antiquity to Pithecanthropus than was hitherto supposed to be the case.

At the conclusion of the paper is a brief discussion of the genealogical tree of the phylogeny of man and the anthropoids, recently published by Prof. G. Bonarelli, of Perugia. According to this table *Pithecanthropus erectus, Homo heidelbergensis*, and Neanderthal man may be regarded either as successive stages in the direct line of descent of Hominidæ or as offshoots from those stages. A. C. HADDON.

THE ORIGIN OF THE PLANETARY SYSTEM.

DR. SEE contends that the planets and satellites of the solar system were captured and their orbits made remarkably circular by a resisting medium. In his view, therefore, Laplace's nebular hypothesis is altogether wrong, whereas the current view is that it is in the main right, though in need of considerable modification and extension.

Dr. See's paper contains a single table, the object of which is to show that, when the sun and planets are expanded to fill the orbits of the bodies revolving about them, their rotations must have been so slow that it is inconceivable that they could have flung off planets or satellites. As an extract from the tables we may quote that, assuming the law of internal distribution remains unchanged, the principle of conservation of angular momentum implies that the sun, when it filled the orbit of the earth, rotated in 3192 years instead of in 25·3 days, as at present. It is no doubt inconceivable that the matter which now forms the earth was being carried round as an integral part of a nebulous sun at one instant, and shortly afterwards revolving as a planet with 3000 times its former velocity; but Dr. See's figures involve the assumption that the law of internal distribution remains unchanged. He probably regards 3000 as a sufficient factor of safety.

A precisely similar point is made with regard to thirty-three other bodies in the solar system. Dr. See then continues that, as detachment has been disproved, capture is the only other alternative. This is not a proof. There are more things in heaven and earth than Dr. See has dreamed of in his philosophy. Capture is a possibility, but Dr. See has done nothing to raise his theory beyond a mere conjecture, even though he points out, in addition, that a resisting medium would diminish the mean distance and the

[1] "On the Cause of the Remarkable Circularity of the Orbits of the Planets and Satellites and on the Origin of the Planetary System." By T. J. J. See.

eccentricity of an elliptic orbit, and that in the case of Jupiter's satellites the outer orbits are highly eccentric, and the inner orbits nearly circular. It may be mentioned that Mercury is an exception to his rule.

Suppose that Laplace had not thought of the possibility of capture. Then Laplace would have been as much entitled to say detachment was the true explanation, because no other was possible, as Dr. See is now entitled to say that capture survives as the only possible explanation. Laplace, of course, would not have reasoned in this way. His theory explains many features of the solar system, in fact so many that when new discoveries showed that his theory was incomplete, there has been a nearly universal reluctance to say that it was altogether wrong. We do not see that Dr. See's hypothesis explains anything. Why, for instance, on the hypothesis of capture are the vast majority of orbits near the plane of the ecliptic and their motion direct?

STATE AID FOR UNIVERSITY EDUCATION.[1]

THE grant in aid of university colleges originated in the demand for advanced education in 1889 arising from the university extension movement, and was intended to help university colleges in providing suitable courses. In twenty years conditions have changed, and some of the university colleges have become universities, but they are still claimants for the aid. The members of the University Colleges Advisory Committee had a difficult task before them, and they submitted a report dated July 24, 1908. On this a Treasury minute, June 3, 1909, has been founded which lays down the conditions for participation in the grant. The conditions are summarised thus :—

(1) Any institution to secure a share of the grant must be prepared to afford satisfactory instruction of university standard, which should normally include English, classics, French, German, history, philosophy, mathematics, physics, chemistry, biology.

(2) The courses of instruction must be attended by a reasonable number of students capable of profiting by the education afforded.

(3) The buildings and initial equipment must be adequate for the courses established.

(4) The aggregate income of the institution, whether derived from grants or otherwise, must be sufficient to maintain all the departments in a state of efficiency, and to provide a superannuation scheme.

(5) The grants should be confined to institutions serving great centres of population, and no new institution should be admitted unless it serves a district not already adequately provided with instruction of a university standard.

(6) Due regard must be paid, not only to the standard and the efficiency of the teaching, but also to the spirit animating the institution and its influence as an intellectual centre.

These are the conditions, and it must be agreed that they appear very just, except number five, concerning the admission of new institutions to the privileges, as there may be two or more institutions in a great centre which afford equal or identical advantages, one, however, receiving the grant to the exclusion of the other. This is the case in London, where there are two large institutions fulfilling the conditions, but excluded because certain other colleges are sharing already in the grant. Both Birkbeck College and East London College more than satisfy all the conditions, and there are several other institutions and polytechnics which fulfil, or come very near to fulfilling, the qualifications..

It will naturally be asked why the grant in aid is to be limited to certain favoured institutions in some centres, and the answer must lie in the miserable inadequacy of the grant. The advisory committee had before them, not the difficulty of the standard of the colleges, but how to make quite too small a meal satisfy the demands of a large, hungry, and rapidly increasing family. In domestic affairs the difficulty has to be met by the father increasing the family allowance, and it would be more logical for Parliament to increase the allowance. The solution of allowing part of the family to starve is indefensible. We have alluded to the condition of affairs in London particularly because London has come off worse in amount than any other city in proportion to its population. London, too, has suffered from want of civic spirit. In the lesser cities strong civic spirit pushes their claims on Parliamentary notice.

It must be noted that the advisory committee is fully alive to the fact that many of the universities and university colleges are drawing grants from several sources, *i.e.* Board of Education, Board of Agriculture, Parliamentary grants, and local rates, and there is danger of their being paid twice over for the same work; but the advisory committee does not suggest at present any way out of this difficulty other than getting a return made to them from each of the granting authorities.

It has been suggested before that all higher institutions should receive their grants from one authority, which should be able to take a survey of the whole kingdom. At present many higher institutions have to depend largely on the local education authority, which secures neither breadth of treatment nor sufficient continuity. The institutions find that there are fat and lean years, and it is not likely that the best educational results will be obtained when there is so much uncertainty. In an article which appeared recently in this journal it was suggested that the control of the higher technical institutions throughout the country should be under a central authority, for prosperity in trade is a national affair, and not local. The same view must be taken in regard to the university colleges and universities. They should be as free from local restraint as possible. This is foreshadowed in the report in the following words :—

> We trust, however, that it may be found possible to regard such a scheme as being merely transitional, and to replace it in the near future by one on the more simple lines we have indicated. . . . a scheme that would comprise in a single vote the whole aid granted by Parliament to universities and university colleges for education of university character and standard. The coordination of the institutions which provide higher education in the country in accordance with the principles of administration embodied in the Education Act, 1902, is proceeding apace, and the universities and university colleges have taken the initiative in connecting themselves with the local education authorities most closely related to them by locality and communications. Universities, however, are non-local as well as local institutions, and it is of importance that this two-fold aspect should be appreciated by the central administration, which has to dispense the State subvention for higher education by way of grants to this or that locality, and which must at the same time pay due regard to the interests and necessities of the country as a whole.

NOTES.

THE present summer promises to be one of the coldest on record, but for rainfall it is likely to be several inches short of the measurement in 1903, when at Greenwich the total fall for the three months, June to August, was 16·16 inches. So far, the highest temperature at Greenwich since the commencement of June is 77·7°, on July 18, whilst at the observing station of the Meteorological Office, in St. James's Park, the highest temperature is

[1] University Colleges (Great Britain). Grant in Aid. Parliamentary Paper 182. (London : Wyman and Sons.) Price 1½*d*.

75°. The Greenwich records only show three days in June with the thermometer above 70°, and the observations since 1841, a period of sixty-eight years, only show one June, 1860, with an equally small number of warm days; but as recently as 1907 June only had five days with the thermometer above 70°. For the first twenty-seven days of July there have been only fifteen days with a temperature above 70°; this is precisely the same number as during the whole month in 1907, whilst in 1879 there were only eight equally warm days, and in 1888 only twelve. In 1907, the summer of which approximates somewhat to that of the present year, there were twenty days in August with a temperature of 70° and above. In 1868, which is about the warmest summer on record, there were in the three months seventy-seven days above 70° and thirty-three days above 80°, whilst in the coldest summer, 1860, there were only twenty-three days with 70° or above, and the sheltered thermometer on no day touched 80°. Taking England as a whole, the temperature this summer has been largely deficient of the average, and the rainfall has been generally in excess, but not to any great extent, whilst the sunshine is everywhere deficient.

M. BLÉRIOT accomplished a flight across the English Channel in his monoplane in the early morning of Sunday, July 25. He started his flight at 4.35 a.m. from Baraques, near Calais, and, having travelled across the Channel, he landed in safety in a field near Dover Castle. According to M. Blériot's own account of the flight, his engine at the time of starting made 1200 revolutions—almost its highest speed—to enable him to get over the telegraph wires along the edge of the cliff, but as soon as this was accomplished the speed was reduced. The monoplane travelled at a height of about 250 feet, and at the time of passing the *Escopette*, the destroyer in attendance, in the Channel the rate of travel was at least 42·5 miles an hour. Twenty minutes after leaving the French coast M. Blériot was able to make out Dover Castle, and, heading the monoplane westward, he followed the coast-line to Dover. Eventually catching sight of his friend, M. Fontaine, waving a large French tricolour to guide him to a suitable place of descent, the monoplane was brought to earth with little damage. The flight represents an achievement of great interest in the history of aërial navigation. On being informed of this notable feat, M. Quinton, president of the Aërial League, remarked, "Before five years are out England will have ceased to be an island. The sea is no longer a barrier. Relations between nations will undergo a change. The strategic and political situation of certain peoples will be transformed." The *Times* gives the following particulars of M. Blériot's monoplane, *Blériot XI.* The area of its sustaining surface, which was at first 14 square yards, was increased last February to 17 square yards. Its spread is 8½ yards. Under these conditions the small monoplane left the ground very easily, but could not stop in the air more than two minutes. Its motor was then replaced by a three-cylinder Anzani of 105 mm. (4·13 inches) bore and of 22–25 horse-power, weighing 132 lb. in working order. With this modification the *Blériot XI.* has made some very successful flights, including one on July 4, when the aëroplane stopped in the air for 50m. 8s., and another on July 13, when it flew from Étampes to Chevilly, a distance of twenty-six miles. It then went to Calais, where it underwent a few tests, with the present result. The framework of the *Blériot XI.* is of ash and poplar stiffened with piano strings. It weighs 45 lb., and is about 23 feet long; it can easily carry a load of 660 lb. placed at its middle point. The landing *châssis*, including the wheels and springs, weighs only 66 lb. The inclination of the tail of the machine, and the warping of the wings, ensuring lateral stability, are effected by means of a hand-lever, whilst the vertical rudder is moved by a bar pressed down by the foot of the aviator. The propeller, which is a Chauvière one of the type known as "Intégrale," is placed in front of the machine, and is so designed that the air it throws back does not meet the framework of the aëroplane. It has a diameter of a little less than 7 feet, and working the *Blériot XI.* it has an efficiency of 85 per cent.

THE Civil Service Supplementary Estimates of sums required to be voted for the year ending March 31, 1910, include 6500*l.* to the Royal Society, as grant in aid of the expenses of the aëronautical section of the National Physical Laboratory. The grants under the Irish Universities Act, 1908, amount to 28,150*l.*, namely, Queen's University, Belfast, 4700*l.*; University College, Dublin, 16,000*l.*; University College, Cork, 5700*l.*; and University College, Galway, 1750*l.*

MR. H. GARRETT, writing from Greensted Rectory by Ongar to the *Times* (July 28), says:—"During the severe thunderstorm on the 13th inst. a meteoric stone fell in the stable yard here with a terrific explosion when within a few feet of the ground, embedding itself in the gravel about 8 inches, the ground around for several feet being perforated with small holes caused by the fragments. The main part and fragments which we could collect weighed 1 lb. 13 oz. The fall was witnessed by my daughters, who were sheltering about eight yards away."

A REUTER message from Melbourne states that it is proposed to invite the British Association to meet in Australia in 1913. The University of Melbourne is communicating with the different Australian universities with the view of formulating definite proposals. It is suggested that the invitation should proceed from the Commonwealth.

THE local secretaries for the forthcoming British Association meeting at Winnipeg desire it to be known that the proposed excursion up the coast of British Columbia to Alaska, now being organised in connection with the Natural History Society of Canada, is unofficial, and is not part of the local committee's arrangements. Those desiring, therefore, to make this journey before the meeting should communicate with Mr. M. B. Cotsworth, Victoria, B.C.

THE death is announced of Prof. G. Arth, professor of industrial chemistry in the University of Nancy. Prof. Arth's first researches were concerned with organic chemistry, his work on menthol and its derivatives being well known. For some years Prof. Arth had been engaged in perfecting methods of metallurgical analysis.

WE notice with regret the death, at Naples, of Dr. V. R. Matteucci, instructor in geology in the University of Naples, and director of the observatory on Vesuvius. It will be remembered that during the eruption of Vesuvius in 1906 Dr. Matteucci followed successfully every phase of the eruption at grave risk to his own safety.

MR. P. W. STUART-MENTEATH desires to direct the attention of our geological readers to the instructive sections to be seen in the neighbourhood of Gavarnie, in the Pyrenean region. The subject has been fully discussed in a paper on the Gavarnie overthrust, and other problems in Pyrenean geology, by Mr. E. E. L. Dixon, with an appendix by Mr. Stuart-Menteath (*Geol. Mag.* for August and September, 1908).

BY the will of the late Miss E. S. Wolfe, who died on June 10, leaving estate of the gross value of 71,520*l.*, with net personalty 66,295*l.*, the sum of 1000*l.* is to be given to each of the following societies among other institutions:—the Royal Anthropological Institute, the Royal Archæological Society, and the Royal Geographical Society. Subject to the payment of duties on the estate, the residue is left to King Edward's Hospital Fund, the Royal Institution, and the Royal Society.

THE National Trust for Places of Historic Interest or Natural Beauty makes an appeal for upwards of 1000*l.* to purchase the central portion of the Cheddar Cliffs with the view of preserving the beauty of that natural monument of scientific interest. There is grave danger that the beauty and grandeur of the gorge may be obliterated before long if the extensive quarrying operations, which have been in progress during the last seven years, are not discontinued. Donations may be sent to the secretary of the trust at 25 Victoria Street, London, S.W.

THE French Association for the Advancement of Science will meet this year at Lille on August 2–7, under the presidency of Prof. Landouzy, dean of the faculty of medicine in the University of Paris. The gold medal of the association, which was instituted last year, is to be awarded to Prof. H. Poincaré, who will deliver a lecture during the course of the meeting. In addition to minor visits to the industries of the neighbourhood, three more extended excursions have been arranged in connection with the meetings. The first of these will be to Douai, where demonstrations by the best-known aviators are to be given; the second excursion will be to the mines of Sessevalle, Aniche, and Gayant, and the third to Gand, Ypres, Bruges, and Furnes. A large number of papers will be read at the meetings, among them being communications from Prof. Poincaré, on integral equations; Prof. A. Gautier, of Paris, on the existence of water vapour in volcanic gases and the origin of thermal springs; Prof. A. Bertillon and Dr. A. Chervin, on metrical anthropology; and Dr. Lewkowitsch, on a new refractometer. The secretary of the association may be addressed at 28 rue Serpente, Paris.

AN important paper on the determination of the bovine or human origin of tuberculosis in the human subject is contributed by MM. A. Calmette and C. Guérin to the current number of the *Comptes rendus* (July 19). They have found that tubercle bacilli of bovine origin can be readily cultivated on a glycerinated ox bile; tubercle bacilli from human beings or birds refuses to grow on this medium, whilst developing readily on human bile or bile from the bird respectively. Another distinction is afforded by the fact that injection of the infected matter into the mammary gland of a goat causes grave mammitis, leading to the death of the animal, if the tubercle bacilli are of bovine origin, whilst cultures of human origin produce a very mild and non-fatal infection. The method has been applied to the diagnosis of a fatal case of acute tuberculosis in a child, aged five months, which had been bottle-fed, and both of whose parents were healthy. The result of applying both the above tests was to show that the tuberculosis was of bovine origin. The authors point out the importance of being able to determine with exactness the relative frequency of tuberculous infections of bovine and human origin.

FIFTY years of Darwinism forms the subject of an article contributed by Dr. W. Breitenbach to Nos. 4 and 5 of *Neue Weltanschauung*.

A LIST of the birds, by Dr. G. M. Allen, forms the eleventh part of the "Fauna of New England," now in course of issue in Occasional Papers of the Boston Society of Natural History.

THE dragon-flies of the Mississippi valley collected during the pearl-mussel survey of that river in 1907 are catalogued by Mr. C. B. Wilson in No. 1692 of the Proceedings of the U.S. National Museum.

THE fresh-water sponges in the collection of the U.S. National Museum are in course of description in the Proceedings of that institution by Dr. N. Annandale, the first instalment (No. 1690) dealing with those from the Philippines and Australia.

IN vol. v., part vii., of the Annals of the South African Museum, Mr. E. Meyrick describes a number of new local Microlepidoptera, while Mr. L. Peringuey discusses new or little-known Hymenoptera of the family Mutilidæ from South Africa.

IN the *Irish Naturalist* for July Dr. R. F. Scharff describes and figures a speckled otter from Lough Sheelin, recently acquired by the Dublin Museum. Although albino specimens are known, this appears to be the only speckled otter on record.

IN the July number of the *Entomologist's Monthly Magazine* Mr. G. H. Verrall announces that he is attempting to re-introduce the large copper butterfly (*Chrysophanus dispar*), in the shape of its Continental phase *rutilus*, into Wicken Fen, where he has turned out a number of the larvæ.

NEW fishes from Japan and the Liu-kiu Islands are described by Mr. J. O. Snyder in No. 1688 of the U.S. National Museum Proceedings, while two new electric rays from the South Atlantic coast of the United States are named and described by Messrs. Bean and Weed in No. 1694 of the same publication.

WE have recently had occasion to notice several papers on crinoids published by American workers, and we have now to add to the list two by Mr. A. H. Clark, published respectively as Nos. 1691 and 1693 of the U.S. National Museum Proceedings, the first of these dealing with seventeen new species belonging to various genera, while the second is devoted to four new species of Rhizocrinus.

THE absence of aquatic forms among the mammals of the Miocene beds of Nebraska has led Dr. F. B. Loomis to the conclusion that these deposits are of aërial rather than lacustrine origin, and this view is confirmed by the study of the tortoises, or turtles, as the author calls them, in American fashion, from the Harrison beds, of which several new species are described by him in the July number of the *American Journal of Science*. All these are land-tortoises of the typical genus Testudo.

THE thorax and the articulation of the wings of insects form the subject of an important memoir, by Mr. R. E. Snodgrass, published as No. 1687 of the U.S. National Museum Proceedings. In this paper, which amplifies conclusions reached in earlier communications, the author attempts to show the uniformity of thoracic structure prevailing throughout all orders of insects, and urges that in no case is there evidence that any of the constituent elements of any one thoracic segment have an origin apart from that particular segment. In his study of the wings he adopts the venation-nomenclature proposed by Comstock.

THE determination of the ages of eels inhabiting the fresh-waters of Sweden and the deductions to be drawn

therefrom form the subject of No. 46 of the *Publications de Circonstance* issued at Copenhagen by the Conseil Permanent International pour l'Exploration de la Mer. As the result of these investigations it has been found that the great majority of the five-year-old eels collect at the mouths of the rivers discharging into the Gottland and Botten lakes, where they remain in a barren condition from five to seven years, after which they make their way, as ten- to twelve-year-old fishes, *viâ* the Kattegat, the Skagerack, and the North Sea to the Atlantic for the purpose of spawning.

THE mystery so long shrouding the young of the sanderling has at length been solved, and in the June number of Witherby's *British Birds* Dr. Eagle Clarke gives an excellent coloured plate of four of the long-sought chicks. This brood was discovered by Dr. Bruce on August 3, 1906, in the north-eastern portion of Prince Charles's Foreland, Spitsbergen, and the chicks and their parent are now mounted in the Royal Scottish Museum. Other chicks were subsequently obtained, in 1907 or 1908, by the Danish expedition to N.E. Greenland. In ground-colour the chicks are greyish-buff, variegated with black and deeper buff, and flecked with white, longitudinal stripes being absent. There is a collar of uniform buff on the back of the neck, and the under-parts are nearly white.

THE July number of the *Journal of Economic Biology* is devoted to three papers on injurious insects and their relations. In the first of these Mr. R. S. Bagnall describes certain new British species of thrips (Thysanoptera), with notes on injurious kinds. In the second Mr. H. H. King has notes, with plate, on a boring beetle of the family Buprestidæ, referable to the genus Sphenoptera, the larvæ of which are doing considerable damage in the Sudan by attacking the stems of cotton. The third paper, by Messrs. W. E. Collinge and J. W. Shoebotham, is devoted to the description of a new genus and species (*Amerus normani*) of Collembola, based on specimens taken in a greenhouse in the garden of the Rev. Canon Norman at Berkhampstead, Herts. A second species of the group, *Neelus murinus*, typically from Cambridge, Mass., U.S.A., has likewise been taken at Berkhampstead.

THE much-discussed problem of the nature of the "ciliated funnels" of the leeches is dealt with at length, and in a very interesting manner, by Rudolf Loeser in the first part of the ninety-third volume of the *Zeitschrift für wissenschaftliche Zoologie*. The author has investigated these organs in three species of Gnathobdellidæ and four of Rhynchobdellidæ. He concludes that in no case can the ciliated funnels be regarded as nephrostomes, their connection with the nephridium being entirely secondary. They are to be compared with the "ciliated urns" of Gephyreans, and, like the latter, are primarily blood-purifying organs, in the "central mass" of which phagocytosis, and also the formation of new amœbocytes, takes place. In the Glossiphonidæ the "capsules" are the phagocytic organs, connected with the body-cavity through the funnels, and giving off their products by osmosis to the nephridia. In Herpobdella (Nephelis) and in the Hirudinidæ the ciliated organs are the places where blood corpuscles develop, while the excretory products are conveyed to the nephridia through botryoidal vessels. The author has also investigated, by injection methods, the relations of the various blood-containing spaces, and his observations tend to support the conclusions of recent authors, such as Oka, on this subject. He regards it as certain that the lateral blood channels of the Gnathobdellidæ are not true vessels, but merely parts of the body cavity with muscular walls.

AN illustrated pamphlet of forty-seven pages, describing how Rio de Janeiro has been freed from yellow fever, has reached us; its title is "Comment on assainit un Pays. L'Extinction de la Fièvre jaune a Rio de Janeiro," by Nerêu Rangel Pestana. The pamphlet is issued by La Mission Brésilienne d'Expansion économique, and is published in Paris by MM. Aillaud et Cie. The deaths from yellow fever in Rio de Janeiro were 1078 in 1898, whereas in 1908 there were only four. The sanitary budget has risen from one million to seventeen million francs. Sanitary works on a large scale were carried out, such as port works, canalisation of marshes, construction of new avenues and roads, with proper alignment through the old unhealthy parts, re-construction of drainage, fumigation of houses, oiling of pools, introduction of pipe water-supply, and so on, and, perhaps as important as anything, a sanitary code, rigorously enforced against obstinacy, ignorance and ridicule, the usual means employed for resisting such measures. As illustrating the activity of the sanitary staff, more than 153,000 breeding-places of mosquitoes were dealt with in 1906. In 1907 the death-rate was 19·2. The general mortality is now no greater than that of Vienna. It must be remembered that occasionally yellow fever disappears quite independently of an attack on the mosquito, but it can hardly be doubted that these splendid triumphs of tropical medicine in Rio de Janeiro, in Santos, and in other places have been entirely due to the war without mercy waged against *Stegomyia fasciata*, and that soon yellow fever will be a disease of the past.

AN account of the American mistletoe, *Phoradendron flavescens*, dealing with the anatomy and some of its biological aspects as a hemiparasite, is presented by Mr. H. H. York in Bulletin No. 120 of the University of Texas. Dissemination is attributed to the agency of birds that eat the seeds. The commonest host plants are hackberry, mesquite, elm, and osage orange. The seedling first forms an attachment disc on the outside of the host, then sends in a primary haustorium which spreads in the cortex; from the haustorium sinkers are developed, which penetrate the wood along the medullary rays. The growth of the parasite is very slow, but it may attain a length of 3 feet in about twenty years. The host plants become misshapen, but are not seriously injured, unless indirectly by wood-boring insects, which first attack the mistletoe.

THE expectation that many striking new plants would be discovered in the collection made by Mr. E. Ule in the State of Bahia is fully borne out by the first list of diagnoses published in Engler's *Botanische Jahrbücher* (vol. xlii., part ii.). Two xerophytic bromeliads from the mountains furnish the types of new genera, Sincoræa and Cryptanthopsis, allied to Fascicularia and Cryptanthus; new species, chiefly rock-inhabiting, are added to Encholirion, Hohenbergia, and other genera. Two root-climbing parasites are additions to the genus Struthanthus, and a new bushy Phoradendron was taken on a Cæsalpinia. Dr. H. Harms, one of the collaborators with Mr. Ule, describes a number of new species for the Leguminosæ, notably species of Calliandra, Mimosa, and Cassia. Under Euphorbiaceæ, new species of Euphorbia, Jatropha, and Manihot are recorded, and Dr. I. Urban distinguishes a new species of Loasa.

A HIGHLY interesting number of the Proceedings of the Boston Society of Natural History (vol. xxxiv., No. 7) is devoted to the flora of the islands of Margarita and Coche, lying off the mainland of Venezuela. The author, Mr. J. R. Johnston, has twice visited the islands, and has

made a close study of the flora of Venezuela. The list comprises about 650 species, of which two-thirds are common to tropical America, thirty-seven are west Indian, and eighty-two are confined to South America, of which one-half are endemic. The Leguminosæ is the predominant family, and supplies many of the common plants, such as species of Cæsalpinia, Cassia, and Calliandra. The family of Cactaceæ is individually, although not specifically, well represented, and the species of Bromeliaceæ are conspicuous on account of their striking colours and appearance. The paucity of species in comparison with the number of genera is marked, the proportion being 1·6 to 1; the specifically largest genus is Croton, with eleven species; Capparis provides nine species.

MESSRS. BAUSCH AND LOMB, Thavies Inn, the makers of the high-class Minot microtomes, have issued a new catalogue of their various patterns to indicate recent improvements. Additional features are noted for the well-known Minot automatic rotary microtome; the knife can be moved to and fro, from side to side, or can be rotated, owing to its insertion in a special knife block; split nuts with releasing lever allow of rapid adjustment, and the feed wheel is provided with a guard. The new model Minot automatic precision microtome, a powerful and rigid type designed for heavy work, although equally efficient for light cutting, has been re-modelled; the gearing between fly-wheel and crank produces an exceptionally smooth feed. A freezing microtome for fixing on the nozzle of a cylinder containing carbon dioxide is a new instrument, intended to provide surgeons with an apparatus for preparing sections that can be examined on the spot.

WE have received the *Studi e ricerche di chimica agraria* for the years 1906–8 from the agricultural chemistry laboratory of the University of Pisa. The volume includes a paper by the director, Prof. Italo Giglioli, on the stimulus to plant growth occasioned by small quantities of manganese salts, &c., and studies by A. Quartaroli on certain properties of phosphates of agricultural interest.

A SUBJECT of great practical importance and scientific interest is discussed in a recent issue of the *Cairo Scientific Journal* (No. 29). For the past twelve years there has been a steady fall in the average yield of Egyptian cotton per feddan, and the loss now amounts to five pounds per feddan per annum at current prices. The late Mr. Gibson, in 1906, attributed the loss to the rise in level of the subsoil water, which is a direct consequence of the canal system now being introduced. One case was noted on the State Domains where a high-level canal raised the water-table of the adjoining land by seepage from a depth of 3 metres to 1½ metres, and the yield of cotton fell off considerably. The remedy appears to lie in a great extension of the drainage system.

ATTENTION has recently been directed in the pages of the *North British Agriculturalist* to the use of soya beans as cattle food. The bean is well known in America and in Asia, but has hitherto not been used in the British Isles. After removing some of the oil, the residue is made into oil-cake containing about 7 per cent. of oil and 40 per cent. of "albuminoids" (*i.e.* 6·4 per cent. of nitrogen, albuminoid being defined as nitrogen×6·25), and is at present cheaper than other foods of like composition. During the spring of this year about 50,000 tons of beans have been imported, it is understood, from Manchuria, and at present prices the cake promises to form a very useful addition to the list of cattle foods.

MR. E. S. THOMAS contributes to the May number of the Journal of the Cairo Scientific Society a useful article summarising the facts of the early mining industries of Egypt. The gold of the desert has been worked from a very early period, an ingot having been found buried with a corpse of the first dynasty, while gold-handled flint knives and stone jars, the mouths of which are ornamented with gold, testify to the artistic skill of the people of the same period. The earliest direct references to expeditions in search of gold date from the twelfth dynasty. Western Asia drew large supplies of gold from Egypt during the period represented by the Tel-el-Amarna letters, and the records of tribute paid in the precious metal by subject races show that immense treasures were at the disposal of the Pharaohs. Silver was also received in large quantities from Crete, Attica, and probably from Cilicia. The first systematic scheme for gold-mining under Egyptian management dates from the nineteenth dynasty, and it continued to be carried on until it became impossible to protect the workers from Bedouin marauders. Large workings in the quartz reefs at Um Rus and Haimur show the vast extent of these operations. Altogether about ninety old workings in search of gold have up to the present been identified in the eastern Egyptian desert, and twenty more known to exist remain to be traced. Exclusive of workings in the Sudan proper, all these lie between lat. 22° and 28°, that is, between Minia and the Sudan border, and east of long. 33°. Many others will probably be discovered in the more remote desert area.

THE Director-General of Indian Observatories has issued a memorandum (dated June 8) on the meteorological conditions prevailing before the south-west monsoon of 1909. Past experience shows that the most important indications regarding monsoon rainfall are afforded by the pressure conditions in South America and the Indian Ocean, and these for the past two months have been decidedly favourable, being above the normal in the former and below in the latter regions. Late and excessive snowfall is unfavourable to the monsoon, especially in north-west India, but since April none of any significance has occurred. From these and other data referred to in the memorandum Dr. Walker draws the following useful inferences:—(*a*) the general conditions are such as have, in a decided majority of years, been followed by a total monsoon rainfall of more than the average amount; (*b*) the indications regarding the geographical distribution are by no means well marked, but suggest that the outlook for the plains of north-west India during the earlier part of the season is somewhat less favourable than that for the field of the Bay current.

ALTHOUGH much work has been done on the relation between the magnetic qualities of steels and their composition, we are still far from being in a position to state what it is exactly which confers on a steel the property of magnetic permanence. The most recent work in this field is that of Mr. T. Swinden, described in the June number of the Journal of the Institution of Electrical Engineers. Mr. Swinden, after examining a number of steels containing 3 per cent. tungsten both magnetically and microscopically, comes to the conclusion that magnetic permanence depends more on the constitution than on the state of crystallisation of the steel.

THE July number of the *Journal de Physique* contains Dr. Hale's address to the Société française de Physique on the magnetic fields of sun-spots. By means of a very careful and detailed comparison of the intensities and polarisations of the doublets and triplets obtained in the Zeeman experiment in the laboratory with the corresponding effects obtained in the spectra of sun-spots by the

help of the Snow telescope at Mount Wilson, California, at an altitude of 1760 metres, Dr. Hale shows that sun-spots consist of columns of ionised vapours circulating in opposite directions in the two solar hemispheres, the axis of rotation being, in general, inclined at a considerable angle to the normal to the solar surface. There appears to be evidence of connection beneath the solar surface of the vortices observed north of the solar equator with those south of that line. The whole of the observations afford strong support to the theory that sun-spots are the normal products of the convection currents which occur in the sun.

THE *Bulletin international* for 1907 of the Bohemian society, L'Académie des Sciences de l'Empereur François Joseph I., was published in 1908, and a copy has just reached us. Drs. B. Kučera and B. Mašek write in English on the radiation of radio-tellurium, and continue a description of their researches, which have led them to the following conclusions among others. The absorption of the α rays from radio-tellurium in metals and gases investigated by Bragg's method is manifested similarly as with α rays of radium and its first transformation products by lowering of the ionisation curve. The atomic stopping power is very nearly proportional to the square root of the atomic weight, and possesses almost the same values as Bragg found for radium C. It is probable, though, that the proportionality constant increases slightly with atomic weight. For the same gas (air) the ranges corresponding to the α rays of the same velocity are inversely proportional to the pressure (density) of the gas. The ranges for the rays of the same velocity in different gases (air, oxygen, carbon dioxide) are inversely proportional to the mean square roots of their atomic weights. The existence of a secondary radiation of α rays which ionises air at ordinary pressure cannot be taken as ascertained.

FROM the account, published in *Engineering* for July 16, of the trials conducted recently by the Scottish Automobile Club, it is evident that electric ignition can be made perfectly trustworthy if well carried out. Fifty-eight cars were fitted with high-tension magnets, four used accumulators only, and three low-tension magnets. Only one car fitted with high-tension magnets had any stops at all, except for cleaning or changing sparking-plugs, a matter which often depends more on the lubrication than on the ignition apparatus. Of the other systems, there was only one small stoppage in any of the cars having accumulator ignition, and two considerable stops in cars fitted with low-tension magnets. The Albion car, fitted with low-tension magnets, went through without an ignition stop, as it has done on previous occasions, and it may be taken for granted that the low-tension system, like the high-tension, can give completely satisfactory results.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN AUGUST:—

Aug. 3. 23h. Mercury in superior conjunction with the Sun.
5. 4h. 15m. Mars in conjunction with the Moon (Mars 0° 13′ S.).
,, 23h. Saturn stationary.
6. 9h. 45m. Saturn in conjunction with the Moon (Saturn 1° 32′ N.).
10-12. Perseid maximum.
11. 19h. 2m. Venus in conjunction with Jupiter (Venus 0° 12′ N.).
13. 8h. Mars in perihelion.
17. 11h. 36m. Jupiter in conjunction with the Moon (Jupiter 4° 17′ S.).
18. 0h. 13m. Venus in conjunction with the Moon (Venus 4° 15′ S.).
23. 3h. Mars stationary.

A LARGE GROUP OF SUN-SPOTS.—During the past week a group of sun-spots, of abnormal size for this period of the sun-spot cycle, has been visible on the solar disc—even to the naked eye. This large group has developed from a few scattered, small nuclei which came round the eastern limb on July 18, and now includes a leading spot of large dimensions and two separate trails of smaller spots. In addition to the large group there was another, preceding, group of medium size and two smaller ones to be seen on the disc on Saturday last. This outburst still further emphasises the extension, in time, of the sun-spot maximum of 1905–6.

PHYSICAL INTERPRETATION OF LUNAR FEATURES.—In presenting the eleventh fascicle of his photographic map of the moon, M. Puiseux placed before the Paris Academy of Sciences some ideas as to the nature and history of the lunar landscape, suggested by the study of the photographs. From the absence of any appearance of division into parallels of the dark and light areas, M. Puiseux argues that the moon certainly has not polar regions of ice and snow such as those seen on the earth and Mars. Then, considering the probable presence or absence of water, it follows that the moon's surface must either be glaciated completely or shows no trace of water areas.

Against the former suggestion, which, it will be remembered, is the one upheld by Herr Fauth, the noted selenologist, there is the relatively low albedo, comparable to that of the terrestrial volcanic and siliceous rocks, but certainly much less than that of snow or ice, and there is also the fact that extremely bright and extremely dark areas are mixed up indiscriminately in small areas. M. Puiseux promises a further communication dealing with the subject of the form and distribution of the dark lunar spots seen on the same photographs (*Comptes rendus*, No. 26).

DOUBLE-STAR MEASURES.—No. 158 of the Lick Observatory Bulletins contains the fourteenth list of double stars discovered and measured by Prof. R. G. Aitken with the 36-inch refractor of the Lick Observatory. All the pairs measured are separated by distances of less than 5″, and in eighty-two cases less than 2″. The present publication contains the measures of 100 double stars, and brings the total number discovered by Prof. Aitken to 2000, 74 per cent. of which are separated by distances of less than 2″.

A discussion of the available data of 7500 known pairs leads Prof. Aitken to the conclusion that, among the stars down to the ninth magnitude, the number of doubles having separations of less than 2″ is greater than those separated by distances exceeding 2″, but less than 5″, in the proportion of 3/1. Hence follows a strong confirmation of the probability that practically all the closer doubles are in reality binary systems, not merely optical pairs.

No. 4338 of the *Astronomische Nachrichten* contains the measures of a number of double stars made by Mr. E. D. Roe, jun., with the 6½-inch refractor of his observatory at Syracuse.

MAXIMUM OF MIRA IN 1908.—Observations of the brightness of *o* Ceti were made by M. Luizet, at St. Genis-Laval, between September 18 and November 28, 1908, and show that the maximum brightness, 3·6 mag., occurred on October 12; this agrees within one day with the epoch given in the *Annuaire du Bureau des Longitudes* (*Astronomische Nachrichten*, No. 4340, p. 332, July 16).

OBSERVATIONS OF JUPITER'S FIFTH SATELLITE.—Although finding it a difficult object to measure, Prof. Barnard succeeded in obtaining measures of Jupiter's fifth satellite during 1908 and 1909 sufficient to determine the times of, and distances at, elongation, and to give a new value of the satellite's period. Western elongations took place at 1909 February 21 14h. 25·4m. (central standard time) and 1909 March 14 12h. 29·6m., and the apparent distances were 56·47″ and 56·00″ respectively; taking $\Delta = 5{\cdot}20$, the latter become 48·08″ and 47·93″. Combining these values with those determined in 1892, the period becomes 0·49817906d., which agrees within one-thousandth of a second of time with that previously determined. It therefore appears that the period is now quite accurately known, and has suffered no sensible change during the seventeen years that the satellite has been under observation (*Astronomische Nachrichten*, No. 4339).

THE FEEDING HABITS OF MŒRITHERIUM AND PALÆOMASTODON.

THROUGH the discoveries in the Oligocene[1] of the Fayûm Mœritherium and Palæomastodon have become famous as two of the earliest, and more or less direct, stages in the ancestry of the elephants. In restorations by various authors each of these animals has been provided with a proboscis of less or greater length, as would befit a more or less remote ancestor of an elephant. As first announced by Dr. C. W. Andrews, to whom we are chiefly indebted for our present knowledge, Mœritherium does anticipate the Palæomastodon type in the enlargement of the second pair of upper and lower incisors and in the general pattern of the grinding teeth. Since the wish is always father to the thought, and nothing is more to be desired than a primitive progenitor of the Proboscidea, it was altogether natural to place Mœritherium in or near the line of ancestry of the elephant, and in such ancestry, as a member of the Proboscidea, the animal has gone into general literature.

A first more cautious note was sounded by Dr. Andrews in his memoir of 1906,[2] p. xvii, in which he observes:—"As already mentioned, Mœritherium was probably an amphibious, shore, or swamp living animal, and it was no doubt owing to the continuation of the conditions favourable to its mode of life that it persisted into the Upper Eocene period. In the meantime, however, either from this or some closely allied type, there had arisen another animal more adapted to terrestrial life and showing a great advance in the direction of the typical Proboscidea: to this creature the name Palæomastodon has been given." Elsewhere (p. xxi) Dr. Andrews notes that Mœritherium favours the view, first put forward by de Blainville, of an original relationship between the Proboscidea and Sirenia. Later on in the same work (p. 119) the same author, in commenting on the similarity between the pelvis of Mœritherium and that of the Eocene sirenian Eotherium, observes:—"Then it may fairly be suggested that Mœritherium and Eotherium, both occurring in the same region (one the most primitive Proboscidean, the other occupying the same position with regard to the Sirenia), are, in fact, closely related, and had a common ancestor in early Tertiary times, probably in the Lower Eocene." On p. 105 we find a comment on the remarkable likeness between the brains of Mœritherium and the Sirenia.

Since these suggestive comments were written other materials have been secured, including a nearly perfect skull and jaws of Palæomastodon by the British Museum and a skull of Palæomastodon and two partly preserved skulls of Mœritherium by the American Museum.

The question of habits and of affinity seems so important and interesting that the writer has taken it up afresh with these additional materials. The inquiry was suggested by the general resemblance which the skull of Mœritherium bears to that of a Sirenian as seen from above and in palatal view. The method of comparison adopted is that of making life-size models of the skulls of Mœritherium and Palæomastodon, then placing the sense organs and the mouth parts in position, guided solely by comparison with existing mammals showing more or less analogous modifications and by the actual condition of the hard parts themselves. This work was done by Mr. E. Christman under the writer's direction.[1] Palæomastodon itself in all probability had not developed a proboscis, although there is no question as to its being in the direct line of proboscidean ancestry. Mœritherium not only had no proboscis, but was totally different from Palæomastodon both in its appearance and habits, and only very remotely related to this animal, if at all. The study shows, further, that Mœritherium is closer to the Sirenians and less close to the Proboscidea than has hitherto been supposed.

A profound difference between these animals is brought out in comparing the top and side views of the skull, when it is seen that, whereas the eyes of Palæomastodon are in the typical mammalian position above the first permanent grinder, those of Mœritherium are very far forward, well raised in the front part of the head, and of very diminutive size, as shown by the shallowness of the sockets. All these are also characters of the Sirenian head. As indicated by the auditory meatus, the ears are relatively in a more elevated position than in Palæomastodon. Both these peculiarities are adaptations to aquatic life to protect the sense organs and bring them near the surface of the water in swimming, so that they will emerge first and disappear last.

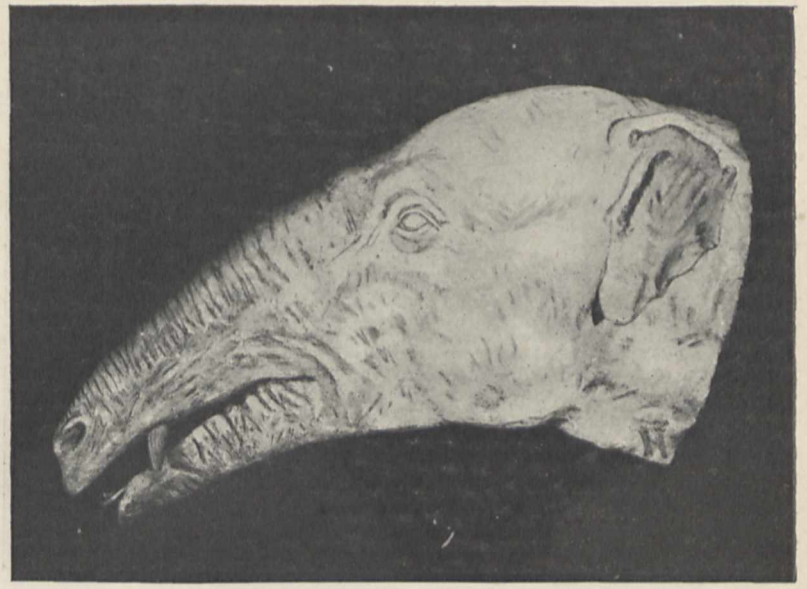

FIG. 1.—Side view of the head of Palæomastodon modelled by Mr. E. Christman under direction of the author.

The cutting teeth and mouth parts of Mœritherium are also opposed in an entirely different manner from those of Palæomastodon, so that it may be said safely that there was not the most remote resemblance either between the mouth parts or the feeding habits of these two animals. In the former the nasal bones do not greatly recede, and there was consequently little or no free retractile power of the upper lip, which is always the rudimentary condition in the evolution of a proboscis, as witnessed in the living tapirs. Comparison with Hyrax, the beaver, and other animals with an enlarged pair of front teeth tends to show that the upper and lower lips were heavy and fleshy, somewhat similar in form and function, that is, in prehensile power, and that the blunt tusks may have been covered when the mouth was closed, somewhat as in the hippopotami. These tusks were feeding rather than fighting weapons, probably because Mœritherium was protected from attack by its aquatic habitat. The conclusion is that Mœritherium was a confirmed and continual river-living animal, feeding mainly under water and on the banks, more specialised for aquatic life than the hippo-

1 These Palæomastodon beds were at first regarded as Upper Eocene, but closer comparison with those of Europe has shown that they should be rather considered as Lower Oligocene.

2 "A Descriptive Catalogue of the Tertiary Vertebrata of the Fayûm, Egypt." (London, 1906.)

1 The models have been reproduced and copies presented to the British Museum. The writer is indebted to Mr. W. K. Gregory for many valuable suggestions.

potami, as indicated by its feeble pelvis, but less specialised than the Sirenians. It would not be far from the truth to say, from our present knowledge of the animal, that Mœritherium is an offshoot of the Proboscideo-Sirenian stock, with *slightly* nearer kinship to the elephants than to the Sirenians.

The distinctive peculiarities of Palæomastodon are that its eyes are in the position typical among mammals, that is, above the first true grinders. The reason that they appear to be so far back is that the lower jaw is extended unusually far forward. The upper jaws, on the other hand, recede, practically terminating at the sides in the very sharp, laterally compressed tusks, which at this stage were chiefly developed as fighting or defensive weapons, while only indirectly of value as feeding organs. It is noteworthy that when the upper and lower lips are restored in such a manner as to enable the animal to close the mouth, the upper tusks are so largely covered that they are not especially prominent.

In contrast with Mœritherium, the nasal bones and openings deeply recede; thus a very wide space is left to be filled by a large retractile upper lip, which could undoubtedly be raised or lowered. The question now arises, How far had this lip begun to transform into a proboscis? Was there a free projecting proboscis as represented in several previous restorations? A negative answer appears to be furnished by the structure and mode of wear of the lower incisors. Together these form a broad, protrusive, spoon-shaped feeding organ, which is invariably greatly worn on the upper surface and somewhat less at the ends. This worn upper surface seems to prove that in the prehension of food the edge of the upper lip was constantly pressed downward against these teeth, thus, with the aid of fine particles of grit and sand, which were occasionally taken in, causing wear. In brief, the food appears to have been seized between the upper lip and the spoon-shaped lower teeth. Palæomastodon was a browser, and this lip could be turned up and retracted effectively to pull down smaller branches, but there is no reason to suppose that it had the free curling and independent prehensile power which characterises a true proboscis. If we critically consider the theory of the animal possessing a proboscis of considerable length, we find it rests upon the idea of kinship with the elephant rather than upon careful study of the mouth parts themselves.

If, now, we consider the elephant, we find that one of its many unique features is entire loss of the prehensile power of the anterior portion of the lower jaws, these parts having receded and disappeared. The elephant thus presents the widest possible contrast with Palæomastodon, in which the most prominent part of the face is the projecting lower teeth and jaw. It is obvious that the development of a proboscis took place step by step with the recession and loss of prehensile power in the lower jaw. If Palæomastodon had possessed an independent prehensile proboscis extending beyond the line of the mouth for the seizing of food, we cannot assign any function to these large and much worn lower incisors. A more probable view, therefore, seems to be that here presented in the model of the head and mouth parts, which were made directly upon a model of the skull itself. In the stages between Palæomastodon and the *M.* (*Trilophodon*) *angustidens*, the Lower Miocene elephant of Europe, the lower incisors have begun to transform into tusks to be employed in uprooting plants and smaller trees, just as the upper tusks are used by elephants now. With this change their prehensile function was gradually abandoned and assumed by the upper lip, which thus began its slow evolution into a freely projecting and prehensile proboscis.

All restorations contain a large element of conjecture; we shall certainly never know how these most interesting animals of the Lower Oligocene rivers of the Fayûm actually appeared, but the first rule of restoration is not to be too much influenced by kinship, but to adhere to the evidence afforded by the hard parts themselves. This rule has evidently been broken by the writer in attributing a small elephantoid ear to Palæomastodon. Unfortunately, there is no means of even conjecturing the shape of the ear of this animal, except to exclude the small aquatic type of ear which may be attributed to Mœritherium.

H. F. OSBORN.

FIG. 2.—Side view of the head of Mœritherium with the eye and ear in position. The form and position of the nostrils is somewhat conjectural. Modelled by Mr. E. Christman under the direction of the writer.

THE HEALTH CONGRESS AT LEEDS.

THE Royal Sanitary Institute and the Royal Institute of Public Health combined this year, for the first time, to hold under the auspices of the Corporation and University of Leeds a joint session.

No more fitting person than Colonel T. W. Harding could have been selected to fill the presidential chair, who fills at the present moment the important office of chairman of the Royal Commission on Sewage Disposal. It is difficult within the space of a few paragraphs to present a comprehensive review of the varied topics which came up for discussion in the different sections, and embraced anything from the treatment of tuberculosis to that of trade effluents, and from the ventilation of cowsheds to the hygiene of the mouth.

Although many of the views expressed, especially in the recently formed child-study section, were of a tentative nature and the result of incomplete experience or of individual opinion, a striking feature of the congress was the earnestness displayed by those participating in it, a remarkable fact when one considers how much of the work connected with sanitary matters is self-imposed, largely unofficial, and purely disinterested.

It seemed appropriate that the president, an old Leeds citizen, should have referred in his opening remarks to the sanitary improvements of the town, which had nearly halved the death-rate in fifty years; but the greater part of his address was devoted to a general survey of the growth of public interest in and control of sanitation, and the present-day problems of urban life. Among the present-day problems he referred to the continued high mortality from phthisis, pneumonia, and diphtheria, and the heavy death-rate among children. Although the presi-

dent pointed to the great advances which have been made in sanitary reform in nearly every direction, he raised the important question as to whether the present system of elementary education is wholly good. "We are spending," he said, "large sums in elementary education; would it not be well to pause awhile and see if we are moving on right lines? We are cramming young minds in frail and half-fed bodies with all the information we can get into them, and most of it will soon be forgotten. By all means let us teach what we can, but without impairing physical development, which is much the most important work to be seen to."

In Mr. J. T. Quinton's (Liverpool) address to the conference of sanitary inspectors we were introduced to the inner working of the local sanitary machine and to the difficulties encountered by sanitary inspectors by the self-interest of those in the council whom they serve. He further touched on the subject of alcoholism, welcomed the introduction of systematic instruction in public elementary schools on its effects, and deprecated the view advanced by some that alcohol constitutes an article of food. He demanded further State interference in the matter of alcoholism, and the repeal of the exemption of patent and proprietary goods from the Food and Drugs Act.

One of the most thoughtful and comprehensive of the sectional addresses was that delivered by Dr. Newsholme (principal medical officer of the Local Government Board) to the preventive medicine section on some conditions of social efficiency in relation to local public administration, which can only be appreciated by a full perusal. Dr. Newsholme began by showing how closely interrelated are the social and sanitary problems, and how a more accurate knowledge and wider outlook will enable social problems to be seen more nearly in their correct perspective. By way of illustration he pointed out that "if the avoidable loss of life and health from communicable diseases were realised by the members of the sanitary authority, they would be less likely to build extravagant town halls while the water supply of the town is impure, or to provide municipal Turkish baths while backyards and streets remain unpaved. . . . And this more accurate knowledge and wider outlook means the abandonment of the old hand-to-mouth and empirical method of dealing with social evils. The conception of poverty and destitution as an element when it is, in fact, a complex compound will disappear, and with it will disappear administration which supplies doles to relieve the symptoms of destitution, without making efficient efforts to investigate its varying causation and to initiate preventive measures against its recurrence." "We have to realise the close interdependence of social evils, which often form a vicious circle where evil effects become, in their turn, sources of evil." As sickness is one of the main causes of sickness, poverty is one of the most potent causes of poverty. The growing tendency is to stop disease, whether communicable or not, at its source, the prompt and early treatment being one of the chief means of securing social efficiency, and the better organisation for the treatment of the sick, from whatever disease, must be regarded as a chief object of the preventive medicine of the future. The monetary value of lives lost, including cost of sickness, through phthisis, enteric fever, and other diseases, is so large that measures of prevention may be regarded as the best possible investment for the community. In the latter part of this suggestive address Dr. Newsholme pointed out the insecurity of tenure of medical officers, who are re-elected for periods of one to five years, and, unlike district medical officers, relieving officers, and vaccination officers, can be removed without the consent of the Local Government Board. He further referred to the overlapping and waste produced by the great variety of authorities dealing with closely related conditions.

In the presidential address to the engineering and architectural section, by Mr. G. F. Bowman (Leeds), reference was made to the question of back-to-back houses, and a strong case was made out for the erection of buildings of the modern type already existing in Leeds; but whether in this connection the working classes "should be the best judges of what is best for themselves" is a dictum open to grave criticism.

Dr. Newman (principal medical officer of the Board of Education) chose for the subject of his address in the child-study section child mortality. He began by pointing out that, of the annual half-million deaths in England and Wales, one-third occur under the age of fifteen years, and of this third 85 per cent. are under five years of age.

Whereas the death-rate at all ages above one year shows a steady decline, there is no such indication below that period. The first two years of life "form a veritable fire through which we pass the vast majority of the children of the nation, losing in the process approximately 150,000 of them every year, and marking many of the survivors with the signs of the flame." The three primary causes, then, are the physique of the mother, infant mismanagement, and exposure. "It is idle," said Dr. Newman, "to patch up children at school age if we first make them all pass under damaging and devitalising conditions at the beginning of their lives."

In the industrial hygiene section Dr. Whitelegge (London), as president, gave an address on the relation of health to industry. He began by referring to the improvements in industrial conditions brought about by the combined action of employers and employed, and to the responsibilities thrown upon local authorities in respect to initial construction of buildings. He pointed out the difficulties which attend an investigation into the causes affecting health in certain complex trade processes unless the different operations are separately grouped, and he further emphasised the importance of keeping safety appliances in an efficient state. In this connection he mentioned the importance of permanent local exhibitions of safety appliances, such as exist abroad, especially in textile centres, in metal and mining localities, and in the Potteries. Thus, in the removal of dust, as in metal grinding, there is no source of information, and unless expert advice is taken costly mistakes may result. There are standards of ventilation, of humidity, and of soluble lead in which employers and employed should have opportunities for instruction. Lead poisoning from glazing has been reduced by three-quarters in the last twelve years, but phthisis, or "potters' rot," from dust inhalation is still prevalent. Clearer definitions as to factory lighting and temperature in reference to humidity are required, and further information should be obtained in reference to fatigue in different arduous employments. The welfare of operatives in certain industries is affected by demands on the part of consumers. A large section of the public had grown accustomed to phosphorus matches, and it was not until the match manufacturers agreed unanimously to the prohibition of phosphorus, coupled with prohibition of import, that the Government was able to put an end to this needlessly dangerous branch of industry.

In his presidential address to veterinary surgeons, Mr. H. G. Bowes (Leeds) welcomed the recognition accorded by the President of the Local Government Board to the necessity of proper veterinary inspection of dairy cattle, though, he continued, "why the farce of the M.O.H. inspecting the cows, accompanied by a veterinary surgeon, should be kept up I don't know." nor why the inspection of cowsheds and byres should not be done by the same inspector. He further advocated the appointment of a veterinary adviser to the Local Government Board, whose advice in dealing with bovine tuberculosis would be invaluable. He emphasised especially the necessity for more rigorous treatment of this disease, which, it is unanimously agreed, is transmissible to, and a recognised cause of, disease in human beings. In view of the widespread nature of the disease at present, the slaughter of all tainted cattle would be impracticable, but a gradual weeding out of the worst cases as centres of infection might be initiated. A most important step has been taken in the Tuberculosis Order which comes into force on January 1, 1910, which requires compulsory notification and slaughter of all cattle obviously affected. He claimed further attention to the condition of cowsheds throughout the country, as exercising an important effect in diminishing the disease. In the conclusion of his address Mr. Bower referred to the abuse of tuberculin by the indiscriminate sale.

The treatment of sewage was among the subjects which came up for discussion at a joint meeting of the engineering, bacteriology, and chemistry sections, when interesting papers were contributed by Messrs. E. J. Silcock,

A. J. Martin, J. T. Thompson, and G. A. Hart. Mr. Silcock dealt with a new method now at work at Rothwell, in which, after removing grit, the sewage is pumped on to a revolving fine-mesh screen, then taken to deep percolating bacteria beds, then through sand filters, and discharged.

In the section of preventive medicine an important paper was read by Dr. Robertson (Birmingham) initiating a discussion on tuberculosis. He pointed out that more human suffering is due to tuberculosis than to any disease, that it was produced by infection derived from cases of phthisis, from milk, and possibly from meat, and developed slowly after the germ is taken into the system. He emphasised the importance of milk and meat in carrying infection, and pointed out that more than 30 per cent. of dairy herds are infected. In this connection more attention should be given to the ventilation of cowsheds. Dr. Woodcock (Leeds) followed with a paper on the physique of the phthisical as a means of diagnosis, whilst Dr. Trevelyan (Leeds) discussed the methods of preventing infection from those already suffering from the disease. An interesting discussion followed, and a resolution was passed "that the Health Congress wishes to direct the attention of agricultural societies to the great assistance which they might render to the community by making it one of their conditions in offering prizes for dairy cattle that the animals should be free from tuberculosis."

Subsequently papers were read on the protection of the food supply. Imported and canned foods were dealt with by Dr. H. Williams (London) and Dr. W. F. Dearden (Manchester), whilst Dr. Savage (Colchester) discussed the administrative measures for examining food supply in general, Mr. W. G. Barnes (London) advocated measures for eradicating tuberculosis from the milk supply, and Dr. Stedman explained methods of administering the "Dairies' Order." In the bacteriology section papers were contributed by Mr. J. Johnstone; on the significance of leucocytes in milk as indicating a need for detailed examination, by Dr. Savage (Colchester); on the catalase of milk as an indicator of disease, by C. Revis (London); and on the growth of the bacillus tuberculosis, by Dr. Moore and R. S. Williams (Liverpool). In the latter the important observation was made that the bacillus will only grow between certain definite limits of oxygen pressure, being equally stopped by absence of oxygen or by more than 60 per cent. To stop and kill the organisms completely about 70 per cent. of oxygen must be present, which does not interfere with the majority of other organisms tested. In the same section a joint paper was read by Prof. Grünbaum and Dr. M. Coplans (Leeds) on the selective action of preservatives, in which they discuss the effect of different preservatives on the growth of organisms. Papers were also contributed by Mr. J. C. G. Ledingham (Aberdeen), on the bacteriology of summer diarrhœa; by Dr. S. G. Moore (Huddersfield), on the advantages derived from its notification to the authorities; and by Dr. Buchan (St. Helens), on administrative measures for its reduction.

An interesting series of papers was read in the engineering and architectural section on water supply and treatment of trade water, and in the section on industrial hygiene lead poisoning, its pathology and prevention, abstracts of which, from want of space, cannot be given.

Sir Charles Cameron gave an attractive popular lecture on underground and overground air.

During the congress the University of Leeds took advantage of the occasion to confer degrees *honoris causa* on the president of the congress, Colonel T. W. Harding, and on Sir James Crichton-Browne, F.R.S., and Major Ronald Ross, F.R.S.

LANCASHIRE FISHERY INVESTIGATIONS.[1]

THE report of the Lancashire Sea-fisheries Laboratory at Liverpool for 1908 gives evidence of sustained investigation into problems that demand several years' work for their solution. The articles are in almost every case continuations of those contributed to the report of 1907, and it is therefore unnecessary in a brief review to do more than summarise the findings of the several workers on the fishery questions with which they have been so long occupied.

Prof. Herdman gives a further instalment of results obtained by tow-netting with modern nets in the Irish Sea. This method of obtaining the floating or drifting organisms is now becoming more delicate, and the catching power of the nets is more accurately known than was formerly the case. The object in view being an exact determination of the distribution and fluctuation of the "plankton," no trouble is too great and no determinations are too laborious to deter the director of the fisheries work. Accordingly, this paper contains an immense amount of data both as to methods and results with regard to the seasonal and local variations in this fauna, and also with reference to the influence of conditions upon its abundance and behaviour. The statistical work involved in such a report is very great, and the credit of these laborious tables is due to the zeal of Mr. Andrew Scott. On the whole, the results of 1908 show the correctness of the conclusions arrived at in the previous contribution to this "intensive study" of plankton round the Isle of Man, but they also demonstrate some seasonal divergences which are in all probability of considerable importance to fishermen, as affecting the arrival of spring or autumn migrants. The only criticism that we feel justified in making upon such a heavy and valuable undertaking is the absence of any analysis of the light-factors that influence plankton, but we hesitate to press this criticism, as Prof. Herdman has not published the whole of his results.

Of the more striking fishery papers, attention may be directed to Mr. Johnstone's important experiments on quarantining mussels. Mr. Johnstone has determined the degree of bacterial pollution in a number of shell-fish taken from Welsh and Lancashire bays, and finds that the contamination, though, as a rule, not serious, is probably due to general contamination of the water or sea-bed in these districts. In some cases, however, the pollution is more serious, and, by transferring these heavily infected mussels to cleaner open water, Mr. Johnstone finds that in four days' quarantine the maximum amount of sterilisation is effected. The bare fact, of course, has long been known, for oysters infected by typhoid, for instance, but this report is a continuation of that more extended investigation which is needed in order to enable fishermen themselves to increase a healthy supply of shell-fish near the larger towns. Mr. Johnstone also contributes papers on the temperatures of the Irish Sea, on the growth and migration of plaice, on parasitic growths in flat fish, and a joint paper with Capt. Weigall on the outfit of the fine new boat, *James Fletcher*, which the Lancashire Sea-fisheries Committee commissioned recently. In addition to these papers, the wider aspects of biological investigations are not overlooked, and we are glad to see that Dr. Bassett has continued his hydrographical study of the Irish Sea by a further analysis of its salinities. It is to be hoped that aid will be forthcoming to provide the Lancashire committee with a member of staff specially devoted to such work.

Lastly, reference must be made to an excellent *résumé* of the method for finding the coefficient of plankton-nets (in regard to catching power) by Mr. Dakin. This gentleman's elaborate study of Pecten, forming an appendix to this report, has been noticed already in these columns (May 6, p. 273), and we may merely, therefore, refer to it as an example of the good results obtained by bringing different methods to bear upon the study of an organism.

[1] Report for 1908 on the Lancashire Sea-fisheries Laboratory at the University of Liverpool and the Sea-fish Hatchery at Piel, No. xviii. Pp. 366+9 plates. Drawn up by Prof. Herdman, F.R.S., assisted by Andrew Scott and J. Johnstone. (Liverpool, 1909.)

ORIGIN AND RITES OF GYPSIES.

IN the *Journal of the Gypsy-lore Society* for April Miss D. E. Yates publishes a translation of a paper by Prof. R. Pischel, originally published in the *Deutsche Rundschau* for 1883, on the home of the Gypsies. Reviewing various references to the origin of this race, he comes to the conclusion, on the evidence of philology, that the Gypsy dialects are closely connected with those of Dardistan, and he accordingly fixes this region as the original Gypsy home. This view is based largely on materials collected by Drew, Biddulph, and Leitner. It is unfortunate that this opportunity was not taken to

utilise the results of Dr. Grierson's linguistic survey, which now supplies ample glossaries and grammars by which the problem may be solved. Pischel's view is accepted by Dr. Grierson in his chapter on the languages of India in the first volume of the Report on the Census of India for 1901. He regards the Indian origin of the Gypsies as fully established, and while it is doubtful from which Indian tribe they really sprung, he believes that they spoke one of the non-Sanskritic Indo-Aryan tongues, which are by him grouped under the heads of Shína-Khowár, Káfir, and Kalasha-Pashai. The work of Sir G. Robertson on the Kafirs of the Hindu-Kush also supplies materials which might have been utilised in re-editing Prof. Pischel's paper.

Mr. E. O. Winstedt contributes to the same number of the journal an interesting paper on the Gypsy rites connected with birth, marriage, and death. It is a good collection of material, much of which has been gathered from comparatively obscure sources, but it is to be regretted that before publication it did not pass through the hands of a competent student of comparative ethnography. Among birth rites, he notes the customs of laying the child on the ground, the passing of the mother and baby through fire into which, among some of the subtribes, drops of the father's blood are allowed to fall. In connection with marriage, we have references to the customs of exchanging wives; the use of the broomstick and tongs as marriage symbols; the lifting of the bride over the doorstep; the exchanging of vows over a dead horse or hen; the blood covenant; the dance upon layers of sweetmeats; the custom of placing lighted candles, eggs, and apples in a stream; a custom, probably misinterpreted, of so-called marriage by capture; methods of divorce; and the curious custom, which has Indian parallels, of the father-in-law cohabiting with his daughter-in-law during the youth of his son. Among death rites, he mentions that of burning the clothing and other property of the dead man at the time of his burial, a custom of which various interpretations are suggested; interment without a coffin; disinterment of the dead; and the pouring of liquor on the grave. The variance of custom among the different Gypsy groups points to the conclusion that they have assimilated much from the races with whom they successively came into contact. It is now probably too late to fix the exact provenience of customs such as are described in this paper. If this could be done it might furnish valuable material for the investigation of the origin of this mysterious people.

CLIMATOLOGICAL REPORTS.

THE climate of the island of Norderney (lat. 53° 43′ N.) forms the subject of part iii., vol. xxxi., of *Aus dem Archiv der deutschen Seewarte*. The observations were very carefully made several times a day for nearly ten years (between 1880 and 1890) by the late Mr. O. J. Ommen; the instruments and exposure were not all that could be desired, but Dr. R. Assmann, of Lindenberg, has taken great pains to correct these defects, as regards temperature, by comparisons with hourly observations at Hamburg, Bremen, &c., the result being that the paper becomes a very useful contribution to the meteorology of the coast of East Friesland. The moderating influence of the sea upon the air temperature is plainly shown; the autumn and winter months have higher, and the summer months lower, temperatures than the Continental stations; the yearly variation at Norderney is only 17·1° C., while at Berlin it is 19·2°. It is interesting to note that the equinoctial gales maintain their old reputation at Norderney, the stormiest months being March and October.

The year-book of the Austrian Meteorological Service for 1907, which has recently been published, contains, as in previous years, hourly (1) readings or means at observatories possessing self-recording instruments; (2) daily observations and monthly summaries at a number of selected places; and (3) temperature and rainfall tables for all stations. Many of the stations are situated at great elevations, and the data are consequently of especial interest. The observations at purely rainfall stations are not included in the year-book, but are published separately by the hydrographic department. With the aid of the Academy of Sciences, the Austrian Meteorological Society and other bodies, the investigation of the upper air by means of balloons has been regularly continued, and the detailed observations are published in the *Anzeiger* of the academy. The reports of earthquake phenomena at various stations are also published in the *Anzeiger*, and, in addition, a weekly report is issued. This special service was taken over during the late Prof. Pernter's administration, and to it the office owes its present name, "Zentralanstalt für Meteorologie und Geodynamik." In connection with its system of weather telegraphy, forecasts are sent by wire daily, free of charge, from April to November, to all post and telegraph offices in Austria; to south Tyrol they are sent all the year round.

The report by Captain H. G. Lyons, director-general of the Survey Department, Egypt, on the rains of the Nile basin and the Nile flood of 1907, contains valuable statistics of the monthly and mean rainfall at a large number of stations in and near the Nile basin, with particulars of the lake- and river-levels of 1907 and previous years. The rainfall at Lake Victoria was 20 per cent. to 30 per cent. in defect, and caused famine in parts of Uganda, while on the Bahr el Jebel, the White and Blue Nile, the rains were mostly weak and irregular; the basin of the Atbara alone had a fair amount. The Nile flood was late in commencing, and very weak throughout the year; the volume of water which passed Wadi Halfa and Aswan respectively, between July and October, was only 0·65 and 0·60 of an average flood. That a flood which was so complete a failure should not have had a disastrous effect on Egyptian agriculture, Captain Lyons remarks, is due to improvements in the irrigation system of recent years and to rains on the Abyssinian tableland in the early part of the year. The investigation of the rainfall of Abyssinia is of great importance in estimating the supply of water, but there is at present an almost complete absence of trustworthy observations. The stations established by the Italian Government in Eritrea furnish most valuable results for understanding the meteorological conditions of the eastern Sudan; telegraphic rainfall reports sent daily from Addi Ugri in August and September rendered important assistance in connection with forecasts of the flood.

The year-book and rainfall report for 1908, issued by the Norwegian Meteorological Institute, have been received. These volumes contain:—(1) Hourly readings and means for Christiania, observations taken three times a day at selected stations, and monthly and yearly summaries at other places; (2) daily rainfall values at 200 stations, with monthly and yearly summaries and other details at 449 stations, and yearly amounts and averages for each year from 1867. The charts showing the yearly distribution of rainfall (isohyets) for each 200 mm. clearly exhibit the effect of the rugged land on the water-laden currents from the Atlantic. The isohyets on the western coasts show amounts of 2000–3000 mm.; these amounts rapidly decrease to 1000 and even to 400 mm. in the interior of the country. The weather forecasts issued by the institute are generally very accurate; those for the Christiania district show an average success of 88·3 per cent. This result is to some extent due to daily telegrams from Iceland and Færöe Islands, and to reports of weather at British stations, now received through the medium of the Deutsche Seewarte.

PROCESSES FOR THE FIXATION OF ATMOSPHERIC NITROGEN.

THE fixation of atmospheric nitrogen on a commercial scale has already been the subject of articles in NATURE (February 8, 1906; August 30, 1906; July 23, 1908). The method used by Birkeland and Eyde depends upon the well-known fact that an electric arc may be broadened out into a fan shape under the influence of a magnetic field. Through the arc thus formed air is driven. Since, however, only a small portion is raised to the temperature necessary for the reaction, while the greatest part serves for cooling, the gases escaping from the Birkeland furnace at a temperature of from 600° C. to 700° C. do not contain more than from 1 per cent. to 2 per cent. of nitric oxide. For further cooling, the gases

are led under boilers or through a distilling apparatus, and, finally, at a temperature of about 50°, into an oxidation chamber, where further oxygen is taken up, forming nitrogen dioxide, which in turn is absorbed by water, and thus converted into nitric acid.

To facilitate shipment, not a pure calcium product, but a basic nitrate less hygroscopic was obtained. By a new process (German patent 206,949) the nitrous gases are absorbed by calcium cynamide, forming a mixture of nitrate of ammonia and nitrate of calcium. When this solution is tested with sulphate of ammonia (Norwegian patent 18,029 of Birkeland) calcium sulphate is deposited, leaving a solution of an ammonium product. By testing this again with sulphuric acid, and distilling, nitric acid is given off, and sulphate of ammonia remains. By this means, therefore, concentrated nitric acid is also obtained from the nitrous gases. The furnaces, used in the Norwegian plants (the first at Notodden) for the production of nitric acid from the air, work with 500 to 700 kilowatts at a pressure of 5000 volts. The coefficient of reduction of these furnaces is 0·7 to 0·75.

The method of Schönherr (Badische Anilin- und Soda-Fabrik) is said to be much more economical in the use of electric energy. In this process a perpendicular tube is employed having at the lower end an electrode, between which and the walls of the tube or an upper electrode a long arc is maintained. The air rushes whirling through the tube, filling it throughout its length, which may be several metres, with a steadily burning arc. There are now three furnaces, each employing about 600 horse-power, and using an arc about 5 metres long. Single-phase current is used at high pressure.

Recently Birkeland has lengthened his furnace and considerably increased the distance between the electrodes. By means of the magnetic field a long arc is produced which takes the shape of a screw and rotates in the furnace; by this means the air, which enters in the direction of the arc, is set in violent motion (American patent 906,682, dated December 15, 1908).

Mention should also be made of the method of Haber and König (French patent 392,670), which may be regarded as a great step in the development of the processes just mentioned. Here the mixture of nitrogen and oxygen is led under a low pressure into the narrow tube in which the flaming arc burns, the tube being well cooled on the outside. By this means, it is stated, gaseous mixtures are obtained from the air which contain from 9½ per cent. to 10½ per cent. of nitrous oxide, whereas in the older Birkeland-Eyde furnace only 1 per cent. was obtained.

In a paper read at the recent International Congress of Applied Chemistry Mr. Bagley directed attention to the production of nitric acid and nitrate of ammonia direct from ammonia gas. A plant is working successfully in connection with a battery of coke ovens in Germany. Ammonia gas mixed with air is forced rapidly through a plug of platinum. Every seventeen parts by weight of ammonia produces sixty-three parts by weight of nitric acid of 36° Be. Nitrate of ammonia is also produced by neutralising the nitric acid with a further supply of ammonia obtained from crude gas liquor. By a modification of the Mond process ammonia is also obtained from the gasification of peat.

IMPROVEMENTS IN PRODUCTION AND APPLICATION OF GUNCOTTON AND NITROGLYCERINE.[1]

FOR centuries the only explosive known to the world was that mechanical mixture of saltpetre, charcoal, and sulphur called gunpowder. Chemical explosives may be said to date from the discovery of guncotton by Schönbein, and it is a fact worth noting on this occasion that the first sample of guncotton in this country was one which accompanied a letter of Schönbein from Basle, dated March 18, 1846, and addressed to Michael Faraday at the Royal Institution. Schönbein referred to guncotton in this letter as follows:—

"There is another point about which I take the liberty to ask your kind advice. I am enabled to prepare in any quantity a matter which, next to gunpowder, must be regarded as the most combustible substance known. So inflammable is that matter that on being brought in contact with the slightest spark, it will instantly be set on fire, leaving hardly any trace of ashes, and if the combustion be caused within closed vessels a violent explosion takes place. That combustible substance is, as I will confidently tell you, raw cotton, prepared in a simple manner, which I shall describe you hereafter. I must not omit to mention that water has not the least action upon my matter, that is, that it may be immersed ever so long in that fluid without losing its inflammability after having been dried again. A substance of that description seems to be applicable to many purposes of daily life, and I should think that it might advantageously be used as a powerful means of defence and attack. Indeed, the Congreveian rockets can hardly be more combustible than my prepared cotton is. What shall I do with that matter? Shall I offer it to your Government? I have enclosed a little bit of that really frightful body, and you may easily convince yourself of the correctness of my statements regarding its properties."

In a subsequent letter he gave this body the name of guncotton.

Attempts to manufacture guncotton in accordance with the method devised by Schönbein were made both in this country and abroad. Accidents which occurred, however, both in Great Britain and France in the early days of manufacture, led to the abandonment of attempts to produce it in these countries; it was only in Austria that its production was persevered with, and a system of manufacture worked out there by Baron von Lenk. Having succeeded in producing guncotton on the manufacturing scale, von Lenk turned his attention to adapting it for propulsive purposes, and although at one time his efforts appeared to have met with a certain amount of success, and batteries of field artillery in Austria were actually equipped with guncotton cartridges, the difficulty of moderating its rate of combustion was never satisfactorily overcome. While this question was still the subject of experiments, serious accidents, due to the spontaneous combustion of guncotton in store, led to its production being given up even in Austria.

In 1863 Sir Frederick Abel took up the study of the manufacture of guncotton in this country with the view of adapting it for propulsive purposes, and, at the same time, of improving its stability, so that its spontaneous combustion in store might be prevented.

He was not successful in the first object, but, as regards the production of guncotton of good stability, the modifications that he introduced into the von Lenk system of manufacture resulted in the production of stable guncotton.

The process of manufacture devised by von Lenk was briefly as follows:—

Skeins of long staple cotton yarn were immersed in a mixture of strong nitric acid of 1·52 sp. gr., one part, and sulphuric acid of 1·84 sp. gr., three parts, contained in iron pans. The skeins were stirred about in the acid bath for a few minutes, removed to a grating above it, and some of the acid squeezed out with a suitable iron tool. The cotton, while still thoroughly wetted with acid, was transferred to earthenware pots, in which it remained for forty-eight hours. The pots stood in cold water to prevent decomposition of their contents. At the end of two days the conversion of the cotton into guncotton was complete; the skeins were removed from the pots, and as much as possible of the acid removed in centrifugal wringing machines. After centrifugalling the skeins were drowned as rapidly as possible in a cascade of water, the object being to remove the rest of the free acid. The final purification was effected by immersing the skeins for about three weeks in running water, boiling for a few minutes in an alkaline solution, and finally washing for a few days in flowing water.

In all that concerned the actual process of nitration Abel followed von Lenk, but instead of using skeins of long staple cotton he introduced the use of cotton waste from the spinning mills, suitably cleaned, and after the free acid had been removed in the preliminary drowning the

[1] Discourse delivered at the Royal Institution on Friday, January 29, by Sir Frederic L. Nathan, R.A.

guncotton, still in the same physical condition as the cotton waste from which it had been produced, was reduced to a fine state of division in a beating-engine. The effect of this important modification was to remove the last traces of "free acid" and of unstable bodies, so that the prolonged washing in cold water could be dispensed with, and, at the same time, a much more stable product obtained.

Cotton fibre is of a tubular structure, and so long as these tubes exist in long lengths the impurities in the interior of the tubes, derived from the evaporated juices of the cotton plant, and more or less affected by the nitration process, are extremely difficult of removal. Not only is the cotton in the form of long tubular fibres, but these fibres are themselves matted and entwined to such an extent that the former process of washing in running water even failed to remove impurities from amongst the bundles of fibre.

The operation of pulping introduced by Abel breaks up both the bundles of fibre and the fibres themselves, reducing the latter to short lengths or destroying them altogether by crushing. In this fine state of division the removal of impurities is much more readily effected by washing.

The manufacture of guncotton by the von Lenk-Abel process was commenced in this country about 1865. Foreign countries took it up in quick succession, and the process was the one universally followed for the next forty years. Some modifications of the nitration process were made towards the end of that period, in one case in the direction of dipping larger charges of cotton waste, and of allowing them to remain in the original acid mixture until nitration was completed, and then transferring the whole contents of the nitrating pan into the acid centrifugal; in another case the nitration process was actually carried out in the centrifugal itself.

In 1905, however, an entirely new system of nitration, hereafter referred to as the "displacement process," was invented by Messrs. Thomson, of the Royal Gunpowder Factory, and this process has been perfected and has entirely replaced the pot system of nitration there, and at Nobel's Explosives Factory at Ardeer, in Scotland. It is also being adopted at other factories both in this country and abroad.

The nitration of the cotton waste is carried out in shallow, circular earthenware pans. These pans are grouped together and worked in sets of four. The bottom of the pan slopes downwards to a central hole, connected by suitable pipes and cocks to a pipe supplying the nitrating acid, and to other pipes through which the waste acid is removed on completion of nitration. The pans are covered with aluminium hoods connected to an exhaust fan, for carrying off fumes.

Nitrating acid is then run in up to a definite mark, and a charge of 20 lb. of dry cotton waste is immersed in the acid in each pan in small quantities at a time. An aluminium fork is used for the purpose. When the charge of cotton waste has been dipped, perforated earthenware plates are placed on the top of it to keep it all under the surface of the acid; a film of cold water is run on to the surface of the plates and serves as a seal to prevent fumes getting into the room, and the aluminium hoods are removed. The cotton waste remains soaking in the acid for two and a half hours; at the expiration of that time its conversion to guncotton is complete. The cock leading to the waste acid pipe is then opened, and the waste acid allowed to flow away from the guncotton at a definite rate, whilst cold water is allowed to flow on to the top of the perforated plates at an equal rate. The water follows up the acid through the guncotton without any appreciable mixing of the water and the acid taking place, and when the whole of the acid has been displaced in this way the water is allowed to drain away from the guncotton, which is then ready for the final purification process. This system of manufacture possesses many advantages over the systems which it is superseding. Foremost among them are:—

(1) Decreased cost of manufacture, due to the facts that for a given output very much less labour is required; that the plant is both very cheap and very durable; that no power is required to work it; that less acid is lost in the washing processes; and that, owing to the absence of fumes and spilt acid, the cost of maintenance of the buildings is reduced.

(2) Increased safety so far as personnel is concerned, because there is no escape or splashing about of acid, which in the old processes was a fruitful source of acid burns, and also because decompositions, which used to take place both in the digesting pots and in the acid centrifugals, with the consequent evolution of poisonous oxides of nitrogen, no longer occur.

(3) A better guncotton is obtained. It is freer from unconverted cotton, and as the whole of the nitration and preliminary washing operations are carried out in earthenware receptacles, it is freer from mineral impurities.

(4) An increased yield to the extent of about 7 per cent. is realised.

The manufacture of guncotton was not commenced at the Royal Gunpowder Factory, Waltham Abbey, until the year 1872. Shortly after that date an improvement was made in the purification process. It consisted in subjecting the guncotton, while still in the waste form, to a series of steam boilings in large wooden vats. In the early days of this process boilings of long duration were used throughout. Later, a system was introduced in which a large number of short boilings at the commencement was followed by a couple of final long boilings. With the introduction of the displacement process of nitration, a thorough investigation of the chemistry of the boiling process was undertaken at Waltham Abbey, and as a result it was ascertained that a more rapid purification was effected by means of two long boilings, each of twelve hours' duration, followed by a series of very much shorter ones.

It is very probable that the displacement system of nitration is itself responsible for the reduction in the amount of boiling required to produce a stable guncotton. Although there is no appreciable amount of mixing taking place between the displacing water and the waste acid, still, mixing at the surface of contact does occur to a slight extent, sufficient to produce a distinct rise of temperature. The zone of warm acid liquid produced passes very slowly through the whole of the guncotton, removing in its course various impurities. The purifying action of this liquid is no doubt due to the fact that it possesses strong oxidising and solvent properties.

The pulping process introduced by Abel is still universally employed, and although its value from a purification point of view is no longer of such great importance now that guncotton is boiled as it was in the early days of cold-water washing, it is, undoubtedly, still of use in effecting a final purification of the guncotton.

In the beating-engine the mechanical process of reducing the guncotton to a pulp is effected, but no actual removal of impurities takes place, because the water is not changed during the operation. The impurities still present in the guncotton at this stage are both mechanical and chemical. The mechanical impurities consist chiefly of particles of metal of various kinds, sand and fine grit, wood and similar substances, introduced originally in the cotton waste and during the processes of manufacture. The chemical impurities are bodies produced by the action of the nitrating acid on bodies other than cellulose; they are not entirely removed in the boiling process, but are set free in the pulping. To remove the mechanical impurities the guncotton pulp, in a large volume of water, is at Waltham Abbey run from the beaters over flannel laid on long shallow troughs, the troughs having pockets with baffle plates at intervals. The rough surface of the flannel retains the fine particles of grit, &c., and the larger particles settle in the pockets or grit-traps. In the last pocket an electromagnet is inserted to remove iron or steel particles which may have escaped retention in the grit-traps.

The guncotton thus freed from mechanical impurities runs into large oval iron tanks called "poachers," where it receives several cold-water washings. The contents of the poacher are agitated by means of a power-driven wooden paddle-wheel, and then allowed to settle. The washing water containing the impurities is drawn off from the surface of the guncotton by means of a large skimmer, in order that not only impurities in solution may be removed, but also any light solid impurities in suspension.

The finally purified pulp is passed to a moulding machine, where it is lightly compressed to remove the bulk of the water, and converted into a form in which it can be easily handled. If intended for use in mines or torpedoes, or for demolition purposes, the lightly compressed shapes are submitted to heavy hydraulic pressure, converting them into dense hard blocks.

The other high explosive of which I am to speak, viz. nitroglycerine, enters into the composition of many modern propellants. Nitroglycerine was discovered by Sobrero in 1847, but it remained for a long time a chemical curiosity only.

Alfred Nobel commenced its manufacture as a blasting agent about 1868, for which purpose he absorbed nitroglycerine with an infusorial earth known as kieselguhr, and gave the compound the name of dynamite; but, prior to this, nitroglycerine had been made on a large scale in America, where it was frozen after manufacture for purposes of transport, and used for blasting.

Nitroglycerine is a liquid, and is a much more violent explosive than guncotton, and whereas the manufacture of guncotton is absolutely safe throughout, that of nitroglycerine is dangerous. The risks attendant on the manufacture of nitroglycerine are due to the facts that the temperature resulting from the chemical reaction is not so easily controlled, and that nitroglycerine, being a liquid insoluble in water, the processes after nitration have to be carried out with a substance not rendered inert, as guncotton is, by admixture with water. For these reasons the nitration of glycerine in the early days of the production of nitroglycerine on a manufacturing scale was carried out in very small quantities.

With the introduction of dynamite, the small pots used for the nitration of glycerine, standing in vessels full of ice water, were replaced by lead tanks, in which considerable quantities of glycerine, amounting to several hundred pounds, were nitrated at one operation. In these vessels the temperature was controlled by means of cold water circulating through lead coils fixed in the tank, and the whole contents of the tank were kept in agitation during the nitration by means of mechanical stirrers or by compressed air escaping through small holes in lead pipes situated at the bottom of the nitrating vessel. On completion of the nitration it was the practice in the early days to drown the whole of the charge of nitroglycerine and waste acid in a large bulk of water, from which the nitroglycerine separated out and was removed for subsequent purification by washing with alkaline solutions in lead tanks. This system entailed the loss of the waste acid, and was superseded by a process in which the nitroglycerine and waste acid were run from the nitrating vessel into another vessel termed a separator, and allowed to separate in it. The nitroglycerine, being lighter than the waste acid, came to the top, and was run off into a third tank for preliminary purification, consisting of several water washings.

This preliminary purification removes most of the free acid adhering to and dissolved in the nitroglycerine, but in order to obtain a stable product a further and prolonged purification is necessary, as in the case of guncotton. This is effected in lead tanks by repeated washings with warm, dilute sodium carbonate solution. The alkali remaining in the nitroglycerine after this treatment is thoroughly removed by washing with purified warm water. As nitroglycerine is a somewhat viscous liquid, special care has to be taken that the washing solutions are brought into very intimate contact with every portion of the charge of nitroglycerine. For this purpose the method universally employed is to agitate the contents of the washing tanks by means of the escape of air under compression through small holes in the bottom of the tank. As a result of this very thorough agitation the nitroglycerine, even after the removal by skimming of as much as possible of the washing liquid, still contains a small proportion of water suspended in it in a very fine state of division. It also contains small quantities of flocculent impurities and mineral matter derived from the glycerine and acids. To get rid of these bodies filtration is resorted to; coarse crystalline salt is very usually employed as a medium, but at Waltham Abbey it has been found that a filter in the form of a mat of sponges is more efficacious and free from the objections salt filters possess.

After the removal of the nitroglycerine from the waste acid, which takes place in a comparatively short space of time, the waste acid was run out of the separator into large lead vessels, where it remained for days, in order to allow of the formation and removal of the last traces of nitroglycerine. This process is known as after-separation, and was necessary to enable the waste acid to be dealt with without risk, because so long as it contained any traces of nitroglycerine it could not be stored or handled without risk of violent decompositions, or even of explosions, taking place.

This system of manufacture, comprising nitration, separation, preliminary washing, final washing, and after-separation, all carried out in different vessels and in different houses, was the one which, with slight modifications in detail, was followed almost universally, and is still in use in many of the older factories in this country and abroad. Its disadvantages are several. In the first place, owing to the fact that it is unsafe to transport or to carry liquid nitroglycerine about, factories are always designed so that it may flow from process to process by gravity. The result, obviously, is that nitroglycerine houses must be built on the side of a hill, or, as this is not always possible, the alternative of building a nitrating house, and also, probably, a separating house, on artificial mounds, has to be resorted to, entailing a very considerable expense.

In the next place, owing to the corrosive nature of the mixture of nitroglycerine and waste acid, and to the acid nature of the nitroglycerine even when separated from the waste acid, the only material which can be used for the cocks necessary to allow the nitroglycerine and acid to run from vessel to vessel is earthenware. The use of earthenware cocks is attended with considerable risk, owing to the fact that there is friction in them between the key and the body of the cock, and there is always the risk in moderately cold weather of the nitroglycerine freezing and fixing the key; force, if used in these circumstances, would be very liable to cause accident. Again, the necessity of storing the waste acid under observation for long periods is a costly one, both as regards labour and plant required.

It was to overcome these disadvantages that the whole system in current use for the manufacture of nitroglycerine received very careful consideration at the Royal Gunpowder Factory some years ago.

The first step that was taken to improve matters was to abolish the use of earthenware cocks in the preliminary and final washing tanks. As the nitroglycerine when it was ready to leave these tanks was thoroughly free from acid, it was possible to get rid of the cocks on these tanks, and to replace them by rubber tubes. During the washing operations this tube is secured to a nozzle fixed to the outside of the tank at a point above the level of the liquid. To run off the nitroglycerine it is only necessary to slip the rubber tube off the nozzle and direct it into another vessel or into a lead gutter used to convey the nitroglycerine to the next operation.

Rubber, however, could not be used in the case of the separator or the nitrator, where either acid nitroglycerine or a mixture of nitroglycerine and acid had to be drawn off. To overcome the difficulty in this case an entirely new system was invented at Waltham Abbey. Instead of running the nitroglycerine and waste acid on completion of the nitration process into the separator, the separation is allowed to take place in the nitrating vessel itself. Nitroglycerine as it separates from the waste acid comes to the top, it being the lighter of the two liquids, and to remove it from the nitrator all that is necessary is to raise the liquid contents of the vessel gradually until the nitroglycerine reaches the top of the nitrator, where a pipe or gutter is fixed to lead the nitroglycerine away into the preliminary washing tank. This raising of the charge is effected by introducing into the bottom of the nitrator, through the same pipe by which the nitrating acid is admitted, the waste acid from a previous charge. The rate of inflow of the waste acid is regulated, so that the nitroglycerine displaced is as free as possible from acid in suspension.

The waste acid has still to be dealt with. It was discovered that the addition of a small percentage of water to this acid, after the nitroglycerine has been separated from it in the nitrator-separator, entirely prevents the further formation and separation of the small traces of the nitroglycerine, which the after-separating bottles were required to deal with.

The advantages of the Waltham Abbey plant and system of manufacture over others are briefly as follows:—

(1) *Increased Safety.*—By the abolition of all cocks through which nitroglycerine had to pass, the risks attendant on their use have disappeared. By the presence of cooling coils in the one and only vessel in which nitroglycerine and acids are in contact, any undue rise in temperature, always a possibility in the circumstances, can be at once checked. It was not usual to have cooling coils in the separator and after-separating bottles.

(2) *Reduction in Total Elevation for, and Area of a Factory.*—The abolition of the separator, and the running off of the nitroglycerine from the top of nitrator, effect a very material saving in the height required.

The after-separating house being no longer necessary, or the separator house when one existed as distinct from the nitrating house, the number of buildings, and therefore the ground area, is substantially reduced.

(3) *Reduced Cost of Production.*—This results from the fact that the capital outlay for a factory is much less, that fewer men are required for a given output, that there is less plant and fewer buildings to maintain, and that the plant itself suffers slower deterioration. Finally, the yield of nitroglycerine is increased by at least 5 parts for every 100 parts of glycerine nitrated.

The substitution recently of Nordhausen for ordinary sulphuric acid has further improved the yield of nitroglycerine, and whereas a few years ago a yield of 210 parts of nitroglycerine for every 100 parts of glycerine nitrated was considered excellent, the average yield at Waltham Abbey is now 230 per cent., a very high figure in view of the fact that the theoretical yield is 246·74 per cent. The use of Nordhausen sulphuric acid also permits of a considerable reduction in the proportion of nitrating acid to glycerine, so that a larger output is obtainable for any given sized plant.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

HARVARD UNIVERSITY has recognised the growing importance of public health and preventive medicine by establishing in its medical school a department exclusively devoted to those subjects. It has appointed Dr. Milton J. Rosenau to the professorship of hygiene and preventive medicine, with the headship of the new department. Dr. Rosenau has lately been professor of bacteriology at the Washington Post-graduate Medical School.

THE council of the Institution of Mining and Metallurgy is prepared to offer five scholarships for the current year (provided suitable candidates present themselves) of the value of 50*l.* each, to assist graduates in mining or metallurgy to take a practical course in mines or works at home or abroad. The scholarships will be awarded to graduates of the Royal School of Mines and other recognised British mining colleges or schools. Further information may be obtained from the secretary of the institution, Salisbury House, E.C.

THE following doctorates have been conferred by the University of London upon internal and external students for the theses mentioned and other papers:—Miss Annie Abram, "The Effects produced by Economic Changes upon Social Life in England in the Fifteenth Century"; Mr. P. Hartley, "On the Nature of the Fat contained in the Liver, Kidney, and Heart"; Mr. E. T. Mellor, "The Geology of the Neighbourhood of Middelburg, &c."; Mr. J. Stephenson, "Studies on the Aquatic Oligochæta of the Punjab"; Mr. W. Makower, "On the Active Deposit of Radium"; and Mr. H. Stansfield, "The Echelon Spectroscope, its Secondary Action, and the Structure of the Green Mercury Line."

AT a recent meeting of the council of the University of Bristol Dr. Lloyd Morgan tendered his resignation of the office of Vice-Chancellor, and in accepting the same the council placed upon record its sense of the distinguished services rendered by him to the cause of university education during the twenty-two years of his tenure of office as principal of University College, Bristol, and its hearty acknowledgment of the unsparing manner in which he has devoted his time and influence to the promotion of the scheme for the foundation of the University of Bristol, now brought to a successful issue. Sir Isambard Owen, principal of Armstrong College, Newcastle-on-Tyne, has been elected Vice-Chancellor of the University, and Prof. J. Michell Clarke Pro-Vice-Chancellor.

MANY evidences of the numerous activities of the Association of Teachers in Technical Institutions are to be found in the July issue of the association's journal, which is published by the St. Bride's Press, Ltd. Addresses and papers read at the annual conference, of which an account appeared in NATURE of June 10, are printed in the periodical, and, in addition, there are several contributions by members of the association on various branches of technological chemistry. Prof. A. F. Holleman, of the University of Amsterdam, writes on substitution in the benzene-nucleus, Mr. Frank E. Weston discusses thermic reactions, and Mr. E. B. Naylor describes a course of instruction in chemistry designed to meet the needs of a mining centre. Full particulars are given also respecting the administrative work both of the parent association and its branches.

MESSRS. CORNISH BROTHERS, LTD., of Birmingham, have published in pamphlet form the address delivered last January by Sir Alexander B. W. Kennedy, F.R.S., in his capacity of warden of the Guild of Undergraduates, to the students of the University of Birmingham. The address is entitled "The Complete Student," and contains much wise and kindly advice to young men entering upon life. Early in the address Sir Alexander says:—"I am sure that the exclusive use of our mental apparatus for technical or professional or business matters, or equally for artistic or scientific matters, renders the large part of that apparatus which is adapted for far wider uses useless and inert. The owner of only half a mind—especially if it be only the money-making half—is a very poor person. Moreover, even the one used half tends to become smaller and less elastic as its owner grows older. As regards his friends, such a one grows every year duller and more stupid; as regards his profession, he becomes less and less able to appreciate its continually changing aspects; as regards himself, he has as deliberately thrown away half of the pleasure of existence as if he had chosen to shut himself up all his days in a tube railway, beautifully illuminated by arc lamps, but absolutely cut off from the light of the sun."

THE London County Council Education Committee has had under consideration lately the question of the attendance of pupils residing outside the metropolitan area at secondary schools within the administrative county of London. The inquiry has led to some interesting comparisons as to the ratio existing between the gross cost per pupil of the education provided in London secondary schools and the amount of fees paid by the pupils. Taking the case of the seventeen secondary schools provided and managed by the committee, the gross estimated cost of education per pupil, apart from capital charges, varies from 12*l.* 14*s.* in the case of the Dalston County Secondary School for Girls to 27*l.* 1*s.* in the case of the Holloway County Secondary School for Boys. The Board of Education grant of 4*l.* 10*s.* is uniform throughout these schools, so that the net cost of education per pupil varies from 8*l.* 4*s.* to 22*l.* 11*s.* The fees charged to fee-paying pupils vary from 4*l.* 10*s.* to 12*l.* a year per pupil. In the great majority of the schools the fee charged is only about one-half that of the net cost, and nearer one-third that of the gross cost. In other words, London parents who send their children to these county secondary schools are called upon to pay only about one-third of what that education costs. It would be a wise policy for the Education Committee to take steps to bring this fact home to the parents, for at present evidences are not wanting that the facilities

which London now enjoys for secondary education are insufficiently appreciated both by the parents and their children.

THE second volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1908, has been received from Washington. An important chapter, running to some 122 pages, provides exhaustive statistics relating to the universities, colleges, and technological schools of the United States. The total value of all gifts and bequests reported by the institutions, of which the Washington Bureau takes cognisance, during the year under review, amounted to 2,964,200*l.* Of this amount 1,029,600*l.* was given for buildings and improvements, 1,468,300*l.* for endowment, and the remainder for current expenses. Twenty-four institutions received 20,000*l.* or more during the year, the most fortunate of the universities being Chicago, which benefited to the extent of 419,700*l.*; Princeton, 200,350*l.*; California, 187,200*l.*; and Harvard, 138,400*l.* The statistics deal with 464 American universities, colleges, and technological schools. For the year 1907–8 these institutions received 3,448,500*l.* from students' fees, 811,000*l.* being for board and lodging. The grand total of the receipts of the institutions reached the large sum of 13,360,000*l.* In their libraries were 12,636,656 volumes. The value of their scientific apparatus, machinery, and furniture was 5,588,300*l.*; their grounds, 11,714,300*l.*; their buildings, 42,878,000*l.*; and their productive funds, 51,954,000*l.* The institution had a teaching force of 21,960, the number of men being 19,254. The number of students under the tuition of this large staff was 265,966.

ON July 21 Lord Monk Bretton asked in the House of Lords what steps had been taken to define the spheres of the Boards of Agriculture and Education, respectively, in the matter of agricultural education. At the same time he referred to the memorandum recently issued by the Board of Education, which implied that a sum of 21,000*l.*, in part at any rate, is available for agricultural education. He stated that he has been in communication with the university authorities and others, and can find no evidence that the money is used for this purpose. Similarly, the Treasury grants and the block-grant system of the Board of Education have not helped agricultural education; money from the latter source, indeed, goes to the relief of the rates. British agriculture, he pointed out, receives much less money than the amount granted in foreign countries, a result due to the absence of agreement and coordination between the Board of Education and the Board of Agriculture. Earl Carrington, in reply, stated that an understanding had that morning been arrived at by the two Boards as to the general lines of their future policy. There will be direct cooperation in regard to educational work, and in particular with the view of improving and extending specialised agricultural instruction. An inter-departmental committee of officers of the two Boards will consider the questions that may arise as to the correlation of work and of grants. Everything is working harmoniously between the two departments. Lord Belper strongly urged that any arrangement between the two Boards should follow the recommendation of the Agricultural Education Committee that agricultural education provided by colleges, farm institutes, and winter schools should be under the direction of the Board of Agriculture, while agricultural instruction given at evening classes connected with elementary schools should be under the Board of Education. The Marquis of Lansdowne emphasised the great importance of the subject. Quoting Sir Horace Plunkett's dictum, that what is wanted in these days is not merely economic holdings, but an economic system and an economic man to carry it out, he went on to say that we cannot get the economic man to carry out the economic system unless the Government takes some pains to give him a proper education.

THE Staffordshire County Council Education Committee has issued its scheme of agricultural education, and a perusal of the circular shows that the committee is fully alive to the difficulties involved. Provision is made (*a*) for those already engaged in agricultural pursuits, and who therefore can only devote their evenings to study, or, at most, a few weeks during the slack winter time; (*b*) for boys and girls leaving elementary schools. The former class always proves difficult to get at. Lecturers in agricultural and horticultural subjects are provided, at a merely nominal cost to the locality, to give courses of six to twenty lectures. Practical demonstrations are also arranged in cooperation with the Harper Adams College. These include:—(1) Manurial experiments to show the effect of different manures on crops and to compare different varieties of crops; (2) hedge-layering and ditching courses, which are necessarily held in the day-time, and for which prizes are therefore given by way of recompense; (3) horticulture and fruit-growing. There are also scholarships for short winter courses, tenable at the Harper Adams College or the Midland Dairy College, which, however, have been very inadequately taken up in the past. Coming now to provision for children leaving school, we find:—(1) Minor scholarships awarded for the Brewood Grammar School (agricultural side); (2) major scholarships for the Harper Adams or Holmes Chapel College, or, in the case of women, the Swanley Horticultural College. Farmers are apt to grumble because boys who take up agricultural scholarships subsequently find something they are better fitted for. Such grumbling is, of course, wholly unreasonable, and shows a want of appreciation of the true meaning of education. We are therefore sorry to see a proviso that "candidates who accept Brewood scholarships are expected to take up agriculture on leaving school. No appointment as pupil-teacher in any elementary school under the county committee will be given to boys who have held Brewood scholarships." How can a boy of fourteen be expected to know just what career he will succeed at best? Why should he be penalised if he elects to go in for farming, and discovers, two years later, that his bent is for teaching? Does not the education committee know that to discover what a boy can do, and to set him at it, is one of the great objects of all education?

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, June 28.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—At the request of the council Prof. Louis **Dollo,** of the Royal Museum at Brussels, delivered an address on the extinct gigantic reptiles of Belgium. The history of their discovery and the manner of their preservation were detailed in a most interesting and racy lecture, the peculiar skeletal arrangements of the iguanodon being specially dwelt upon.

July 5.—Prof. Cossar Ewart, F.R.S., vice-president, in the chair.—Notes on the skeleton of a Sowerby's whale (*Mesoplodon bidens*) stranded at St. Andrews, and on the morphology of the manus in Hyperoodon and in the Delphinidæ: Sir William **Turner,** K.C.B. This species of whale was first recognised in 1800 from a specimen cast ashore on the Moray Firth, and described by Sowerby. Not until 1872 were other specimens found on the Scottish coast. The present specimen led to some corrections of former conclusions, especially in regard to the differences of sex. Some interesting results were given in regard to the comparative anatomy of the hand in this whale and the allied genera of Hyperoodon and dolphins. The occurrence of five distal carpal bones in the Sowerby's whale disposed of the theory that this number did not occur in mammals.—Current and temperature observations in Loch Ness: E. M. **Wedderburn** and W. **Watson.** The observations were complicated, and at times conflicting, secondary currents and cross-currents being frequent, and evidently forming part of the circulation of the lake. Of the general conclusions the following may be mentioned. When the lake is of uniform temperature the direct current produced by wind is felt to considerable depths, and the return current is also felt in the deepest parts. When the lake has become stratified and the temperature discontinuity has appeared, the return current is almost always above the discontinuity. When the wind changes direction or follows a calm, the direct surface current is felt to considerable depths, but after the wind has been blowing for about twelve hours the return current asserts itself, and the direct current is restricted to a narrower zone.—Pettersson's observations on deep-water oscillations: E. M.

Wedderburn. In the Gullmar Fjord, off the Skagerack, Pettersson observed oscillations of temperature and salinity with a period of fourteen days. This he attributed to the action of the moon, although he admitted that he could not give any reason for the effect. Mr. Wedderburn suggested that it was due to a temperature seiche in the Skagerack. When a layer of depth h and density ρ floats on a layer of depth h' and density ρ' in a land-locked bay of length l, the period is given by the formula

$$T = 4\pi / \sqrt{g(\rho + \rho')/(\rho/h + \rho'/h')}.$$

With $l = 250$ metres, $h = 20$ metres, $h' = 100$ or 200 metres, $\rho = 1.023$ and $\rho' = 1.027$, the calculated periods are 13·9 days for $h' = 200$ metres and 14·2 days for $h' = 100$ metres.—A Carboniferous fauna from Novaia Zemlya: Dr. G. W. **Lee.** This was an account of a collection of fossils found by Dr. W. S. Bruce during a cruise with Major Andrew Coats in the yacht *Blencathra*. The fossils were found at Cape Cherney in 71° north latitude, and proved that the Carboniferous seas had extended some six hundred miles further north than had hitherto been supposed. The collection contained more than thirty species similar to the fauna of the lower limestone of the Scottish coal-fields and of the Yoredales of England.—Note on the flight of Nigerian arrows: Dr. C. G. **Knott.** These were unprovided with feathers, and rotation seemed to be given to the arrow by the action of the air upon the head, the asymmetrical form of which was probably originally occasioned by the manner in which the wings and barbs were forged. Experiments on the rotation were described.—The development of the auditory ossicles in the horse, with a note on their possible homologues in the lower Vertebrata: Ray F. **Coyle.** The malleus, stapes, and lucus were developed from an area which is originally homogeneous, and lying between the proximal ends of the first two visceral bars. Later the malleus and lucus are split off, bearing a close relation to the first bar. The stapes is related neither to the first or second bar nor to the auditory capsule, arising as an element peculiar to the Mammalia.

July 12.—Dr. Horne, F.R.S., vice-president, in the chair.—A further contribution to a comparative study of the dominant phanerogamic and higher cryptogamic flora of aquatic habit in Scottish lakes (Scottish Lake Survey): George **West.** The lochs studied were those of Kirkcudbrightshire, Wigtonshire, Fife, and Kinross. In north-west Kirkcudbrightshire the lochs are of highland character, but the flora, though resembling that of the Ness district, does not thrive to so great a depth. This is due partly to the comparative shallowness of the Galloway lochs and to the deposit of dead leaves of grasses over the floor of the loch. The lochs of south-east Kirkcudbrightshire are of lowland type, and have in many cases a rich and luxuriant flora. In Wigtonshire both types of lochs are found, those in the open moor being scanty in flora, while those within the zones of active agriculture are of lowland type and of rich and varied vegetation. The populous mining, manufacturing, and agricultural regions of Fife and Kinross are characterised by many lochs of the lowland type, some of them being very luxuriant in aquatic flora, because the non-peaty water contains a rich supply of food-salts, due in many instances to the activity of man in the surrounding district. The paper enumerated about 250 species of plants found in the lochs of the areas named.—Osteology of Antarctic seals (Scottish National Antarctic Expedition): Dr. R. B. **Thomson.** The seals brought home by Dr. Bruce numbered in all forty-four, and included all the Phocidæ except the elephant seal. The most interesting capture was that of two Ross seals, the dentition of which differs markedly from that of other Antarctic seals. The dentition is remarkably feeble. The chief food being soft-bodied cephalopods, the incisors and canines have developed into needle-pointed re-curved hooks of great delicacy, while the post-canines have been allowed to degenerate. Other anatomical peculiarities were described, one interesting anomaly being presented by the fifteenth dorsal or last rib-bearing vertebra. On one side there is the normal condition, an articular facet bearing a feebly developed rib; on the other there is a well-marked process representing the absent rib, showing that the costal processes in the lumbar vertebræ are the homologues of the ribs.—A negative attempt to detect fluorescence absorption: Dr. R. A. **Houstoun.** Results which seemed to indicate fluorescence absorption have been obtained by Burke, by Nichols and Merritt, and by Miss Wick, but, after careful experimenting and making every allowance for the uncertain nature of the phenomenon studied, the author is inclined to refer these positive results to systematic errors in the photometric arrangement.—The effect of internal friction in cases of compound stress: G. H. **Gulliver.** The minimum resistance to deformation and the inclination of the surfaces of sliding were given for any system of stress in a body, the internal friction being supposed to be operative. The application of the formulæ to experimental data did not yield very consistent results. With internal friction taken into account, the modified expression for the equivalent bending moment of a shaft under combined bending and twisting gives values intermediate between those given by the formulæ of Rankine and Guest.—A new experimental method of investigating certain systems of stress: G. H. **Gulliver.** The lines of maximum shear in a strained solid, as indicated by surface changes in the manner already described by the author, were compared, by superposition, with the stream lines of a viscous fluid in channels of definite shape obtained by the method of Hele Shaw. The comparisons were extremely satisfactory, and showed how analogous the equations of strain in the one case are to the equations of flow in the other.—Motion of Neptune's satellite: David **Gibb.** The calculations were made under Prof. Dyson's supervision, and were based upon the numerous observations which have been made in the American observatories since 1892, when Struve discussed all that had until then been made. From 650 equations of condition, twenty-two sets of normal equations were formed and solved. The results led to various corrections to be applied to Struve's elements. The eccentricity of the orbit of the satellite was found not to exceed 0·001. From the changes in the node and inclination, which are due to the spheroidal form of Neptune, the inclination of the orbit to Neptune's equator could be found—about 21°. The longitude of the node of Neptune's equator on the earth's equator was found to be about 205°, and the inclination of the two equations 132·8°. From these it was deduced that the pole of the satellite's orbit describes a small circle about the pole of Neptune in about 580 years, and that Neptune's equator is inclined at an angle of about 27° to the plane of its orbit round the sun.—The monsoons of the Chilian littoral: R. C. **Mossman.** The paper was a general discussion of the prevailing winds in this region of the southern hemisphere, showing how they are influenced by the circumpolar distribution.—The super-adjugate determinant and skew determinants having a univarial diagonal: Dr. Thomas **Muir.**—The illuminating power of groups of pin-hole burners: R. G. **Harris.** The variation of the illuminating power of symmetrical groups of two, three, and four burners with the distance between contiguous members of the groups was found to require somewhat complex equations for its expression. The graphs were of the same general form, and could be accounted for qualitatively on the assumption that the variation of illuminating power was due, for the most part, to a two-fold effect of the increase of distance between the burners on the supply of oxygen. The more open distribution of burners increased this supply, but the diminished draught attending such open distribution diminished it.—The life-history of *Hydrolius fuscipes*, L.: F. Balfour **Browne.** A complete and detailed monograph on this common and interesting form of life.

PARIS.

Academy of Sciences, July 19.—M. Émile Picard in the chair.—Researches on the movements of the upper layer of the solar atmosphere: H. **Deslandres.** Details of the spectroheliograph at the Observatory of Meudon are given, together with some of the results of a study of the calcium line K_3.—The determination of the displacements of the axis of rotation of meridian telescopes: Maurice **Hamy.**—The reduction of plant assimilation during cloudy weather: A. **Müntz** and H. **Gaudechon.** During direct exposure to sunlight the quantity of carbon fixed by plants is about five times as great as during

cloudy or rainy weather.—The determination of the bovine or human origin of Koch bacilli isolated from tuberculous lesions in human beings: A. **Calmette** and C. **Guérin** (see p. 135).—The origin of the contrasts of colour and sudden changes of level which are found in the moon: P. **Puiseux.** The hypothesis of snow or ice being the cause of bright spots on the moon is considered and rejected, as is also the suggestion that the dark spots are caused by deposits of cosmic material.—Observations of the comet 1909*a* (Borrelly-Daniel) made at the Observatory of Marseilles with the comet finder: A. **Borrelly.** Positions are given for June 21, 26, and July 8 and 13.—Observations of the comet 1909*a* (Borrelly-Daniel) made at the Marseilles Observatory with the Eichens equatorial of 26 cm. aperture: M. **Coggia.** Positions are given for June 18, 20, 24, and 25.—Systems of differential equations: Edmond **Maillet.**—The existence, in the magnetic decomposition of the absorption bands of a uniaxial crystal, of dissymmetry of positions observed parallel to the lines of force, the field, and the optical axis of the crystal: Jean **Becquerel.** The author has repeated his earlier experiments on this subject with a more powerful magnet (field-strength, 34,000 Gauss). The unsymmetrical change of position, as also the changes in the intensities of the lines, are in accord with the theory of W. Voigt.—The relation between the electric double refraction of mixed liquids and the optical double refraction of the solid constituents of these solutions: J. **Chaudier.**—Harmonic analysis and resonance: Henri **Abraham.**—The application of the magnetic properties of metals to automatic coin machines: Antal **Fodor** and M. **de Büty.** The use of a permanent magnet in a coin slot machine is applied in such a manner that the machine only works when a nickel coin is used. Discs of copper, zinc, or tin drop through without affecting the mechanism: iron blocks the machine, and prevents it being further used.—Researches on the phosphates of thorium: A. **Colani.** A description of the preparation of thorium chlorophosphate and double phosphates of calcium and strontium with thorium.—The synthesis of papaverine: Amé **Pictet** and A. **Gams.** The steps in this important synthesis are as follows:—veratrol, acetoveratrone, amino-acetoveratrone hydrochloride, homo-veratroyl-amino-acetoveratrone, and homoveratroyl-oxy-homoveratryl-amine. This last substance is dehydrated in xylene solution with phosphorus pentoxide, and the base thus obtained is identical in all respects with natural papaverine.—The catalysis of the fatty acids: J. B. **Senderens.** It has been shown in a previous paper that thoria and alumina, heated to a suitable temperature, convert the vapours of the fatty acids into the corresponding ketone. The properties of the oxides of chromium, calcium, zinc, copper, and cadmium have been investigated from this point of view, but none of these oxides is so advantageous as thoria in this reaction.—The presence of dimethoxy-2 : 3-methylene-dioxy-4 : 5-allyl-1-benzene in the essence of *Crithmum maritimum*: Marcel **Delépine.**—Some reactions of anthranol: Robert **Padova.**—The di-iodine addition derivatives of the higher fatty acids of the series $C_nH_{2n-4}O_2$: A. **Arnaud** and S. **Posternak.** The fixation of two atoms of iodine is nearly instantaneous in acetic acid solution.—A new base extracted from rye containing ergot; ergothioneine: C. **Tanret.** The method of extraction and the chemical and physical properties of this new base are described; its composition is $C_9H_{15}N_3O_2S$.—The constitution of perseulose: Gabriel **Bertrand.**—Contribution to the study of cultivated oats: M. **Trabut.**—The influence of the radium radiations on the chlorophyll and respiratory functions of plants: Alexandre **Hébert** and André **Kling.** No direct effects on these two functions can be traced; some secondary effects appear to be due to the slight changes induced in the plant cells.—The muscular work electrically provoked in the cure of diseases by reduction of the nutrition, and in particular the cure of obesity: J. **Bergonié.**—The anti-rabic properties of the cerebral substance: A. **Marie.**—The action of the pancreatic juice on esters: L. **Morel** and E. **Terroine.** The action of the pancreatic juice on esters is very slight, but is considerably reinforced by the addition of bile salts.—A new endoparasite of insects: Louis **Léger.**—The instability of the Swiss plateau in post-Glacial times: E. **Romer.**

CALCUTTA.

Asiatic Society of Bengal, July 7.—Some notes on mineralogy: Prof. E. **Sommerfeldt.** (1) Measurement of angles in crystals. An apparatus is shown (devised by the author) which permits the use of a simple goniometer like a theodolite-goniometer. (2) Isomorphism between anhydrite and barites. The method of Ostwald for recognising isomorphism was used for answering the question, Are the sulphate of barium and calcium isomorphous? The answer is that one salt is not able to remove the supersaturation of the other, and that, therefore, no isomorphism exists between them.—The Shou (pronounced Siau) or Tibetan stag: Lieut.-Colonel J. **Manners-Smith.** A note on the distribution and habits of *Cervus affinis*, and on specimens living in captivity in Nepal.—The Loranthus parasite of the Moru (*Quercus dilatata*) and Ban (*Quercus incana*) oaks: E. P. **Stebbing.** Mistletoes are exceedingly abundant on these two species of oak in certain parts of the north-western Himalaya. They attack the trees about Naini Tal and throughout Kamaon so extensively as, with the aid of boring beetles which follow them, to cause at times their death. It seems that moss aids the mistletoe seeds in obtaining a lodgment.—Decomposition of ammonium platinichloride and platinibromide under the influence of heat: Prafulla Chandra **Ray** and Atul Chandra **Ghosh.**

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