THURSDAY, AUGUST 25, 1910.

RECENT AERONAUTICAL PUBLICATIONS.

(1) *The Art of Aviation. A Handbook upon Aëroplanes and their Engines, with Notes upon Propellers.* By R. W. A. Brewer. Pp. xiii+254+12 plates. (London: Crosby, Lockwood and Son, 1910.) Price 10*s.* 6*d.* net.

(2) *How to Build an Aëroplane.* By R. Petit. Translated by T. O'B. Hubbard and J. H. Ledeboer. Pp. xiii+118. (London: Williams and Norgate, 1910.) Price 2*s.* 6*d.* net.

(3) *How to Build a 20-foot Biplane Glider.* By A. P. Morgan. Pp. 60. (New York: Spon and Chamberlain; London: E. and F. N. Spon, Ltd., 1909.) Price 1*s.* 6*d.* net.

(4) *Les Aéroplanes, considérations théoriques.* By P. Raybaud. Pp. 24. (Paris: F. Louis Vivien, 1910.) Price 1 franc.

(5) *Ballons et Aéroplanes.* By G. Besançon. Pp. 346. (Paris: Garnier Frères, 1910.) Price 1.75 francs.

(6) *L'Aviation.* By Prof. Paul Painlevé and Prof. Emile Borel. Pp. viii+266. (Paris: Felix Alcan, 1910.) Price 3.50 francs.

(7) *Navigation in der Luft.* By Prof. A. Marcuse. Reprinted from the *Denkschrift der ersten Internationalen Luftschiffahrts-austellung zu Frankfurt a. M.*, 1909. I., pp. 46–59. (Berlin: Julius Springer.)

(8) *Stabilitié des Aéroplanes, Surface métacentrique.* By Prof. M. Brillouin. Reprinted from the *Revue de Mécanique*, 1909. Pp. 80. (Paris: H. Dunod and E. Pinat, 1910.)

(9) *Die Seitensteuer der Flugmaschinen.* By Prof. H. Reissner. From *Flugtechnik und Motorluftschiffahrt*, 1910, 8, 10. (Munich and Berlin: R. Oldenbourg.)

(10) *IV. Congrès international d'Aéronautique*, 1909. *Procès verbaux, Rapports et Mémoires.* Pp. iv+473. (Paris: H. Dunod and E. Pinat, 1909.) Price 8 francs.

(11) *Bibliography of Aëronautics.* By Paul Brockett. Pp. xiv+940. (Washington: Smithsonian Institution, 1910.)

(12) *Petite Encyclopédie aéronautique.* By L. Ventou-Duclaux. Pp. 144. (Paris: F. Louis Vivien, 1910.) Price 1.75 francs.

(13) *The Encyclopaedia of Sports and Games.* Edited by the Earl of Suffolk and Berkshire. New and enlarged edition, in monthly parts. Part i., pp. 80, with numerous plain and coloured illustrations, including article "Aëronautics." (London: William Heinemann, 1910.) Price 1*s.* net each part.

THE present season has been, so far as aviation is concerned, a record of brilliant successes and terrible calamities. The recent fine performance of Mr. Moisant in flying from Paris to near Dover forms the fourth cross-Channel record, the preceding one being the late Mr. Rolls's flight to France and back without a stop on June 2. Mr. Moisant's performance differs from the previous ones in that he carried his mechanic as a passenger, and that he steered his entire course by compass, not having been over the ground before. His flight was not performed under by any means ideal weather conditions, for within a few miles of the English coast he ran into a rainstorm, which, owing to the high relative velocity at which the machine was being driven, or, as a newspaper reporter imagined, "with the high wind prevailing coupled with the speed at which the aëroplane was travelling" beat on the aviators' faces and on the machine with the violence of hail. Again, when approaching the English coast, the machine is stated to have been sucked down from 800 to about 200 feet, as the result of air currents set up by the cliffs. And while the Holyhead to Dublin course still awaits completion, it cannot but be said that Lorraine's preliminary flight from Blackpool to North Wales was an excellent performance, and it is quite possible that the Irish Channel may be crossed before this review is actually printed.

On the other side, we have a terrible list of fatalities, and the mere smash up of a machine that has cost hundreds to build has become a matter of such everyday occurrence as to confirm the view often expressed by the present reviewer, that it would have been better, cheaper, and probably quite as quick in the long run to have first got everything done that could be done in studying the problem of aviation by the methods of exact science and to have developed the practical side subsequently.

Mr. Brewer's book has only been out a short time, the preface being dated April, 1910, and yet in his introduction he directs attention to the small loss of life that has been incurred in the development of flying machines. The tide of good fortune would certainly seem to have recently turned, as we have before us records of no fewer than eleven deaths through accidents with either balloons or aëroplanes during the month of July, while the preceding three months claimed a death-roll of twenty-eight or more. The *Standard* of July 13 gave a list of eleven fatal accidents precedent to the death of Mr. Rolls, commencing with Lieutenant Selfridge in 1908, and not including previous fatalities, such as those of Lilienthal and Pilcher, and the death of the Marchese Vivaldi Pasqua has just been announced, following on a series of fatal accidents in Belgium, America, and elsewhere.

The fact that Mr. Brewer (1) has acted as assistant to Mr. Grahame White will probably secure for his book a large circulation, but for the more intelligent reader a greater recommendation probably arises from the fact that the author has concentrated his attention mainly on those features of the aviation problem on which he is most competent to speak with authority as the result of practical experience, namely, the structural details of aëroplanes, propellers, and particularly of internal-combustion engines. In fact, an important feature of the book is that we find here illustrated descriptions of the main features of the principal types of motor, such as the Antoinette, Gnome, Panhard, Wright, and similar information regarding the different leading types of monoplane and biplane. To add to the completeness, tables are

given showing the numerical data (dimensions, weight, horse-power, speed, and so forth), both in regard to motors and aëroplanes. The reader can see at a glance what the present position is with regard to details of construction.

The book is a compilation of useful information, and not a mere exposition of the author's fads; in fact, it is conspicuously free from dogmatic expressions of opinion. Indeed, the author carefully states that "it is not intended that an aëroplane could be designed upon the data contained herein." He has, however, directed attention clearly to the great improvements still required in those details of construction with which he is most conversant. For example, he says:—

"The study of aërial propellers is only in its infancy, and an enormous amount of experimental work remains to be done. The efficiency of present-day designs is abnormally low, and in many cases not more than 50 per cent."

Again, in the chapter on "future developments," we are told:—

"The depreciation of the 1909 flying machine is enormous, the life of the engine is seldom more than 200 miles; in some cases it is a very few miles indeed, and breakdowns or seizures are a constant evil."

The author believes in an internal-combustion turbine. This might obviate the rotatory inertia of the present Gnome motor, which must affect the steering by its gyroscopic action. "Strength of materials" also receives discussion, and derives additional interest from the fact that it is a moot point whether defect in this respect or instability was the cause of certain recent fatalities. Mr. Brewer believes that the flying machine of the future will, like a ship, have living accommodation for passengers and crew; and had he permitted himself to go a little outside his own speciality he would have seen that a necessary condition for progress is the abolition of "ailerons," "gauchissement," or "warping." But the author very wisely fights shy of stability considerations, though he has, on the other hand, an instructive chapter on the art of flying, in which he says:—"Mr. Rolls has described the initial sensations as those received in driving a motor-car which is skidding in all directions at once."

The details of Henson's model of 1843 show that the conception of an aëroplane is by no means new, but that the want of a sufficiently light and powerful motor is the obstacle which has hitherto prevented its realisation.

As the author carefully disclaims any attempt to deal with mathematical considerations, one cannot, of course, take very serious exception if the few references which he gives are occasionally inaccurate or obscurely stated. It will be sufficient to take a few examples. On p. 12 he says, when speaking of the components of pressure he refers to the lift, as one of them, "and that, acting in a horizontal direction to overcome the skin friction of the machine, this is called the drift," forgetting that in an inclined plane drift exists independently of skin friction. On p. 15 he states Joessel and Aranzini's formula for the centre of pressure, and proceeds to explain that the coordinate of this point has a maximum value—a conclusion at variance with the formula in question. In the next sentence he speaks of "conditions of stability" where equilibrium is meant. On p. 87 he reminds us of the Irishman who said, "There were five of us; there was myself, that's one, there were the two Flynns, that's two, there was Mike Murphy, that's three," and so on. For of the "five variables" in propeller design, the first is "the speed of the machine and the power available." (This is, however, a trivial objection.) On p. 20 he says that the sum of the sine of a certain angle and the tangent of another angle may be written down as twice the sine or tangent of either angle; but there is no evidence that the angles are meant to be equal or nearly so. And the statement of von Loessl's law of resistance (p. 236) gives $P = P_0 \sin \alpha$, whereas on p. 15 we have $P = 2P_0 \sin \alpha$ with α small.

Criticisms of a similar character apply with greater force to M. Petit's book (2), for which we have to thank Messrs. Hubbard and Ledeboer, editors of the *Aëronautical Journal*, for an English translation.

It would have been better if M. Petit had confined his attention to the theme described by the title "How to Build an Aëroplane," and had not trenched on dangerous ground of a theoretical character. To begin with, the author bases his discussion of thrust on a moving plane on Wegner von Dallwitz's formula. According to this the thrust varies as the tangent-squared of the angle of attack. When this angle is small the thrust would thus become a quantity of the second order of small quantities, and the law would approximate to the "sine-squared" law originally proposed by Newton. That this result is not in accordance with experiment has been sufficiently shown by Langley and others. If in order to cut matters short it is necessary to confine the discussion to one theory of air resistance, the choice is therefore a bad one. English readers will do well to remember that tg stands for tangent, otherwise the printing of this in italics, while sin and cos are in Roman type, may mislead them.

On pp. 22–36, in discussing lateral stability, the author falls into a very common error in regard to the effects of varying the height of the centre of gravity, and when his treatment of the subject contains such statements as that "this application of the centre of gravity is shown in elementary physics by the pendulum," misunderstandings are likely to arise. In reality equilibrium and stability are but little affected by raising or lowering the main planes relatively to the centre of gravity, or, what is the same thing, lowering or raising the centre of gravity relatively to the main planes. If the resultant pressure always acts along a perpendicular to the main planes through their centre of pressure, and if this perpendicular passes through the centre of gravity, it will continue to do so when the aëroplane receives an angular displacement, and there will be no moment tending to right the machine. In this respect an aëroplane differs from a pendulum and a balloon. The matter is a little difficult to make clear, and will

probably have to be explained elsewhere at greater length than is possible in this review; for this reason it is useful to have a name for the result, and I call it the Principle of Independence of Height. It is, of course, liable to modification in consequence of skin friction and other causes. In the meantime, it is an error, into which it is easy to fall, to imagine that because the weight has a moment about the centre of pressure, the aërodrome will swing about that point. It will acquire angular momentum about that point by slipping sideways without rotating. To examine the tendency to rotation, moments must be taken about the centre of gravity.

The mistake was indeed a very excusable one, but the wording of such statements as

"The force G_1E and the angle ϕ produce a component O_1D." "Which is the best way to obtain a low centre of gravity? The oldest method was to arrange the planes so that they formed an obtuse dihedral angle,"

hardly tends to make matters clearer.

The book contains much descriptive matter regarding motors, the fuselage, and methods of starting and landing, but the author would have been more convincing if he had been less dogmatic in the chapter on "The Future" in his attacks on the ornithopter and helicopter, and his claims for the monoplane as against the biplane.

We hope the criticisms contained in this review will not deter Messrs. Hubbard and Ledeboer from making further contributions to our aëronautical literature. So many books have recently appeared in France of about the same size and character as "How to Build an Aëroplane" that English translations are at present particularly useful in giving some insight into the state of progress on the other side of the Channel.

Theoretical considerations of all kinds have been carefully avoided in Mr. Morgan's little book (3), which deals purely with the details of construction of a biplane glider. Now that public attention has been centred on record-breaking flights, it is peculiarly important that the initial requirements for "learning to fly" should be brought before our notice, and the author strongly emphasises in his preface the fact that all our most successful flyers have commenced with gliders before taking to motor-driven machines, the Wright brothers having spent no fewer than three years in gliding flights. The author shows how anyone can build a glider of the type developed by Octave Chanute at a cost for the materials of about 2*l.* or 3*l.*, and it is much to be hoped that the book will induce would-be aviators to start in the right way.

M. Paul Raybaud's pamphlet (4) of twenty-four pages is intended to advance certain views regarding air resistance, such as, for example, that the air resistance on a moving surface does not act normally to the surface, but in a direction determined by the law of equality of action and reaction, that the centre of pressure of a plane area is fixed relative to the plane, that if any area is projected on a plane perpendicular to the line of relative motion, the projection of the centre of pressure is the centre of pressure of the projection (p. 9), and so forth. The arguments are of a superficial character, such as "it is evident" (p. 9), and when it comes to explaining the behaviour of a plane let fall obliquely (p. 13), he is compelled to introduce a force Q, which is statically equivalent to admitting a shifting of the centre of pressure, contrary to the previous statements.

Histories of balloons have been published in France at various times, some of them illustrated by grotesque figures of flying machines imagined or proposed. M. G. Besançon has now given us, in a small pocket-book (5), a pretty complete history of the actual development of aërial navigation from Galileo's experiments on the density of the atmosphere and Montgolfier's discovery of the balloon down to Blériot's cross-Channel flight. The first section, which deals with balloons, contains a brief account of the construction of their envelopes, of motors and propellers, and a reference to the advantages and disadvantages of various gases for the purpose of inflation.

Profs. Painlevé and Borel (6), on the other hand, condense their historical introduction into the first twenty pages, where they divide the history into four periods, namely, the legendary period, the heroic period, the scientific period, and the industrial period. They discuss the laws of air resistance, and briefly refer to the well-known controversy on the sine law *versus* the sine squared law, and the discussion embraces not only aëroplanes, but also bird-flight, ornithopters, and helicopters. Stability is referred to, but not at great length; the property which we have described as the principle of independence of height is, however, mentioned. In an appendix of more than eighty pages, certain elementary applications of mechanical principles are discussed at greater length than would be possible in the text.

The term "aërial navigation" is now used in so wide a sense that it is necessary to explain that Prof. Adolf Marcuse's article, "Navigation in der Luft" (7), deals with navigation proper, or the steering of a dirigible by means of charts and geodetic and astronomical observations. It is a general summary of progress made up until the autumn of 1909, in a subject which is much studied in Germany, but is altogether neglected in England. The author distinguishes three methods of place-determination, giving rise to terrestrial, astronomical, and magnetic navigation; of these the first three will be readily understood, while the third embraces not only steering by the compasses, but the determination of position by observation of the magnetic elements and the use of magnetic charts.

We now come to two papers which represent substantial progress in developing mathematical theories of equilibrium and stability. Prof. Marcel Brillouin's paper on metacentric curves and surfaces (8) is an important contribution to the theory of statical equilibrium and stability. When an aëroplane is moving uniformly and the lines of action of the resultant thrust are plotted relative to the aëroplane for different inclinations of the relative wind these lines will envelop a curve whch the author calls the metacentric curve. Diagrams are given of these curves for different arrangements of two planes, showing that they are

of very varied forms, and furnished, as a rule, with eight cusps, four of which correspond to grazing incidence of the air on one or other plane. Into the relative uses of statical and dynamical methods of approaching the problem of stability it is not necessary to enter at great length, although Prof. Brillouin refers to this question in the introduction. It must be pretty evident to anyone who has studied the problem that both methods must be pushed to their ultimate conclusions before aviation is reduced to an exact science; and further, our 1904 papers on dynamical stability were never intended to be final. What Prof. Brillouin has done is to reduce materially the amount of work still remaining to be done in a field of investigation of a new and difficult character.

Exactly the same remarks apply to Prof. Reissner's article (9). The steering of aëroplanes in turning curves is a difficult problem, which up to the present has not received the attention that it deserves, with the result that a great deal of an aviator's attention is devoted to counteracting the tendency of aëroplanes to turn in circles, or sometimes, not improbably, to describe spirals with decreasing convolutions until, if unchecked, they would twizzle round and fall like the seeds of certain trees. In fact, as Dr. Reissner himself points out in his introduction,

"on the motion in a curved path we find only meagre references, in which it is only attempted to satisfy one equation of equilibrium, instead of considering the six, as is necessary with every body moving in free space."

Dr. Reissner has used approximate methods; for example, in places he assumes the radius of the curve to be large. Anyone working at problems of this class will realise the necessity of employing such methods of approximation in order to reduce the mathematical work to a minimum in the early stages of the investigation. When one is thoroughly familiar with the simplest solutions, it becomes much easier to take account of modifications in which some of the terms previously neglected are re-introduced.

While on the subject of steering, it is interesting to refer to the Dunne biplane, of which a short account is given in the *Aëronautical Journal* for July, and of which a noticeable feature is that the planes actually have a negative angle of attack near the tips, so as to receive a downward pressure there. It is evident that by such a method it is possible to counteract the tendency of most aëroplanes to heel over excessively to the inside when rounding curves without making the lift vanish.

The report is before us (10) of the fourth International Congress of Aëronautics, which met at Nancy from September 18 to 23, 1909. The attendance at this congress was smaller than one might have expected, the membership list containing just over seventy names, but including Government delegates from the United States, Belgium, France, Italy, and Russia. The congress was divided into three sections, of which the first, devoted to aërostation, appears to have given considerable attention to aëronautical cartography and navigation proper. In the reports of the second section (aviation) we find discussions of propeller-thrust, laws of air resistance, the efficiency of motors, and other matters of like character, while the third section was devoted to scientific and other questions of a somewhat more miscellaneous nature.

The interest of the Smithsonian Institution in aëronautics dates almost from the commencement of its work, and this interest has been greatly stimulated through the secretaryship of the late Dr. Samuel Pierpont Langley, who brought with him to the institution the nucleus of a library of aëronautical literature. A most fitting memorial or tribute to his services to aëronautics is afforded by Mr. Paul Brockett's "Bibliography of Aëronautics" (11). While primarily intended as a catalogue of the material contained in the Smithsonian collection, this volume of 940 pages will prove a valuable—perhaps an indispensable—work of reference in the hands of every student of aëronautics.

A work of reference of a rather more popular character is M. Ventou-Duclaux's "Petite Encyclopédie aéronautique" (12). The reader who wishes to follow intelligently the records in the daily Press of aviation meetings and fatalities requires some information regarding the meaning of such terms as Gnome motor, carburettor, Curtiss biplane, Panhard motor, centre of pressure. All such expressions he will find explained if he consults this little dictionary. For some reason "Virage" does not occur.

The "Encyclopædia of Sport" (13), which is to be completed in thirty parts, opens with an article by Lord Montagu of Beaulieu on aëronautics. It contains a good, popular account of the subject, well illustrated by photographic reproductions of the chief aëroplanes and dirigibles, and of most of the "record" flights, such as Blériot's Channel flight, Paulhan's Manchester flight, and the flights of the principal French and German military dirigibles. The other articles in this number are on "Alligator," "Ammunition," "Angling," "Antelopes" (the last unfinished).

In the *Revue des Sciences* for June, 1908, Captain Paul Renard discussed the problem of the dirigible balloon. In the issues for April last he has given a couple of general articles on the problems of aviation.

Mr. Walter Child, of 35 Alfred Place West, London, S.W., has printed on a small card a diagram showing graphically the results of a new determination of the position of the centre of pressure of a lamina (a rectangular plate of magnalium) for varying angles of attack. According to him the centre of pressure approaches the front edge when the angle of attack vanishes. The method employed was to poise the plate on any assumed axis, to revolve it on a whirling table, and to read off the angle after the plate has come to the position of equilibrium. It may be mentioned that a rough and ready way of demonstrating the shift of the centre of pressure is by loading a rectangular glider and balancing it upon a finger, so that the centre of gravity occupies a known position, and then ascertaining by trial at about what angle the glider will fly if suitably projected. Mr. Child would have been wise to state the length and breadth of his lamina, and in view of the divergence of opinion

regarding the limiting position of the centre of pressure for vanishing inclination, and the probable influence of skin friction, careful examination of the conditions of experiment seems desirable.

We have before us a prospectus, issued last April, of "Aviation Investment and Research, Limited," promoted with a share capital of £100,000, with Major J. A. Meldon and Mr. Ernest Dawe, 33 Southampton Street, as secretaries, a venture the progress of which will be watched with considerable interest.

If there is one inference to be drawn from a survey of the papers mentioned in this review, it is that a large amount of attention has been given to the application of the statical formulæ, $X = R \cos \alpha$, $Y = R \sin \alpha$, to problems of lift and drift, but that the other equations of equilibrium or of motion of a solid body have been until now largely left to chance, the skill of the aviator being made to take the place of exact mathematical calculation, with uncertain results. It may be safely stated, however, that the time is not very distant when "equilibrium and stability of aëroplanes" will become a subject suitable for courses of lectures in the mathematical departments of our universities. G. H. BRYAN.

ECONOMIC MYCOLOGY.

Fungous Diseases of Plants; with Chapters on Physiology, Culture Methods, and Technique. By Prof. B. M. Duggar. Pp. xii+508. (London: Ginn and Co., n.d.) Price 8*s.* 6*d.*

PROF. DUGGAR'S book, although intended primarily for the student in the United States, will be welcomed by the plant pathologist in all countries.

The plan on which the book is arranged is excellent, and the subject-matter is illustrated with 240 drawings and photographs, which are almost all good, while some of the photographs of diseased plants (especially those taken by Prof. H. H. Whetzel) stand out with an excellence which could not be surpassed. In the first fifty pages a full and lucid account is given of isolation and pure-culture methods and the technique of fixing, imbedding, and staining; this is followed by chapters on various physiological phenomena, such as the requirements of fungus spores for germination, aspects of parasitism and saprophytism, and so forth, concluding with a valuable chapter on environmental factors. A short chapter deals with the "principles of disease control," including the preparation of fungicides. This chapter might with advantage have been amplified, and information given on such points as the strength of Bordeaux mixture to be used in potato spraying, the nature of the spray required in the various washes, and the main types of spraying machinery. The information given concerning the lime-sulphur wash is too scanty to be of much practical value. With regard to the fungicidal action of Bordeaux mixture, the statement is made:—

"It has been fairly well demonstrated that the germinating spore will absorb from the nearly insoluble copper compounds of Bordeaux mixture sufficient toxic substances to cause its death."

No account is given of the legislative control of plant diseases, an omission which should be rectified in any future edition. America was the first country to take State action in this direction, and many inter-State regulations controlling the spread of diseases are now in force. At the present time the Government of the United States is considering the best means of putting into force an Act to secure the examination of all plants at the ports of entry in order to prevent the importation of fungus and insect pests.

The remaining part of the book, consisting of 400 pages, describes the various species of fungi and bacteria which are known to cause injury to plants of economic importance in America. The aim of the author has been, in the treatment of each disease, to keep in view three considerations—(1) to describe the pathological effects and other relations of host and parasite; (2) to make clear the life-history of the organism causing the disease; and (3) to indicate the methods of prevention and control. A short bibliography, which will be very valuable to the student in other countries besides America, precedes the account of each disease.

Considering the amount of information which is given on so large a number of diseases, the suggestion that some of the more important diseases might have been given a fuller treatment must seem somewhat ungracious. It is, however, unsatisfactory for a student to be merely told, *e.g.* concerning *Botrytis cinerea*, that "much interesting biological work has been done upon this fungus." The bare statement that follows, viz., "infection frequently fails when conidia germinate directly upon the surface of delicate parts," is likely to be somewhat misleading, since it is not qualified by any reference to the results obtained by Kissling (whose name is quoted in the bibliography), which demonstrated that certain plants can be easily infected in this way. One or two omissions in the list of diseases may be noticed. The mildew (*Sphaerotheca humuli*) which attacks the hop and other plants (but not the rose) in Europe is in the United States commonly found attacking the leaves of roses; no mention is made of this disease, the "mildew" of the rose being attributed entirely to *S. pannosa*, which, in the States, is apparently the less common of the two species. It is curious to find no reference to the "mildew" of the cultivated hop. Another omission is the "covered smut" of barley (*Ustilago hordei*), which is not uncommon in the States. The "crown gall" of lucerne (*Urophlyctis alfalfae*) is found, not only "in South America and Germany," but is known also in Switzerland and Italy, and has occurred in England in Kent.

Except for a few comparatively unimportant omissions, however, this manual is thoroughly comprehensive. Throughout the work there is evidence of much first-hand knowledge of the diseases described. In some cases Prof. Duggar has followed up his researches in the States by paying a visit to Europe to study the same disease there, and in this way he has been able to throw light on certain vexed questions of

diagnosis and nomenclature. For instance, the true relationship of the Rhizoctonia fungus which causes diseases of various cultivated plants is made clear; the Rhizoctonia disease of potatoes is the same in Europe and America, while *R. medicaginis*, which attacks lucerne, asparagus, and sugar-beet in Europe, is a distinct species which does not occur in America.

Since many of the fungus diseases described occur in England, there is a considerable amount of information of direct practical value to the fruit-grower and market-gardener in this country. We find, for instance, an account of the recently discovered bud infection of peaches in the case of the peach "leaf-curl" fungus (*Exoascus deformans*), and of the best method of treating this disease. Excellent descriptions are given of such common diseases as the "brown rot" of fruit-trees (*Sclerotinia fructigena*) and apple and pear "scab" (*Venturia pomi* and *V. pirina*). Especially interesting is the account given of the various apple "cankers" which occur in the United States—the "blight canker" (*Bacillus amylovorus*), the "blister canker" (*Nummularia discreta*), the "European apple canker" (*Nectria ditissima*), the "bitter-rot canker" (*Glomerella rufo-maculans*), and the "black-rot canker" (*Sphaeropsis malorum*). A sharp look-out for the American "canker"-producing fungi should be kept by the apple-grower and economic mycologist in this country. It may be noted here that the Sphæropsis-canker has just been detected in Surrey. The exact appearance of the injury produced on the bark by the various "canker" fungi is shown by means of excellently reproduced photographs; one is tempted to say that Prof. Whetzel's photograph at Fig. 170 of the "Sphæropsis-canker" is the best of its class that has appeared in any book.

One of the most interesting chapters deals with the recent outbreak in the States of the European currant rust (*Cronartium ribicola*), a disease which was unknown in America until 1906. Investigation showed that the fungus was being introduced in its *aecidial* stage on seedlings of white pine (*Pinus strobus*) imported from Germany. A determined effort is being made to destroy all the diseased pines which have been introduced, and to prevent further importation of infected seedlings.

Sufficient has been said as to the scope of this work to indicate that it can be heartily recommended to the student of fungus diseases in this country; it is, in fact, indispensable, for no such manual previously existed in this country. E. S. SALMON.

HERTWIG'S TREATISE ON ZOOLOGY.

Lehrbuch der Zoologie. By Prof. R. Hertwig. Pp. xii+670. Neunte Auflage. (Jena: G. Fischer, 1910.) Price 11.50 marks.

THE new editions of Prof. Hertwig's text-book of zoology follow one another with such startling rapidity that it must be clear to everyone that on the continent at least it must have met with extraordinary success. This is perhaps not surprising, for, apart from the influence which Prof. Richard Hertwig's prominent position among the zoologists of the world must command, the "Lehrbuch der Zoologie" is certainly one of the best—if not the best—treatises on the subject in the German language.

There was a time not so very long ago when the English student of zoology was almost dependent upon the translations of the text-books of German authors, but in later years his wants have been supplied by his own countrymen, and it does not seem probable that Prof. Hertwig's book, excellent as it is in many respects, will find a large circulation in this country.

If it should fall into the hands of our own students, the parts which they will find most useful are those which deal with the more general problems of cytology, fertilisation, and inheritance. On these subjects the author writes with the authority of one whose own personal researches and those of a large number of his pupils have commanded the attention of the scientific world, and although there may be many who cannot fully accept the views set forth in explanation of the facts, the charm of their concise statement and the ingenious manner in which they are woven together are bound to create interest and reflection.

In dealing with the problem of fertilisation, for example, Prof. Hertwig considers that we can now accept—"mit grosses Bestimmtheit"—that it is the chromatic nuclear substance from which the chromosomes are derived that bear the hereditary characters, and in support of this he quotes some striking evidence drawn from the recent researches on the cytology of the germ-cells, and brings them into line with the results of the Mendelian experiments on inheritance. As Prof. Hertwig puts it, the theory seems very convincing, but there are some authorities who still doubt whether this theory will really bear the weight that is put upon it, and we should like to see the evidence that clearly tends to disprove it given some credit in a book that should be an impartial review of the present state of knowledge.

In the systematic part of the book the student will find a clear description of the principal characters of the classes and orders of the animal kingdom illustrated by many excellent figures. It cannot be expected that in the attempt to cover such a wide field within the limits of a single volume, the book will be entirely free from serious omissions and inequalities of treatment, but there are some features carried over from the earlier editions which really require some amendment if it is to maintain the undoubted success it has already achieved. The Enteropneusta, for example, are still classified as a class of worms. This is a position which has still some defenders, and in itself does not call for special comment; but as the author directs attention to the points of relationship between Balanoglossus, Rhabdopleura, and Cephalodiscus, surely the student will expect to find some position assigned in the text to the last two genera.

There are several other points, too, in which the book will hardly meet with the requirements of modern students. There is no figure, and a very meagre description of such important forms as Kœnenia and Anaspides; there is no mention made of the interesting trematode Temnocephalus, and, what

is perhaps more astonishing still, there is no description or statement of any kind about the septibranch Pelecypoda. The statement that there are nephrostomes in Amphioxus needs correction, and the retention of the Ctenophora as a class of Cœlenterata justification.

Several new figures have been introduced into the ninth edition, and these are all of considerable value, but it is a pity that the only illustrations of the large and important order of the Alcyonaria are copied from the old, and in some respects incorrect, figures by de Lacaze Duthiers of *Corallium rubrum*. It is very desirable that a figure of a Pennatulid and some drawings of Alcyonarian spicules should be added. A better figure of Millepora should be found than that which appears on p. 217. But with all these faults, which are many when the book is critically examined, there can be no question that in general scope and breadth of treatment Hertwig's "Lehrbuch der Zoologie" is one of the most notable of the text-books of our times.

COSMOGONY AND GEOPHYSICS.

Scientific Papers. By Sir George Howard Darwin, K.C.B., F.R.S. Vol. iii., Figures of Equilibrium of Rotating Liquid and Geophysical Investigations. Pp. xvi+527. (Cambridge: University Press, 1910.) Price 15*s*. net.

THIS volume opens with the well-known paper, "On the Influence of Geological Changes on the Earth's Axis of Rotation" (1877), in which Sir George Darwin investigated whether it was possible for known causes to produce a motion of the earth's axis comparable with that required by geologists to account for the supposed "Glacial period" in the earth's history. The result is definitely established that any change in the obliquity of the ecliptic which can have been produced by gradual deformation of the earth's shape is necessarily very small, about 1/2200 of a second of arc at most. The possibilities of wanderings of the pole are shown to be greater—from 1° to 3° in each geological period is possible. Cumulative motions of this type might account for the change since the supposed Glacial period, but any such explanation would be incompatible with the belief of geologists that where the continents now stand they have always stood.

This important paper is followed by six shorter ones, and the remaining eight papers, all of them of extreme complexity, deal with figures of equilibrium of rotating liquid.

A mass of fluid left to itself will, of course, form into a sphere under the gravitational action of its parts. If set into rotation this sphere will flatten at the poles, and Maclaurin showed that the flattened bodies corresponding to all degrees of rotation may be a series of spheriods so far as conditions of equilibrium are concerned, although obviously the very flat figures would be unstable. It has been known for some time that these spheroids are not the only figures of equilibrium. Jacobi found that certain ellipsoids with three unequal axes were possible figures, while Thomson and Tait pointed out that figures consisting of one, two, or more rings may be figures of equilibrium, although probably few of these will be stable.

The subject, of course, derives its great interest from its bearing on the origin of stellar systems and on Laplace's nebular hypothesis in particular; consequently the question of stability or instability is one of extreme importance. As an actual nebula in space loses its heat it will shrink in size, while keeping its angular momentum constant. For abstract discussion it is easier to deal with a fictitious mass of fluid of constant size, the angular momentum of which continually increases. Unless some cataclysmic breakdown occurs, this rotating mass must find for itself a continuous path through series of configurations of equilibrium all of which are stable. The problem of fundamental importance for cosmogony is that of discovering the far end of this path. Do we see it represented, as Kant and Laplace may have thought, in Saturn and his rings, or do we see it, as Sir George Darwin and others now think probable, in the earth-moon type of system? Or does the path lead only for a certain way through stable continuous configurations, and then end in a cataclysm?

This is the problem on which Sir George Darwin has for some years been leading the attack. Obviously there are the two methods of trying to trace out the path from the beginning to the end, and of trying to guess at the end and construct the path back to the beginning. Papers ix. and xv. of the present volume are devoted to the latter method. If increased rotation is going to lead to an earth-moon system, it ought to be possible to trace back the earth-moon system through diminishing rotation and through continuous stable configurations to the initial spherical form. In this connection, Sir George Darwin has directed attention to some almost overlooked, although highly important, work of Roche, who showed that a system consisting of a planet with an infinitesimal satellite in contact cannot be stable. He has accordingly attempted to examine above what limit the ratio of the masses of satellite to primary must lie for stability to be ensured. No perfectly definite conclusion is reached, but it seems as if the limit must be greater than the ratios observed in the solar system. This somewhat nugatory result is disappointing, and suggests that a better way of attacking the problem may be the direct one of examining all possible series of configurations, starting from the initial sphere.

The only road which the fluid can take on leaving the spherical form consists of the series of Maclaurin's spheroids, but this road is intersected by an infinite number of cross-roads at different points ("points of bifurcation"). At the first point of bifurcation, the series of Maclaurin's spheroids loses its stability, and the configurations represented on the cross-road through this point are found to be stable. Moreover, it appears that this particular cross-road represents the well-known series of Jacobian ellipsoids. Poincaré has shown that this road also is intersected by an infinite number of cross-roads, and that the first of these cross-roads represents a series of pear-shaped figures which look as though they might end by

dividing into a large and a small mass. At this stage everything turns on the question of which is stable of the series of figures through this point of bifurcation, the Jacobian ellipsoids on the main road, or the pear-shaped figures on the cross-road. Sir George Darwin believes he has proved the pear-shaped figures to be stable, but M. Liapounoff challenges this, and, as the result of an independent investigation, thinks these figures are unstable. Each investigator has again verified his own calculations, and Sir George Darwin has applied various checks to his work which afford some evidence, although not proof, that his original conclusion was accurate.

Here the problem at present stands, at a deadlock. Short of discovering a serious error in one or other of the two investigations, the only explanation of the discrepancy seems to lie in the rejection of certain remote, and apparently very small, terms by Darwin. These might possibly be found to turn the balance, but it is almost inconceivable that they should.

Whatever the outcome may be, the present volume stands as a record of the amount of patient labour and degree of mathematical and scientific skill brought by one worker to the examination of one theory of cosmogony. Before the scientific world permits other theories to take their place by the side of this one, it will do well to ask whether the truth of these other theories has been investigated with a degree of patience, skill, and power at all comparable with what is shown here.

THE POLAR WORLD AND GLACIAL GEOLOGY.

Die Polarwelt und ihre Nachbarländer. By O. Nordenskjöld. Pp. vii+220; 77 figures. (Leipzig: B. G. Teubner, 1909.) Price 8 marks.

DR. OTTO NORDENSKJÖLD is especially well qualified for a comparison of the Arctic and Antarctic regions, which he has personally explored in Greenland, Iceland, Spitsbergen, Alaska, Patagonia, and during his leadership of the Swedish Antarctic Expedition. He has now issued a short work on the polar world, in which he has given a general geographical description of the Arctic and Antarctic lands, and reference to the interesting problems connected with their geographical structure, inhabitants, and glacial geology. The book is based on a series of popular lectures and is issued without references. It is illustrated by seventy-six views, mostly taken by the author or on expeditions of which he was a member. The only map is a sketch of part of southern Patagonia.

The book owes its main value to its statement of the author's conclusions relating to various geographical and geological problems in which he is especially interested. Greenland is naturally described first, as it is the typical polar country, it being the most accessible and best-known land still covered with an ice-sheet. The author rejects Nansen's view of the nature of its ice gradient, and says that the problem of the Greenland inland ice was not solved by his expedition, which crossed the country at its narrow southern end, where the glacial conditions are not fully representative.

Dr. Nordenskjöld describes the fiord system of north-eastern Greenland, which he considers as the greatest in the world. Its valleys were once occupied by glaciers during a former greater extension of the Greenland ice cap; unless they had been filled with ice he would refuse them the name of fiords. He admits that part of Greenland has never been covered by ice, though he remarks that the evidence for this conclusion must be treated with caution. He briefly discusses the Eskimo, the most interesting of polar people. He accepts their Asiatic origin as apparently beyond question; the problem regarding them which he regards as still unsolved is the home of their present culture. Hamberg has suggested that the race developed its special characters in Alaska, but Dr. Nordenskjöld doubts this conclusion, as he thinks it probable that, if so, they would have spread westward into Asia, where but few of them occur, as well as eastward. He thinks their last home was probably within the centre of their present area of distribution, and not on its margin.

After describing Iceland and Jan Mayen, Dr. Nordenskjöld turns with enthusiasm to Spitsbergen, which he describes as the classical land of Arctic research. It is at present of little economic value, as it has been abandoned alike by whale, walrus, and seal hunters. Since 1905 attempts have been made to mine its coal, but Dr. Nordenskjöld regards the success of these attempts as very doubtful; and he thinks the country will be mainly of value as a tourist resort. He raises the question of the ownership of Spitsbergen, refers to the respective titles to its possession by Holland, Great Britain, Norway, Sweden, and Russia. A conference between the last States is now discussing the political status of the archipelago.

Dr. Nordenskjöld also describes the Arctic areas of America and Siberia, and gives a brief summary of recent work on the Antarctic, with an account of southern Patagonia, and a reference to Tasmania and New Zealand. He directs attention to the evidence of the former greater extension of ice in nearly all polar and subpolar countries, and he recurs frequently throughout the lectures to glacial problems. As the cause of the former glacier extension he regards Arrhenius's theory of refrigeration of the earth owing to the diminution in the carbonic dioxide in the atmosphere as inherently probable; he admits, however, that the chief different glacial centres of North America and elsewhere are not contemporaneous, that there was no equivalent glaciation of Siberia, and that there is no evidence of a former existence of ice in some parts of Alaska as in the Yukon district. The oft-made suggestion that the ice developed in localities which had a moist climate and heavy snowfall he rejects from the evidence of Kerguelen, where, in spite of these conditions, there is much ice-free land. Kerguelen, however, is only in the latitude of Paris.

Consideration of the westward extension of the Scandinavian ice-sheet leads him to consider the general belief that the Scandinavian ice filled the North Sea and deflected the local glaciers northward.

Dr. Nordenskjöld concludes that there is no proof that the Norwegian ice extended to the British coast, and an alternative explanation that the North Sea was filled with such heavy pack-ice as to press back the glaciers which flowed from the English mountains he rejects as "extraordinarily improbable" from all the evidence given by Arctic and Antarctic ice. He makes the interesting suggestion that the shallow areas of the North Sea were filled with barrier-ice formed *in situ*, like that of the Ross Sea, and that its obstruction was the cause of the deflection of the British glaciers.

J. W. G.

STRUCTURE AND CARE OF TEETH.

Our Teeth. How Built Up; How Destroyed; How Preserved. By R. Denison Pedley and Frank Harrison. Pp. 99. (London: Blackie and Son, Ltd.) Price 5*s*. net.

THE authors of this little book are well known to the members of the dental profession, but as the work is obviously intended for the lay public it may be as well to state at once that both Mr. Pedley and Mr. Frank Harrison occupy a high position in dental surgery; indeed, the fact that Mr. Harrison was chosen as president of the Odontological Section of the British Medical Association and Mr. Pedley as one of the vice-presidents in 1908 sufficiently demonstrates their title to advise and instruct the general public upon things dental. The book opens with a discussion of dental anatomy and physiology, illustrated with diagrams and photomicrographs of remarkable excellence. The authors have not hesitated to employ quite high powers, even such a magnification as ×2250; into the actual photomicrograph they have introduced explanatory labels with lines pointing to the special objects to which it is desired to direct attention.

Obviously in a work of this kind an abstruse dissertation upon tooth-development would be out of place; the authors plump for a theory and instal it as correct. Thus on p. 30 there occur illustrations and letterpress which would lead the reader to believe that the process of enamel calcification was quite understood, and that the process in the case of dentine was universally acknowledged to consist of the conversion of the odontoblast, whereas the former is very far from settled and the latter is supposed by some of the best living authorities to be a matrix calcification not involving the cells at all; however, the process as described in the book has the sanction of very good observers in the past, and it is no drawback for a writer on a technical subject addressing a lay audience to be dogmatic.

The pictures and description of dental caries and its pathology are both excellent; the valuable work done by Dr. Miller, of Berlin, is duly recognised, but the pioneer work of Milles and Underwood in 1881 (two years before Miller's first essay) is not noticed, which seems an omission. In the 100 pp. the authors run over structure, development, nourishment, growth, disease, allied disease, and treatment, so that the gift of condensation has been required to no small extent. The style throughout is lucid and interesting, the illustrations quite remarkably good and well reproduced, and if the opinions of the authors, or the authorities upon whom they rely, are stated occasionally as *ex cathedra* and unquestionable, such treatment of scientific questions is very difficult to avoid in a work addressed to a popular audience. The authors are to be congratulated upon having produced a thoroughly clear and useful manual, and on having left no doubt possible in the reader's mind as to their own views.

OUR BOOK SHELF.

The Funeral Papyrus of Ioniya. (Theodore M. Davies' Excavation: Bibân el Molûk.) With Introduction by Edouard Naville. Pp. viii+20; plates 34. (London: Archibald Constable and Co., Ltd.) Price 21*s*. net.

AMONG the objects discovered by the American explorer, Mr. Theodore M. Davies, in the tomb of Queen Thîy's parents in the Bibân el Mûlûk at Thebes was the funeral papyrus of Ioniya, the father of Amenophis III.'s great Queen. This was first worked over by Prof. Newberry in 1906, who published a summary of its contents in Mr. Davies' "The Tomb of Ioniya and Touiyou" (Constable and Co.) in 1907. Photographs of the document were then placed in Prof. Naville's hands for fuller publication, and the volume now before us is the Swiss Egyptologist's account of this important eighteenth-dynasty copy of the Book of the Dead. The papyrus itself measures 9 metres 70 cm. long; it is written in linear hieroglyphs with vignettes finely executed in colour, and contains some forty chapters, one of which is new to science. This new chapter is illustrated by a vignette of nine serpents, and is entitled "Coming out of the Day." It belongs to the group of chapters of the gates and pylons where the deceased has to show his knowledge of the names of the occupants and warders. To the finely reproduced facsimiles of the document M. Naville has added a translation, based mainly on that of the standard edition of the Book of the Dead by the late Mr. Le Page Renauf—the edition which Mr. Naville himself completed and edited.

Helmholtz. Eine Zeitschrift für die exakten Wissenschaften mit besonderer Berücksichtigung ihrer Anwendungen. Herausgegeben von Dr. Th. v. Simson. Bd. i., No. i. (Helmholtz-Verlag: Neustadt au der Haardt, April, 1910.) Price 16 marks per volume.

ANOTHER scientific journal! It must be confessed that the necessity for the existence of this journal is not at all evident. There is no particular reason, so far as the reviewer can see, why the contents of this number could not have found a place in many other quarters.

The *pièce de resistance* is the article by Arrhenius on "The Laws of Digestion and Resorbtion." This consists in a "quantification" of the experimental work of E. S. London in St. Petersburg, and is decidedly interesting. After this comes a series of portentously solemn "scientific aphorisms" by C. H. Walter, which the reviewer has been quite unable to digest. There is an article by F. Fittica on "The Transmutation of the so-called Elements," in which this author tells us again how he transmuted phosphorus into arsenic (by heating it with ammonium

nitrate), &c. To borrow the language of a sister science, there exists a slight doubt as to the veridical nature of these phenomena. However, an editorial footnote commends them to the reader's notice.

In an interesting article, H. Lunden gives a description (with sketch-plans) of Arrhenius' new Nobel Institute laboratory at Stockholm. Several other short articles deal with such varied topics as sun-spots and magnetic storms, precautions against coal-dust explosions in mines, &c. Enough has been said to indicate the catholicity of the editor's views concerning the scope of his new journal.

List of Documents in Spanish Archives relating to the History of the United States, which have been printed or of which Transcripts are preserved in American Libraries. By J. A. Robertson. Pp. xv+368. (Washington, D.C.: Carnegie Institution of Washington, 1910.)

THIS publication of the Carnegie Institution is the most recent of the "papers" of the Department of Historical Research of the Institution at Washington. The editor of the series points out in a preface that the volume may be regarded as an accompaniment to Prof. W. R. Shepherd's "Guide to the Materials for the History of the United States in Spanish Archives."

The two lists contained in the present book concern the history of the territory included within the boundaries of the continental United States of to-day. All matter touching that territory only indirectly or by inference as a part of the Indies has been rejected. The first list consists of published material, the original manuscripts of which exist in Spanish archives, or which, with good reason, are conjectured to exist in Spain; the second is much the longer, and is a list of transcripts in libraries and archives in the United States from originals in Spanish archives.

Lightning and the Churches. By Alfred Hands. Second edition. Pp. 92. (London: J. W. Gray and Son, 1910.) Price 1*s.* net.

THE first edition of this interesting pamphlet was dealt with in a note in our issue of April 22, 1909 (vol. lxxx., p. 228), and we welcome this second edition as indicating that increased attention is being directed to the important matter of protecting buildings from damage by lightning. Mr. Hands, who has expert knowledge of the subject, says that investigation shows that about twenty churches are struck and damaged in Great Britain every year. In some years the number is much greater; in 1907, for instance, thirty-nine suffered from this cause, and in 1908 there were thirty-one. Architects and others, whose business makes them responsible for the protection of buildings against lightning, would do well to study this little work.

The British Isles in Pictures. A Geographical Reading Book. By H. Clive Barnard. Pp. 64, containing 58 illustrations. (London: A. and C. Black, 1910.) Price 1*s.* 6*d.*

THERE are thirty-two beautiful coloured pictures in this volume, which will delight young pupils of geography, and serve also to explain graphically to them the characteristics of many kinds of scenery found in their native land. The black and white illustrations will also help to secure and maintain the interest of a class. The letterpress provides useful information; and, though it is hardly suitable for a text-book, it will serve admirably to supplement the geography lesson proper. The cheapness of the volume should ensure it a wide popularity.

LETTERS TO THE EDITOR.

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

The Temperature Coefficients of the Ferromagnetic Metals.

EXPERIMENTS on the temperature coefficients of magnets published some years ago (Roy. Soc. Phil. Trans., vol. cciii., 1903) showed that the magnitude of the coefficient is largely dependent on the dimension ratio of the magnet, but that when the dimension ratio is sufficiently increased to make the self-demagnetising factor negligible, the coefficient is then characteristic of the ferromagnetic material. Observations made at that time, but not published, on iron, nickel, and cobalt magnets heated up to 100° C. showed that the coefficient was large in nickel, less in iron, and least in cobalt, the order being the inverse of the order of the magnetic critical temperatures of these metals.

I have recently repeated these experiments, carrying the temperature to 300°–400° C., and within this range it appears that when the magnetic intensity in the cyclic state is plotted against a scale, in which temperatures are calculated as percentages of the critical temperatures, then the points lie very nearly on one curve. In short, if corresponding temperatures are chosen, the temperature coefficient is the same for iron and nickel, and probably for cobalt. (The details of the experiments I omit here, but I should say that the cobalt employed was not pure, and behaved irregularly at 300° C.)

For example, the temperature coefficient of nickel between 15° and 115° C. is 0·0005, and it is the same for iron between 250° and 430° C., the corresponding temperatures; the temperature coefficient of iron between 7° and 107° C. is 0·0002, and it is nearly the same for cobalt between 90° and 220°, the corresponding temperatures.

Curie has shown that when iron is heated it passes continuously through the critical temperature from the ferromagnetic to the paramagnetic condition (in the latter state obeying the gas laws *mutatis mutandis*), and that the curves which trace the change from one state to the other are the counterpart of the curves which trace the passage of a liquid to a gas. An equation to the fluid curves may therefore be applied to the magnetic curves, and van der Waals's equation may be appropriately used, since it takes account of the facts that there is mutual attraction of the molecules and that there is a limit to fluid density, facts which have their counterpart in ferromagnetism in the mutual attraction of the molecular magnets and in the limit to magnetic intensity. One of the conclusions drawn from van der Waals's equation and the theory of corresponding states is that the coefficient of density, or expansion, of all liquids at corresponding temperatures is the same, and by similar reasoning this law is deducible for magnets. This is, in fact, the law to which the experiments cited above lead.

It is also worthy of notice that the temperature coefficient of density of liquids is of the same order as the temperature coefficient of intensity of ferromagnetics, just as the temperature coefficient of density of gases is of the same order as the temperature coefficient of intensity of paramagnetics.

Within the limits of this letter it is not possible to discuss these facts, but they show that certain magnetic problems may be treated by an application of van der Waals's equation with results consistent with experiment.

Manchester. J. R. ASHWORTH.

The Ratio between Uranium and Radium in Minerals.

DR. BOLTWOOD established the constancy of this ratio for all the minerals he examined (*Phil. Mag.*, April, 1905). He examined, however, no mineral in which uranium was present as phosphate, nor did he examine the then newly discovered mineral thorianite. Later, Mdlle. Gleditsch (*Comptes rendus*, cxlviii., 1451; cxlix., 267) found that the ratio radium to uranium was about

18 per cent. greater in thorianite than in Joachimsthal pitchblende, while in autunite, a phosphate of uranium, this ratio was about 20 per cent. less. She separated the radium chemically before estimating it.

This month appeared in the *Philosophical Magazine* (p. 345) a communication by Mr. F. Soddy and Miss Pirret on this subject. They find that, by determining the radium directly in the mineral, the ratio is practically the same for thorianite as for Joachimsthal pitchblende, but that in their specimen of autunite the ratio is only 44 per cent. of that of pitchblende. During the last three months I have been engaged on this problem also. I find that the ratio in thorianite from Java agrees within the limits of experimental error with that in specimens of pitchblende from Joachimsthal and from German East Africa, the latter of which is probably of primary formation. In my specimen of autunite, however (from Autun, in France), the ratio is only 27 per cent. of that of the pitchblendes. Thus, taking the ratio Ra to U in pitchblende as 1, in Mdlle. Gleditsch's specimen of autunite it is only 0·80; in Mr. Soddy and Miss Pirret's it is 0·44, and in mine 0·27.

To explain these somewhat exceptional results, it must be assumed either (1) that the Ra has been washed out of the mineral in some way, or (2) that the mineral is very young, and that therefore the Ra is not yet present in equilibrium amount.

To throw light on these points, I hope to determine the ratios uranium to ionium and to actinium in different specimens, not only of autunite, but of the family of minerals $R'(UO_2)_2(R''O_4)_2.8H_2O$ (R'=Ca, Ba, Cu; R''=P, As), of which it is a member.

ALEX. S. RUSSELL.

Physik.-Chem. Institut der Universität, Berlin,
August 6.

Elemental Weight Accurately a Function of the Volution of Ideal Space-symmetry Ratios.

SUFFERING from a malady of the eyes, I may be excused the two following errors in my communication published in NATURE of July 21:—

(1) For *hex*, or the cubic line-ratio, read throughout *oct*, or the octahedral line-ratio; and for *oct* similarly read throughout *hex*.

(2) In the table at the end, No. 6, read 1·00766 as the mean, in place of 1·00765, the product in this instance (No. 4 in the references to the general formula) deviating by .0·00001 from the experiment; in the other cases the figures are exact. H. NEWMAN HOWARD.

Aberdovey, North Wales.

The Jamaica Earthquake.

MAY I point out that in the review of "Recent Earthquake Investigations" (NATURE, August 11, p. 165), the date of the Jamaica or Kingston earthquake (where the loss of life was 800, and of property about 2,010,000*l*.) is wrongly stated? It took place on January 14, 1907, and not on June 14, 1906. D. MORRIS.

Boscombe, August 12.

CHOLERA AND ITS CONTROL.

NOTHING is more striking, even to the casual observer, than the change that has taken place in the attitude of the public, no less than of those who have charge of the public health, towards those great epidemic outbreaks that swept Europe up to the end of the eighteenth century "and after." Until the Great Fire of London in 1666—indeed, until the rise of the great school of sanitary reformers of whom Chadwick and Simon may be taken as types—panic and despair were the predominant emotions aroused in the presence of plague, cholera, and the like. With a knowledge of the results of what could be done by the adoption of efficient sanitary measures, these two paralysing influences were gradually rendered less effective, especially as the call to preventive and curative work could be made to divert men's minds from brooding and evil anticipation. Men then realised how much could be done to ameliorate the conditions of communities attacked by these diseases, and how successful were the preventive measures adopted as regards transference not only from community to community, but from individual to individual, with the result that organisation took the place of panic and hope succeeded on despair. Still, men were working in the dark, and the mystery enshrouding the mode of spread of disease was profound until Pasteur, Koch, Lister, and their many disciples gradually evolved from the chaos of theory, fact, and fancy the germ-theory of disease, and isolated from the welter of organisms by which the patient was surrounded the one that in each case appeared to be the specific cause of the disease.

In no case is this more marked than in that of cholera, and at the present time one may see in different parts of Europe reproduced different phases of the history of the evolution of our methods of dealing with cholera epidemics at different periods. In Russia and in some parts of Italy, where fatalism and apathy prevail, and where sanitary science has not yet reared its head, cholera still arouses panic, only to be followed by the lethargy of despair. In other parts of Europe efforts—in many cases very inadequate—are made to combat the spread of the disease, whilst in northern Europe, including such places as Amsterdam and London, the announcement that cholera may invade the country, or that it has already gained a foothold, simply means a call to renewed sanitary efforts directed by intelligent experience and skill, which will prevent the disease from entering the country except as carried by isolated patients, and the treatment of patients in such fashion that there will be no further extension beyond a very limited area.

At the present juncture, when cholera may spread from Russia, Italy, Roumania, or elsewhere, the crisp instructions issued to port medical officers no less than timely account of the outbreak of cholera in Rotterdam last year about this time (see the *Times*, August 10), should give comfort and courage, both to those who have to deal with cholera in our ports, and to those who at one time would inevitably have been attacked in large numbers. Between August 20, 1909 (when cholera was found in three children in one family, who died suddenly with the clinical symptoms of cholera, the nature of the disease being at once confirmed by full bacteriological examination) and September 11, what might have expanded into a great epidemic in Rotterdam began and was crushed. The facilities for the spread of the diseases are perhaps greater in Rotterdam than in any other seaport town in the world, but by careful isolation, not only of the patient, but of "contacts," *i.e.* people who have come in contact with the patients at any time after the outbreak of the disease, in "isolation" wards, and "observation" sheds, by warning the people against the use of unfiltered water, the eating of green fruit, and excessive indulgence in the use of alcoholic liquors, the epidemic was cut short. Fines and imprisonment were awarded to those who interfered in any way with the authorities in carrying on their work, either by obstructing them or by failing to notify cases where the illness showed any symptoms of cholera. Careful observation of suspected cases, disinfection of houses, bed linen, clothing, of patients and contacts alike, were all resorted to; but, on the other hand, all who helped were well treated, receiving whatever wages they would have earned normally; indeed, we are told, they were so well treated generally that "many presented themselves as contacts in the hope of receiving food, clothing, and wages without working." It may be said that these methods were, on one hand, harassing, and, on the other,

expensive; but as compared with the work and expense involved in outbreaks such as at one time or another have attacked our north European ports, the work and expense involved are absolutely trifling.

All this, of course, is exceedingly reassuring, but we have, on the other hand, as the outcome of our knowledge of the life-history of the cholera bacillus and its relation to the human subject, a fact which, disregarded, may be a source of great danger, though, knowing of its existence, precautionary measures may be taken which may render it harmless. Of 108 patients, presumably "contact patients," or patients who had recovered, examined at Rotterdam in 1909, nearly 4 per cent. were found to be bacilli-carriers, corresponding to the so-called typhoid-carriers which, only recently recognised, seem to play such an important part in the dissemination of the typhoid fever germ. The cholera bacillus was found in these carriers for periods of from five to twelve days after they came under observation. It is pointed out that, this being the case, out of more than 100 people leaving a cholera-infected port four (approximately), according to the above statistics, may carry these germs for twelve days, so that any port within twelve days' distance at which these carriers land might be infected by cholera. How far this observation accords with the experience of port officials it is impossible to say at present, but no doubt the matter will be carefully gone into now that attention has been directed to it.

A very interesting outcome of the curative treatment of the cases of cholera that occurred in the Rotterdam outbreak is that, although the epidemic death-rate in Holland during 1909 was about 45 per cent., the death-rate in the municipal hospitals, where special treatment was carried out, was only 13 per cent. Here the doctors resorted to the hypodermic injection of a normal saline solution, sometimes in quantities of several quarts a day, the effect of this mild saline solution, as pointed out by the *Times* correspondent, being not only a replacing of the moisture which the system loses as the result of the extreme watery diarrhœa, but "a direct stimulation of the heart and also an indirect stimulation of the heart by diluting the blood and thus reducing friction."

The whole treatment, both preventive and curative, of cholera is the outcome of modern methods of medical research, a fact that may be commended to those who, either through prejudice or ignorance, or both, would limit the study of bacteriology and experimental medicine to the field the bounds of which are those of their own narrow vision.

MALARIA PROPHYLAXIS IN INDIA.[1]

"A PROBLEM of Imperial magnitude." "Epidemics of smallpox, cholera, and plague are grievous afflictions, but neither singly nor even collectively are they responsible for so much economic inefficiency, and what is worse, actual human misery, as the recurrent scourge of malaria." These words of the Viceroy and the Lieutenant-Governor of the Punjab respectively impress us with the magnitude and seriousness of the problem that the conference had to consider. If we attempt to translate these words into figures, we are met with difficulties, owing to the fact that the registrar of deaths in India is often the ignorant village chowkidar, but as a rough approximation, it may be assumed that the mean death-rate is about 5 per 1000, *i.e.* over a million deaths annually throughout the country as a whole; whereas in the jails, owing to the care with which prisoners are treated, the mean death-rate from malaria is only 1 per 1000.

But even if the figures for the country as a whole be correct, an analysis of them does not reveal where the real mischief lies. If we assume, for example, that we know the malarial death-rate of a particular town or district the figures available still do not show us whether, as not uncommonly is the case, some parts of the town or district may not be quite free from malaria. It is evident, then, if prophylactic measures are to be applied economically and from financial considerations, this is a prime necessity: one of the first and most important steps must be to determine accurately what areas are malarial, or are so to such an extent as materially to affect the whole of the inhabitants; for it is obviously unnecessary to apply prophylactic measures to those areas which do not need them; but unfortunately there appears to be evidence that this has already been done, not to mention the "fatuous" instance recorded of oiling drains, under instructions, where minute examination showed that no anopheline larvæ existed. But on the other hand, there is already work waiting to be done. What is the nature of this work, and how is it to be done?

It is these questions that mainly occupied the attention of the delegates to the conference. It was pointed out that a multitude of different conditions exist in India, but that small villages surrounded by swamps are in the enormous majority, and again it was stated that the mitigation of malaria in India is chiefly the problem of its mitigation in small villages. For scattered populations, small villages, and rural areas we have the opinion of Major Ross quoted that we must generally fall back upon quinine, yet, rightly, the conference put mosquito destruction in the forefront of its policy, for no doubt—and this is also Ross's opinion—this is the fundamental method; the question is, to what extent is it financially possible?

The resolutions of the conference on this point are expressed in an apparently contradictory sentence. They state "that it will not be possible to protect rural areas by any scheme of drainage which is financially practicable, but it has been found that in some highly malarious tracts the level of subsoil water has been materially lowered with great permanent benefit by drainage operations, the cost of which was not prohibitive." This question of drainage was discussed at length by the conference, and very contradictory views were expressed, not only as to its practicability owing to expense, but as to its benefit, evidence being adduced to show that even in well-drained areas there had, in some cases, been no reduction in malaria.

It is a somewhat discouraging fact that no instance of a drainage scheme with successful result was put before the conference, but that already many unrecorded failures have occurred. It seems to us a matter of importance, then, to inquire into the cause of these failures, so as to ascertain if anything was left undone that could now be better done. Ill thought-out schemes are not uncommon. We ourselves know of a case where a large, shallow tidal area of water, quite free from anophelines, was converted into an ideal breeding-ground by partial filling with earth and by the consequent formation of many hundreds of pools. The danger, too, was pointed out of draining a permanently flooded area, whereby a comparatively healthy was converted into an unhealthy tract, with numerous pools in the rainy season. Some difference of opinion was expressed as to the effect

[1] Proceedings of the Imperial Malaria Conference held at Simla in October, 1909. Pp. vi+107. (Simla: Government Central Branch Press, 1910.)

of a high subsoil water on the malaria rate, but it was eventually agreed that "pukka" surface drainage and the lowering of high subsoil water level were anti-malarial measures of primary importance.

It is clear, then, that although failures are on record, and although finance may be a great difficulty, the permanent policy which is adopted is to drain, and, moreover, large drainage schemes may not always be prohibitive from their expense, as the sale of the land re-drained may defray the cost. Any particular scheme must, however, be well thought out, *after*—and this, in our opinion, is essential—the extent of malaria in the particular area has, as far as possible, been accurately estimated, and with the help of sanitary engineers the conditions determining the mortality minutely investigated. Then, and then only, can the effect of the scheme be accurately gauged in all its bearings, and "the devastating flood of recommendations" be checked by concrete facts.

We are, perhaps, in the habit of regarding malaria as an endemic rather than an epidemic disease, but a study of the conditions in India shows clearly that it has indeed terrible epidemic manifestations, such as occurred in the Punjab in 1908. We cannot discuss here the cause of these epidemics, but refer those interested to the report itself. We mention them here because it was said that if we could check epidemic "fulminant" malaria "we should have removed the most urgent and distressing effect of this disease, and those manifestations which the people themselves are most impressed by." A study of this question of epidemics impresses on us more than anything the magnitude of the problem to be dealt with, and the urgent need for re-study of the many problems of endemic and epidemic malaria. With regard to these epidemics, the opinion was expressed that they could probably be predicted, and that the only possible way of dealing with them was by the use of quinine.

The importance of quinine as a prophylactic measure cannot be overrated. We have the fact that this is the main method adopted by the Italians; we have the experience of Canada as related by Prof. Osler; the "marked success" of this method on the Panama Canal; and, indeed, we have the striking fact that the only successful prophylactic experiment presented to the conference was that carried out in the Punjab jails, where, by the administration of 15 grains of quinine once a week to each prisoner, the malaria death-rate was, with one exception, reduced to the lowest figure on record, and this during the great epidemic of 1908. That the quinine question, like the drainage question, requires very careful study, the papers read at the conference show. We hope, too, that the period of rivalry, if not of actual animosity, between the advocates of drainage and quinine has passed, though it must surely be admitted by those who are impartial, that quinine has at least one advantage, that it can be applied at once in many cases where drainage is completely impossible. The difficulties of the administration of quinine in India cannot, however, be overlooked.

We would conclude by pointing out the need also for "minor" measures, if we might call them so. An extended study is necessary of the numerous enemies of larvæ—fish, and a variety of predaceous insects, &c.—and of the complete inhibitory effect on larvæ of weeds such as Lemna. We would venture to suggest the appointment of one or more officers to study solely the "bionomics" of the mosquito in all its aspects. We would also urge the appointment of officers for the study of the various malarial problems already alluded to. We think, too, that officers should visit Italy to study quinine prophylaxis there; and that the methods advocated by Major Ross in Mauritius, and those carried out in Panama, should also be studied on the spot.

Finally, there remains one method no less difficult, but one essential to the success of all the others, and that is the education of the people. That the Government has a many-sided and difficult problem before it is clear, but the problem has now been systematically taken up, and we feel confident that when the next malaria conference meets progress will be reported.

KENTISH BIRDS.[1]

THE latest book on the "Birds of Kent"—the third to appear in recent years—is entitled, very appropriately, a history of the birds of the county. For the author, who has been sixteen years preparing this work, has given especial attention to the present and past status of all those species the distribution of which within the county is not quite general, and of those which have become rarer or more common, or have begun or ceased to breed within what we may term historic times, that is, since Kentish birds were first noticed by the older writers; and he has most carefully worked out chronologically the histories of fading and vanished species, as, for instance, the chough, raven, harrier, buzzard, kite, avocet, &c. In this connection we may, however, point out that too much importance must not be attached to the use of the word chough in Shakespeare's description of the cliff at Dover,

"The Crows and Choughs that wing the midway air,"

for there is evidence to show that the older writers must have often meant jackdaws when they wrote choughs. The name chough, indeed, seems to have been originally as generic as pie; and just as they distinguished the mag-pie and the jay-pie, so in time they distinguished the less-known chough as the Cornish chough. Happily, this history is not obliged to confine itself to dealing with the decreases of all the more interesting species, but can detail the increases of some, and point out the gratifying fact of some kinds of wild ducks and other birds breeding in increasing numbers. Of that little wader which has always been associated with the county—and may be called *the* county bird—viz. the Kentish plover, it is extremely satisfactory to read of the steady increase in the number of breeding pairs of late years. Here again we have an exhaustive and valuable article. Very interesting details, too, are given of the nesting of the golden oriole in four localities and in some of them for several years in succession. The present status of the Sandwich tern is set forth, and of the Dartford warbler (the third bird the name of which connects it with Kent) we learn with regret that it is now extinct in the county, its history therein being admirably drawn up. Exact information on these points has been wanting hitherto.

In his accounts of the different species, the author has found it necessary, in order to treat adequately of their history, status, distribution, migratory movement, and economic aspects, to confine his remarks strictly to these questions, and to omit all references to plumages, songs, general and nesting habits, and anecdotes, except in so far as these affect the other questions or offer peculiarities of themselves, or bear some particular relation to the environment of the species in the county. Even so the volume is bulky,

1 "A History of the Birds of Kent." By Norman F. Ticehurst. Pp. lvi + 568. (London: Witherby and Co., 1909.) Price 21s. net.

and if the omission of these lighter matters make the book less fascinating to read than some others, it detracts nothing from its solid worth. Beginning with a bibliography, the volume contains an introduction of twenty-seven pages, dealing with the topography, geology, rivers, vegetation, avifauna, migration, museums, and collections of and in the county, and of the former authors on the subject. Then follows the detailed account of each species on the lines indicated. Excluding forty-two "doubtful species," which are included in square brackets, these number 312; 107 birds breed regularly in Kent, thirteen have bred only once or on very rare occasions, and fifteen formerly bred and have ceased to do so.

Kent has of late years produced an extraordinary number of rare birds, accidental visitors to these shores, several of them having been "new" to the British list; and in reading the pages of this volume one is impressed with the enormous importance in the compilation of a long county list of rare birds of the existence on the spot of a bird-stuffer always on the look-out for a rare bird, and ready to offer it for the inspection of the trained ornithologist; for it is to be noticed that nearly all these rarities which have apparently been pouring like a stream upon the shores of Kent in the last few years have passed through the hands of one bird-stuffer. Another point which will strike the reader is the sharp eye for a rare bird possessed by some of the Kentish men—more than one great rarity has been secured by shepherds, and most of them by people who were ready to part with them—for we should be loth to think that these gunners shoot all and sundry that come within range on the chance of getting a good bird. At the same time, this apparent habit of men with guns patrolling the county during May and other parts of the close season is a little disquieting, and seems to require attention. Not that we suggest for one moment that the shooting of these stray wanderers—far out of their usual range of distribution—does a tittle of harm to the respective species, or that their reaching the hands of the critical ornithologist serves any but a good purpose. But at the same time the habit—unchecked, it would appear—of shooting on marsh and shore in the breeding season is essentially a bad and harmful one, and in the case of irresponsible people may easily lead to the death of breeding wildfowl or waders.

Among the many wonders of migration oversea is the fact disclosed in this volume of rare birds from remote countries arriving, not only singly, but in pairs and small parties. Thus two snow-finches (a sedentary species living in the Alps) were shot from a party of five; three white-winged larks observed together, and all secured, and three black larks (new to our list) out of five. So, too, sandpipers from America come not only singly, pairs of the solitary and spotted sandpipers being here recorded. In some years there has been quite an American invasion. In July, 1908, examples of the solitary, pectoral, and Bartram's sandpiper occurred; and 1906 produced both Bonaparte's and the pectoral sandpipers.

The twenty-four plates comprise reproductions of the plates in old books of Kentish specimens, some modern Kentish rarities, and nesting sites and bits of Kentish scenery, the typical haunts in the county of various species. These are very pleasing and appropriate to the objects of the book. By permission of the publishers we are enabled to reproduce one of the illustrations. There is also a good map at the end of the volume, which is nicely got up and well printed on good unglossed paper, so that, despite its bulk, the book is not very heavy.

The "Hoppen Pits," Dungeness. Breeding Haunt of Black-headed Gulls, Moor-hens, Reed-warblers, &c. From "A History of the Birds of Kent."

ON AND OFF DUTY IN ANNAM.[1]

THIS is the work of an Englishwoman, who accompanied her husband, a doctor in the French Colonial Service, to Nhatrang, on the coast of Annam. On landing in Saigon, the capital of Cochin China, she recounts her impressions of the city in terms much more favourable than one would expect who had visited the place in its early stages of development. It was then a scattered, sickly settlement; it is now "the Paris of the East," with its wide, well-appointed boulevards and imposing public buildings, the Governor's palace, cathedral, theatre, and hotels, after the best models in Europe. All the more praise to the Government for the transformation of this once swampy wilderness into probably the fairest city in further Asia, equipped with all the latest scientific appliances in effective operation. Its Pasteur Institute has done admirable work in arresting the ravages of plague, cholera, and diseases common to the tropics. The author and her husband were sent to Nhatrang, where the doctor was appointed assistant to the president of the Pasteur Institute, Dr. Yersin, who was one of Pasteur's first pupils, and justified his being chosen to carry out colonial work by his original discoveries, and his energy successfully displayed in other directions.

FIG. 1.—A Well-made Moi Dwelling. From "On and Off Duty in Annam."

The author's notes on the native dread of the European treatment of disease are piquant, and enlivened by her keen sense of humour. Their superstitious treatment of the sick is in itself a plague, accountable for greatly increasing the death-rate. This lady's efforts in founding a home in this distant colony will fascinate the reader used to all the comforts and amenities of the West. Her servants had to be taught the elementary principles of truth and cleanliness, and to adopt her point of view regarding honesty, but she had other worries provided by the inroads of destructive insects that had to be dealt with. Her success in utilising the most unpromising material, and creating a pleasant home are worthy of all praise. The cost of living in this region, under the eye of a trained economist, compares favourably with that of the West. She found seven shillings a week sufficient allowance for the cook, who had to provide "three courses for lunch and the same for dinner." This may induce some of the "hard hit" at home to emigrate to the hospitable shores of Annam.

The manners and customs of the Annamites, which are ably set forth, may stem the tide of settlers flowing Eastward. Be that as it may, the author's pictures of life in this region are not without attraction.

The history of Annam is passed in review in this interesting work, and the part played by the aborigines, whose country she explored when off duty. Government and religion are also discussed. But in this vast section of eastern Asia some weighty problems await solution regarding the different races that people its area, and the religions which they follow.

Cambodia, the latest acquisition of France, is touched upon with a light hand, and in some respects it is the most important of her Eastern possessions. It was at one time an extensive and powerful kingdom, inhabited by a highly civilised race of men, whose stone temples, cities, and palaces remain to bear witness to their skill as builders, and to their knowledge of art. In the last and greatest temple reared, Nakhon Wat, one has evidence that this was an early stronghold of Brahmanism, a Far Eastern outpost of the faith. In its outer galleries, sculptured in low relief, half life-size, on the stone walls a series of illustrations meant for all time of the chief episodes of India's sacred epics, the Ramánayána, and Mahábhárata, in which the design, craftsmanship, and drawing are so excellent as to suggest Western influence. There is no Brahmanical temple in India so vast and imposing. Notices of Cambodia are found in the Chinese annals of the Tsin, Sui, and Tang

FIG. 2.—The Verandah of the Pasteur Institute. From "On and Off Duty in Annam."

[1] "On and Off Duty in Annam." By Gabrielle M. Vassal. Pp. xi + 283. (London: William Heinemann, 1910.) Price 10s. net.

dynasties, which throw some light on the early history of this region.

The author describes the ancient temple at Nhatrang, stone built, with inscriptions in primitive Pali, similar to those found in Nakhon Wat, and other monuments scattered over a vast area.

In conclusion, the book covers a wide field of interest, and is a welcome addition to the literature of further Asia. J. THOMSON.

LAKE CHAD.[1]

THE first volume gives the geographical results of the mission presided over by Captain Tilho (which undertook, in connection with British delegates, a delimitation of the Anglo-French frontier in the region of Lake Chad and northern Nigeria). The main purport of this volume is the survey and delineation of that extraordinarily puzzling feature in African geography, Lake Chad—a "lake" described by Captain Tilho as being nothing but an immense marsh with variable stretches of open water nowhere more than 12 feet deep.

Probably the first definite mention of Lake Chad (under the name of Zad) occurs in the writings of Frederick Hornemann, at the very close of the eighteenth century. (Hornemann, who was taken into the employ of the English African Association, and sent by them to reveal this lake and also the central course of the Niger, is believed to have reached the Niger and to have died in the Nupe country about 1800.) But rumours of a great sheet of water in the heart of Africa, beyond the Sahara Desert, had probably reached the Romans in the first century of the the Christian era, through their connection with Tunis, Tripoli, and Fezzan, and these stories were reflected in the conjectured Libya Palus of Claudius Ptolemæus, who wrote in the middle of the second century. When the Arabs and Moors had become thoroughly acquainted with the geography of the Sudan they revived these traditions, but mixed them up with both the Niger and the Nile systems.

As a matter of fact, the basin of Lake Chad is curiously on the balance between the watersheds of the Nile and of the Niger. The work of other and earlier French expeditions (especially that of Dr. Auguste Chevalier) which preceded that of Captain Tilho has put before us evidence of a faunistic and geological character which prompts the supposition that Lake Chad is the very last vestige (shrinking annually, one might say) of a vast, *shallow*, inland sea, which covered much of the region north, east, and, above all, west of Lake Chad, of the basin of the Niger north of the mountains, and probably communicated with the sea along the basin of the Senegal River. Whether there was any north-eastern outlet towards the Nile basin is more doubtful. Looking at the most recent map of Africa in relief, it would seem more probable that there has been for ages a bridge of high land through the Tibesti country which has connected southern Tunis with Central Africa, and separated the Niger-Chad basins from that of the Nile; but it is more likely that down to the close of the Secondary epoch, or even at the very beginning of the Tertiaries, there may have been a connection between the Chad-Shari basin and that of the Congo. Nearly the whole of the Congo basin was, down to a relatively recent period, a vast fresh-water lake. A rise of ground so slight as scarcely to be perceptible to the traveller separates at the present day the basin of the Shari River from that of the Mubangi-Wele, which, of course, marks the existing limits to the north of the former Congo Sea, that sea which in Tertiary times forced its present narrow outlet through the Crystal Mountains into the southern Atlantic. Many arguments for the justification of these hypotheses (as also for arguing the relatively early detachment of the Congo Sea from that of the Sahara) may be found in the remarkable works of Mr. G. A. Boulenger on the fresh-water fishes of Africa. From this same source, again, may be derived further arguments for the relatively recent existence of the Chad-Niger Sea, and perhaps also for the close geographical connection between that vast area of fresh water and the great lake which formerly filled up much of the Bahr-al-Ghazal-and-Upper-Nile regions, a lake represented at the present day by the Sudd region.

Other French expeditions dealing with the country between Lake Chad and the Mubangi-Congo have established the existence (it is said) of the manati in the Shari River, and, above all, in the isolated lakes and pools to the north-east of that stream. The manati is also stated to be found in the Niger River between Sego in the west and Yauri in the east. If this is really the case, it is further evidence for the existence and the relatively recent drying-up of this vast fresh-water Sahara Sea; for the manati is a Sirenian mammal the nearest relations of which are found fossil in lower Egypt, in the West Indies, and in Florida. The manati is still found as a living animal in the estuaries and broader rivers of West Africa, but it would be exceedingly difficult for it to reach the Upper Niger over the Busa Rapids, though it might, and perhaps does, pass up the river Benue, and thus reach the Shari by way of the Tuburi marshes. (The manati is not found in the Upper Congo.) With regard to these Tuburi marshes, we have here a very interesting problem to discuss. Another French scientific expedition established not long ago the feasibility of passing from the Upper Benue by canoe through the Tuburi marshes into the Logun River, and thus into the Shari and Lake Chad. Its leader (Lieut. Faure) has proved that at the height of the rainy season of that particular year there was continuous water communication between the mouth of the Niger and Lake Chad, so that Lake Chad was then nothing but a backwater of a river system in Central Africa which sent a superfluity of its waters to the Benue and the Niger.

Captain Tilho's work, however, though it touches on some of these hydrographical problems, deals mainly with the configuration of Lake Chad, in the volume under review. It shows that the average depth of the lake is only 1 metre 50 cm. (say 4 feet 10 inches), and in the great stretches of open water scarcely more than about 3 metres (say 10 feet). It is simply a vast swamp joining the waters of the Komadugu, which enters the Chad on the north-west, with the floods of the Shari coming in on the south-east. During the three years of study devoted by this mission, the only area of open water remaining in the Chad was quite outside British political limits, and lay to the north and north-west of the Shari delta. The rest of the lake surface was either completely dry land (north of the Komadugu River) or it consisted in the east of an archipelago of almost innumerable islands interspersed with lagoons, pools, and navigable creeks. Where Denham saw the waters of Lake Chad at Ngigmi in 1822 there may be a few tiny pools or a small area of moist ground, but the rest of the northern third of the lake has become absolutely dry land.

No doubt to the later expeditions of Barth and Vogel the surface of open water in Lake Chad was

[1] République Francaise. Ministère des Colonies. "Documents scientifiques de la Mission Tilho" (1906–9). First Volume. Pp. lx + 412 and Cartes. (Paris, Imprimérie nationale, 1910.)

already much restricted and blocked with swamp vegetation. There has been not only partial desiccation due to a lessening in the rainfall of West Central Africa, but also a raising of the lake level by the excessive growth of marsh vegetation—papyrus, reeds, rushes, grasses, and the ambatch tree. The water of Lake Chad would also seem to be increasing in salinity, which, however, does not appear to interfere with the growth of vegetation. On the contrary, when every now and then (according to the stories of the natives) the lake is partially recreated by floods from the Shari and the Komadugu and the water becomes fresh, the vegetation tends to disappear, partly by its being drowned, and partly because the water has lost some element suited to its growth.

Some further geographical information is given as to the Bahr-al-Ghazal Channel, or Soro, as it should preferably be called (in order not to confuse it with the name of the western basin of the Nile). This would seem to have been an ancient outlet of the flooded Chad, which carried these waters along a definite channel towards the north-east into the Bodele depression. Another possible *déversoir* of Lake Chad exists still in Lake Fitri, far away to the south-east, which this mission showed still to possess an area of open water of nearly 150 square miles.

H. H. JOHNSTON.

NOTES.

WE have received a programme of the International Congress on Radiology and Electricity to be held at Brussels on September 13–15. Among the important matters to be brought forward is the question of radium standards and nomenclature. The congress will be divided into three sections. In the first section, general questions of terminology and methods of measurement in radio-activity and subjects connected with ionisation will be discussed. The second section will be devoted to subjects relating to the fundamental theories of electricity, the study of radiations (including spectroscopy, the chemical effects of radiations, and allied subjects), radio-activity, atomic theory, and cosmical phenomena, such as atmospheric electricity and the radio-activity of the atmosphere. The third section is biological, and will be devoted to the consideration of the effects of radiations on living organisms. This section will deal with purely biological subjects, as well as the use and application of various radiations for medical purposes. A long list of papers already promised is given in the programme, as well as a list of members up to date. A special exhibit of apparatus relating to the work of members is to be held in connection with the congress, and members are invited to forward exhibits to the Physical Laboratory of the University of Brussels. A number of excursions have already been arranged to take place after the congress, and special facilities will be granted to members on the Belgian and French railways. Intending members should communicate with Dr. J. Daniel at Ostende, rue Wellington 28.

THE preliminary programme of the twenty-fifth congress of the Royal Sanitary Institute, to be held in Brighton on September 5–10 under the presidency of Sir John A. Cockburn, K.C.M.G., has now been issued. Dr. A. Newsholme (Principal Medical Officer, Local Government Board) will deliver the lecture to the congress on "The National Importance of Child Mortality." Dr. Alex. Hill will deliver the popular lecture on "The Bricks with which the Body is Built." In connection with the congress, a health exhibition of apparatus and appliances relating to health and domestic use will be held as practical illustration of the application and carrying out of the principles and methods discussed at the meetings. The congress will include general addresses and lectures, and there will be two section meetings for two days each, dealing with:—Section i., sanitary science and preventive medicine, *president*, Prof. E. W. Hope; Section ii., engineering and architecture, *president*, Mr. H. Rofe. Eight special conferences will be held, dealing respectively with municipal representatives; port sanitary authorities; medical officers of health; engineers and surveyors to county and other sanitary authorities; veterinary inspectors; sanitary inspectors; women on hygiene; and hygiene of childhood.

THE death is announced, at seventy-five years of age, of Prof. F. von Neumann, who from 1876 until 1909 held the chair of political economy at the University of Tübingen.

WE regret to see the announcement of the death of Dr. Louis Olivier, at fifty-six years of age. Dr. Olivier was the founder and editor of our esteemed contemporary the *Revue générale des Sciences*, which ever since it first appeared, twenty years ago, has taken a leading place among the scientific periodicals of the world.

THE International Horticultural Exhibition of 1912 will be held in the grounds attached to the Royal Hospital, Chelsea. These beautiful grounds were laid out by Sir Joseph Paxton, and they are well adapted for the purposes of a horticultural exhibition. The area leased to the exhibition authorities is approximately twenty acres, and nearly sixteen will be directly available for the accommodation of the exhibits. In the remaining portion, which includes some shrubberies, there are many fine specimen trees.

THE following news of north polar exploration has been sent to London by the manager of the Nordenfjeldske Steamship Company of Trondhjem:—*Kong Harold* has returned from polar ice. Reached 80° 10′, within 10° Pole. Met *Fram* expedition at Spitsbergen. *Fram* has discovered volcano and hot springs Wood Bay; beach covered with lava. Zeppelin has taken possession of tract of land at King's Bay, and has named it Zeppelinshafen.

IT is reported by the Polar Sea yacht *Laura*, which arrived at Tromsö on August 17 from East Greenland, that the expedition ship *Alabama*, belonging to the Danish explorer Captain Mikkelsen, was crushed by the ice at the end of March last. The crew were saved, and wintered on Shannon Island. The Copenhagen correspondent of the *Morning Post* states that Captain Mikkelsen with Mr. Iversen, who started from Shannon Island on March 3, are trying to reach Cape York, on the western coast of Greenland, travelling by way of Peary Channel and the inland ice. If insurmountable difficulties are encountered, they can return to Shannon Island, where a house, in which there are provisions sufficient for two years, has been built. On August 7 Captain Mikkelsen and his companion had not yet returned, and it is supposed that they continued their way through the Peary Channel to Cape York, or that they are returning along the east coast, having spent the summer there.

THE Anthropological Society of Paris, in the last issue of its *Bulletins et Mémoires*, gives a report of the meeting, attended by leading anthropologists from all parts of Europe, to commemorate the fiftieth anniversary of its foundation. An interesting feature in the report is a series of papers contributed by the foreign delegates describing the progress of research in the various parts of Europe. As representative of the Royal Anthropological

Institute, Prof. W. Ridgeway sketched the results attained in this country during the last fifty years. Describing the refusal of the Prime Minister of a grant in aid of the proposed Bureau of Anthropology, who at the same time admitted that a knowledge of the science was indispensable for our Indian and Colonial administrators, he added:—"If, then, in the United Kingdom we have not done all that we ought to extend the study of man, I beg you to remember that the Anthropological Institute has to depend upon the subscriptions of its members. Your distinguished society has long been recognised as of public utility by the State."

IN *Folk-lore* for June Mr. Andrew Lang discusses the strange myth of Theseus and the Minotaur. He argues that the fact of human sacrifice in Minoan times is not established, and that the suggestion that Minos, like the priest kings described by Prof. J. G. Frazer, had to fight for his life at stated periods, rests upon a passage in Homer which cannot bear that meaning. He concludes that the historic fact in the Attic myth is the sending of Attic captives into the Cretan bull-ring, where boy and girl acrobats played perilous tricks with bulls, as often depicted in Cretan art. The rest of the myth is a common *märchen* localised.

IN a recent number of the Journal of the Royal Society of Arts, a paper by Mr. H. Gibson is reprinted, embodying the investigations made by Mr. H. P. Slade of the dew-ponds on the Thorpe Downs, Berkshire. The result is to show that dew contributed nothing to the water supply, which appears to be entirely the consequence of rainfall. Dew, in fact, is only scantily deposited on such high grounds owing to draughts of air, which cause rapid re-evaporation. As the temperature of the water was found to be at night much lower than that of the surrounding air, the author believes that the possibility of dew condensation is disproved. He concludes that a catchment area consisting of galvanised corrugated iron stretched upon a wooden frame, with a roofed reservoir to collect and store the rainfall, would be more economical and sanitary, as a souce of water supply, than the most ingenious dew-pond ever constructed.

INFORMATION has been received by the *Times* that the new direct wire connecting Montreal with the Bamfield Creek cable station has been completed by the Canadian Pacific Railway, and was handed over to the Pacific Cable Board on Monday. The longest cable in the world (3458 nautical miles) is thus connected with a land line 3000 miles in length, and communication between Fanning Island (long. 159 W., lat. 3 N.) and Montreal (long. 75 W., lat. 45 N.) will be effected with only one retransmission. The Pacific Cable Board expects, as a result of this new arrangement, to be able to reduce the average time in transmission between Australasia and London by fifteen minutes.

A FIFTH report on research work carried out for the Metropolitan Water Board by Dr. Houston, director of water examination, has been issued. One important section contains the results of the examination of *raw* Thames and Lea water for the presence of the typhoid and Gärtner bacilli. The total amount of water dealt with was 12 litres, averaging 62,688 microbes per cubic centimetre. From this vast number of bacteria, one was isolated having all the characters of a typhoid bacillus; another corresponded to the Gärtner bacillus. If present, therefore, these microbes must be extremely scanty in the raw waters, for control experiments carried out with the raw waters artificially inoculated with these organisms showed that the methods employed sufficed to reveal a very small infection. Another search was for Morgan's bacillus No. 1, supposed to be a cause of summer diarrhœa of infants, but it was not found in the raw waters.

IN the *Irish Naturalist* for August, Dr. A. R. Jackson records from Ireland a spider, *Erigone capra*, new to the fauna of the British Isles.

IN the paragraph on the local forms of musk-ox in our last week's issue (p. 211), the statement that the range of the species extends to the west of the Mackenzie applies only to a past epoch.

TO the August number of the *Naturalist* Mr. Sheppard contributes an illustrated article on Neolithic implements from Bridlington, where there appear to have been four sites for their manufacture, one of which occurs near Danes' Dyke, the ancient earthwork stretching across Flamboro' Head. All the implements are made from black flint, quite different from the local grey flint. Some of the specimens recently obtained, more especially a so-called sickle, are stated to be of unusual types.

TO the Proceedings of the Philadelphia Academy for April Mr. J. P. Moore contributes the second part of an article on polychætous annelids dredged off the Californian coast by the *Albatross* in 1904. In the Polynoidæ twelve species are described as new, while four previously known from Japan are for the first time recorded from the American side of the Pacific. The other groups discussed are the Aphroditidæ and Segaleonidæ, of which new forms, including a new genus, are also described.

WE have received from the author, Mr. P. H. Grimshaw, a copy of a paper from the July number of the *Annals of Scottish Natural History* on the species of insects frequenting Scotch grouse-moors. The list was compiled in connection with an investigation of the food of young grouse, undertaken at the instance of the Grouse Disease Committee, and it was considered that its publication might be of interest from a faunistic point of view. Species known to be eaten by grouse-chicken are denoted by asterisks.

IN concluding an article on chromosomes and heredity, published in the August number of the *American Naturalist*, Prof. T. H. Morgan states, in a guarded manner, that some progress has been made in the interpretation of the mechanism by which sex is determined in the organism. He considers it certain "that we have discovered in the microscopic study of the germ cells a mechanism that is connected in some way with sex determination; and I have tried to show, also, that this mechanism accords precisely with that the experimental results seem to call for. The old view that sex is determined by external conditions is entirely disproven, and we have discovered an internal mechanism by means of which the equality of the sexes where equality exists is attained. We see how the results are automatically reached even if we cannot entirely understand the details of the process."

IN reference to the recent article on "Wild Plants on Waste Land in London" (August 11, p. 184), a correspondent suggests that various seeds may have been brought to the ground in the nose-bags and hay trusses of horses employed during the demolition of the buildings or passing along the neighbouring streets. Many of the plants on the waste ground near the Strand are common weeds of arable land.

MUCH interest attaches to two palæobotanical papers by Dr. E. C. Jeffrey that have been published in the Proceedings of the Boston Society of Natural History (vol. xxxix., Nos. 9 and 10). In the first the author describes a petrified stem taken from the remains of a Triassic forest in Arizona, that presents several novel features. The wood structure resembles that of living representatives of the Araucarineæ, but the plant produced short shoots that persisted and elongated with the growth of the stem. The leaf traces, on the contrary, did not, as in present-day genera, persist in the secondary wood. The author regards the persistent short shoots as primitive, and therefore indicating the antiquity of the two coniferous groups of Abietineæ and Araucarineæ in which these characters occur. The second paper deals with fossil remains of a conifer, collected in Massachusetts in the Lower Cretaceous days, in the shape of two short shoots similar to, but distinct from, the brachyblasts of Pinus, and referred to the genus Prepinus previously proposed by the author.

A POPULAR account of the date gardens of the Jerid at the northern fringe of the Sahara Desert is contributed by Dr. T. H. Kearney to the American *National Geographic Magazine* (July). The author's journey was undertaken with the object of obtaining palms for the date orchards established by the United States National Department of Agriculture in Arizona and California. The two largest oases in the Jerid district comprise about 6000 acres each. The ownership is much divided, as individual holdings range from a few square rods to several acres. More than a hundred distinct varieties are grown, differing in shape, colour, and flavour. The variety exported to Europe strikes the mean between the hard and very soft kinds, and is characterised by its translucent flesh and keeping quality. The method of propagation is by offshoots that arise from the base of the palm; these, when dipped in clay and bound with layers of leaf-stalk fibre, will travel safely any distance.

THE Board of Agriculture and Fisheries reminds growers of potatoes that it is their duty under the Destructive Insects and Pests Order of 1910 to report to the Board all outbreaks of wart disease, otherwise known as black scab of potatoes, cauliflower disease, "fungus," &c., in counties in which no officer has as yet been appointed by the local authority to receive reports. The penalty for neglecting to report disease is 10*l*. The presence of disease should be again reported this year, notwithstanding the fact that it may have existed and been reported last year. A leaflet describing the disease may be obtained on application to the Secretary, Board of Agriculture and Fisheries, 4 Whitehall Place. Letters so addressed need not be stamped.

THE West Indian Bulletin (No. 3, vol. x.) contains an article by Mr. Ballou on legislation in the West Indies for the control of pests and diseases of imported plants. Such control has been exercised since 1884, and was considerably developed in 1898, when the Imperial Department of Agriculture was organised. The text of the various laws and proclamations is given, and certain modifications are suggested. It appears that legislation has been distinctly beneficial. Messrs. Bancroft and South briefly describe the fungi which have from time to time proved injurious to cultivated crops in the West Indies. The account is brought up to date, only a few minor unidentified forms being omitted. A note is added containing a summary of the diseases, probably caused by bacteria, which have not yet been fully investigated.

FROM the Agricultural and Forestry Department of the Nyasaland Protectorate we have received a Bulletin, by Mr. McCall, on bacterial blight in cotton caused by *Bact. malvacearum*, by far the worst enemy of Egyptian cotton cultivators in Nyasaland, having reduced the output of several estates by at least 60 per cent. in the past season. The disease first appears on the leaves, causing them to shed; then the bacteria get into the branches, and soon the flowers and bolls die. No method of control is yet known. Mr. Purves deals with tree-planting in the highlands of the country. In general, the natural timber consists of small slow-growing hard-woods and shrubs. There is an increasing demand for building timber and firewood, and it seems likely that plantations may be profitable. A number of suitable trees are recommended.

WE have received from the Agricultural Institute at Pusa copies of several of their recent publications. The *Agricultural Journal of India*, which is intended as much for the intelligent lay reader as for the professed agriculturist, contains an article on the outbreak of blister-blight (*Exobasidium vexans*, Massee) on tea in the Darjeeling district in 1908 and 1909, which caused a considerable amount of damage. In the first instance the leaves are attacked, then the disease spreads to the leaf stalks and the young green stems, where the damage is more serious, although less conspicuous. The disease is not new, and has been known for more than forty years in the Brahmaputra valley in Upper Assam, but not elsewhere. The districts are widely separated, yet the disease has not appeared in intervening places. A memoir is issued by Mr. Annett on the cause of the colour of black cotton soil. He finds several per cent. of titaniferous magnetite, and also a certain proportion of humus, both contributing to the colour. Mr. Howard issues a report on his fruit experiments. Of the numerous interesting results one may be noted: the effect of grass growing round the tree was apparently fully as injurious as in the Woburn experiments. Tillage of orchards, however, is not an unmixed advantage, as it exposes the soil to considerable washing in the rainy season. A system of embanking combined with monsoon leguminous cover crops seems to be the best means of preventing this loss. Dr. Butler describes the wilt-disease of pigeon pea, which he finds is brought about by *Fusarium udum*, n.sp.

THE U.S. Weather Bureau has issued its useful meteorological charts of the North Atlantic and North Pacific Oceans for September, and of the South Atlantic and South Pacific for the season September–November, 1910. The North Atlantic chart contains an account of the violent West India hurricane of September 16–21 last, with synoptic charts showing the existing weather conditions at Greenwich noon over the North Atlantic and Gulf of Mexico during that period. On September 16 the storm was south-west of Jamaica, moving north-westward, and warnings of its approach were issued to various ports. It continued its north-westerly direction, reaching the Gulf ports on September 20, where exceptional severity was experienced, thence curving northwards and moving up the Mississippi Valley. About half the coal fleet anchored along the banks of that river were sunk, but the remainder were saved as a direct result of the action taken on the advice of the Weather Bureau. Arrangements have been made by the Bureau to obtain during the present hurricane season (July to November) wireless storm telegrams from vessels in the Gulf of Mexico and all West Indian waters.

In connection with the production of undamped electrical oscillations of high frequency by the arc and condenser method, Messrs. M. Kimura and K. Yamamoto, of the Kyoto University, have carried out a series of determinations of the effects of atmospheres of various vapours on the volt-ampere "characteristic curves" of the carbon-copper arc. The carbon electrode was solid, and was used as the kathode. The copper anode was water-cooled. The curves obtained are all of the usual form, which suggests a rectangular hyperbola, and show that the vapours tried stand in the following order of relative efficiency:—hydrogen, hydrogen mixed with benzene, methyl alcohol, methyl and ethyl alcohols mixed, ethyl alcohol, air, the volts absorbed for a given current being highest for hydrogen. The complete paper is contained in part iv. of the second volume of the Memoirs of the College of Science and Engineering of Kyoto University, just to hand.

The following figures for the solubility of ether in water are given by Mr. Y. Osaka in the Memoirs of the College of Science at Kyoto, and will be of interest to people who are constantly making use of this solvent:—

Temperature	0°	5°	10°	15°	20°	25°	30°	
Solubility (Osaka)	13·13	11·18	9·55	8·22	7·08	6·13	5·39	gr. per 100 gr. water.
Solubility (Seidell)	13·12	11·4	9·5	8·2	6·95	6·05	5·4	gr. per 100 gr. water.

Prof. Bone and Dr. H. F. Coward have replied, in the Journal of the Chemical Society, to the criticisms by Berthelot and others of their work on the production of methane by the direct union of hydrogen with carbon. In their most recent experiments they have obtained yields of 95·8, 95·6, and 91 per cent. of that theoretically obtainable from the weight of carbon used. The carbon used was particularly pure, containing not more than 0·06 per cent. of hydrogen, or 0·06 per cent. of ash. The gas produced (at 1150°) contained only a trace of carbon monoxide, never exceeding 0·03 per cent., and the amount of nitrogen was also very small.

It is seldom now that one firm is entrusted with the order for as many as ten vessels for any navy, and the successful completion of such an order by Messrs. Yarrow and Co. for the Brazilian Government forms the subject of an article in *Engineering* for August 19. The ten torpedo-boat destroyers are all of one design, an important advantage both from the tactical point of view and also from the standpoint of management by Brazilian officers and crews. They partake generally of the British "river" class, in which were embodied greater strength and other qualities to enable the vessels to maintain their speed in a heavy sea. The guaranteed speed of 27 knots has been easily exceeded by every ship. The length between perpendiculars is 240 feet, and the displacement is 650 tons. The ratio of length to beam is 10·2 to 1. Each vessel has two sets of four-cylinder triple-expansion engines, balanced on the Yarrow-Schlick-Tweedy system, and supplied with steam from two double-ended Yarrow boilers. The greatest power developed on an official trial was 8877 indicated horse-power, in the case of the *Parana*. The coal-consumption trials showed that at 14 knots speed the radius of action was 3690 nautical miles.

Engineering for August 19 directs attention to the important and continuous increase in Germany's imports of British coal—from 1899 to 1909 the increase is more than 115 per cent. The figures are 4,873,555 tons in 1899 to 10,498,118 tons in 1909. In no place, perhaps, has British coal to a more marked extent encroached upon German coal than in Berlin. In 1890 British coal consumption in Berlin amounted to 105,894 tons, or 7·53 per cent.; last year the respective figures were 946,102 tons, and 39·88 per cent. The total consumption in Berlin in the two years was respectively 1,406,961 tons and 2,372,310 tons. Coinciding with this increase in British coal consumption is a notable decrease in the consumption of coal from Silesia, and it is from this quarter also that complaints are loudest. Fears are openly expressed that British coal is in a fair way of, lastingly and fully, securing the Berlin market unless proper precautions are taken soon and with the greatest possible energy. The increase in import of British coal to Berlin is to a great extent owing to the growing consumption of British gas-coal at the Berlin gas-works.

Many ingenious pieces of apparatus for illustrating the principles and laws of heat are described and illustrated in a new catalogue (List 56) just issued by Messrs. A. Gallenkamp and Co., Ltd. The aim of the makers has been to produce at a moderate price instruments which can be used continuously by students without getting out of order, and will yield accurate results. A noteworthy feature is the inclusion of a number of new devices which have been described in text-books or periodicals, or before scientific societies. Teachers of physics will find the catalogue of service in the selection of experiments for the lecture-room and laboratory.

OUR ASTRONOMICAL COLUMN.

The Perseid Meteoric Shower.—Observations of this phenomenon have been received by Mr. Denning from twelve stations, and he informs us that the results are fairly satisfactory. Clouds, it is true, greatly interfered with watching on the important nights of August 11 and 12, but August 10 was clear.

The character of the display seems to have been of an average character. Meteors were not strikingly abundant, but there were enough to make the event exciting and to attract the interest of the general public. In Norfolk one observer was very successful, and relates that he counted twenty-one meteors in eight minutes between 1h. 16m. and 1h. 24m. on the morning of August 12, and estimated that they were falling at the rate of about 250 per hour! Other observers give the number as much less, but testify as to the brilliancy of some of the individual meteors.

Mr. C. L. Brook, of Meltham, saw splendid Perseids on August 8, 11h. 26½m., and on August 10, 12h. 5½m., with paths from 319°+68° to 279°+50° and 7½°+41½° to 350°+25° respectively. Mr. W. H. Steavenson, at Cheltenham, recorded the latter as moving from 90°+58° to 120°+48°, and saw another magnificent meteor at 13h. 11m., twice as bright as Venus, shooting from 120°+48° to 135°+40°. Others, comparable with Jupiter, followed at 13h. 18m. and 13h. 30m. The fireball of 12h. 5½m. fell from a height of 81 to 51 miles over the eastern region of Yorkshire. Its length of path was 45 miles, and velocity about 31 miles per second. It was a true Perseid, with radiant at about 45+56, but the exact place is not defined, as at Meetham Mr. Brook saw the meteor moving westwards, while at Cheltenham Mr. Steavenson observed it travelling to east.

Miss Warner, at Bristol, saw a number of meteors on August 10, the finest being a Perseid equal to Venus at 10h. 25m. It was, however, very low in the east, passing under Andromeda and Pegasus. Mr. D. E. Packer, of Birmingham, saw 200 meteors in watches of twenty-one hours between July 31 and August 14. There were thirty of the apparent brightness of Jupiter and twenty equal to Saturn.

Mr. W. Johnson, of Lastingham, witnessed a fine meteoric display on August 12. During the evening there were many brilliant meteors, including two of quite exceptional lustre. The display seemed at its best between 11 and 12 p.m.; clouds prevented observations after midnight.

Metcalf's Comet, 1910*b*.—Numerous observations of the comet discovered by the Rev. J. H. Metcalf on August 9 are recorded in No. 4434 of the *Astronomische Nachrichten*.

The magnitudes given for the whole object range from 9·0 to 11·0, and show no marked increase or decrease with the date. While some observers report a stellar nucleus, others say that there is no definite nucleus, but there is a central condensation in the nebulosity forming the head. A short tail is reported by the majority of observers, M. Guillaume, using the equatorial *coudé* of the Lyons Observatory, with a power of 360, giving the length on August 11 as about 1·5′, and the direction as towards E.

From observations made on August 11, 13, and 15, Dr. Kobold has calculated parabolic elements and an ephemeris, the former giving the time of perihelion as August 30·018 (Berlin M.T.). The later part of the ephemeris is given below :—

Ephemeris for 12h. (M.T. Berlin).

1910	α	δ	Mag.
	h. m.	° ′	
August 24 ...	15 46·6 ...	+16 15·0	
,, 25 ...	15 45·4 ...	+16 18·8 ...	10·7
,, 26 ...	15 44·2 ...	+16 22·4	
,, 27 ...	15 43·1 ...	+16 25·9	
,, 28 ...	15 42·1 ...	+16 29·2	
,, 29 ...	15 41·0 ...	+16 32·3 ...	10·9

Owing to the short arc yet observed, the elements are, of course, somewhat uncertain. From this ephemeris we see that the comet is now moving very slowly in a direction slightly N. of W. through the constellation Serpens.

PHOTOGRAPHS OF DANIEL'S COMET, 1907*d*.—The advantages to be secured from widespread cooperation, especially in the study of the physical features of comets, are well illustrated in a paper by Prof. Barnard which appears in No. 194, vol. xlix., of the Proceedings of the American Philosophical Society. There Prof. Barnard publishes twenty-five plate reproductions of photographs secured by him, with the 3·4 and 10-inch Bruce portrait lenses, during the period July 11 to September 8.

The physical changes depicted from day to day are very remarkable; but Prof. Barnard shows, by comparing his plates with series taken at Lick and Juvisy, that much shorter periods produced such great changes that some of the features became recognisable with difficulty. The time difference in the case of the Lick photographs is, generally, about two hours, for the Juvisy plates about six hours, yet even in the comparison between Yerkes and Lick there are very distinct changes shown. In several cases it is shown that a detached portion of the tail, although receding from the head, was still moving sunwards in the path followed by the comet.

PRECESSION AND THE SOLAR MOTION.—In No. 614 of the *Astronomical Journal* Prof. Boss publishes the results of an investigation of the proper motions of more than 5000 stars, uniformly distributed over the whole sky, and deduces therefrom the position of the solar apex and corrections to Newcomb's values for precessions and for the equinox of 1874. For the position of the apex he derives, for 1875·0, R.A. = 270·52° ± 1·08° to ± 1·53°, dec. = +34·28° ± 0·90° to ± 1·28°. Other solutions, for selections of stars, such as those of different magnitudes or large proper motions, are obtained, but they show no sensible modifications of these values.

For the velocity of the sun in space Prof. Boss finds 24 km. per second as a useful constant to adopt for the present, and is of the opinion that the value (19·9 km.) determined from spectroscopic observations is open to objections inherent to that method.

Further, he finds that his results strongly support the hypothesis of the random motions of the stars, an hypothesis which is directly opposed to the several ideas of definite "star drifts" which have been published in recent years.

CALCIUM VAPOUR IN THE SUN.—No. 1, vol. xxxii., of the *Astrophysical Journal* contains a paper, by Mr. C. E. St. John, which is full of important results concerning the distribution and the circulation of calcium vapour in the solar atmosphere. The research was undertaken in order to provide data for the better interpretation of spectroheliograms in so far as they reveal the disposition and inter-relation of the various solar layers. In 1872 Young observed the reversal of the H and K lines in disturbed regions, in 1883 Lockyer photographed them, and in 1892 Hale and Deslandres noted the reversals distributed over the entire disc.

With the splendid apparatus available at Mount Wilson, Mr. St. John has measured the various parts of the K line (K_1, K_2, and K_3), and, referring these measures to Fabry and Buisson standards, has determined the apparent displacement at various points on the disc, thus deriving data which indicate the conditions, altitudes, &c., under which the emitting vapours exist.

Among other results, he finds that the vapours producing the K_3 (absorption) line show a descending motion of 1·14 km. per sec., while the vapours producing the K_2 (bright) line have, generally, an ascending motion of 1·97 km. per sec. A comparison of the angular velocities obtained points to the vapour-producing K_3 being at a greater elevation than the hydrogen which produces the Hα line. A comparison of the wave-lengths of K_2 and K_3 at, and away from, the limb indicates that these intermediate and higher levels of the sun's calcium atmosphere are not greatly disturbed by currents parallel to the solar surface.

From measurements of the widths of K_3 and H_3, and reasoning from their behaviour in the calcium arc spectrum, it appears that the quantity of calcium vapour in the upper levels must be extremely small, while, from similar considerations of the K_2 and H_2 lines, the emitting vapours would be relatively thick and dense. In approximate figures, the 5000 km. depth of the solar envelopes above the photosphere is divided into 1500 km. for the upper (absorbing) atmosphere and 3000 km. for the emitting layer, leaving 700 km. for the layer which emits the bright chromospheric radiations. A curious result is that the K line persists for some 500 or 600 km. above the level at which the H line ceases to show.

On determining the wave-lengths of H_3 and K_3, a difference of 34·810 A. was found, which differs by 0·010 Å. from the value derived from Rowland's tables; this discrepancy is probably caused by an error of that amount in Rowland's wave-length for H.

Mr. St. John's paper takes up forty-seven pages of the journal, and there are other important results which are too numerous for full discussion in these columns.

OBSERVATIONS OF THE MOTION OF THE UPPER AIR.[1]

THE two publications before us evidence the progress which is being made in different ways in our knowledge of the upper currents of the atmosphere. Dr. Figee, invalided home owing to the trying climate of Java, has taken the opportunity of discussing the observations (286) of the height of clouds, made at Batavia, 7° S., 107° E., in 1896–7, and later observations of cloud-velocity. The results for *height* agree generally with the values obtained in the same period at Manila, 14° N., 121° E. The following table gives the heights in km., the mean values for Paris and Potsdam being added for comparison :—

Cloud	Ci.	Ci.S.	Ci.Cu.	A.Cu.	Cu.
Batavia	11·5 ...	10·6 ...	6·3 ...	5·4 ...	1·74
Manila	10·9 ...	11·4 ...	6·6 ...	5·3 ...	1·7
Paris and Potsdam ...	8·7 ...	7·6 ...	5·7 ...	3·3 ...	1·5

The *motion* of the higher clouds shows different features at the two places. In both the seasons, November–April, May–October, the drift is towards the south-west at Batavia, a result corroborated by the recent work of Van Bemmelen, while at Manila it is towards the south-west in the latter season, but nearly north in the former. The value of the results in Dr. Figee's paper can be rightly appreciated only when they come to be utilised in preparing an atlas of monthly charts showing the main features of the circulation at the cirrus-level, an atlas which is much needed at present.

The second paper is a discussion of fifty-one pilot-balloon

[1] (1) Royal Magnetical and Meteorological Observatory at Batavia: Report on Cloud-Observations at Batavia made during the International Cloud-year 1896–1897 and subsequent years. By Dr. S. Figee. Appendix ii. to vol. xxx. of the "Observations." Pp. 32. (Utrecht: Kemink and Sons, 1910.)

(2) "Velocità e Direzione delle Correnti Aeree alle diverse Altitudini Determinate a Mezzo dei Palloni-Sonde e Piloti." By Dr. G. Pericle. Pp. 55–126; 5 plates. (Milana: U. Hoepli, 1910.)

ascents made at the Geophysical Observatory, Pavia, during 1908. The balloons were observed to heights exceeding 10 km. in six cases, and exceeding 5 km. in thirty-one additional cases. The ascents were made generally during comparatively calm weather, so that the results cannot be taken as representative of average conditions, a restriction applying, of course, to all pilot-balloon observations.

The values of the observed wind are collected in a convenient table, which is accompanied by a brief description of the general pressure distribution on the days of the ascents, and by diagrams showing the paths of the balloons and the wind at all heights for each ascent. An outstanding feature of the results is the large proportion of cases, thirty-two out of forty-four, in which the wind above 3 km. has a northerly component, compared with three cases in which an extensive southerly current was found. This agrees with the cloud observations at Perpignan and Pola, and is markedly different from those at Paris and Berlin.

Dr. Pericle finds that the wind usually veers with increasing height up to 2 km., veers as often as it backs from 2 to 5 km., and usually backs above 5 km. A sudden increase in the velocity of the wind was observed in thirty-one cases at heights between 2 and 4 km., and this was accompanied generally, but not invariably, by a change in direction. The average change is from 5·2 m.p.s. below the level of the discontinuity to 9·4 m.p.s. above it. The wind veered in passing upwards in thirteen cases, backed in thirteen cases, and did not change in five cases. The "backing" is usually larger than the "veering," the average value being 29° for the former and 18° for the latter. These results confirm the temperature observations in indicating the intermediate layer from 2 to 5 km. as the region where the more immediate causes of remarkable meteorological phenomena are to be sought.

E. GOLD.

FURTHER RESULTS OF THE JESUP NORTH PACIFIC EXPEDITION.[1]

FORCE of circumstances has prevented Prof. F. Boas from giving to science a complete monograph of the Kwakiutl, but he has given a further instalment in the publications of the Jesup North Pacific Expedition, which, so far as it goes, together with his study of the sociology of these interesting Indians (Report U.S. Nat. Mus. for 1895 [1897]), practically supersedes the reports published by the British Association. The present memoir deals with the industries of the Kwakiutl, but the author acknowledges the "many gaps and imperfections," which he has endeavoured to supply by correspondence; even so, we have an important contribution on the technology of a representative tribe of the north-west coast, a district in which the natives have developed a culture which differs markedly from that of other American Indians.

FIG. 1.—Kwakiutl Village at Newettee, Vancouver Island.

The two key-notes from the material side of this culture are the cedar tree and the salmon. The former is utilised for a large number of purposes, and as the wood splits easily large planks are readily made; hence we have a peculiar type of house construction. Also, the manufacture of chests and boxes is very characteristic; boxes are made by bending a board, a kerf having been made where the corners are to come; the two ends are then sewn together. In the late summer enormous numbers of salmon migrate up the rivers, thus affording food which, with proper preparation, can be stored for future consumption. Fishing is carried on by means of traps, nets, hooks, and with the spear. In some cases, also, combinations of fish-weirs and nets are used, or fish are speared or hooked in pounds

[1] "The Jesup North Pacific Expedition." Mem. Am. Mus. Nat. Hist., N.Y. Vol. v., pt. ii. "The Kwakiutl of Vancouver Island." By Franz Boas. Pp. 301–522 (plates xxvii–lii)+ix. Vol. viii., pt. i. "Chukchee Mythology." By Waldemar Bogoras (*loc. cit.*). Pp. 197. Vol. ix. pt. i. "The Yukaghir and the Yukaghirized Tungus." By Waldemar Jochelson (*loc. cit.*). Pp. 133; 1 map. (Leiden: E. J. Brill, 1909–10.)

connected with traps; many of these are described by the author.

In this favoured wooded region berries are abundant, and there are numerous land mammals and birds. The principal method of hunting the former is by means of traps; bow and arrow and spear are not used extensively for this purpose. Birds are generally snared or shot with arrows.

FIG. 2.—Kwakiutl Mask representing Whale and Thunder-Bird. Length 172 cm.

The peculiar socio-religious beliefs and practices of the Kwakiutl, together with their skill in working wood, have led to the decoration of the majority of their domestic tools and appliances with human and animal forms and motives. House posts are often decorated with human and animal forms, and human effigies are frequently carved; but their fancy runs riot in the masks which are employed on ceremonial occasions; these often have movable jaws, and are well carved and brilliantly painted; numerous plain and coloured illustrations of these are given, one of which is shown in Fig. 2.

Prof. Boas has "spared no trouble to collect descriptions of customs and beliefs in the language of the Indian, because in these the points that seem important to him are emphasised, and the almost unavoidable distortion contained in the descriptions given by the casual visitor and student is eliminated." He goes on to say he has for many years advocated a more extended application of this method in our studies of the American aborigines. Other field workers might with advantage adopt this suggestion, which has, however, been more or less systematically employed by previous investigators. In this particular instance, Prof. Boas has given a presentation of the culture as it appears to the Indian himself. These accounts by the Indians of their technical processes afford very interesting reading from various points of view, and it was a happy idea to publish them in full, but, as so many Kwakiutl texts have already been published, it seems hardly worth while to have gone to the expense of printing so many of the native texts in full in addition to the translations.

Dr. W. Bogoras gives us forty-seven Chukchee myths and tales, ten incantations, and several songs, proverbs, riddles, &c., the native text being given in many instances. The pronunciation of the women differs from that of the men; they generally use *s* instead of *c* and *r*, and *ss* instead of *rk* and *ch*; also contracted forms of words are never used by them. They are not unable to pronounce these letters, and in tales, when quoting a man's words, they use the male pronuciation; but in ordinary conversation the male pronunciation is considered unbecoming in a woman. The tales give a valuable insight into native life and thought, and, on the whole, appear to be very similar to those current among the tribes living on the north-west coast of America, but no comparisons are made or general conclusions drawn in the present memoir.

Of great interest and value is the first part of Dr. W. Jochelson's monograph on the Yukaghirs, a tribe now on the verge of complete physical and ethnic extinction. The whole area between the rivers Lena and Kolyma, and between the Arctic Sea and the Verkhoyansk Range, may be considered as the ancient boundary of the Yukaghir tribe. Probably Finnish tribes were formerly the neighbours of the Yukaghir west of the Lena, as the Yakut and Tungus appear to have come there in comparatively recent times, but the original home of the Samoyed tribes was evidently in the Sayan Mountains, whence they were driven northwards by the Turko-Tatar peoples; in their new abode they had to wage long wars with the Finnish tribes. Chukchee formerly inhabited the tundra between the mouths of the Alaseya and Kolyma rivers; when the Russians came they moved east, and only about sixty years ago one division crossed the Kolyma and spread west as far as the Yerchen (long. 150° E.). Now the Yukaghir are confined to the north and north-west of their ancient area.

The term Yukaghir is probably of Tungus origin; the people call themselves Odul, which means "strong," "powerful." A sufficiently full account is given of the physical characters of the people, accompanied by numerous excellent photographs of types. There is an admirable account of their physiological characteristics, and their nervous diseases are treated in detail, the description of arctic hysteria being the best we have seen. Two principal forms of arctic hysteria may be distinguished; one has little to distinguish it from fits of hysteria in civilised countries. The fits occur mostly in grown-up girls or young women, while in the young males they are principally due to the influence of religious imagination; they are observed in the nervously strained youths who are inclined to become shamans. The characteristic feature of this type is that the patient continues to sing a long time,

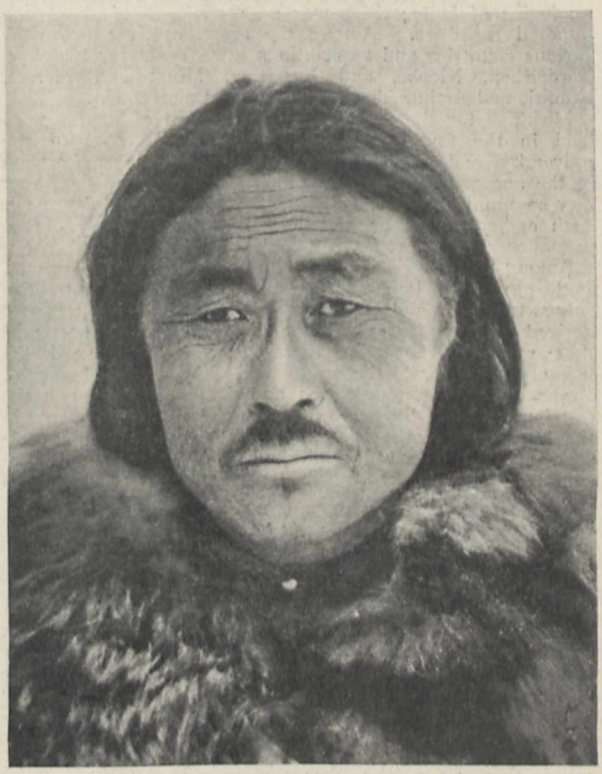

FIG. 3.—A Man of the Yukaghir Tribe.

enunciating in the song the wishes of the spirit that tortures him or her. The other form is more strange and complicated, the first symptom being extreme impressionableness and a feeling of fright or timidity. At the least knock, shout, or unexpected noise, the patient shudders or falls backward, and the fright usually evokes the most obscene words or phrases. Another phase is akin to

hypnotic aural suggestion; the visional auto-suggestion is also well known among other races, for example, the *latah* of the Malay peoples. Persons who are past thirty or forty years of age, and chiefly women, are subject to this second form of arctic hysteria.

The chapter on family life is of especial importance; a careful account is given of relationship terms and the ideas of kinship; the system is essentially classificatory, with some suggestive modifications, the information here given being more detailed than is usually the case with even professed ethnologists. A review of the facts pertaining to marriages shows that, just as in the period of courtship, there are two distinct tendencies, one towards loose sexual relations, and the other towards idealising constancy and mutual faithfulness. So, also, in marriage, there is a striving towards exogamy and an inclination towards consanguineous marriages, which, it seems, were common in former times. Both the Yakut (who in general practise very strict exogamy) and the Yukaghir observe that children born from consanguineous marriages are generally unhealthy. Dr. Jochelson has not only given us a detailed account of a vanishing people, but he alludes to problems that will interest the student of comparative ethnology. A. C. HADDON.

INTERNATIONAL CONGRESS OF ANATOMISTS AT BRUSSELS.

THE second quinquennial Congress of Anatomists was held at Brussels on August 7–11. The societies participating in it were the Anatomische Gesellschaft of Germany, the Association des Anatomistes of France, the American Association of Anatomists, the Anatomical Society of Great Britain and Ireland, and the Unione Zoologica of Italy; there was an attendance of about one hundred members. Among the representatives from the various countries and associations were Waldeyer and Von Bardeleben, Nicolas and Laguesse, Minot and Piersol, Romiti, and Arthur Thomson, Paterson and Dixon.

Meetings for the reading and discussion of papers were held in the forenoons in the physics classroom of the university, and demonstrations were given in the afternoon in the anatomical department in the Parc Leopold. About fifty communications were read, of which the majority dealt with embryological or histological subjects; many of the papers were of great interest and importance.

Among the papers presented by members from Germany, Poll gave an important communication dealing with spermatogeneris and oogenesis in hybrids. Using material derived mainly from hybrid pheasants, he demonstrated that spermatogenesis in them never went beyond the primary stage, or to the production of fully formed sperms. Braus gave a communication and demonstration upon the distribution of motor nerve fibres to the muscle segments in the lateral fin of the skate, and showed that each muscle segment in it received an innervation from a number of spinal nerves, and he also demonstrated the contraction of from 5–8 muscle segments upon stimulation of a single spinal nerve.

Neumayer showed a beautiful series of models illustrating the development of the skeleton of the head in Bdellostoma St. L., and Fetzer showed a model and sections of a very early human embryo closely resembling the ovum of Peters. In it the fixation and the histological structure of the trophoblast were particularly well seen.

Lenhossek gave a communication on the nerve-cells of the ciliary and otic ganglia in man, and showed some very fine specimens of them. Several communications from members of the German and American societies dealt with the development of the blood cells, Maximow giving a communication upon the development in Selachians and Amphibians, Frau Wera Dantschakoff that in Reptiles, and Minot upon the nomenclature and morphology of blood cells in general. He appealed for a more rational and scientific terminology than at present exists, and for the abolition of terms such as "normoblasts."

The papers from French anatomists included one from Lams, accompanied by a demonstration of beautiful specimens on the fertilisation and early changes in the ovum of the guinea-pig, which gave rise to an interesting discussion upon the *rôle* of the tail segment of the entering spermatozoon, in which Brachet and Van der Stricht took part. Dubreuil showed the development of the lamellæ in the upper end of the femur, and the relation which they present to the entering vessels. Several communications from members of this society dealt with the presence and character of Mitochondria in various tissue cells.

Huntingdon and McClure, of the American Society, dealt with the development of the lymphatic system, and demonstrated a loosening of the intima of the early veins, by which lymph channels could take origin within the lumen, outside the intima.

Lee gave a communication upon the implantation of the ovum in various North American rodents, and Huber demonstrated some fine corrosion preparations, illustrating the morphology of the renal tubules and vessels in vertebrates.

Of the British and Irish Society, Hill (London) demonstrated, by a fine series of photographs, the growth and maturation of the marsupial ovum as illustrated by Dasyurus. Berry (Melbourne) gave a communication upon Tasmanian crania; Evatt (Winnipeg) advanced a new view of the homologies of the urethra and vagina in the sexes; Arthur Thomson and Whitnall (Oxford) dealt with the anatomy of the angle of the iris and a ligament acting as a check to the action of the levator palpebræ superioris; and Waterston (London) gave a communication upon the shape of the human stomach and the action of formalin. A paper from Cameron (London) was read, upon the development of the anterior commissure and adjacent parts.

Most of these papers will probably be published at an early date, and hence no description of them need be given here.

On the last day of the congress an important step was taken in the appointment of an international committee to consider the question of a uniform embryological nomenclature, on the model of the Basel anatomical nomenclature for general anatomy. A committee of representatives from each country represented at the congress was appointed, with power to co-opt additional members, and with Prof. Mall, of Baltimore, as general secretary.

The members of the congress were entertained at a municipal reception in the magnificent Hotel de Ville, and they also appreciated greatly a demonstration given by Dollo of the great collection of fossil Iguanodons in the Natural History Museum.

BRITISH MARINE ZOOLOGY.

THE Bureau of British Marine Zoology has been established under the directorship of Mr. S. Pace, late director of the Millport Marine Biological Station. The objects of the bureau, we learn from the prospectus before us, are twofold:—(1) to compile a bibliography of all works dealing with the biology of the European seas, and (2) to establish a marine biological station of a movable character with adequate staff, but relatively simple and inexpensive equipment, to work at faunistic problems at one or two points on the coast, with no reference to any question of their possible economic importance.

It is intended that the bibliography should be issued in a large number of parts each year, and that the issue of each part should follow the papers referred to in it at the shortest possible interval. From the specimen pages of such an issue submitted to us, we gather that the papers are classified both under the author's name and according to subject-matter, and they are accompanied by very brief synopses of their contents, the brevity of which is increased by the use of the numerous abbreviations employed. Such a bibliography should be of very considerable value to workers at marine biology. Whilst, of course, it cannot compare with such periodicals as the *Zoological Record* or the *Zoologisches Jahresbericht*, it will anticipate the appearance of these by many months.

With respect, however, to the second project for which the bureau has been established, viz. to carry on an exhaustive faunistic survey of the marine life at one or more points on our coasts, a point of cardinal importance is at once raised. We have at present about half a dozen "stations" for the study of marine biology. There is hardly one of these which receives anything like adequate

support. The largest of them, the Marine Biological Association's station at Plymouth, is faced with a serious deficit, and is forced to contemplate the curtailment of its operations. The amount of sympathy and support which the cause of "pure" science can evoke in Great Britain is, unfortunately, very small. We should therefore regret very much to see another "station" started, especially as the staff at Plymouth have carried out just such a faunistic survey of the coast near Plymouth as Mr. Pace desiderates.

Mr. Pace believes that the intrusion of the economic motive "must arrest, if it does not entirely hinder, scientific research." If the zoological schools of this country would concentrate on supporting one station, economic work might be dispensed with, and we might have a purely scientific biological station like Wood's Hole in America. But this goal is far off. Each new zoological school seems to desire its own station, and since the "stations" must look outside the ranks of professional zoologists for support, this support must be attracted by the promise either to devote part of the energies of the staff to economic problems, as the council of the Plymouth station have done, or to undertake the dissemination of popular knowledge of natural history, as the council of the Millport station has done. After all, the foundations of our knowledge of natural history were laid by the splendid amateurs of the last generation, of whom the founder of the Millport station was one. A great service to science would be accomplished if we could resuscitate this race.

We agree with Mr. Pace that it would be an admirable thing if marine biological research in this country could be organised; but it seems to us that the first step in this direction would be the whole-hearted support of the Marine Biological Association, which was founded for this purpose, and this association, if adequately financed, could provide a steamer which would serve the purpose of faunistic investigation better than the movable laboratory which Mr. Pace desires. Mr. Pace's scheme is an admirable one for starting investigation in a new country—it was that adopted by Canada for seven years; but in Canada it has been given up, and a permanent station on the model of Plymouth has been substituted for it.

E. W. MACBRIDE.

INHERITANCE IN THE DOMESTIC FOWL.[1]

IN the conditions under which they work, students of genetics enjoy exceptional advantages in America, where the munificence of private benefactors or the enterprise of various States has already led to the creation of several institutions specially endowed for this line of research; and from time to time the record of their work may appear in the form of a sumptuous publication issued by the Carnegie Institution of Washington. Dr. Davenport is already known for his investigations on heredity in poultry, and the present volume forms a continuation of the account of his researches to which a volume in the same series was devoted in 1906.

The memoir deals mainly with characters which, at any rate in some cases, are remarkable for the considerable grading that is found among the offspring of the various crosses. To this category belong the feathering on the shanks and the extra toe, both normally found in certain breeds of fowl. It has been recognised for some years that the inheritance of polydactylism in poultry often exhibits irregularities as compared with that of other characters where the mode of transmission is of a simple Mendelian nature. There are cases where the polydactyl condition may behave as a dominant to the normal in the ordinary way, but there are also cases where a bird with normal feet, bred from a polydactyl strain, may transmit the polydactyl condition to some of its offspring, *i.e.* where the individual does not exhibit the extra toe, though breeding tests show that the factor or factors for it must be carried by some of its germ-cells. The dominance of such a character as exhibited by the zygote may range from completeness down to *nil*. Nevertheless, some of the F_2 birds are without the extra toe, and are incapable of transmitting it; in other words, some of the germ-cells of the F_1 birds are completely free from the element, whatever it may be, to which the extra toe is due.

Hitherto it has not been possible to express this case more precisely, and though Davenport's results confirm our previous knowledge, he has been unable to construct a definite factorial scheme to cover the facts. He concludes that in polydactylism, as also in other cases, such as rumplessness and the feathered shank, dominance varies quantitatively, and that the degree of dominance is inheritable; but, of course, this does not help us in understanding what these varying degrees of dominance are due to. It may be that further work will make this more clear, or it may be that the heredity of these meristic characters differs from that of other characters in some way that has not yet been perceived. For the present, we can only confess to ignorance.

An account is given of crosses between either Houdan or Polish and single combs, and an attempt is made to explain the results on the supposition that two comb factors are concerned. Here again the irregularities between normal expectation and observation are attributed to quantitative variation in the degree of dominance. Experiments with fowls' combs have hitherto given such well-defined results that it seems not impossible that the complexities encountered by the author are due to the fact that he is dealing with more than two comb factors in this particular cross. The author's statement that many forms of comb appear in the F_2 generation is probably not without significance.

A chapter is devoted to the inheritance of the high and widely open type of nostril found in the low-combed Polish and Houdan breeds. From an elaborate system of grading his data, the author concludes that the widely open condition is dominant to the more usual narrow form of nostril, and that the intermediate grades are the result of imperfection of dominance, though here again no suggestion is given of the cause of this imperfection. There is little doubt that this character of wide nostril is largely dependent upon the size of the comb, and we cannot help feeling that the treatment of the question would have been more satisfactory had the nostril and comb characters been worked out in relation to one another.

The inheritance of crest Davenport considers a somewhat more complex case than it was originally thought to be, and he suggests that its nature depends certainly upon two, and possibly upon more than two, factors.

A short chapter is devoted to the results of breeding from a wingless cock. When crossed with normal birds the offspring were all normal, and some of these bred together again produced nothing but normals. Davenport suggests that winglessness is dominant to the normal condition, that the wingless cock was heterozygous, and that dominance in subsequent generations was imperfect. It may be pointed out that the facts accord equally well with the view that the abnormality was a purely somatic one, and was not reflected in the germ-cells of this wingless bird.

A number of experiments were made on plumage colour, largely with the view of elucidating the nature of buff and of black, and the author has seen his way to express his results in simple terms. Perhaps one of the most interesting results is the appearance of a definite proportion of white birds in the F_2 generation from a cross between black and buff Cochins. The author is, however, less happy in his discussion of the inheritance of blue, and his attempt to make the colour-inhibiting factor of the white Leghorn partly responsible has led to an account that is inconsistent with itself.

The memoir concludes with a general discussion on topics connected with heredity.

AGRICULTURE AND ALLIED SCIENCES.[1]

THE number of agricultural and horticultural publications has reached somewhat alarming proportions during the last few years, but there is always room for really good works; and in this category must be placed the Journal of the South-eastern Agricultural College, Wye, Kent, No. 18 of which is under notice. This publication

[1] "Inheritance of Characteristics in Domestic Fowl." By C. B. Davenport. Publication No. 121. Pp. 100; 12 plates. (Washington: Carnegie Institution, 1909.)

[1] "The Journal of the South-eastern Agricultural College, Wye, Kent," No. 18. Pp. 443. (London and Ashford: Headley Brcs., 1909.) Price 6*s.*; Residents in Kent and Surrey, 3*s.*

deserves to be more widely known, for as a compendium of all that is latest and best in agricultural research it is far in advance of most of its compeers. The book is divided into parts dealing with the farm, chemical analysis, zoology, botany, veterinary work, and general notes. Where so much is good it is difficult to do more than merely direct attention to some of the most striking portions of the book. A masterful article on the financial aspect of sheep-washing will well repay perusal, and the splendid series of plates illustrative of sheep-shearing are so lucid as to be self-explanatory.

The report on zoology deals mainly with entomology, and is illustrated very fully by many striking plates, one of which is of especial interest, showing as it does female

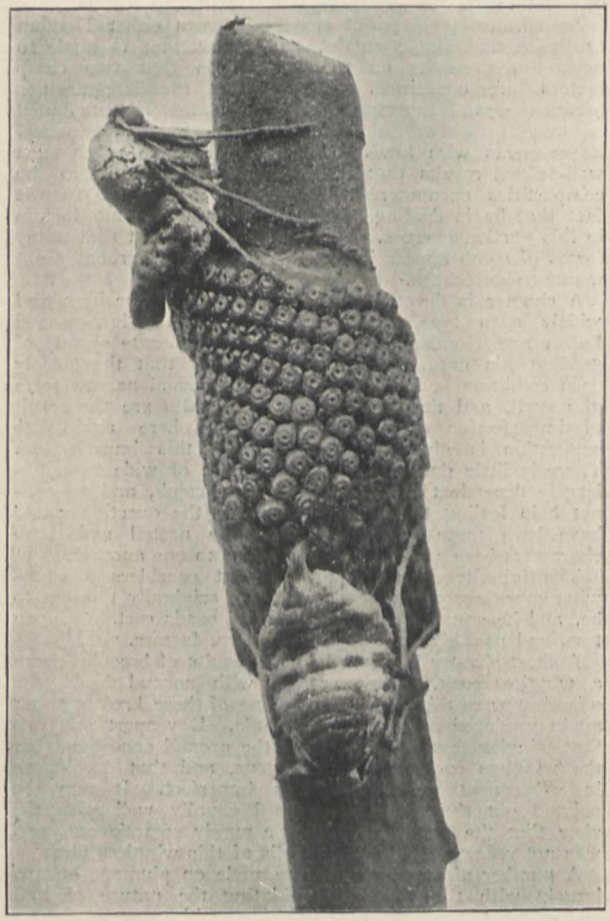

Photo. *F. Edenden.*

FIG. 1.—Female March Moths: The lower one laying her egg-band beneath one of the Lackey Moth (× 4). From the Journal of the South-eastern Agricultural College.

March moths laying their eggs in proximity to the egg-band of a lackey moth. That insidious pest *Tylenchus devastatrix* receives attention, and further notes are promised for the next report. A very interesting article on the British Culicidæ concludes one of the most fascinating portions of the book.

In addition to the general analytical work, the analytical report deals, for the most part, with soya-bean cake and meal. Economic mycology and experiments on hops form the chief items in the botanical report. It is interesting to note that the good work carried on at Wye in dealing with American gooseberry mildew, apple "scab," and "black scab" of potatoes, is being continued. The notes on the making and application of Bordeaux mixture, with notes on Bordeaux injury, illustrated by no fewer than twenty-three plates, will be greatly appreciated by fruit-growers. Two plates showing the right and wrong kinds of spray for Bordeaux mixture are interesting. In addition to the American gooseberry mildew, the somewhat neglected but no less prevalent Sclerotinia (Botrytis), "die back," of the same plant is described.

In the previous issue of the journal attention was directed to the importance of the male plant in the growing out of hops, and it appears that the advice tendered in the article in question has borne good fruit, and that several Kentish hop-growers have obtained good results by retaining, or even planting, male hops. The veterinary report, always interesting, is especially so in this issue on account of the announcement of the termination of a long series of "struck sheep" experiments, and the probable discovery of a preventive treatment.

FIG. 2.—Diseased Gooseberry Branch, showing the Botrytis fructification at × and elsewhere. From the Journal of the South-eastern Agricultural College.

The general notes consist of a summary of the college events of the year, and will appeal to all old students. To those who desire to keep abreast of the times in matters agricultural the journal is indispensable. C. A. E.

THE BICENTENARY OF THOMAS SIMPSON.

ON August 20 occurred the bicentenary of the birth of Thomas Simpson, who may be regarded as one of the last of the English school of mathematicians of the eighteenth century. Newton, Halley, the Gregories, Muston, Demoivre, Brook Taylor, Maclaurin, had all passed away before Simpson reached middle age, and the study of mathematics in England was entering upon that period of stagnation which left us without a single mathematician in any way comparable with the great writers on the Continent.

Simpson was the son of a Leicestershire weaver, and was

born at Market Bosworth, August 20, 1710. He was brought up as a weaver, and the little learning he obtained as a boy was gained in spite of many disadvantages and obstacles. Indeed, the opposition he received from his father at last drove him from home, and he went to Nuneaton, where, at about the age of twenty, he married his landlady, a widow of fifty.

His acquaintance with mathematics began at the age of twenty-four with "Cocker's Arithmetic," the study of which he combined with that of astrology, his tutor being a fortune-telling pedlar. Simpson's astrology, however, brought him more trouble than credit, and on the charge of frightening a girl into fits by "raising the devil" he had to leave the district. He spent some time at Derby, and in 1735–6 he went to London, worked as a weaver in Spitalfields, and taught mathematics in his spare time. A year or two afterwards, with the sole assistance of Edmund Stone's translation of L'Hôpital's "Analyse des Infiniments Petits," Simpson wrote "A New Treatise on Fluxions," which was considered a notable contribution to the literature of that comparatively new subject. Other publications followed, his pupils increased, and he gained a considerable reputation.

In 1743, through the influence of William Jones, the mathematician, Simpson obtained a post as professor of mathematics at the Royal Military Academy, Woolwich, and two years later he was elected a Fellow of the Royal Society, having already been made a member of the Academy of Sciences, Stockholm. After holding his post at Woolwich for eight years he was seized with illness, caused, it was thought, by overwork. Advised to try his native air, he journeyed to Bosworth in February, 1761, and died there on May 14, in the fifty-first year of his age. He was buried in the churchyard of Sutton Cheney, a parish a short distance from Market Bosworth, where in 1790 the Leicestershire antiquarian John Throsby placed a tablet over his grave. Simpson had one son, who became a captain in the Royal Artillery, and one daughter. His wife survived him many years, received a pension from the Crown, and died in 1782 at the great age of 102.

EDGAR C. SMITH.

ELECTRICAL AND OTHER PROPERTIES OF SAND.[1]

THIS material, which flows so freely through my fingers and may be poured in the manner of a liquid from one vessel to another, is common sand. Specimens from various parts of the world are here exhibited; there are sands from the Sahara Desert, from New Zealand, France, Scotland, and several parts of England. There are also bottles of the coloured sands from Alum Bay, in the Isle of Wight, and Redhill. It may be pointed out at once that this coloration is merely due to the presence of an adherent layer of oxides or hydroxide of iron, for even varieties which appear under the microscope to contain little or no coloured particles generally have a trace of iron clinging to the grains.

For instance, a small quantity of white sand from Charlton, having been wetted with strong sulphuric acid before the lecture, will yield on the addition of water a solution containing iron. A few drops of ferrocyanide of potassium give a strong blue characteristic precipitate.

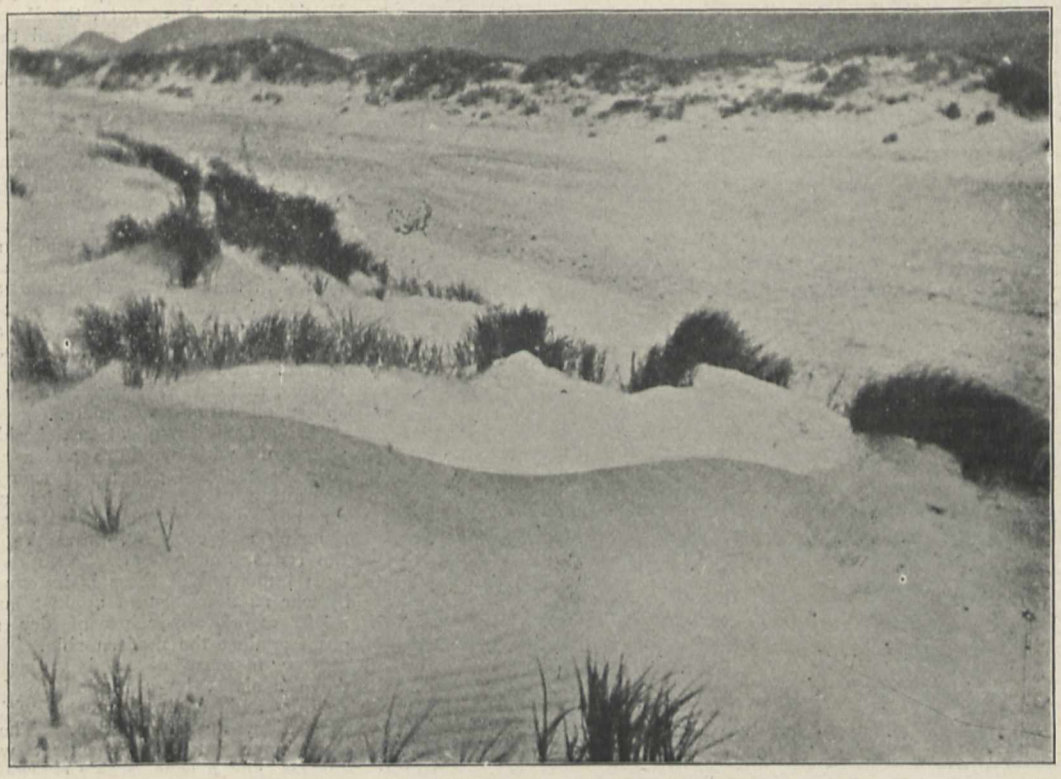

FIG. 1.

Further, the so-called black iron sand from New Zealand consists almost entirely of magnetite. If some of it is poured out upon a sheet of paper and brought near to a powerful magnet, you see that the grains fly eagerly to the poles and form large clusters there. This powder, on account of the regularity of its grains, their highly magnetic character and freedom from dust, is particularly useful in the laboratory for tracing lines of magnetic force. It is interesting to compare this with the black oolitic sand from Compton Bay, in the Isle of Wight, for that is a silicate of iron, and therefore non-magnetic.

I wish now to direct your attention to some of the phenomena connected with sand in large quantities, such as are met with upon wide stretches or drifts.

Blown sand, having been stopped by hedges and grass, gradually accumulates to a mound (Fig. 1)—in some cases with serious consequences. Dr. Vaughan Cornish, who has made a special study of this subject, has clearly proved,

[1] Discourse delivered at the Royal Institution on Friday, February 11, by Mr. Charles E. S. Phillips.

however, that the formation of a sand dune is very frequently due to wind eddies. The second photograph was, in fact, taken by him in Egypt, and depicts the steady, irresistible march of millions of tons of sand, encroaching upon and slowly burying casuarina trees (Fig. 2).

To come nearer home, the seriousness of problems arising out of this state of things may be illustrated by two photographs obtained recently at Southport, in Lancashire. In the first one (Fig. 3), the back garden of a newly built house is nearly buried beneath the enormous hill, which will probably soon cover the whole property. The second (Fig. 4) shows that the familiar appearance of a sandy beach at low water, with regular lines of ripples, may be

FIG. 2.

produced by the direct action of the wind, and, incidentally, the utter futility of constructing an esplanade in such a neighbourhood. All these phenomena depend, in some measure, upon the size, weight, and shape of the sand grains themselves.

Silica, a substance which occurs in numerous impure forms, and constitutes a large portion of the rock masses known to geologists, is also to be found in a pure state as crystalline quartz. Here is an actual specimen about 18 inches long, which, together with the beautiful group of quartz crystals by its side, known as amethysts (and tinted, probably, by a trace of organic matter), are the property of this institution. Sand, therefore, being the result of rock disintegration, assisted by the grinding action due to the motion of wind or water, varies in composition in different localities.

The next slides are photomicrographs taken with a low-power objective. They represent some grains of sand found at Charlton and the Isle of Eigg respectively (Figs. 5 and 6). The former are seen to consist of minute silica particles of very irregular form, whereas the larger grains of the Eigg sand are remarkable for their smoothness. It is owing to this fact that the latter possess a peculiar property, to be referred to later.

Owing to the Sahara Desert having once formed the bed of a vast sea, it is, of course, found to be rich in marine deposit.

The damage which sand is capable of doing has been already referred to. It must not be forgotten, however, that its utility in the arts and crafts is of the utmost importance. The Egyptians are reputed to have been the first to find a wide use for it. They were probably the earliest glass-workers in the world. By the time glass-making was begun in England, viz. about 1611, the Romans and Venetians had so far mastered the art of blending sand with other substances that almost all the technical difficulties had already been overcome.

Now the melting point of silica being about 3000° C., it cannot be worked in an ordinary furnace. In glass-making the sand is therefore heated with a salt of one or more of the alkaline group of metals, preferably with sodium carbonate. At a moderate temperature sodium silicate is formed, and if this be subsequently heated in the presence of either lead oxide or borax, the melting point of the mass is still further reduced. Here is a white-hot crucible containing sand so treated and melted. You see the glass pours out like treacle, and sets rapidly into a transparent slab upon a hot brass plate.

Many useful applications, besides providing us with windows and glass-ware, have been found for sand, such as the decorating of hard surfaces by means of an impinging stream of its particles, scouring and cleaning, preventing slip on the roads, and so on. By no means the least important of these is its employment in war as a protection against bullets; a thickness of 20 inches of dry sand is proof against the modern rifle.

Now a mass of sand grains moving down a slope, by a motion consisting of rolling and sliding, meets with great opposition, due to friction. The grains thus come into close contact with the surface, and a considerable charge of electricity may readily be obtained by the simple device of allowing them to impinge upon a suitable substance.

A stream of sand flowing from the base of this reservoir B (Fig. 7) strikes upon an oblique sheet of tin T, which is attached to an insulating pillar N. An electrostatic voltmeter connected with the metal plate serves to measure the electrical potential. You see that in a moment the tin becomes charged to 3000 volts. The needle, however, soon falls back. Something has changed. The plate has, in fact, become dulled and pitted where the sand struck it. A fresh part reproduces the high potential. Filter paper is far more serviceable, and so is a wooden surface. One may rapidly obtain a potential of 6000 volts if the sand fall upon paper or wood, and this can be maintained for a considerable time. If the reading of the voltmeter diminishes, a fresh portion of the surface offered to the sand stream immediately brings it to its original value as before. The greater efficiency of paper (preferably filter paper) as compared with a metal sheet in producing the electrification, appears to arise in the following way.

A fine layer of dust soon becomes firmly imbedded in the metallic surface, so that further sand falling does not come into contact with the metal itself. On the other hand, it is probable that these particles cut through the fibres of the paper, and thus free themselves. I need hardly point out that the filter papers used should not be specially dried. Pieces which have been left about in a room for a few hours absorb sufficient moisture to ensure the right degree of conductivity.

The sign of the charge is always positive, in spite of the fact that a rod of silica rubbed upon the paper electrifies it negatively. In 1843 Faraday had noticed this curious reversal, and briefly refers to it in his experimental researches. Even if the actual silica rod be broken up into pieces, say as large as an orange-pip, and allowed to fall upon the paper held obliquely, the sign of the electrification is still positive. Further experiments have shown, however, that the sign of the electricity caused by friction against glass or silica depends upon the form of the rubbed surface. For instance, a strip of paper stroked by the smooth side of a tube of either substance becomes negatively electrified, whereas if the sharp edges of the end graze the paper, the sign of the electrification of the latter is positive. Now sand consists of sharply angular particles of silica, and even the comparatively large pieces obtained by crushing the tube, as previously described, have razor-like jagged edges. We should therefore expect, from the result of the experiments just mentioned, that when either sand grains or even large silica chips fall upon paper they will electrify it positively—and this is what actually occurs. Why an edge of glass should give an opposite charge to that produced by a flat surface when rubbed, say, with paper, is a question of great interest and difficulty. But that this is the explanation of the strange electrical behaviour of practically all powders appears certain.

The sand grains themselves become, of course, negatively electrified after striking the paper, so that this is often a convenient method of obtaining a high potential of either sign. Further, a stream of sand falling upon a metal plate will give a comparatively low potential, say 600 volts, for an indefinite period, in spite of pitting, and a tolerably steady value may be obtained by catching the grains upon a second disc (previously dulled by a sand-blast) connected with the apparatus required to be constantly electrified. As the charge increases upon this, a point is reached when some of the impinging sand particles become deviated by repulsion, so as to completely miss it. If the potential falls below the critical value, a reverse action takes place, and the plate rapidly charges up.

Turning for a moment to the question of the electrification produced in sand by the friction between the grains, experiments upon this point may be conveniently made by catching the particles, which roll down the surface of a sand cone, upon a small wet insulated table. Any electrification of the latter may then be detected in the usual manner. If the grains are all of the same nature, we should not expect to find other than slight irregular charges. The friction between particles differing in composition would give more definite results. Thus white sand racing over iron sand might be expected to show a charge; but experiment gave only a feeble electrification. I mention this because it is of interest in connection with the atmospheric electrical phenomena which often accompany sand storms in hot climates. Even if the wind electrified the surface of the sand over which it blows, the charge would probably leak instantly to earth, for in common with all powders it readily absorbs moisture into the interstices between the grains. When making electrical experiments with this material, it is therefore essential to have it well warmed.

FIG. 3.

There is still much useful work to be done in studying the electrical conditions in the neighbourhood of wide stretches of warm sand swept by dry wind. Owing to lack of data, it is difficult to form an opinion as to the part which this substance plays in the remarkable electrical phenomena sometimes witnessed during a storm.

I spoke of allowing sand to run down itself. Here is a cell made by separating two glass plates, 14 inches square, by strips of wood along the bottom and top edges. The sides are open. Through a hole in the upper distance strip sand pours from a funnel, and builds itself into a beautifully symmetrical conic section. Presently the base will so far widen that any further increase shoots the

sand off through the open ends of the cell. When this point is reached the cone can no longer grow. A supply of white sand is then poured in, and seen to run down the sloping sides without carrying any of the coloured particles with it. The base has spread out proportionately as the cone increased in height, so that the angle which the sides make with the horizontal shall be 35°. If the sand be wet or damp, this law no longer holds. The addition of sufficient water materially diminishes the friction between the grains.

It is often observed when walking along the sea-shore, upon sand left wet by the receding tide, that for a moment the foot, on touching the ground, is surrounded by a comparatively dry area. This appearance is quickly followed, however, by one which indicates that the sand has gathered moisture, for on lifting the foot—which has by now probably sunk a little below the surface—the excess of water is particularly noticeable. In order to explain

FIG. 4.

this we must have recourse to some ingenious experiments made a few years ago by Prof. Osborne Reynolds. He pointed out that a number of particles, whether spheres or irregular grains, may fit together in such a way that the size of the spaces enclosed by them is either a maximum or minimum. Figs. 8 and 9 show a sectional view of a collection of spheres, arranged in what Prof. Reynolds calls abnormal and normal piling respectively. It is evident that the spaces between the spheres are far less in the second than in the first case. Now here is an elastic bag tied upon one end of a glass tube. The arrangement is partly filled with sand and coloured water —the latter standing 2 inches in the tube, so as to serve as an index. If the bag is now tapped, all the particles in it become normally piled. We have seen that any departure from this arrangement will enlarge the spaces between them. It is no longer surprising to notice, therefore, when the bag is pinched and the grains are thus made to ride up on one another, that the liquid in the tube, instead of rising, actually sinks.

Returning to the effect observed upon the sea-shore, we see that the pressure of the foot disturbs the arrangement of the sand-particles from one of normal piling to one in which the interstices between the grains become larger. Since these spaces were originally full of water (held up by capillarity), they are now no longer filled, and we obtain a comparatively dry area. Water is rapidly drawn in from all sides, however, by the partial vacuum formed in the interstices, and the internal friction diminishes. The sand feels insecure. On withdrawing the foot normal piling is resumed, the excess of water producing a puddle, until it slowly percolates away whence it came.

This brings me to the subject of quicksands.

A certain amount of unnecessary mystery seems to surround this matter. I hasten to point out that the grains of quicksands appear to be in no way extraordinary. Nevertheless, the fact remains that sand in certain localities upon the coast readily gives way under a load. Instances are recorded where a cart driven over a wet shore has rapidly disappeared below the surface. The general opinion seems to be that this is due to a soft underlying layer of clay or mud, which no doubt in some instances is the true explanation. Mr. Carus-Wilson, who is an expert in these matters, pointed out to me recently, however, that another factor may be the imprisoning of gas between the grains, due to decomposition of organic matter. Experiment certainly supports this view, for you see that one of these beakers of wet sand easily sustains a weight which sinks down in the other. Yet both appear similar. The sand in the second beaker, however, was mixed when dry with a powder capable of effervescing if wetted. In the neighbourhood of dangerous bogs, in Ireland especially, it is evident that a quantity of gas is imprisoned in the mud.

It must also be borne in mind that any surface in so good a contact with wet sand that the air is excluded will be held fast by atmospheric pressure; and further, that an object so situated, and tilted this way and that, will rapidly become embedded and swallowed up. It is by this simple process that the celebrated Goodwin Sands have claimed so many victims. A large percentage of the vessels stranded upon them, however, float safely off on the rising tide, but now and then one is caught and doomed. In the past they have been responsible for many a shipping tragedy; and there is a pathetic interest attaching to the fact that ribs and other remains of ships, long lost and forgotten, sometimes reappear for a time above the surface. Since the advent of steam, it is happily a rare occurrence for a vessel to be lost upon a sandbank.

In 1849 boring operations were carried out on the Goodwins by the engineering staff of Trinity House. The Deputy Master and Brethren, whose generous offer of assistance on all matters relating to this subject I gratefully acknowledge, have kindly lent a model made at the time, which shows the nature of the sand found at increasing depths. Solid chalk was reached at 80 feet below the surface.

Let us now turn to some experiments upon the flow of sand through a tube. This long glass barrel is filled and ready. I free the nozzle, and collect the powder which flows out during ten seconds. The quantity so obtained is placed in one pan of a balance. When the height of sand in the tube has fallen to only a few inches above the outlet, I repeat the operation, placing the second amount collected in the opposite one. You see that the pans again stand level. It is therefore clear that the sand pours out at the same rate, irrespective of its height in the tube.

The question now is, how has the "head" been so completely destroyed? This may be answered by a further experiment.

A glass cell 2 feet high, 14 inches wide, and ½ inch deep, is closed in at the sides only (Fig. 10). A movable section of a cone O, made of wood and imitating one of sand, is pushed up through the lower opening. Resting upon this, and fitting its sloping sides, is a strip of felt D. If the wood section be lowered (as shown in the figure), the felt, resembling an inverted V, remains wedged between the glass back and front of the cell. A very small force, however, will dislodge it.

Suppose we replace the wood model and hold it in position by a strut S. Regarding this as a section of a sand cone, we see that its entire weight would be carried upon the base of the cell. Sand is now poured in from the centre of the top opening, and rests upon the sloping felt. The point to notice is that it supports its own weight. When the particles are interlocked it resembles the span of an arch, for if I now remove the wood section the sand remains in position. When more is added, and the cell is nearly filled, the net weight is considerable, yet the felt bridge is not deformed in the least. Further, a wooden plunger P, fitting the top opening, and carrying heavy weights, may be inserted without increasing the pressure upon the felt.

Since the angle which the slope of a dry sand-cone makes with the horizontal is 35°, the height, h, to which the particles will build in a tube of radius r, so that the base of the cone corresponds to the diameter of the tube, is $h = r \tan 35°$. If we consider an element of the section just referred to, it is evident that a vertical downward force applied to the top of the sand becomes resolved in two directions, making an angle of 55° with the vertical. Now, applying the well-known formula for a symmetrical triangular frame loaded at its apex, we have

$$H = \frac{Wl}{4h} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where H is the horizontal thrust, W the load, l the span, and h the height.

Regarding the cell as the section of a tube, $l = 2r$ and $h = r \tan 35°$. Therefore, substituting these values in (1), we have

$$H = \frac{W}{2 \tan 35°} = \frac{W}{1{\cdot}4}.$$

The ratio of the force applied vertically to that of the lateral thrust is thus equal to twice the tangent of the angle which the slope of a cone makes with the horizontal, viz. 1·4.

For instance, if the vertical force due to a weight placed on the sand is 100 lb., the lateral pressure will amount to about 71 lb. A piston resting upon a column of sand only a few diameters high, contained in a strong tube closed at its lower end by merely a thin membrane, is capable, therefore, of sustaining very heavy loads.

In order to demonstrate this on a moderate scale, I have arranged a sort of gallows, through the projecting arm of which a flanged brass tube is inserted vertically. This tube is 0·5 inch in diameter, and closed at its lower extremity with a piece of cigarette paper held in position by an indiarubber band. A small quantity of sand is tipped into the tube from above—enough to fill it to a height of 3 inches. The column within will therefore measure 6 diameters. The tube is then well tapped to ensure normal piling of the grains, and a loosely fitting iron plunger is inserted so as to rest upon the sand. Attached to the plunger is a cross-piece carrying a ring at each end, which may be grasped with the hands. My assistant (who weighs about 11 stone) thus suspends himself safely, his weight being supported by the small sand column. If the piece of cigarette paper is now removed, he is let down with an unpleasant jerk.

Some idea of the close arrangement of the particles may be gathered by noticing that a long column of sand,

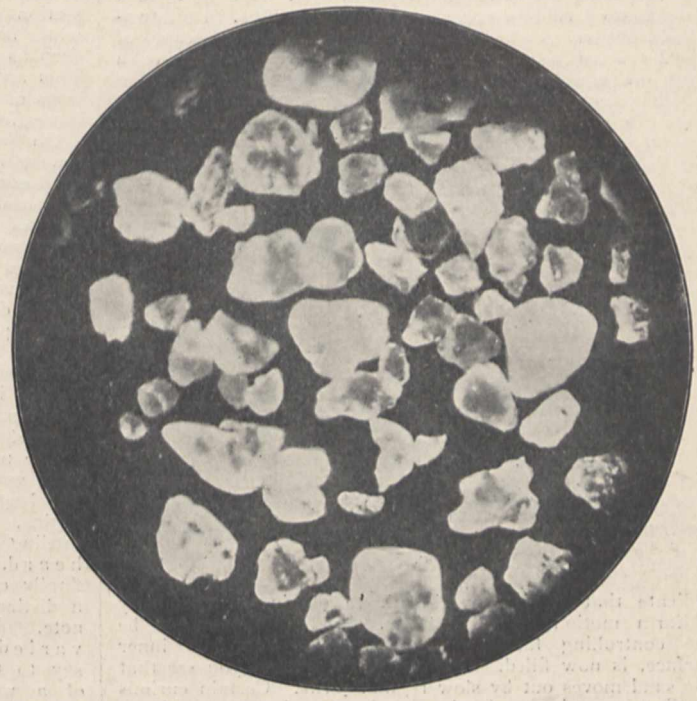

FIG. 5.

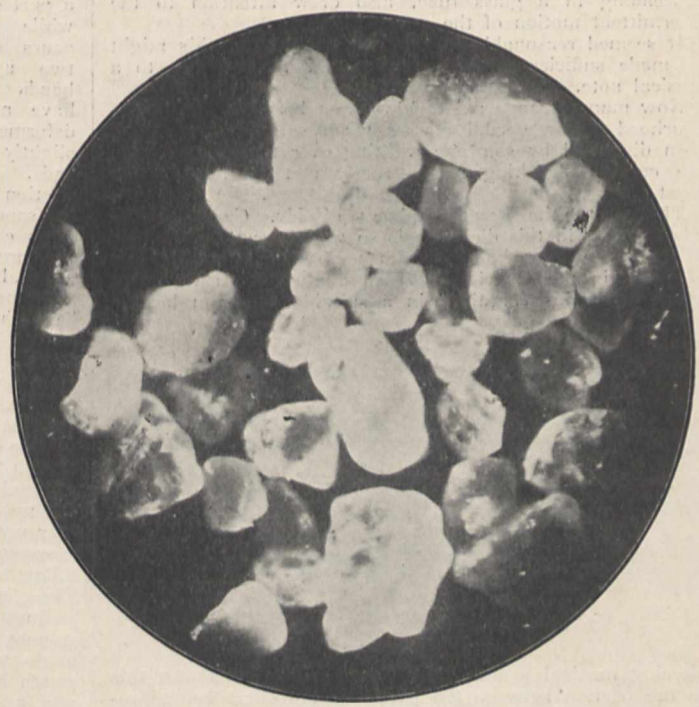

FIG. 6.

moving downward within such a tube, will produce a vacuum above it sufficient to lift water to a height of about 6 feet. (Experimentally shown.)

These experiments upon loaded sand columns clearly

prove, therefore, how it is that the "head" is destroyed, and explain why the powder issues from an orifice at a uniform rate.

Lord Rayleigh applied this principle to a very interesting device, which he used here some years ago, for the purpose of slowly rotating a smoked disc. A weight stood upon a sand column contained in a glass tube. Its downward motion as the column lowered, due to escape of powder from a nozzle at the end, served to operate a train of wheels. The question arises, however, as to whether such a motion is quite uniform. In other words, does the sand move regularly in the tube? Experiments

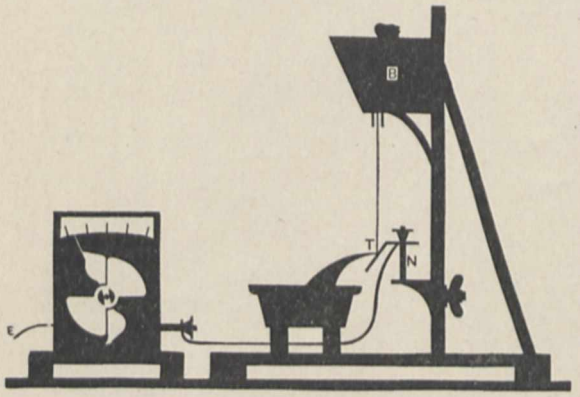

FIG. 7.

indicate that it is very difficult to obtain an absolutely uniform motion by this means. Friction appears to be the controlling factor. A tube, oiled upon its inner surface, is now filled. On freeing the nozzle, you see that the sand moves out by slow regular jerks. Certain curious rattling sounds, emitted occasionally by the column descending in a glass tube, also drew attention to the intermittent motion of the grains.

It seemed reasonable to hope, therefore, that this might be made sufficiently rapid and regular to give rise to a musical note.

Now many strange noises have been heard in the neighbourhood of large sand masses when surface layers have been disturbed by someone walking over them; and there are curious shrieking sands—rarely met with upon the coast.

Thanks to the great kindness of Mr. Carus-Wilson, whose work in this direction is so well known, I am able to exhibit a remarkable specimen of sand from the Isle of Eigg, in the Hebrides. When a plunger strikes down upon the grains contained in a suitable cup, you hear a

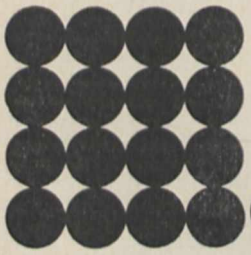

FIG. 8.—Abnormal Piling.

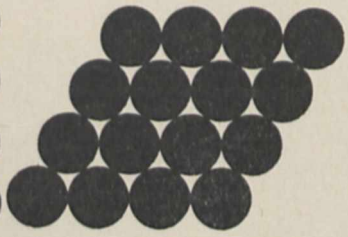

FIG. 9.—Normal Piling.

piercing musical sound. Mr. Carus-Wilson attributes this to the friction between the particles, the effect being produced in much the same manner as that which results from gently rubbing an agate style upon glass. He has discovered musical sand in Poole Harbour, as well as at other places.

The essential conditions for the production of this sound are:—

(1) That the grains be nearly of the same size and rounded.

(2) That they be clean and free from adherent fine dust.

(3) That the vessel in which they are struck have sloping sides, and be made of a suitable material.

But to return to the question of obtaining musical sounds from ordinary sand.

There stands, fixed to the wall, a large glass-fronted section of a tube. It is filled with alternate bands of white and black sand, the latter being about one-sixth as deep as the former. An outlet is provided at the bottom. This arrangement enables the motion of the different portions of the sand column to be observed while the powder issues from the orifice.

On freeing the nozzle, we see that the centre of the lowest black band immediately falls, and that, as the sand continues to escape, successive bands become similarly deformed. It is clear that the grains from the central part of the column are moving rapidly downward, and, since no eddies can form in the remainder, the whole becomes divided into a core of moving particles and a large surrounding mass of dead sand (Fig. 11).

The diminished density of the axial region releases the lateral pressure upon the sides of the tube, and the upper part of the column suddenly slips until the grains again pack and seize as before.

Now if sand of a suitable fineness be slowly passed in this manner through a glass tube of correct dimensions, a musical note may be produced.

The tube should be about 1 inch in diameter, and filled with sand resembling that found in the Charlton pits. The length of the one now ready is 3 feet. When the flow begins, a curious rattling sound is heard, which finally changes to a distinct musical note. It may be varied slightly, say to the extent of a whole tone or so, by gripping a part of the tube while the sand pours out. The two upper dark bands (Fig. 11) have not become deformed, except slightly at their ends, owing to friction between the sand and tube. It is essential for the production of musical sounds that the ratio of the length of a column to its diameter be such that the upper portion moves downward without central deformation. In order to explain the cause of the sound, we must therefore consider the motion of this more or less compact body of particles.

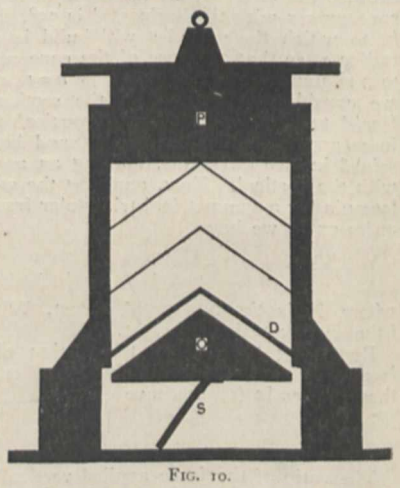

FIG. 10.

Now, if the lower half of the tube be filled with mercury and the rest with well-packed sand, the regular lowering of the liquid causes the granular piston apparently to stretch until its extension is about 2 per cent. of its original length. It is not until that point is reached that the upper layers begin to move downward. The particles, however, are no longer normally piled. A further slight movement of the lower layers causes the upper ones to follow and to overrun a little (owing to their momentum). Therefore, even if the mercury is adjusted to pour out uniformly from the orifice, the upper part of the sand column moves downward with an intermittent motion, analogous, in fact, to that of a weight drawn over a rough surface by an elastic string. It is also clear that, within wide limits, the motion of the upper layers may be independent of, or completely out of phase with, that of the lower ones, and still produce a musical note.

The glass wall of the tube is thrown into violent vibration by the intermittent rise and fall of the lateral pressure upon it, so that damping the barrel raises the pitch of the note. The greater part of the sound is due, however, to the direct action of the sand column upon the air above it, for even a tight wrapping of tape but slightly affects its

quality. Where the tube is filled entirely with sand, the pitch of the note emitted rises as the column diminishes, owing to a proportional decrease of inertia.

In order to see in what way varying the friction between the grains would influence the result, we may fill the tube with magnetic sand and magnetise the column longitudinally. This can be conveniently done by winding a current-carrying wire round the tube. With such an arrangement, the sound produced by the descending column, though feeble at first, is strongly increased on magnetising the grains. Each time the circuit is "made," the sound, almost inaudible before, is plainly heard. In all cases the closeness of the grains, *i.e.* the proportion of normally piled particles, largely determines the pitch of the note. Other factors are the state of the glass surface, the size and roughness of the grains, as well as the rate at which they issue from the nozzle. By suitably adjusting all these conditions, a limited number of notes may be obtained. So far, I have succeeded in producing only five with any degree of certainty, one note being, in fact, obtained by damping the vibrations of the largest tube. The sound is hardly pleasant, but nevertheless I venture to play, if I can, a simple tune upon what may perhaps be called the sand-organ.

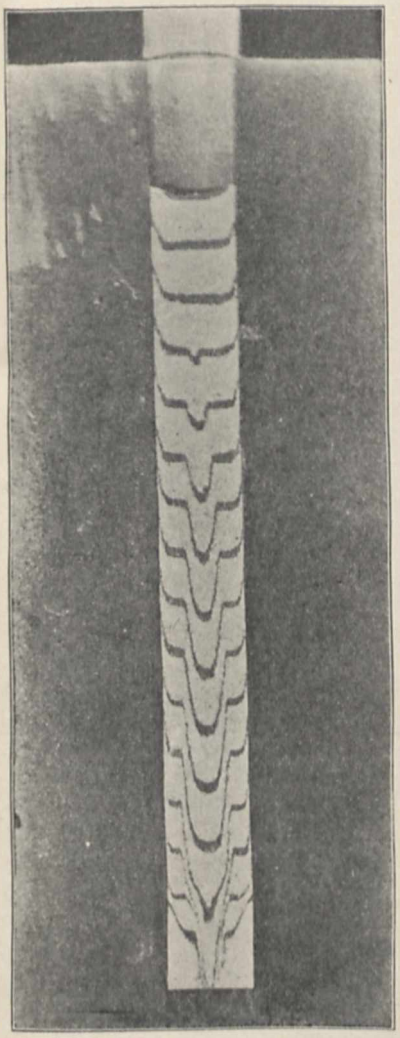

FIG. 11.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. B. C. A. WINDLE, president of Cork University College, has announced that Miss Belle Henan is prepared to place at the disposal of the college at once a sum of 10,000*l.* for the foundation of scholarships to be named the Henan Scholarships.

THE September number of *School Hygiene*, ready on September 1, is a special congress number containing a full descriptive account of the third International Congress on School Hygiene held in Paris on August 2–7. The inaugural speech of the president, Dr. Mathieu, is given in full, as are also the address to the congress by Dr. J. Kerr, chief school medical officer to the London County Council, "The Doctor's Work in the Schools," and by Dr. Chotzen, of Breslau, "Instruction on Sex." Descriptive accounts of the proceedings in the eleven sections, a notice of the exhibition, a special report of the gymnastic and dancing displays by the English and Continental classes, make up a very complete account of the congress.

THE organisation and coordination of educational effort are, we are glad to know, receiving the attention of the Board of Education. There are in many places several institutions competing with one another in their endeavours to attract large numbers of students in their classes, instead of each institution being assigned a definite place and work in an organic scheme for the educational advancement of the district. In connection with technical education, for instance, we have courses in university colleges, technical institutions, evening and similar schools; and to obtain a clear idea of the number and educational standing of students receiving instruction in pure and applied science in our State-aided institutions is almost impossible. The recent report on university colleges, of which a long abstract appeared in these columns, was a great advance upon any previous report, yet the tables published in it did not show the number of students in the various faculties, so no facts could be obtained from them as to the number of students in the country receiving relatively advanced instruction in scientific or engineering subjects. The volume of statistical information published by the Board of Education shows the number of students in technical schools and classes, but as much of the work thus carried on is of a very elementary character, the numbers give little indication of the actual progress of technical education in its true sense. In the "Regulations for Technical Schools, Schools of Art, and other Forms of Provision of Further Education in England and Wales," just issued by the Board of Education (Cd. 5329), Sir Robert Morant states that the Board hopes to issue, before the end of this year, a body of new regulations which will make more adequate provision for the coordination of continuation schools (day and evening), the grouping of subjects into organised courses, and the coordination of grants to institutions of university rank. At present these institutions receive grants from the Treasury and also from the Board of Education, whereas in an organised educational system one department of State should be sufficient to allocate their grants-in-aid. Separate regulations will be arranged to simplify the present plan; and it is hoped that the requirements which the Board will lay down to be satisfied by the institutions concerned will be such that they can be secured "without interfering with the freedom of universities to work out their curricula in the ways best suited to their individual needs."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 16.—M. Bouchard in the chair.—J. **Guillaume**: Observations of Metcalf's comet, made with the bent equatorial at the Observatory of Lyons. Two sets of observations were taken on August 11. The comet was about of the eleventh magnitude, and appeared to be of a bluish tint. The head was about 30″ in size, with a central condensation.—M. **Coggia**: Observations of the comet 1910*d* (Metcalf, August 9, 1910), made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Positions of the comet and comparison stars are given for August 11 and 12.—M. **Borrelly**: Observations of Metcalf's comet, 1910*d*, made at the Observatory of Marseilles with the comet finder. Data given for August 11 and 12. The comet is described as being of the eleventh magnitude, and as having neither nucleus nor tail.—J. **Chatelu**: Observations of Metcalf's comet made at the Observatory of Paris with the 30·5-cm. equatorial. Data given for August 11, 13, and 14. Magnitude about 10·5. The nebulosity surrounding the nucleus appears to measure about 45″ of arc.—R. **Bourgeois**: The daily movement of the top of the Eiffel Tower. The motion is due to the unequal heating of the four pillars, and varies between 3 cm. and 17 cm. In spite of the recent floods in Paris, the mean position of the summit has not changed since 1908. The direction of the motion appears to change with the season of the year.—Louis **Wertenstein**: Radio-

active projections. The particles projected from radium B can pass through a thickness of 10 $\mu\mu$ of silver. The free path of the particles in hydrogen is inversely proportional to the pressure, and amounts to 34 mm. at a pressure of 15 mm. and 24 mm. at a pressure of 22 mm. At atmospheric pressure the free path is 0·7 mm.—William **Duane**: The energy of the radium rays. Of the five methods tried to put in evidence the energy of the radium rays, no clear results were obtained with a bolometer, a radiometer, and a thermopile. Positive results were obtained with a differential gas thermometer and a sensitive calorimeter. Details are given of the apparatus employed in the last case. The quantities of heat measured are due to the α rays.—E. **Mathias** and H. Kamerlingh **Onnes**: The rectilinear diameter of oxygen. The system of cryostats employed permitted the determination of the densities of liquid and gaseous oxygen at a series of constant and exactly known temperatures, ranging between −120·4° and −210·4° C. The diameter for oxygen was found to be rectilinear, with a high degree of approximation.—P. **Langevin**: Electric and magnetic double refraction. The hypothesis of molecular orientation completely explains quantitatively both Kerr's phenomenon and the magnetic double refraction of liquids.—Daniel **Berthelot** and Henry **Gaudechon**: The photochemical decomposition of the alcohols, aldehydes, acids, and ketones. The gases produced included carbonic acid, carbon monoxide (in all cases examined), hydrogen, methane, ethane, and butane. No unsaturated hydrocarbons were found.—Marcel **Mirande**: The action of vapours on green plants. The action of the vapour of numerous organic substances upon green leaves was studied. Blackening, with or without the evolution of hydrocyanic acid, was found to be caused by many of the substances tried.—J. **Wolff** and E. **de Stœcklin**: The peroxydasic characters of oxyhæmoglobin.—M. **Bresson**: The existence of a specific methylglucase in beer yeast.

CAPE TOWN.

Royal Society of South Africa, July 20.—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. T. **Muir**: Factorisable continuants. A short paper with the above title was presented to the society more than six years ago, and appears in the Transactions, vol. xv., pp. 29–33. Attention is now directed to the fact that the fundamental theorem of this paper has by some oversight just been published as a fresh discovery of Prof. Metzler's in the British Association Report (Winnipeg Meeting), p. 390. The identity of the two results is seen on changing the letters n, a, b, c of the earlier paper into $n+1$, r, aa, $a(\beta-a)$.—E. **Jacot**: The effect of the electric discharge on water vapour. Experiments leading to results not in agreement with those of M. Henry (*Journal de Physique*, January, 1909, pp. 33–8), viz. that kathode rays are produced in vacuum tubes containing water vapour at pressures higher than is the case in tubes containing air. The electric discharge brings about reduction of the vapour. In tubes containing metallic electrodes, the reduction, if started by the passage of a discharge, will even proceed quite independently of the discharge. In electrodeless tubes, the final steady state of pressure of electrolytic gas depends on the pressure under which the water vapour is initially admitted, and is affected by the presence of coloration on the glass due to chemical action by kathode rays.—Dr. A. W. **Rogers**: Note on "Verneuk Pan." Verneuk Pan is a flat surface cut in shale and partly covered with sandy mud, which forms a thin layer only. It is a striking example, being more than 100 square miles in area, of numerous pans on the Dwyka formation in the north of the colony. It has an outlet over a bar of hard dolerite. The formation of this and other pans which lie in the course of streams was probably due, in the first place, to the extremely low grade reached by streams behind bars of hard rock, then to the unfavourable conditions for plant-growth owing to the increasing brakness of the soil, which is due to the lack of sufficient surface drainage, and the scope thus given to the wind to remove dust and sand from the bare ground.—Dr. J. R. **Sutton**: A further note on the diurnal variation of level at Kimberley. The suggestion is made that the diurnal oscillation of level may be of photo-electric origin. Experiments made to test the idea are so far not very definite. Meteorological results at Kimberley are not in disagreement with some kind of photo-electric theory. The extreme range of the pendulum from west to east is greatest on clear days, and least on very cloudy days. Also the range of earth temperature is greater or less according as the sky is clear or cloudy. When the barometer is lowest, during the passage of a barometric depression, the diurnal range of the pendulum diminishes to a minimum, and rises to a maximum as the depression passes away. The clouds which form in the depression are responsible for a large part of the variation of level indicated by the range of the pendulum.—Dr. L. **Péringuey**: Recent finds made in rock shelters once occupied by Strand Loopers (a branch of the Hottentot race). The relics imply a simple culture, remains of which were little or not known hitherto. But that culture was not limited to these troglidytes, nor were these aborigines cantoned only in caves. A comparison of the scenes painted on stone implements, such as a quern, and on flat slabs found under a considerable depth of kitchen refuse, showed certain peculiarities to be met with only in paintings occurring in localities far removed from these cave shelters. The figure of a giraffe in an open-air painted scene, not far removed from the shelters, as well as two teeth of crocodile, clearly pointed to wanderings in the interior of the colony on the part of the dwellers.

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