THURSDAY, AUGUST 17, 1916.

NEUROLOGY.

An Introduction to Neurology. By Prof. C. Judson Herrick. Pp. 355. (Philadelphia and London: W. B. Saunders Co., 1916.) Price 7*s.* 6*d.* net.

ALL the special sciences naturally seek incorporation into some comprehensive scheme of thought which tends to embody the conceptions that we hold into one organic unity. Neurology, for instance, is brought out, with its component parts of anatomy, physiology, and psychology, into the conception of biology. In no department of human thought is this striving for an organic unity better exemplified than in the co-ordination and subordination of these special studies into the wider and more embracing science of biology.

The researches which have been brought together in this volume cover an immense reading; the references amount to many scores of contributions, and the book will be of great value to those who seek for an exact knowledge and a succinct account of the nervous system, the highest controlling machinery of animal and human life; for it is the nervous system that determines the adjustments and mutual relationships of all the other systems, as well as those of its own activities, which are so regulated as to promote its own welfare.

The study of neural actions must proceed from the more simple to the more complex—*i.e.*, from simple reflex action up to acts of consciousness involving deliberation, reflection, and judgment. This progress depends upon (*a*) a correlation, which is the resultant of all the afferent processes involved; (*b*) the co-ordination or orderly co-adjustment and sequence of these—absence of this means inco-ordination; and (*c*) the full association of responses secured by individual modifications. In the simple reflex mechanism there are three essential factors: (*a*) an initiating organ or receptor, sensitive to receive a stimulus which is often far less in intensity than the energy liberated, and which may only be some change of environment acting upon the organ; (*b*) a conductor to and from a correlating centre; and (*c*) an effector or organ of response—the data from these three instruments being as necessary for the most elementary nervous response as they are for the highest mental manifestations, including abstract thought. The author accepts the classic experiments of H. S. Jennings to explain the adaptation of an organism to its changing environment, and he divides behaviour or conduct (which he calls "action system") into two kinds, viz., that which is innate and invariable, and that which, through "docility or plasticity," is modifiable and variable or labile. He maintains that every reaction contains elements of both, the variable being characteristic of the higher animal type, implying an intelligently directed choice, yet expressed always through the agency of the lower centres.

The volume under review commences with a useful biological introduction, describing life as a correlation of physical forces for the conservation of the individual, the continued welfare of any living organism depending upon a properly balanced adjustment between itself and its surroundings—*i.e.*, between internal and external relations. An interesting chapter is devoted to the neurone or the nerve cell, which is itself an independent unit, leading an independent life, and separated from its fellows by a reticulated continuum—the synapse—yet it is linked with them by this fibrillar structure, which acts as a damper or a resistance to the passage of impulses, thus limiting excitability. The neurone effects the conduction of physico-chemical waves towards the effectors, but in one direction only, and this by means of its dendrites, axon, and collaterals, which are continuous with the nerve fibre. The author omits to mention the important discovery that the living neurone consists of protoplasmic granules, each surrounded with a lipoid oxidising substance; the Nissl granules of the neurone, or the tigroid bodies, being artefacts after death.

The last four chapters are devoted, fully but concisely, respectively to the physiological psychology of pain and pleasure—*i.e.*, the hedonic tone of consciousness connected with modifications of the subject by the object; the track of the pain nerves in the spinal cord being illustrated in the text; to the general anatomy of the cerebral cortex, and here, we note, there is no reference to the extremely valuable and important work of Dr. G. A. Watson on the mammalian cortex; and to reflex acts, instinct and intelligence. This chapter opens up two or more interesting psychological points, viz., whether reflex acts and instinct are only biological adaptations, and whether instincts are intelligent acts. In regard to these the opinions of psychologists differ, but the view of the majority is that every instinctive act is determined by intelligence. Between the chapters named the text is mainly histological and descriptive.

The book is concise and scientifically accurate, but owing to its extreme technicality it is difficult to read except by the expert anatomist or the senior advanced student. It certainly should be in the hands of every teacher of psychiatry. The illustrations are numerous and well chosen to illustrate the text, the bibliography is extensive, and the index as perfect as can be made and doubly useful through the help of the glossary. It may safely be added that the author has succeeded in his aim "to disentangle the inconceivably complex interrelations of the nerve fibres which serve all the manifold functions of adjustment of internal and external relations."

ROBERT ARMSTRONG-JONES.

PSYCHOLOGY.

(1) *Human Motives*. By Prof. J. J. Putnam. Pp. xvii+179. (London: W. Heinemann, 1915.) Price 5*s*. net.

(2) *Sleep and Sleeplessness*. By H. A. Bruce. Pp. ix+219. (London: W. Heinemann, 1915.) Price 5*s*. net.

(3) *The Meaning of Dreams*. By Dr. I. H. Coriat. Pp. xiv+194. (London: W. Heinemann, 1915.) Price 5*s*. net. (*Mind and Health Series*.)

(1) A READABLE volume, with many apt quotations for which Emersonians in particular will be thankful. Motives may be classified as, on the one hand, due to sense of obligations (virtually religious), and on the other to self-regarding, emotional impulses which are the outcome of biological evolution. Prof. Putnam emphasises and supports the rationality of religious ideals, remarking that, "in so far as religion is the expression of the truth, it expresses the most important aspect of the truth"—a pregnant phrase; and he advances weighty philosophical arguments in favour of Theism. On the biological side he follows Freud very largely in tracing many motives and ideas to repressed desires. He wisely realises that Freud goes rather far in pushing his theory, but argues that it is based on a large accumulation of data. A hostile critic might say with some justification that Freud came to conclusions and then interpreted all new data in terms of those conclusions; moreover—this is usually not sufficiently recognised—the data themselves are untrustworthy when accumulated by a theorist with an already elaborated system, for they will inevitably be influenced by his conscious or unconscious suggestion.

(2) We are still very ignorant of the physiology of sleep, but Mr. Bruce gives a good popular survey of the psychological side. Dealing with dreams, he explains the common flying dream as initiated by the rise and fall of the chest, plus absence of sensations from the soles of the feet; many dreams of discomfort in certain organs are due to incipient disease noted by the subconsciousness, though not known to the waking mind; and others are due to external stimuli as of noises outside or to memories. Briefly, it may be said that most dreams are attempts of the subconscious to interpret internal or external stimuli, the character of the dream being largely determined by the emotion-complexes which were roused by the experiences of the previous day. As to dreams in which problems are solved (*e.g.*, Prof. Hilprecht's case) or information apparently supernormally received (Miss Conley's case), Mr. Bruce quotes extensively from the Proceedings of the Society for Psychical Research, but thinks that all can be explained on normal lines. In attempting such explanation of some actual cases, however, the phrases "it is probable that," "it is safe to assume that," are notably frequent; and though we may sympathise with the author's aims, we may discern a certain rashness in his assumptions. On insomnia the anti-drug attitude is adopted, and stress laid on suggestion, for which, however, more is claimed than most practitioners would concede. A drug is sometimes necessary to break the insomnia habit; but either veronal, trional, or adalin is better .than the old sulphonal, which is all that is here mentioned.

(3) More Freud. Every dream represents the fulfilment of a repressed wish. If during your father's lifetime you dream that he is dead, it is because, through jealousy of his place in your mother's affections, you wished him dead. If you deny it, the truth of it is confirmed; you did wish it, but the wish was repressed into the subconscious and forgotten. And if you do not dream that he is dead but only that he is an assistant in the business of which he is really the proprietor, the explanation is pretty much the same; you have evidently wished him superseded. Similarly with the flying dream: this is due to a wish for absolute freedom from all restraint. The dream-flyer is evidently a Free Lover and an Anarchist. If the dream absolutely refuses to be an Œdipus affair, you interpret by other wishes, remembering for your assistance that the dream itself is often a disguise. *E.g.*, a woman dreams that one of her brothers is going to be hanged. The interpretation is that in consequence of two other brothers having died of cancer and tuberculosis, which she therefore feared in her own case, she wished that they had died of something else; even hanging would have been preferable! Dr. Coriat advances this interpretation quite seriously. Now we may readily admit—without comparing Freud with Darwin, as Dr. Coriat does—that dream-observation and analysis are important for the investigation of the subconscious, and that Freud has done good pioneer work; but in both Freud and many of his followers the good work is vitiated by a peculiar narrowness. They suffer from *idée fixe*—a well-known psychosis. The neatness of the formula that every dream represents a repressed wish has hypnotised them, as a bright point will hypnotise the gazing subject, and they can see nothing else. We may hope before long for an interesting volume on the psychology of the Freudian psychologists, analysing their peculiar obsession.

THE DECLINING BIRTH-RATE.

The Declining Birth-rate: Its Causes and Effects. Pp. xiv+450. (London: Chapman and Hall, Ltd., 1916.) Price 10*s*. 6*d*. net.

THIS book constitutes the Report of, and includes the chief evidence taken by, the National Birth-rate Commission, instituted, with official recognition, by the National Council of Public Morals. The committee was a strong one, and included upon it Dr. Stevenson, Superintendent of Statistics for the General Register Office, and Dr. Newsholme, Medical Officer of the Local Government Board. The subject of the declining birth-rate is one of enormous importance at the present time. The birth-rate reached a maximum

in 1876—36·3 per 1000 population—and has gradually fallen since then to about 23 at the present time, and this in spite of the marriage-rate having remained almost constant. The decline of the birth-rate has not operated uniformly throughout the country, but is more marked among the middle and upper classes. Thus in Hampstead the corrected birth-rate fell from 30·01 in 1881 to 17·55 in 1911, while the corresponding rates for Shoreditch are 31·32 and 30·16.

The general conclusion of the committee seems to be that the decline in the birth-rate is due to the deliberate limitation of families by anti-conceptives and other means. At the same time it is to be noted that the result of a census—a comparatively small one, it is true—taken by the Commission of those who employed anti-conceptive measures and of those who did not showed that the size of the families was slightly larger among the former! The conclusion arrived at by the Commission seems to be based upon the unanimous opinion of the witnesses of the extensive and increasing use of anti-conceptive measures, particularly among the more well-to-do classes of the community. Two of the witnesses, however, Dr. Chalmers and Dr. Brownlee, maintained that there are cycles in fertility, and that now we happen to be in a cycle of low fertility. Among the lower classes, especially in industrial areas, the use of abortifacients appears to be rife, and this may be a not unimportant factor in reducing the birth-rate.

Various topics bearing on the question are dealt with in the evidence, such as the influence of financial circumstances, housing, religious belief, etc. One point of interest brought out is that the fertility of "college" women seems to be as great as that of "non-college" women, though, as might be expected, the age at marriage of the former is somewhat higher than that of the latter.

The Commission is unable to formulate any measures for arresting the decline beyond the use of moral suasion to induce the married to fulfil their responsibilities.

The volume is an intensely interesting one, and should be in the hands of all who are interested in this national question. R. T. HEWLETT.

SANG'S SEVEN-PLACE LOGARITHMS.

A New Table of Seven-Place Logarithms of all numbers from 20,000 *to* 200,000. By Edward Sang. Reprinted from the original stereotype plates now in the custody of the Royal Society of Edinburgh. Pp. xviii + 365. (London: C. and E. Layton, 1915.) Price 21*s.* net.

THIS table was originally printed in 1870 from the stereotype plates in the custody of the Royal Society of Edinburgh. The present book is a reprint published in 1915.

Edward Sang (1805–90) was perhaps the greatest calculator of logarithms. An excellent account of the extraordinary energy that he brought to bear upon this work is to be found in a paper by Dr. C. G. Knott, of the Royal Society of Edinburgh, which forms part of the Napier memorial volume published in connection with the Napier tercentenary held in Edinburgh in July, 1914. Sang computed, independently of all previous work, the logarithms to twenty-eight places of all primes up to 10,037, each prime being put into relation to at least three others. By combination of these primes he tabulated the logarithms to twenty-eight places of all integral composite numbers from 1 to 20,000, a few gaps due to uncalculated primes being left. From this table he calculated by interpolation a great table of logarithms to fifteen places of all integral numbers from 100,000 to 370,000. Dr. Knott considers that Dr. Sang was justified in assuming the absolute accuracy of these tables to the fourteenth place.

This material, which may be regarded as a fundamental basis for all future tabulations, has never been published. All mathematicians would agree that publication should take place, and Dr. Knott discusses at length different methods of procedure. As the manuscripts are beautifully written he inclines to the opinion that it would be simple and a guarantee of accuracy to reproduce them as line engravings by photography. He considers that a quarto volume of some 1200 pages would suffice for the fundamentally important parts of the manuscripts, and he estimates that the cost of reproduction by photography would be about one-third or one-fourth the cost of setting them up in type in the usual way. It would, indeed, be a fitting outcome of the Napier tercentenary if this could be brought about, and the writer is convinced that if Dr. Knott and his colleagues in Scotland will persevere with the idea they will be astonished at the support they will receive even in these strenuous times.

This reprint is perfectly and conveniently printed with the usual description and examples of computation. P. A. M.

OUR BOOKSHELF.

Mentally Deficient Children: Their Treatment and Training. By Drs. G. E. Shuttleworth and W. A. Potts. Pp. xix + 284. Fourth Edition. (London: H. K. Lewis and Co., Ltd., 1916.) Price 7*s.* 6*d.* net.

WE welcome very heartily the fourth edition of Drs. Shuttleworth and Potts's excellent handbook on mentally deficient children. The book has been very carefully revised, and a chapter added concerning the mental troubles of youth. The main new feature of the present volume is an extremely interesting account of the Mental Deficiency Acts of 1914—these being the ultimate result of the Royal Commission of 1904.

The Acts now enable the authorities to deal with all mental defectives: (*a*) if under twenty-one years, at the instance of parent or guardian; or (*b*) at any age if found neglected, abandoned, destitute, or cruelly treated, criminal or inebriate, or being the pauper mother of an illegitimate child—and Dr. Shuttleworth states that "with the judicious administration of the new Acts it is hoped that Great Britain will stand ahead of

other countries in its treatment of the mentally defective class." He points out the great advantage of "the physiological education of the senses" (Séguin) of these children, and afterwards of their mental and moral education, both to the individual concerned and to the community. He shows how such children can find occupation and happiness as inmates of permanent working homes and contribute appreciably to the support of such homes, also how the "improved imbecile" is of far less risk to future generations, especially if carefully supervised.

Certain weak points in the Acts are dealt with, particularly the inadequate provision for "backward children," who tend to gravitate to the "special" schools, and the *inadequate after-care* of the children on leaving the institutions. This latter defect must necessarily damp the enthusiasm of the teachers, on whose devoted self-sacrifice the efficient working of the Acts is largely dependent. We strongly recommend the book to all interested in the subject, though mainly written for the medical profession. W. F. B.

The Microscopy of Vegetable Foods, with Special Reference to the Detection of Adulteration and the Diagnosis of Mixtures. By Drs. Andrew L. Winton, Josef Moeller, and Kate Barber Winton. Pp. xiv+701. Second edition. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 27*s.* 6*d.* net.

JUST as the sophistication of foods and drugs has developed, so have the means of detecting them been devised. For this purpose microscopical examination is one of the most important procedures, and a knowledge of the microscopic characters of the products and of their chief adulterants is therefore essential. Not only the analyst, but the miller, the brewer, the oil-presser, the cattle-food manufacturer, the canner, and the coffee and spice grinder, should all be conversant not only with the naked-eye characters, but also with the microscopic structure of their raw materials.

The present book, now in its second edition, deals with the needs of most of these industries, and the authors have, we think, successfully accomplished their task.

First, equipment, methods, and general principles are dealt with, after which the microscopic characters of the various products and their chief adulterants and impurities are described. In this way grain, oil-seeds, legumes, nuts, fruit and fruit products, vegetables, alkaloidal products and their substitutes (coffee, tea, cocoa, etc.), spices and condiments and commercial starches, are all considered at length, and an enormous amount of valuable information is collected and collated.

The text is illustrated with no fewer than 635 figures, and concludes with a full bibliography, glossary, and index. The book is, of course, especially written for American practice, and many articles are described which are rarely met with in this country, but it will be found none the less useful by our analysts and laboratories.

R. T. H.

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.]*

A Peculiar Thunderclap.

POSSIBLY some one of your readers may be able to throw light upon the peculiarity of a thunderclap which occurred here during a severe thunderstorm on July 27. This parish lies in a hollow of the hills, and almost always escapes close contact with thunderclouds. On the date mentioned a peal of extraordinary suddenness resembling the crashing burst of a big gun followed instantaneously a vivid flash at my point of observation. Two or three trees were afterwards observed to have been struck, and a paling rail near some wire was split into pieces and thrown some distance. Now the peculiarity is this: that very similar experiences were noted at places more than a mile distant and in various directions. The same crash following immediately on the lightning was noted by quite a number of independent witnesses. A mile to the east of this dwelling the lightning was seen to run down a wire fixed to the top of a flagstaff. About a mile to the north a farmer driving home was alarmed to see the lightning flash along the wire paling by the roadside and split one post at least and cast the fragments on the road.

On considering all the circumstances, I think the following may be an explanation. The thunderclouds which contributed mostly to the storm were floating at a pretty high elevation, possibly 2000 ft., as during the greater part of the day they were just grazing the tops of the hills. But about 3 p.m. a bank of cloud began to form in this hollow much nearer the ground, and half an hour later, when the thunderclap came, the light was much obscured. My opinion is that the lower cloud drew an overwhelming charge from the clouds above, and accordingly flashes sped to earth from several points at the same instant.

I have, of course, made certain that we are dealing here with one and the same thunderclap, as was not difficult to do, seeing that all the other peals of thunder were comparatively distant. JOHN DON.

Lumphanan, Aberdeen, July 30.

The Gun-firing on the Western Front.

THE firing of very heavy guns at a great distance was clearly audible at Harpenden throughout the days of August 7 and 8, as well as on previous occasions. The direction of the sound is evidently from the south-east, and that of each explosion lasts about two seconds. Our elevation is 440 ft., and the local wind has been from west to north-west. The distance between Harpenden and Bapaume would be about 185 miles. SPENCER PICKERING.

MR. PIPER'S letter (NATURE, August 3) is interesting. My extended experience confirms his. When the great bombardment began I was staying at a farmhouse on high ground near Chilham, Kent. We heard the firing day and night during the two weeks, and I roughly calculated that three or four guns were fired *per second*. During almost all the time the wind was S.W., and often quite strong, yet this did not interfere with the sound if one was sheltered from the wind and away from rustling foliage.

The firing front would be S.E., and about 100 miles away. I. W. BOOTHROYD.

9 The Circus, Greenwich, S.E.

THE PRESIDENCY OF THE BOARD OF EDUCATION.

THE office of President of the Board of Education has again become the shuttlecock of politics, pointedly illustrated by the remark so aptly made by a member of the House in the course of the important debate of July 18 on the introduction by Mr. Henderson of the Education Estimates, that "I have sat for eleven years in this House, and I have heard during that time no fewer than five Ministers make their statements on educational matters." It is thus that we are content to deal with the vital question of education. The circumstances of the war have forced home upon the attention of the least reflective of politicians the claims of the subject to the serious attention of the nation.

The course of the debate, in which members of very diverse political views participated, indicates that the time is fully ripe for a drastic review of the question in all its bearings. To do this effectively requires that there should be placed in control of the department, which should now take an equal place in the hierarchy of Government with the other great departments of the State alike in respect of the salary attached to it and of the dignity and responsibility in which it is held, a man of large and clear vision, of intimate knowledge, and of deep sympathy with the educational well-being of all classes of the people, and who is prepared with a single mind to devote all his time and thought to the consideration and solution of the serious problems which beset it. We have got as the most pressing need of the time to create in the English nation, as distinguished, say, from the Scotch, a genuine belief in the value of education as the true and only uplifting and sustaining force in the spiritual life and continued progress of the people. This can only have some chance of realisation in the event of the office of Secretary of State for Education—since that should be its rightful designation—being in the hands of such a man as is here described, who enjoys the confidence of the people and is prepared to regard the office, not as a stepping-stone or mere adjunct to some other, but as one demanding a continuity of thought and policy throughout the whole time his Government is in power. Such a Minister should be prepared, not merely from his place in Parliament, but from time to time in various great centres of population, to set forth his policy and to seek to arouse in the people by the enunciation of his ideals and by the methods of their realisation a great enthusiasm for education as the true foundation of the national salvation. It is not a question of a classical education *versus* an education in science, nor a question of industrial and commercial supremacy, nor of one *class* as distinguished from another, but of the right upbringing and development of all the children of the nation according to their gifts and capabilities. To a man of such distinction as is here foreshadowed would inevitably be committed a full inquiry under his presidency and with the aid not merely of officials, but also with that of the best available thought and ripe experience of every class, into the present conditions of education as exhibited throughout its entire range, from the kindergarten up to and including the university, with a view to its unification and to the establishment of a broad highway along which the gifted children of the nation might freely travel. This, as the course of the recent debate shows, is the psychological moment, and it should be seized with a firm hand. It will mean, as Mr. Henderson puts it, "money and more money." It will demand a higher and more attractive status for the teacher, with a clear avenue for the highest public service of which he is capable. But it will result that the coming generation of Englishmen will possibly be as receptive and as appreciative of the fruits of investigation, often enough due to the patience and genius of their own countrymen, as are the foreign enemies whose culture they hold in such disdain.

EXPERIMENTS IN AERODYNAMICS.[1]

THE volume before us gives some of the first results obtained in the four-foot wind tunnel which has been erected at the Massachusetts Institute of Technology, and consists of ten sections dealing with various phases of the work. The first section gives a detailed description of the wind tunnel, the design of which is practically identical with that of the four-foot tunnel at the National Physical Laboratory, Teddington. This is followed by a discussion of the dimensional theory as applied to aerodynamic problems. The theory is treated in a simple and easily followed manner, but due credit has not been given to Lord Rayleigh, who first proposed the theory in this form. Lord Rayleigh is mentioned, however, in this connection in a later section of the book. Section 3 deals with the inclined tube alcohol manometer for measuring small pressure differences. The results of the calibration of such an instrument against a standard Chattock manometer are given. The inclined tube instrument certainly has no advantages over the Chattock form, and experience at the National Physical Laboratory shows that the latter is exceedingly convenient for use. The theory of the pitot tube is considered, and experimental results are appended to show that several types of combined pitot and static pressure tubes give identical calibrations.

An interesting comparison with the National Physical Laboratory is given in the form of characteristic curves for the wing section known as R.A.F.6, and this comparison shows in a striking manner the accuracy of wind tunnel experiments. The results obtained in the two wind tunnels agree to the order of about 2 per cent., which is as good as the accuracy of manufacture of the models will allow.

The question of the steering of a dirigible is dealt with in one section of the volume, and the conclusion is drawn that it is almost out of the

[1] "Report on Wind Tunnel Experiments in Aerodynamics." Smithsonian Miscellaneous Collections, vol. lxii., No. 4.

question to put sufficient fin area on a dirigible to render it directionally stable, but that it may be controlled by comparatively small movements of the rudder. This conclusion is also in agreement with National Physical Laboratory results.

Section 8, on swept-back wings, and the following section on the effects of dihedral angle, are of considerable interest. The Dunne aeroplane has excited much interest, and great claims have been made for its stability. The results of the experiments in the American wind tunnel show that the effect of swept-back wings on longitudinal stability is nil, and that the degree of lateral stability due to a sweep back of 20° is equally well obtained by a dihedral angle of only $2\frac{1}{2}°$, while the latter is much better from a constructional point of view.

The last section deals with the critical flow round flat discs normal to the wind. A mathematical investigation is given for the case of non-viscous irrotational motion, and it is shown that the results are of the same order as those of the experiments. The mathematical treatment is obviously inadequate, since it ignores just those qualities of the motion which affect its critical change of flow: the viscosity and the rotational motion. Similar problems have received attention at the National Physical Laboratory, and it is hoped to obtain, from actual photographs of the motion in special cases, some information which is not forthcoming from the hydrodynamical theory.

On the whole, the results given in the Smithsonian publication are very interesting and afford a useful independent comparison with those obtained in our own country at the National Physical Laboratory. The excellent agreement obtained in the general conclusions of the present volume with the previous work at the National Physical Laboratory leaves no possible doubt concerning the accuracy of experimental work of this description, or of the great utility of such experiments in helping forward the design of all kinds of aircraft. E. F. R.

GEOFFREY WATKINS SMITH.

BY the death of Captain Geoffrey Watkins Smith, of the Rifle Brigade, who was killed by a shell in France on July 10 in a trench just taken from the enemy, zoological science loses one of the most promising and brilliant of its younger adherents, and his many friends have to regret a particularly lovable and gracious personality. Though only thirty-four years of age, Geoffrey Smith, by the abundance and originality of his researches, had won for himself a secure place in the scientific world, and his work was of such a nature that each step gave promise of further and more important discovery. It is not possible within the present limits of space to give more than a bare outline of his career and performance.

Geoffrey Smith, a son of Mr. Horace Smith, the well-known Metropolitan magistrate, was born at Beckenham, Kent, on December 9, 1881. He was educated at Temple Grove, East Sheen, and afterwards at Winchester College, of which he was a scholar, and in due course obtained a scholarship at New College, Oxford. At Oxford, working under the late Prof. Weldon, he devoted himself to the studies for which he had already shown great aptitude in boyhood, and gained a first class in the Honour School of Natural Science in 1903. He proceeded to the Zoological Station at Naples in the same year, and remained there till 1905, when, having finished his monograph on the Rhizocephala, the only monograph in the Naples Fauna and Flora written by an Englishman, he returned to Oxford to take up the duties of demonstrator and lecturer in the University Museum. In 1906 he was elected fellow and tutor of New College in succession to Prof. G. C. Bourne, and remained at Oxford till October, 1914, except for an excursion to Tasmania in 1907, the scientific results of which are published in a volume entitled "A Naturalist in Tasmania."

Geoffrey Smith's monograph on the Rhizocephala, an excellent piece of zoological research, has already been mentioned. As a result of his voyage to Tasmania he made several solid contributions to zoological science, publishing a memoir on the Anaspidacea, living and fossil, in 1909, and monographs on the fresh-water Crustacea of Tasmania and on the fresh-water Crayfishes of Australia in 1909 and 1912. But his chief and most important work was his series of memoirs, eleven in number, on the experimental analysis of sex, issued from 1910 to 1914. In these essays, following up clues suggested to him by his work on the Rhizocephala, Geoffrey Smith attempted, and attempted successfully, to probe the physiological causes of the phenomena of secondary sexual characters. He showed that the assumption of female characters by the parasitised male crab Inachus is due to a profound change in metabolism induced by the parasitic Sacculina, and incidentally demonstrated that the facts proved that the male is heterozygous and the female homozygous for sex. By a masterly association of ideas he showed the close analogy between this physiological regulation in parasitised crabs and the phenomena of regulation which produce immunity in bacterial diseases. He extended his observations to bees, frogs, fowls, and pheasants, and successfully demonstrated similar physiological processes in these animals, at the same time bringing acute critical experimental work to bear on certain current theories of sex production.

Much had been achieved, but much was left unfinished when he accepted a commission in the New Armies in 1914. It is doubtful whether the work so brilliantly initiated can be carried on by any other hand, certainly not with the same prospect of success.

A final word must be said in praise of the elegance of Geoffrey Smith's literary style, and the grace, humour, and courtesy with which he was wont to deal with attacks upon his work.

NOTES.

ON the initiative of the Royal Society, a Board of Scientific Societies, consisting at present of representatives of twenty-seven scientific, including technical, societies, has been established for the furtherance of the following objects:—Promoting the co-operation of those interested in pure or applied science; supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; and discussing scientific questions in which international co-operation seems advisable. An executive committee has been appointed, consisting of the following members:—Sir Joseph Thomson (chairman), Dr. Dugald Clerk, Sir Robert Hadfield, Mr. A. D. Hall, Prof. Herbert Jackson (hon. secretary), Sir Alfred Keogh, Sir Ray Lankester, Prof. A. Schuster, Sir John Snell, Prof. E. H. Starling, Lord Sydenham, and Mr. R. Threlfall. The first meeting of the Board was held on July 20, when important questions relating to scientific, educational, and industrial matters were under consideration, with a view to effective steps being taken for co-ordinating the work carried out at present by a number of independent bodies, or initiating action in the case of other matters of national importance.

IT is announced that the *Discovery*, with the Shackleton Relief Expedition, left Plymouth Sound last Thursday. She will proceed to Port Stanley, Falkland Islands, to embark Sir Ernest Shackleton, and then leave for Elephant Island. It is hoped that she will reach the Falkland Islands by the end of September, and Elephant Island a week later. The *Discovery* should have no difficulty in penetrating the pack and reaching the stranded men. On the other hand, it is quite possible that the conditions will be so favourable in October that little or no ice will be encountered. Lieut.-Commander J. Fairweather, R.N.V.R., is in command of the *Discovery*. He has had long experience among Arctic ice, although this is his first visit to the Antarctic.

IT is stated in the *Times* that the sum of 2500*l.* is being raised by the Archangel Society for the study of the Russian Far North, in furtherance of the search for the two Russian expeditions which sailed in 1912 under, respectively, Lieut. Brusiloff and M. Rousanoff. The money in question is to be used as rewards for information obtained as to the fate of the explorers.

A COLLECTION of British-made laboratory apparatus is on view at the Institute of Chemistry, 30 Russell Square, W.C. The exhibition will remain open until the end of September.

A WARNING against the suggested use of benzoate of soda as a substitute for sugar in jam-making has been issued by the Board of Agriculture and Fisheries. It is pointed out that serious results may follow if the substance in question is used for the purpose named.

THE programme of the celebrations on June 13 in connection with the centenary of the Botanic Gardens, Sydney, has just reached us. Speeches were delivered on the occasion by the Governor of New South Wales, the Premier, and the Minister for Agriculture, and a brief historical address was given by Mr. J. H. Maiden, F.R.S., the director of the gardens. Three vistas were named respectively after Capt. Cook, Sir Joseph Banks, and Governor Phillip, and a rosery is to be known in future as the "Centenary Rosery." The following memorial trees were planted simultaneously by representatives of the Empire and the Allies:—Great Britain and Ireland, the British Oak (*Quercus pedunculata*); Australia, the Bunya Bunya (*Araucaria Bidwilli*) and the Flame Tree (*Brachychiton acerifolia*); Sydney, the Port Jackson Fig (*Ficus rubiginosa*); New Zealand, the Kauri (*Agathis australis*); South Africa, the Cape Chestnut (*Calodendron capensis*); Canada, the Sweet Gum (*Liquidambar styraciflua*); India, Indian Date Palm (*Phoenix sylvestris*); Belgium, Black Belgian Poplar (*Populus monilifera*); France, Nettle Tree, or Perpignan Wood (*Celtis australis*); Russia, the Aspen (*Populus tremula*); Italy, Lombardy Poplar (*Populus nigra*, var. *pyramidalis*); Serbia, the Carob (*Ceratonia siliqua*); Montenegro, the Olive (*Olea europaea*); Portugal, Portugal Laurel (*Prunus lusitanicus*); Japan, Japanese Maple (*Acer japonica*); after which a memorial stone of a proposed museum of botany and horticulture was laid.

WE regret to record the death of Mr. Charles Dawson, which occurred, after a long illness, at Lewes on August 10. Mr. Dawson was born in Lancashire on July 11, 1864, but spent most of his early life at St. Leonards-on-Sea, where he soon became interested in the geology and archæology of the neighbourhood. Encouraged by the late Mr. S. H. Beckles, he devoted attention especially to the fossil remains of reptiles found in the Wealden formations quarried round Hastings, and made a large collection, which he placed in the British Museum, and continually enriched almost until the end of his life. He discovered some new species of iguanodon, of which one was named after himself by Mr. R. Lydekker. After persistent search in the bone-beds for many years, Mr. Dawson also found the first tooth of a Wealden mammal (*Plagiaulax dawsoni*). His interest in archæology gradually led him to studies of prehistoric man, and for many years he searched the gravels and other superficial deposits of southern Sussex for traces of man and his handiwork. He was ultimately rewarded, in 1912, by the discovery of the now famous skull and mandible of *Eoanthropus dawsoni* in a very old gravel at Piltdown, near Uckfield. During his busy professional career as a solicitor Mr. Dawson never neglected any opportunity of contributing to the knowledge of the geology and archæology of the district in which he resided, and his comparatively early death is a distinct loss to science.

THE death is announced, in his seventy-third year, of Dr. William Simon, professor of chemistry at the Baltimore College of Physicians and Surgeons since 1880. He was president of the Maryland Pharmaceutical Association in 1887. Dr. Simon was the author of a manual of chemistry, and had done special work in autochromatic photography.

THE death is announced, at the age of seventy-four years, of Dr. Ferdinand Fischer, professor of chemical technology in the University of Göttingen.

THE report of the Advisory Committee for Aeronautics, 1915–16, contains a summary of the work carried out by the Advisory Committee during the past year, and shows in a striking way the effect that the war has had upon aeronautics in general and upon experimental aeronautics in particular. The experimental work at the National Physical Laboratory is first dealt with, and the extent of the developments in this branch of the work is very marked, the aeronautical department at the laboratory having prac-

tically doubled in size since the outbreak of war. The experimental work that has been done covers a wide range, including experiments in the wind channels on models of aeroplanes and parts of aeroplanes, airships, and kite balloons; investigations into the strength of fabrics, wing spars, light alloys, stream-line wires, and other materials of construction; and researches into many special subjects that have arisen from time to time. The work of the Royal Aircraft Factory is summarised, with particular attention to the experimental side of the work, and to the endeavours which are being made to link up model experiments with full-scale tests. Considerable stress is laid on the precision with which the performance and stability of a new design can now be calculated, and on the fact that it has been found possible to obtain large quantities of good, stable, and serviceable machines from firms without previous experience of aircraft construction by providing them with complete drawings and details. The design of new machines proceeds by making a few trial machines, and four main types have been standardised for contract purposes. A brief account of the work done specially for the Admiralty Air Department, and of the meteorological work of the past year, completes the report. The technical appendix, containing detailed results of experiments, cannot, of course, be published during the war, but it is clearly emphasised in the report itself that the detailed technical results are freely communicated to Government contractors who need them, and who apply for them through the proper channels.

THE paper by Messrs. H. J. Fleure and T. C. James, published in the Journal of the Royal Anthropological Institute, vol xlvi., January–June, 1916, one of the most valuable recent contributions to the study of the races of Great Britain, must be read as a whole with due regard to the mass of statistics on which the authors base their conclusions regarding the geographical distribution of anthropological types in Wales. At present they are inclined to believe that a Brythonic advance into Wales, probably *viâ* Powys, occurred at some time not remote from the Roman invasion. It may have been in waves pushing back old languages or dialects which were probably nearer to the Gaelic group than is Brythonic. As regards physical types, they note a characteristic increase of the fair, medium-headed type as we descend into the Severn basin and that of the Wye, and all through this region, and the Welsh border generally, there is a suggestion of dilution of pigment in the Neolithic or Mediterranean type. Whether this can be connected with the Brythonic invaders is doubtful; it may be due to later infiltration. They also remark that while the fair-haired, light-eyed men of the Severn and Wye valleys often have medium to broad heads, this type also appears in eastern England. The suggestion is made that in the latter area the infusion may be partly Brythonic, partly Anglo-Saxon. It is not safe to assume that the fair men in eastern England are necessarily post-Roman Teutons; they may be Brythons, and it is difficult to distinguish their ultimate origin. There is at least the possibility that the pre-Roman peoples are fairly well represented even in East England.

IN the Journal of the Royal Anthropological Institute, vol. xlvi., January–June, 1916, Mr. Harold Peake investigates the ethnology of the people who destroyed the Trojan city known as Hissarlik II. Following the lead of Mr. Ellsworth Huntington, he suggests that a period of drought, beginning about 2450 B.C., led to extensive race movements of Arabian tribes across the Sinaitic peninsula into the Egyptian delta, while later waves successively invaded Palestine and Syria, introducing the knowledge of metals, perhaps gained from their kinsmen in Egypt, and founding Damascus. Thence they migrated to Assyria and Babylonia. Meanwhile the drought in the steppes adjoining the Caspian led to the migration of the Bak tribes into China. Later on the Nordic steppe-folk on either side of the Volga, finding their pasturage diminishing, occupied the region abandoned by the Bak tribes, and passed into Persia, where they became known as the Kassites. Others of the same group overran Galicia and Rumania, and penetrated into Hungary and Thrace. This last body divided into two groups; one occupied the Larissan plain, while another party crossed the Hellespont, destroyed Hissarlik II., and poured into Anatolia. These may have later appeared south as the Amorites, or they may survive to the present day as the Kurds. Many of these conclusions are speculative, but the theory now presented with a considerable array of corroborative evidence clears up many difficulties, and is decidedly attractive.

THE Royal Botanic Gardens, Kew, have received a very interesting and valuable presentation from Lady Church in the collection of botanical water-colour drawings brought together by the late Sir Arthur Church. The drawings have been placed in a room leading out of the North Gallery—once Miss North's studio—and are now open to public inspection. The exhibition of the pictures has been made possible by the generosity of Lady Church. There are some fine examples of the work of Simon Varelst, G. D. Ehret, R. P. Nodder, A. Power, and other well-known flower painters. In order to make the collection as representative as possible some examples of the work of W. H. Fitch, Sir J. D. Hooker, F. Bauer, and others have been placed on the walls from the collection of paintings already at Kew. An account of the collection is given in Kew Bulletin, No. 6, 1916.

THE luminous and very poisonous fungus, *Pleurotus japonicus*, which grows on decaying trunks of the beech tree in Japan, has been investigated by Katamura in the Journal of the College of Science, Tokyo, vol. xxxv., p. 1. The light is emitted from the gills, which are luminous all over, and the range of temperature for luminosity is 3°–40° C. It is stated that 100 sq. cm. of luminous area gives light enough for reading, and that the light is noticeable for a distance of some 30 m. The poisonous properties of the fungus do not appear to be destroyed by cooking.

THE wild and cultivated forms of the Japanese cherries form the subject of a monograph by M. Miyoshi in the Journal of the College of Science, Tokyo, vol. xxxiv., art. 1. The species concerned are *Prunus mutabilis*, Miyos., *P. sachaliensis*, Miyos., and *P. serrulata*, Lindl. Some sixty-eight varieties of the last-named species are described and figured in a series of very beautiful coloured plates. Ten forms of *P. sachaliensis* and sixty-five forms of *P. mutabilis* are similarly described and illustrated. There is some introductory historical matter, and under each form the Japanese name, flowering time, and other particulars are given. Many of the forms are now known in Great Britain, but the monograph deserves careful study by all lovers of flowering trees, if only because of the artistic beauty of the plates.

THE *Scottish Naturalist*, in the form of a double number (July–August), is devoted entirely to the "Report on Scottish Ornithology in 1915." Though this *résumé* contains nothing of very remarkable import, it is full of interesting items. Among these must be mentioned an extension of the breeding range of

the gannet, four pairs of which nested on the Noup of Noss, Bressay, Shetland, during this season. Until now all the known nesting-places of this species in our islands, with the exception of the Bass Rock, have been on the west coast. This report is the work of Misses Evelyn Baxter and Leonora Rintoul, and we regret to notice that while showing a determination to be very up-to-date in the matter of nomenclature they have not adopted that laid down by the British Ornithologists' Union, of which they are honorary members.

IN the *Irish Naturalist* for July Mr. R. A. Phillips describes and figures two species of fossil Pisidium new to Ireland. They were obtained from a deposit in the Suir, near Fiddown, about fifteen miles above Waterford. One of these, *P. supinum*, was found in association with a thickened, triangular form of *P. casertanum*, which it closely resembled; the other, *P. parvulum*, has apparently not previously been recognised as a British species, having been "confused with, and mistaken for," the young of *P. supinum*. Mr. Phillips, in his paper, gives the distinguishing characters between the two species in tabular form. Many of the shells which he has obtained from the Suir and Shannon have all the appearance of drift-shells only recently killed; hence it is probable that the species will be found living in both rivers. For similar reasons he believes that *P. supinum* will also be found living in Irish rivers.

THE second volume of "Papers from the Geological Department, Glasgow University" (see NATURE, vol. xcvi., p. 236), bears further testimony to the energy of Prof. J. W. Gregory and his colleagues. One of the most notable contributions is that in which Prof. Gregory records the discovery of pebbles of the Moine Gneiss in Torridon Sandstone, and thus makes a marked advance in the stratigraphy of the Scottish Highlands. His description of "Pseudo-Glacial Features in Dalmatia" contains several illustrations from the karstland that are specially interesting at the present time.

DR. H. H. HAYDEN'S "Notes on the Geology of Chitral, Gilgit, and the Pamirs" (Rec. Geol. Surv. India, vol. xlv., pub. 1916, p. 271) need no apology for incompleteness. They were drawn up during steady journeying in a region of rocky and snow-capped heights, of which the photographic illustrations give a striking record. Dr. Hayden finds that the trend-lines of the mountains between the Pamirs and Kungur and Mustagh-ata do not present anomalies such as Suess and Fütterer pointed out. Stoliczka's and Ivanov's observations on the Pamirs, published in 1878 and 1886, are now for the first time supplemented.

DR. W. F. SMEETH'S "Outline of the Geological History of Mysore" (Bangalore, price one rupee) is accompanied by a coloured geological map of southern India, on a scale of about one inch to one hundred miles. The references to the banded iron-ores, the quartz-magnetite dykes or tongues in charnockite, and the intrusive character of the "peninsular gneiss," once regarded as "fundamental," are brief, but are suggestive for comparison with other pre-Cambrian regions. The Dharwar schists have affinities with the Keewatin series of North America.

THE remarkable new canal between Arles, on the Rhone, and Marseilles is the subject of an article by Prof. Piero Gribaudi in the *Bollettino della Reale Societa Geographica Italiana* for July (vol. v., No. 7). The canal, which was opened last May, is carried through the hills north of Marseilles in a tunnel four and a half miles long and 72 ft. wide, with a depth of 10 ft. of water. It will make direct barge traffic possible between Marseilles and the Rhone. Equally important is the construction of a new line of railway from Marseilles to Miramas, where it connects with the Paris-Mediterranean line. This new line leaves Marseilles westward along the coast, and is an alternative to the long Nerte tunnel, which was always the weak link on the old line in case of an accident.

THE Canadian Department of Mines has just published a volume (Bulletin No. 11) upon the "Investigation of the Peat Bogs and Peat Industry of Canada in 1913–14," by Aleph Anrep, which will be found interesting to all concerned in the problem of the utilisation of peat. It may be looked upon as a continuation of the volumes upon peat already issued by the same Department, and brings the information upon this subject well up to date. The first portion contains detailed descriptions of a number of peat bogs in Ontario, Quebec, Prince Edward Island and Nova Scotia, and is followed by a particularly well illustrated account of the botany of these bogs. This is followed by a series of notes upon special appliances for the manufacture of peat fuel, and upon the peat production in certain foreign countries, and an appendix contains abstracts of Canadian patents for excavating and handling peat and for the manufacture of peat fuel. This bulletin is a further example of the sedulous care with which the Canadian Government endeavours to foster the development and utilisation of the natural resources of the Dominion; it is greatly to be desired that the example thus set may be followed in our country, and that we may see before long some Government department specially charged with the duty of seeing that British natural resources are turned to the best possible account.

AN attempt to gauge the agricultural possibilities of Australia so far as the climatic factor is concerned has been made by Mr. Griffith Taylor, and his results are published in Bulletin No. 11 of the Commonwealth Bureau of Meteorology. The scope of the inquiry includes the distribution of cattle, sheep, and wheat. Rainfall is the chief control in the case of wheat, and scarcely of less value as regards cattle and sheep. Temperature is an important factor in the case of wheat, and of considerable influence in the distribution of sheep. Cattle, on the other hand, show a wide adaptability to temperature. The author briefly considers the topographic control and the question of accessibility, but to both these, as well as to the question of soil, more attention would need to be paid to make such a survey complete. These, however, he rules outside the scope of the memoir. From a consideration of the temperature and rainfall in the wheat lands of Texas and northern India, Mr. Taylor concludes that south-eastern Queensland is well suited for wheat grown under the same conditions. The area at present under wheat in Queensland is small. In these new wheat lands it is suggested that the Indian practice should be followed of planting the wheat towards the end of the summer rains—that is, early in March. The wheat would ripen in about four months, during which it would receive an additional five inches of rainfall.

IT is, we think, almost an article of faith amongst chemists that the preparation of sodium chloride pure enough for ordinary analytical operations is a comparatively easy matter. But, according to Mr. Clifford Lohman, who writes from Cornell College in the *Chemical News* of August 4, this is not the case. Three specimens of sodium chloride (presumably of

American manufacture), each alleged to be chemically pure, contained respectively 0·57, 0·45, and 0·49 per cent. of potassium chloride. Samples prepared by this author (1) by precipitation of a saturated solution of common salt with hydrogen chloride; (2) by purification with milk of lime, excess of which was precipitated with sodium carbonate, the excess of the latter being neutralised with hydrochloric acid; (3) from metallic sodium by dissolution in water and neutralisation of the solution with hydrochloric acid; and (4) by neutralising with hydrochloric acid a solution of the most nearly pure caustic soda (not purified with alcohol), contained respectively: (1) 0·42, (2) 0·32, (3) 0·27, and (4) 0·48 per cent. of potassium chloride. In each case the potassium was estimated by the platinic chloride method. It would be interesting to learn whether the "chemically pure" sodium chloride of English origin is equally contaminated.

THE ions of low mobility the presence of which in air at ordinary pressures was discovered by Langevin have frequently been called large ions owing to the belief that their low mobility was due to their relatively great mass. Some measurements made at the suggestion of Prof. Millikan by Mr. L. B. Loeb, and published in the July Proceedings of the American Academy of Sciences, seem to indicate that this belief was unjustified. Using the alternating-field method of Rutherford, Mr. Loeb has measured the mobilities of both positive and negative ions at fields from 90 to 12,000 volts per centimetre, and in neither case has he found any marked increase in the mobility. At the high speeds due to the strong fields the clusters of uncharged molecules about an electron, which were supposed to constitute the ion of low mobility, should be broken up and the mobility show an increase corresponding to the reduced mass. As the measurements show no such increase, the author adopts the theory that each ion consists of a single molecule and its low mobility is due to the action of its charge on neutral molecules increasing the number of collisions.

ACCORDING to the *Scientific American*, there has been a remarkable increase, since the war commenced, in the number of American engineering firms who make use of the metric system of measurement. Many firms who two years ago upheld the yard, foot, inch, eighths, sixteenths, thirty-secondths, and sixty-fourths as more convenient than the metre and its decimal subdivisions are now turning out machines gauged solely on the metric system. This remarkable *volte-face* appears due to the desire on the part of American firms to meet the demand for machinery which, in the past, has been supplied by Germany. Whatever the reason for this rapid change, the fact that it has been carried out voluntarily in so short a time seems a sufficient refutation of the argument that the introduction of the metric system into engineering works in this country would cause endless confusion and great expense.

WE have received from Prof. R. Gautier, director of the Geneva Observatory, the annual report describing the chronometrical service carried on in that institution. It appears from the report that the war has affected the activity of the observatory very adversely, and that the number of instruments submitted to trial conditions has fallen below that of any year since 1872. Of marine chronometers only one has been received, and of pocket watches, 152, as against 296 in 1914. M. Gautier takes, however, a hopeful view of the national industry in the future when normal conditions have returned, basing this opinion on the improved character of the work. For if the number of instruments has been less, the proportion of those which obtain the highest certificate of excellence has increased. No less than 95 per cent. of the whole deposits has obtained a first-class certificate, and less than 10 per cent. of the instruments submitted to test has failed. These figures constitute a record in the history of the annual trials. M. Gautier gives some details of the examination of chronometers at the neighbouring observatories of Neuchatel and Besançon, giving also an abstract of the Kew results for comparison. The effect of the war is everywhere noticeable in the quantity of instruments deposited, but the quality of the work is everywhere maintained with gratifying uniformity. The general adoption of the Guillaume balance has contributed to this successful result. In the Kew report it is stated that the Swiss manufacturers have universally adopted the Guillaume type, and "il n'y a pas de doute que l'emploi de ce type de balancier contribue largement aux brillants résultats obtenus par les montres déposées par ces fabricants."

IN response to many requests, the Board of Agriculture and Fisheries has issued (at 1*s*.) a second edition of vol. i. of the "Special Reports on the Mineral Resources of Great Britain." It will be remembered that the work deals with the uses, distribution, treatment, and output of tungsten and manganese ores, and that in it particulars are given of the mines containing the ores.

AN interesting volume has been sent to us by the Royal Cornwall Polytechnic Society, entitled "Historical Synopsis of the Royal Cornwall Polytechnic Society for 81 Years, 1833–1913," by Wilson Lloyd Fox, with indexes by Howard Fox. The work is divided into two parts, covering the periods 1833–81 and 1882–1913. The activities of the society have been numerous and valuable, and merit this permanent record.

A NEW series entitled the "Cambridge Botanical Handbooks" is being edited by Prof. A. C. Seward and Mr. A. G. Tansley for the Cambridge University Press. The development of certain branches of botanical science in recent years has emphasised the need for books by specialists on different groups of the vegetable kingdom, and the new series is being issued to meet this want. A book by Prof. West dealing biologically with all the algæ included in the Myxophyceæ, Peridinieæ, Bacillacieæ, and Chlorophyceæ, both fresh-water and marine, will be the first volume to appear. It will be followed by another work by Prof. West, on all the fresh-water algæ (with the exception of desmids and diatoms) which are known to occur in the British Isles. Volumes on lichens, fungi, and gnetales, by Miss Lorrain Smith, Dr. Helen Gwynne-Vaughan, and Prof. Pearson respectively, are in an advanced state of preparation.

THE Harvard University Press (Cambridge, Mass., U.S.A.) has begun the publication of a series entitled "Harvard Health Talks," being the substance of some of the public lectures delivered at the Medical School of Harvard University, and aiming at providing in easily accessible form modern and authoritative information on medical subjects of general importance. Among the volumes in the series we notice "The Care and Feeding of Children," by J. L. Morse; "Preservatives and other Chemicals in Food: their Use and Abuse," by O. Folin; "The Care of the Skin," by C. J. White; "The Care of the Sick Room," by E. G. Cutler; and "The Care of the Teeth," by C. A. Brackett. The series is published in this country by the Oxford University Press.

OUR ASTRONOMICAL COLUMN.

A LARGE SOLAR PROMINENCE.—An eruptive prominence of exceptional altitude was photographed by Mr. Evershed at Srinagar, Kashmir, on May 26, 1916. Photographs were obtained at intervals from near the beginning of the outburst until the final fragments had risen to a height of a little more than a semi-diameter from the sun's limb. The velocity away from the sun was 190 km. per sec., and faint extensions could be traced at 18′ from the limb, representing a height of close upon half a million miles. This would appear to be the highest prominence which has yet been recorded. (*The Observatory*, vol. xxxix., p. 358.)

THE SPECTROSCOPIC BINARY σ AQUILÆ.—The variable radial velocity of this star, detected at Mt. Wilson in 1912, has been further investigated by Mr. F. C. Jordan (Pub. Allegheny Obs., vol. iii., No. 22). The star is interesting as one in which both components are readily observed separately. Both spectra are of type B 8, and from their relative intensities it is inferred that the components differ in brightness by about half a magnitude. The period is 1·95022 days, with a probable error of about 8½ seconds. The orbit is sensibly circular, and the velocities of the components 163 and 199 km. per sec. respectively, that of the primary being the highest so far known with the exception of β Lyræ, V Puppis, and μ^1 Scorpii. The star is of further interest as an additional case in which the K line of calcium indicates a velocity differing from that given by other lines of the spectrum. The mean velocity differs so little from that of the system, −5 km., that it suggests an origin of the line in the system itself. If the line were due to absorption by a calcium cloud stationary with respect to our stellar system, its velocity due to the solar motion would be −16 km. The individual plates show considerable variations, but these are apparently unrelated to the oscillations of the component stars.

BANDED SPECTRA FROM THE ELECTRIC FURNACE.—At the Mount Wilson laboratory Dr. A. S. King has investigated the conditions of occurrence in the electric furnace of the banded spectra which have been attributed to titanium oxide, magnesium hydride, and calcium hydride (*Astrophysical Journal*, vol. xliii., p. 341). All the bands in question have been identified in the spectra of sun-spots, and those of titanium oxide are the most characteristic feature of the spectra of Antarian, or third-type, stars. The outcome of Dr. King's experiments on titanium is to confirm the conclusion previously arrived at by Fowler, that the bands attributed to the oxide of this element are certainly dependent upon the presence of oxygen, and to show that with a sufficient supply of oxygen in the furnace the spectrum consists of the bands alone. There was no evidence of a material change in temperature caused by the introduction of oxygen, and there would seem to be no reason for the disappearance of the line spectrum unless an actual compound were formed. In the case of magnesium and calcium, the experiments similarly indicated a clear dependence of the bands on the presence of hydrogen, without any apparent change in the action of the source. While the bands appeared through a considerable range of furnace temperatures, the upper limit for their greatest strength was about 2300° C. There would accordingly seem to be ample justification for regarding the presence of the three sets of bands as evidence of a relatively low temperature in sun-spots, and the occurrence of titanium-oxide bands as direct evidence of the presence of oxygen in the Antarian stars and in the sun.

THE WORK OF THE NATIONAL PHYSICAL LABORATORY DURING THE YEAR 1915–16.

THE report of the National Physical Laboratory for the year 1915–16 again presents a record of useful national work. The importance of the laboratory has been rendered more prominent owing to the war, not only because of the direct assistance it has been called upon to give to the Services, but also through its co-operation in the solution of industrial problems which our blindness and lack of national prudence has been content to leave unattempted, an open field wherein the scientific and technical organisation of Germany might find its reward.

Two prominent members of the general board of the laboratory, Sir Frederick Donaldson and Mr. Leslie Robertson, lost their lives, in their country's service, on the *Hampshire*. The board have put on record in the report their appreciation of the services rendered to the laboratory by these members of their body. Sir Frederick Donaldson was an active member also of the executive committee. Mr. Leslie Robertson, from the nature of his duties as secretary to the Engineering Standards Committee, had been closely associated for many years with the work of standardisation and maintenance of standards, which constitutes one of the main functions of the laboratory.

Last year the laboratory had also to mourn the loss of two of its earliest and most active supporters, Sir Andrew Noble and Sir Arthur Rücker, both members of the Treasury Committee, presided over by Lord Rayleigh, which in 1897 reported in favour of the establishment of the laboratory.

One-quarter of the permanent staff of the laboratory are at present on active service. Two who served in France have lost their lives. One, taken prisoner at Antwerp, succeeded about a year later in escaping from Döberitz. During the past year the services of all away have been much missed, and it has been necessary to provide a constantly increasing temporary staff, including many women, of whom it is recorded that their work has been very efficiently done.

Owing to the depletion of the staff and the large demands made on the laboratory by the Admiralty, the War Office, and the Ministry of Munitions for the investigation of special questions, the research work has necessarily suffered, and in many departments has been altogether in abeyance. On the formation of the Ministry of Munitions, Dr. Glazebrook, the director of the laboratory, was appointed its scientific adviser on physical questions. The laboratory undertook the testing of gauges required in the manufacture of fuses and shells. The initial difficulties were considerable: the degree of accuracy needed in the gauges was scarcely realised at first by many of the numerous manufacturers who gave their assistance to the Ministry in meeting the needs of the Army, and the laboratory has earned their confidence and appreciation by the valuable help it has been able to give, both directly and indirectly, in the improvement of the methods employed.

The war has lent a great stimulus to the production in this country of optical glass, an industry which had previously tended more and more to become a German monopoly. The shortage in the early months of the war must have been a source of most serious anxiety to those responsible for the supply of optical munitions, and it is a matter for congratulation that the difficulty has been met so successfully. Research on optical glass has now been undertaken by the laboratory, with the aid of a grant from the Privy Council Committee for Scientific and Industrial Research. This work is of the utmost national and scientific im-

portance, and the committee will doubtless spare no effort to ensure that it is actively continued and extended, and that in the future no risk shall be run of this fundamentally important industry passing into foreign hands. Research on chemical and other glasses has been done during the year by the laboratory, as well as by other institutions.

As is well known, one of the principal difficulties in the manufacture of optical glass lies in the choice of suitable refractory material for the pots in which it is made. The report states that the research has so far been mainly directed to the production of satisfactory pots, and that similar work on heat-resisting materials, and more generally on the behaviour of the rare earths and other substances at high temperatures, is of great importance in a large number of industrial processes. For such work a technological laboratory on a large scale is needed; and notwithstanding the economic difficulties existing, it is to be hoped that the matter will receive immediate and serious consideration.

The laboratory has earned a world-wide reputation for its successful investigation of some of the more difficult questions in aeronautics. The immediate importance of the work to the Army and the Navy has led to large additions to the equipment for aeronautical research, for which new buildings have been provided during the year; in these a second 7-ft. and a second 4-ft. channel have been installed. The laboratory has now five air-channels, as well as a whirling table, available for experiments on models, and with a greatly increased staff has been continuously occupied in dealing with the questions constantly arising in connection with the design of new types of machine. In the investigation of light alloys and materials of construction a large field of work remains open, and it is satisfactory to learn that this branch of the work is receiving increased attention on an extended scale.

Provision for other new work has been rendered possible through a timely gift from Sir Charles Parsons. Arrangements have been made, at the request of the Röntgen Society, for the examination of materials employed for the protection of X-ray workers. The equipment has been installed, and the conditions of test are being determined in conjunction with the Council of the Röntgen Society.

By desire of the Ministry of Munitions, arrangements were made for the testing of prismatic compasses in considerable numbers. A paper describing the methods employed was read before the Optical Society. Assistance has been given to the Board of Trade in preparing a specification of liquid compasses for use on the lifeboats of merchant ships. The examination of the luminous dials fitted on instruments for night use constitutes an important branch of new test work, involving also the examination of the luminous radium compounds employed. Tests of radium preparations have been continued, and further improvements have been made in the methods of testing optical pyrometers, which are now being manufactured in increasing numbers in this country.

Turning to work which falls more appropriately under the heading of research, an investigation has been made into methods of magnetic testing of straight and curved bars, and improvements effected. The work has been described in a paper presented to the Institution of Electrical Engineers. A research on magnet steels is in progress. In the heat division an appreciable amount of work has been done in the investigation of the thermal conductivity of various substances, both refractory materials for furnace construction and materials employed for cold-storage work. The rate of heat transmission through roofing materials has also been investigated, and found to depend to a much greater degree upon the emissivity of the surface than on the rate of conduction through the material. The loss of heat through special roofing material was thus found to be 20 per cent. greater than that through galvanised iron, owing to the difference in surface emissivity. When the special material was painted with aluminium paint, the transmission became practically identical with that of the sheet iron. Other experiments on heat loss from surfaces have been continued, and an investigation has been conducted into the qualities of British-made porcelain for pyrometer tubes.

In the Optics Division, tables for the construction of small telescope objectives from glasses of usual types have been prepared and published at the request of the Ministry of Munitions, and the results of continued experience and investigation in the design and calculation of lens systems have been communicated to the Physical Society in a series of papers. Another investigation relates to the improvement of hydrogen vacuum tubes for use in the examination of optical glasses.

The Metrology Division has been closely occupied with special test work. Some work relating to the sizes of commercial sparking plugs and tapped holes for motor engines has been carried out for the Engineering Standards Committee.

In the Engineering Department progress has been made with a number of researches. A new machine has been constructed for testing the endurance of specimens under combined bending and twisting. The methods of notched-bar impact testing have been investigated; various methods for testing the hardness and wearing properties of metals have been compared, and experiments have been carried out on the resistance of wood to reversals of stress. Shock tests on railway couplings have been made. The measurement of the rate of growth of cracks in the Tower of London is a matter of general public interest. In Aeronautics the investigation of stability has been extended to the case of curvilinear motion.

In the Metallurgy Department, investigatory work has been mainly confined to matters of immediate importance; some interesting papers relating to appliances for metallurgical research have been read before the Institute of Metals. Valuable papers have been contributed to various institutions by members of the staff of the Froude Tank, which has, however, also been occupied almost entirely with urgent work for the Admiralty.

The report makes it clear that the laboratory has borne its full share of the burden which has fallen upon the nation, and the country is indebted to the director and his staff for their strenuous efforts in the furtherance of technical efficiency.

THE RECENT DEVELOPMENT OF GERMAN AGRICULTURE.—Germany

THE fact that on each hundred acres of cultivated land Germany feeds seventy of her people while Britain can only support forty-five has rightly received wide publicity in the daily Press. The memorandum by Mr. T. H. Middleton, Assistant-Secretary, Board of Agriculture and Fisheries, which explains how Germany does this, should be studied by all who have the welfare of British agriculture at heart. The two chief factors in the recent remarkable development of German agriculture are her settled economic policy and her well-thought-out system of agricultural education. It was the belief that he was essential to the community, and that his land would not be allowed to go out of cultivation, rather than the extra profit

on his wheat, that has inspired the German farmer to greater efforts during the last ten years. The need for well-educated men as managers of estates is more commonly recognised in Germany than in England; hence a career is open to successful students from the training institutions of Prussia, while the English student who lacks the capital to farm on his own account must look abroad for an outlet for his knowledge of practical agriculture.

Mr. Middleton believes that our system of education, though starting thirty years behind that of Germany, mainly wants time to grow. It is unfortunate that it had only just started before the war and that results will be sought at a time when patience will be necessary but very difficult to exercise. The chief immediate cause of the increased productivity of German soil is the increase in the use of artificial manures. The German farmer is no more skilful than the British, but his natural obedience to authority leads him to apply artificial manures in such quantities as his instructors, relying on the systematic work of the experiment stations, may from time to time direct. Twice as much nitrogen, one-third more phosphate, and five times as much potash are used in Germany as on an equal area of our cultivated land. As regards the two former manures, we import nearly three tons more feeding stuffs per one hundred acres than the Germans, and this should balance to some extent the smaller amounts of nitrogen and phosphate applied direct to the soil; but careless storage of farmyard manure results in the loss of some 50 per cent. of the nitrogen and a good deal of the phosphate, so that far less than the theoretical amount ever gets to the growing crop. Germany is fortunate in that she has not only immense deposits of potash salts, but also vast areas of light soils able to give abundant returns from these manures when skilfully applied. This combination plays an important part in the recent progress of German farming.

THE ROYAL AIRCRAFT FACTORY INQUIRY.

THE whole question of the Royal Aircraft Factory administration and cost seems to turn on whether it is to be regarded as an experimental or a productive concern. If it is to be regarded as a factory for the production of service machines, then there is little doubt that it is not administered as efficiently as it might be. But if it is to be regarded as a purely, or at least chiefly, experimental establishment, then the case is completely altered. In the development of a new industry, such as aeronautics, there must be a certain amount of experiment, and in modern times the tendency is to arrive at a satisfactory result by the application of science to the fullest possible extent, rather than to attain that result by a lengthy process of trial and error. The inevitable result of the scientific method is that it appears as though a considerable amount of money is being wasted with no appreciable result, but in reality the money is being well spent if it leads to scientific results of a widely useful nature. The Royal Aircraft Factory should therefore be judged by its achievements in the advance of aeronautical science rather than by its actual output of machines for service use. There can be no doubt at all that the work done at the factory, in conjunction with the model experiments and mathematical investigations at the National Physical Laboratory, has elucidated many questions of vast importance concerning the design and stability of aeroplanes in a way which would perhaps never have been done by private firms, where output is the primary consideration. Once it is admitted that this scientific information is needed, the Royal Aircraft Factory stands justified by its past work. By all means reorganise, if by such reorganisation increased efficiency can be obtained, but let it not be at the expense of the exceedingly valuable experimental work which is being done, and which can be done in no other way at the present time.

It is often argued that private firms can produce machines equal to those of the Factory, without spending so much time and money on the experimental side. This is by no means true, since the results of such experimental work at the Factory and elsewhere have always been available to a large extent to any who cared to avail themselves of them, and many good points in proprietary machines are indirectly due to this fact. There is still an inclination on the part of some firms to view the scientific side of the subject with suspicion, and even to depreciate experimental aeronautics altogether, but surely the sooner experimental results become more widely known the better it will be for the future development of the aeronautical industry. In the provision of these scientific fundamentals of aeronautics the Royal Aircraft Factory has played, and is playing, an important part, and any attempt at reorganisation which would impair its utility as an experimental establishment, and reduce it to the level of a productive factory for existing designs, would be a great mistake at the present early stage of aeronautical development.

LORD KELVIN AND TERRESTRIAL MAGNETISM.[1]

LIKE most branches of physics, terrestrial magnetism has associations with the name of Kelvin, and, characteristically enough, these associations are at the two confines of the subject, the immediately practical, and the speculative. Lord Kelvin, I need scarcely remind you, introduced important changes of design into compasses, and the construction of compasses was an important object of the Glasgow firm which eventually bore his name.

The other point of contact between Lord Kelvin and terrestrial magnetism, as already mentioned, relates to theory. All here know that there occur from time to time phenomena known as magnetic storms, during which there are difficulties in carrying on ordinary telegraphy. There has long been a belief that the sun is the principal, if not the only, source of magnetic storms, and of the less striking regular changes every day visible. Lord Kelvin directed attention to the difficulties in the way of accepting any sensible *direct* magnetic action between the sun and the earth. His earliest remarks on the subject, to which I shall refer, are contained in a short note on p. 154 of vol. iv. of his "Mathematical and Physical Papers." "The sun's magnetisation," he said, "would . . . need to be 120 times as intense as the earth's to produce a disturbance of 1′ in declination even by a *complete reversal* in the most favourable circumstances."

The much later communication, to which I next refer, was made in 1892 to the Royal Society, on an occasion—a presidential address—when original contributions to science are unusual. Lord Kelvin, however, devoted fully half his address to terrestrial magnetism. After referring to various solar and terrestrial magnetic phenomena he adds (*loc. cit.*, p. 307):—"But now let us consider . . . the work which must be done at the sun to produce a terrestrial magnetic storm." He then quotes from a paper by the late Prof. W. G. Adams data relating to a magnetic storm of June 25, 1885, and proceeds:—"To produce such changes as these by any possible dynamical action

[1] Abridged from the Seventh Kelvin Lecture delivered before the Institution of Electrical Engineers on February 17, by Dr. C. Chree, F.R.S.

within the sun, or in his atmosphere, the agent must have worked at something like 160 million million million million horse-power. . . . This result, it seems to me, is absolutely conclusive against the supposition that terrestrial magnetic storms are due to magnetic action of the sun; or to any kind of dynamical action taking place within the sun, or in connection with hurricanes in his atmosphere, or anywhere near the sun outside. It seems as if we may also be forced to conclude that the supposed connection between magnetic storms and sun-spots is unreal, and that the seeming agreement between the periods has been a mere coincidence. We are certainly far from having any reasonable explanation of any of the magnetic phenomena of the earth; whether the fact that the earth is a magnet; that its magnetism changes vastly, as it does from century to century; that it has somewhat regular and periodic . . . solar diurnal . . . variations; and (as marvellous as the secular variation) that it is subject to magnetic storms."

To-night I shall confine myself to three of the outstanding problems enumerated by Lord Kelvin: the secular change, the solar diurnal variation, and the phenomena of magnetic disturbances.

Secular Change.

Our knowledge of secular change prior to the nineteenth century is confined to declination and dip. For these elements we have in some districts data covering more than three centuries.

The total range of D (declination) observed in London has exceeded 35°. The only actual turning point observed, 24·6° W., presented itself about 1818, the direction of secular change then altering from westerly to easterly. We have no idea how the value, 11¼° E., observed in 1580 stood to the previous turning point. The declination was approximately the same as at present in 1730. When, if ever, it will have the same value again, we have not the ghost of an idea. The change in each of the centuries 1600 to 1700 and 1700 to 1800 was about 16°, whereas during the last hundred years the change has been only about 9°. The rate of change has, however, markedly increased of late years, as may be recognised on consulting Fig. 1, which shows the change at Kew during the last fifty years.

The turning point in the dip, when it attained its highest value, presented itself about 1723, or nearly a century before the turning point in D. The dip in London is now lower than it has been since observations began. Of late years the rate of change has been very small, but whether this heralds the near approach of a minimum, or is merely a temporary slackening, we do not know.

The intensity of magnetic force changes as well as the direction. Thus at Kew between 1890 and 1900 H (horizontal force) increased from 0·18169 to 0·18428 c.g.s. When dealing with such small changes as ordinarily present themselves in terrestrial magnetism, it is convenient to employ as unit 1γ, or 0·00001 c.g.s. Thus the mean annual rise of H from 1890 to 1900 was 26 γ. After 1900 the rate of increase of H rapidly fell off, and the element seems to have attained a maximum and begun to diminish. V (vertical force) has been diminishing for some time.

Diurnal Variation.

To give a full account of the diurnal variation as it presents itself at different parts of the earth would require a large treatise. Here I shall confine myself to data from two stations, and to certain aspects only of these data. The one station, Kew, is fairly representative of the British Isles. The other station is that used in 1911–12 as the base station of the National Antarctic Expedition under the late Captain Robert Falcon Scott, R.N. The reduction of the Antarctic observations has been prosecuted at Kew Observatory for the last two years under my supervision. For permission to make a free use of existing data I am indebted to the committee of the Captain Scott Antarctic Fund.

The tragic fate of Captain Scott is still no doubt fresh in your memories. It produced a great impression on his countrymen, who saw in it evidence that the characteristics on which the nation prided itself in more warlike times still survived. The appreciation of courage is practically universal, but even a scientific audience may have to be reminded that the prosecution of pure science under the arduous conditions prevailing in the Antarctic calls for no small measure of pluck and endurance. It also calls, if success is to be attained, for other qualities, which though making less appeal to the public imagination, are perhaps of equal value for the welfare of a nation, viz., scientific knowledge and forethought. If I am able to-night to mention important deductions from the Antarctic observations, it is to the physical observers, Dr. Simpson, F.R.S., and Mr. C. S. Wright, that recognition is in the first place due. In spite of the great difficulties arising from the low temperature and the extraordinarily disturbed magnetic conditions, they secured an almost unbroken record for a period of nearly twenty-two months.

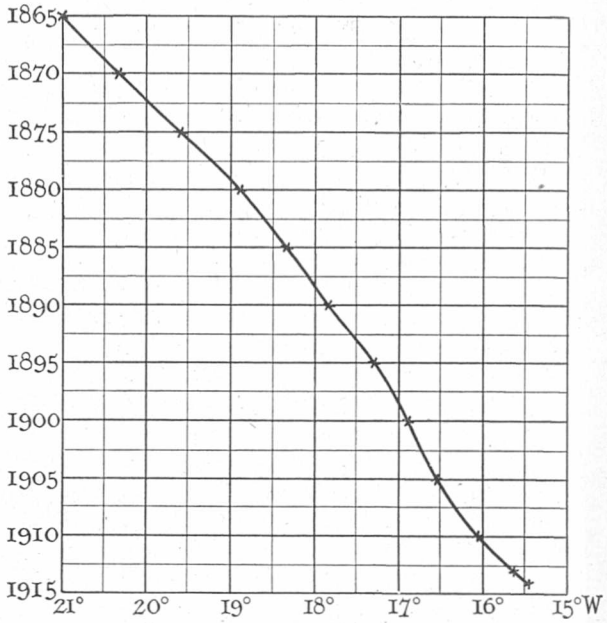

FIG. 1.—Changes of westerly declination at Kew since 1865. Change in the last fifty years 5⅜°. Present annual change 9′.

In Fig. 2 the vector diagrams refer to mean results from the whole year. The full-line diagram represents at either station results based on all, or all but highly disturbed days, the dotted-line diagram results from quiet days only, the origin, the centre of the cross, being the same for the two. The Antarctic quiet days (selected by myself) were ten a month, as against five at Kew (international quiet days). Thus *a priori* we should have expected less difference between the two Antarctic diagrams than between the two Kew ones. As regards type, there is, in fact, less difference in the Antarctic, but as regards amplitude the difference at Kew is slight, and not always in favour of the all-day vector, whereas in the Antarctic the excess of the all-day vector is conspicuous at every hour.

The great difference in amplitude between the Antarctic diurnal inequalities from all and from quiet days suggested a comparison between inequalities from highly disturbed days, on the one hand, and quiet days on the other. To secure a demonstrably impartial selection, I took for each month the five international quiet days selected at De Bilt and the five days which had the largest "character" figures on the international list. "Day" in this connection means a period of twenty-four hours commencing at Greenwich midnight. Thus Greenwich civil time has been used in the curves in Fig. 3, which embody the results obtained for the two sets of days in the Antarctic. When comparing Antarctic results in Figs. 2 and 3, it must be remembered that 11h. on the former answers to 0h. on the latter.

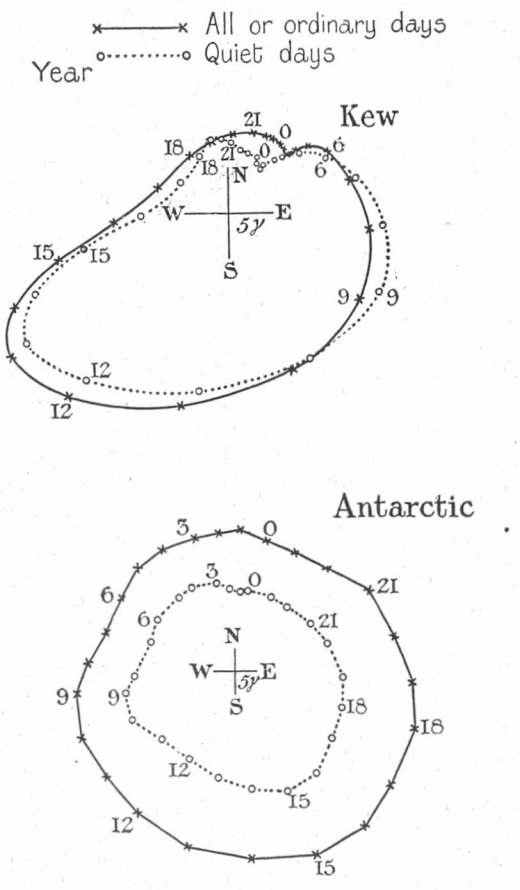

FIG. 2.—Diurnal variation.

Fig. 3 is confined to the four midwinter months, May to August.

Large as was the difference between the all and quiet-day vectors in Fig. 2, it is quite eclipsed by the difference between the disturbed and quiet-day vectors in Fig. 3. In the latter figure the amplitude of the disturbed-day vector averages about four times that of the quiet-day vector. In fact, the vector for the disturbed winter day averages about the same as the vector of the ordinary summer day.

While opinions may differ as to what the phenomena shown by Figs. 2 and 3 really imply, it can scarcely be questioned that they have an important bearing on theories which attempt to account for the diurnal variation. A difference in type between simultaneous diurnal inequalities at different places is a natural enough consequence of difference of geographical position. But the influence of disturbance is out of all proportion greater in the Antarctic, and presumably also in the Arctic, than in the temperate latitudes of Europe, and no mathematical formula which contains only geographical co-ordinates and sun's position can adequately meet the case of diurnal inequalities the ratio of the amplitudes of which at different places varies from day to day according to the prevalence of disturbance.

The 27-Day Period.

A remarkable feature in magnetic disturbance is the so-called 27-day period. This seems to have been first noticed by J. A. Broun[2] in 1858, but the phenomenon for some reason was practically overlooked until rediscovered by W. Maunder[3] in 1904 in Greenwich magnetic storms, and about the same time or a little earlier by A. Harvey[4] in Toronto disturbances.

All I think we are really entitled to say is that if a certain day is disturbed, days from twenty-five to thirty days later have more than the usual chance of being

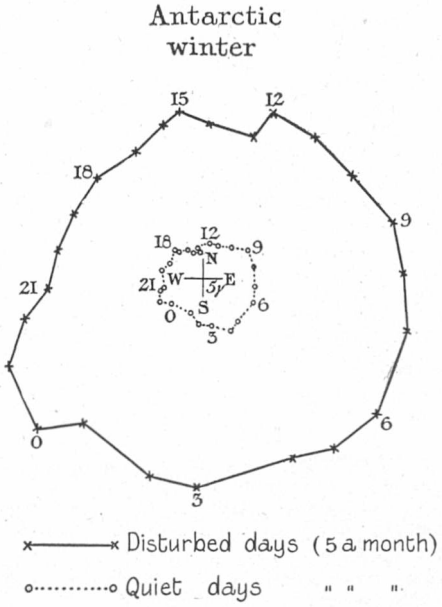

FIG. 3.—Diurnal variation.

disturbed, and this probability is greater for the twenty-seventh day than for the twenty-sixth or twenty-eighth.

If we confine our attention to large magnetic disturbances an obvious difficulty arises. Large disturbances are rare, and if all but large disturbances are disregarded, a very inadequate supply of data remains. If, on the other hand, we count a large number of disturbances as magnetic storms, numerous chance repetitions in twenty-seven, or any other specified number of days, must be expected; and in the absence of any precise definition of what constitutes a storm—and none commands general respect—claims as to repetitions in twenty-seven days naturally fail to carry conviction. There are, however, ways of testing the existence of the period less exposed to criticism, and those I have tried point to the real existence of a 27-day period in a certain sense of the term.

The first thing is to get what will be generally accepted as an impartial measure of disturbance, so that days may be selected as representative of dis-

[2] *Philosophical Magazine*, August, 1858.
[3] R.A.S. Notices, vol. lxv., pp. 2 and 538, etc.
[4] Proceedings of the Royal Astronomical Society of Canada, 1902–3, p. 74.

turbed conditions, and every day may have a numerical measure attached to its disturbance. International "character" figures naturally suggest themselves for the purpose.

The "character" figures were entered in successive columns, representing from so many days before to so many days after the representative disturbed day. The successive columns were summed, and the resulting means taken as a measure of the average disturbance presented from so many days before to so many days after the representative day.

The days recognised by Maunder as magnetic storms average only about one a month, and were much more numerous in some years than others. If the 27-day period had been a phenomenon confined to such highly disturbed days, the procedure adopted here could scarcely have brought it into evidence, except in disturbed years. It proved, however, to be as much in evidence in the less disturbed as in the more disturbed years. This suggests that it is not peculiar to disturbed conditions, a conclusion which is strongly supported by Fig. 4, which shows the results of applying the procedure explained above to the international quiet days as well as to the representative disturbed days of the nine years 1906 to 1914. The representative days in each category were five a month. The normal line in Fig. 4 represents the mean "character" figure, 0·60$_4$, of all days of the nine years. Above this normal line we have the primary and secondary pulses associated with the representative disturbed day, the "character" figure of which was 1·26, and below it are the primary and secondary pulses associated with the representative quiet day, the "character" figure of which was 0·11. The secondary pulse associated with the representative quiet day is not quite so deep as that associated with the representative disturbed day, but the same is true and to a like extent of the primary pulses.

The graphical representation of the results for the individual years in Fig. 4 is confined to days 0 and 27. The extreme top and bottom of the lines represent the "character" figures on the representative disturbed and quiet days, on the same scale that serves for the nine years combined. The top and bottom of the thickened portions of these lines represent the "character" figures on the days which are twenty-seven days subsequent to the representative disturbed and quiet days respectively. The total length of the vertical line may be regarded as a measure of the primary difference pulse (disturbed less quiet), and the length of the thickened portion as a measure of the corresponding secondary pulse. The short horizontal line shows the "character" level of the average day of the year. The lengths of thickened line above and below this level may thus be regarded as representing respectively the amplitudes of the secondary pulses of disturbed and quiet conditions. Above the nine lines are given Wolfer's mean sun-spot frequencies for the respective years.

The 27-day period is conspicuously shown in Fig. 4 in every year except 1914, where the secondary pulse associated with the representative disturbed day is abnormal. The two years in which the 27-day period is most in evidence are 1911 and 1913, both, especially the latter, years of few sun-spots; while 1907, the year of sun-spot maximum, shows it less than any other year except 1914. In 1912 the secondary disturbed

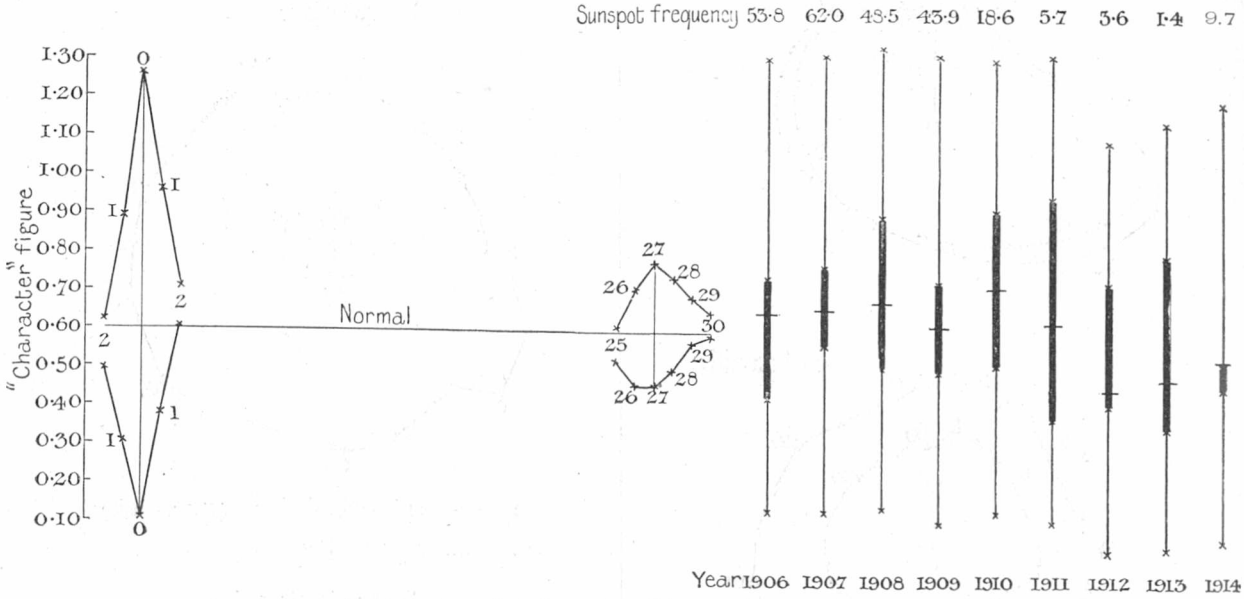

FIG. 4.—27-day period. International "character" figures 1906 to 1914.

pulse is much better developed than the secondary quiet pulse, and 1913 shows the same phenomenon to a minor extent. In 1906, on the other hand, the secondary quiet pulse is the more prominent. In the years 1907 to 1911 the development of the two secondary pulses is very similar.

A good deal probably remains to be done to unravel the exact nature of the relationship between sun-spots and magnetic phenomena. There can scarcely be any doubt that the range of the mean diurnal variation for the whole year varies from year to year in almost exactly the same way as the mean sun-spot frequency or the sun-spot area. Also the two phenomena exhibit a 27-day period, and to approximately the same extent. In the average year of an 11-year period, 1890 to 1900, the daily range of H at Kew showed a decided tendency to be above its mean value during several successive days subsequent to the appearance of exceptionally large sun-spot area, the maximum in the range following four days after the maximum in the area. The phenomenon, however, did not seem to arise from special disturbance, but rather to be a variant of the phenomenon of large regular diurnal

variation in years of many sun-spots. As regards disturbance, in some years there seems a clear connection with sun-spots, in others little, if any. This is what we might expect to happen if the 27-day periods in the two elements in one year tended to be in phase, and in another year did not. But the 27-day period may be prominent in magnetic phenomena in years when there are almost no sun-spots. Also the 27-day period is exhibited by magnetic calms as well as by magnetic storms, and no one has suggested that limited solar areas can exercise a calming influence on terrestrial magnetism.

On the question naturally of most interest to my audience, whether terrestrial magnetism has any direct bearing on the problems of electrical engineering, a few words must suffice. If wireless phenomena are affected, as has been suggested, by the greater or less conductivity of the upper atmosphere, one would expect them to have certain features in common with magnetic phenomena. In particular, the 11-year period and the 27-day period might be expected to disclose themselves. If these periods affect wireless to anything like the same extent as they do terrestrial magnetism, there should be no great difficulty in establishing the fact, if systematic observations were directed to that end. Another possibility is that means may be developed for utilising some of the power that now goes to magnetic storms. This would naturally be most feasible in high latitudes where aurora and magnetic disturbance are most in evidence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn from the *British Medical Journal* that Prof. Charles Richet, of the University of Paris, has been awarded the State prize for poetry. The subject was "The Glory of Pasteur."

EXAMINATIONS in biological chemistry, bacteriology, fermentation and enzyme action, and in chemical technology will be held in connection with the Institute of Chemistry in October next. The lists of candidates will close on September 12.

DR. A. LAUDER, of the Edinburgh and East of Scotland College of Agriculture, has been elected honorary secretary of the Edinburgh and East of Scotland section of the Society of Chemical Industry, in succession to Dr. J. P. Longstaff, now general secretary of the society in London.

MISS S. E. S. MAIR and Mrs. A. M. Chalmers Watson, on behalf of women medical graduates, students, and their friends, have offered to pay to the Edinburgh University Court within a year the sum of 4000*l.* to defray the cost of undertakings intended to facilitate the medical education of women.

THE following Edgar Allen entrance scholarships are being offered by the University of Sheffield:—Two open to men and women, and two restricted to the "sons of workmen earning daily or weekly wages and foremen of workmen and managers." Each scholarship is of the annual value of 100*l.*, and is tenable for three years.

THE part of the forthcoming calendar for 1916–17 of University College, London, dealing with the faculty of engineering has been published in advance as a booklet. This faculty, including the departments of civil, mechanical, electrical, and municipal engineering, is intended to provide for students wishing to devote themselves to engineering as a systematic training in the application of scientific principles to industrial purposes. The courses of work are suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, Engineering Department of the General Post Office, Department of the Director of Engineering and Architectural Works in the Admiralty, Patent Office, and other similar services. Facilities are provided also in the engineering departments for post-graduate and research work in all subjects of engineering. The more important engineering institutions grant various exemptions to holders of the different certificates awarded by the college. All communications from intending students should be addressed to the Provost.

THE calendar for the session 1916–17 of the North of Scotland College of Agriculture is now available. The classes of the college are held in the buildings of the University of Aberdeen, except those in agricultural engineering, which are held at Robert Gordon's Technical College. The college farm at Craibstone, about five miles from Aberdeen, includes experimental plots, an experimental and demonstration garden, and a horticultural department. Field experiments and demonstrations are carried out on ordinary farm crops. Feeding and other experiments upon stock are conducted, and there are extensive woods, including both conifers and hardwood trees, on the estate, which are being utilised for the purposes of the forestry department. It is proposed to institute a school of rural domestic economy for girls. There is a large mansion-house on the Craibstone estate which will be equipped as a residence in which classes will be carried on. It is proposed to provide courses of instruction suitable for those who intend to spend their lives on farms and crofts. For the instruction of classes in nature-study and school gardening, two acres of ground at Kepplestone, Rubislaw, have been laid out as a demonstration garden.

THE valuable series of papers on the better co-ordination of science and industry read during the last six months before the American Chemical Society was followed by the appointment of a committee, who have now presented a report based on the examination of the subject from three different points of view, viz. those of the university, of the industries, and of the consulting chemists. The report is classified under findings, conclusions, and a single recommendation to the effect that a permanent central committee should be created and appointed by representatives of the universities and the industries to study opportunities and make public recommendations. The distinction is drawn between industrial problems which are common to specific industries, so that research on them can be carried out in universities and published, and those problems which cannot properly be published, and are, therefore, not adapted to university treatment. On the other hand, the industries are asked to make known to the universities problems which are not of sufficient importance to the industry to undertake their solution directly so that the universities can use them as live material on which the students can be trained. The recognition by the university that the industry alone is in a position to state its problems, and by the industry that it should be prepared to give the necessary financial assistance to the university to investigate these, is an important step towards the desired co-ordinated effort. It is pointed out that no matter how efficiently the university may train its men, the industries that take up such men must be prepared to expend much time, effort, and money in training them for the specific work before them, but it is agreed that co-operation between the university and the works as to the requirements of the latter in the fundamentals of instruction seems possible, feasible and mutually profitable. The findings deal with certain controversial points in the educatior

of the technical chemist. For example, the part-time system whereby the summer vacation is spent in the industry is condemned; the value of industrial fellowships is regarded as diminishing as the liberty to publish is restricted. The report is eminently practical, and it will well repay serious consideration in this country.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, May 30.—Prof. W. W. Haldane Gee, vice-president, in the chair.—Dr. W. H. R. **Rivers**: Irrigation and the cultivation of taro. In the New Hebrides and New Caledonia irrigation is only used for the cultivation of *Colocasia antiquorum*, the taro of the Polynesians. This intimate connection between irrigation and taro, which is found in other parts of Oceania, suggests that if irrigation belongs to the megalithic culture (W. J. Perry, Manchester Memoirs, vol. lx., part i.), taro must have had a similar history. The distribution of the plant supports this suggestion, showing a close correspondence with that of the megalithic culture when its tropical and semi-tropical habits are taken into account. It occurs in Oceania, the Malay Archipelago, India and eastern Asia, Arabia, Egypt, East and West Africa, the Canary Islands, Algeria, southern Italy, Spain and Portugal, as well as tropical America. Since the original habitat of the plant is southern Asia, its use as a food was probably acquired by the megalithic people in India and taken by them both to the east and west. Although the general distribution of taro in southern Melanesia corresponds with that of the megalithic influence, a difficulty is raised by the island of Malekula, in the New Hebrides. So far as we know, irrigation does not occur in this island, although megalithic influence is present in a very definite form. To account for the absence of irrigation in this island it is shown that modes of disposal of the dead point to two megalithic intrusions into Oceania, and the high degree of development of irrigation in such outlying islands and districts as New Caledonia, Anaiteum, and north-western Santo in Melanesia, and the Marquesa and Paumotu Islands in Polynesia, suggests that this practice belonged to the earlier of the two movements. There is reason to believe that this movement had relatively little influence in Malekula.—Prof. G. Elliot **Smith**: The arrival of *Homo sapiens* in Europe. At a time when little was known of early man and his works beyond the stone implements which he fashioned, Sir John Lubbock (afterwards Lord Avebury) suggested the use of the terms Palæolithic and Neolithic to distinguish respectively between the earlier part of the Stone age, when crudely worked implements were made, and the later period, when more carefully finished workmanship was shown. In spite of the fact that subsequent investigation revealed a high degree of skill in the craftsmanship of the Upper Palæolithic period, which in many respects shows a very much closer affinity to the Neolithic than to the Lower Palæolithic period, Lubbock's terminology has become so firmly established that it has continued to determine the primary subdivision into epochs of the early history of man. Recent research has brought to light a vast amount of new information relating to the achievements of Upper Palæolithic man, and has conclusively shown that human culture and artistic expression had already attained the distinctive characters which mark them as the efforts of men like ourselves. This view has been amply confirmed by the general recognition of the fact that, after the disappearance of Neanderthal man at the end of the Mousterian period, the new race of men that supplanted them in Europe and introduced the Aurignacian culture conform in all essential respects to our own specific type, *Homo sapiens*. Thus the facts of physical structure, no less than the artistic abilities and the craftsmanship, of the men of the Upper Palæolithic proclaim their affinity with ourselves. The earlier types of mankind which invaded Europe and left their remains near Piltdown, Heidelberg, and in the various Mousterian stations belong to divergent species, and perhaps genera, which can be grouped together as belonging to a Palæanthropic age, which gave place (at the end of the Mousterian epoch in Europe) to a Neoanthropic age, when men of the modern type, with higher skill and definite powers of artistic expression, made their appearance and supplanted their predecessors. So long as primary importance continues to be assigned to the terms Palæolithic and Neolithic, the perspective of anthropology will be distorted. Though the facts enumerated in this communication are widely recognised, it is found that the writers who frankly admit them lapse from time to time into the mode of thought necessarily involved in the use of the terms Palæolithic and Neolithic. If modern ideas are to find their just and unbiassed expression some such new terminology as is suggested here becomes necessary.

PARIS.

Academy of Sciences, July 31.—M. Ed. Perrier in the chair.—At the preceding meeting of the Academy the president, in announcing the death of Sir William Ramsay, gave an account of his work in chemistry.—J. **Bergonié** and C. E. **Guillaume**: Surgical instruments adapted to the field of the electro-vibrator. Ordinary surgical instruments utilised in the field of the electro-vibrator are, like the projectile sought for, submitted to an intense oscillatory movement, a matter of difficulty for the surgeon. To reduce this vibration to negligible proportions, it is necessary that the instruments should be constructed of a metal non-magnetic and of high resistivity. The iron-nickel alloys, containing between 22 per cent. and 30 per cent. of nickel, fulfil these conditions, but offer difficulties in manufacture. Another group of alloys suitable for this purpose contains 90 per cent. nickel, the remaining 10 per cent. consisting of chromium, manganese, and a little copper. Such an alloy, under the name of baros, has been used for some years for weights of precision, and fulfils all the conditions of the present problem; it works like mild steel, is practically unoxidisable, and is free from action in the field of the electro-vibrator.—R. **Garnier**: Study of the general integral of equation (VI.) of M. Painlevé in the neighbourhood of its transcendental singularities.—H. **Arctowski**: The influence of Venus on the mean heliographic latitude of the sun-spots. The earliest communication on this subject was due to Warren de La Rue, Stewart, and Lœwy in 1867, and F. J. M. Stratton has recently taken up the same question. The author does not think the results of Stratton's calculations can be considered as conclusive, and has made a fresh series of calculations based on the Greenwich heliographic observations. It is difficult to decide from the curves whether the action of Venus is direct or the inverse.—A. **Colani**: The oxalates of uranyl and potassium.—C. **Zenghelis**: The composition and use of Greek fire.—F. **Diénert** and L. **Gizolme**: The influence of the algæ on submerged sand filters on the purification of water. The purifying power of these filters is a function of the development and vitality of the algæ, and can be

measured by the reduction of the alkalinity of the water.—J. **Amar**: The dynamographic path. The apparatus described permits of a graphical record being traced of the movement and forces exercised by the limbs in walking. It has been applied to the study of models of artificial limbs, and of pathological cases of injured or missing limbs.—C. **Galaine** and C. **Houlbert**: The removal of flies from houses. The visible part of the spectrum for flies appears to be comprised between the green and the orange. Making use of this fact, coloured glass, especially blue, is suggested for hospitals, and for protecting food in restaurants and shops, without restricting the free access of air.—E. **Fleurent**: A method of preserving bread destined especially for prisoners of war. The method suggested by the author in 1915 has been tried in practice, and its value has been confirmed.—J. **Roubinovitch**: Ocular compression in the examination of the oculo-cardiac reflex.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 7, vol. ii.).—L. B. **Loeb**: The mobilities of gas ions in high electric fields. The results, though at variance with those of most observers at low pressures for negative ions, are in good agreement with recent results of Wellisch, and likewise lead to the conclusion that the "cluster" theory is no longer tenable.—H. H. **Donaldson**: The relation of myelin to the loss of water in the mammalian nervous system with advancing age. There is no evidence that the cell bodies and their unsheathed axons suffer any significant loss of water; the progressive diminution in the water content of the brain and spinal cord is mainly due to the accumulation of myelin, the formation of which is a function of age, the most active production occurring during the first twentieth of the life span.—R. W. **Hegner** and C. P. **Russell**: Differential mitoses in the germ-cell cycle of *Dineutes nigrior*. The most conspicuous difference discovered between the origin of the oocyte in *Dineutes nigrior* and in Dytiscus is in the number of differential mitoses; in *Dineutes nigrior* there are only three, whereas in Dytiscus there are four.—E. S. **Larsen** and R. C. **Wells**: Some minerals from the fluorite-barite vein near Wagon Wheel Gap, Colorado. A description of specimens of the unusual mineral gearksutite, of a peculiar kaolinite, and of a new fluoride-sulphate, creedite.—P. D. **Lamson**: The processes taking place in the body by which the number of erythrocytes per unit volume of blood is increased in acute experimental polycythæmia. It is concluded that the liver acts as a reservoir for erythrocytes. The process by which the liver increases the number of the erythrocytes is thought to be a loss of plasma from the liver capillaries, together with a constriction of these vessels, driving the erythrocytes on into the blood stream.—I. S. **Kleiner** and S. J. **Meltzer**: The influence of morphin upon the elimination of intravenously injected dextrose in dogs. Morphin increases the elimination through the kidneys of intravenously injected dextrose and retards the return of the sugar content of the blood to its previous level.—C. P. **Olivier**: The work of the American Meteor Society in 1914 and 1915. From the 5543 observations of meteors, 139 radiants have been deduced with sufficient accuracy to calculate parabolic orbits for the meteor streams they represent.—A. J. **Dempster**: The light excitation by slow positive and neutral particles. Very slow positive rates are still able to excite light with a speed corresponding to fewer than 5 volts. The neutral rays can also excite light at very slow speeds; the excitation may occur directly because of the collision of a neutral particle with a neutral molecule of the gas.—C. D. **Perrine**: An apparent dependence of the apex and velocity of solar motion, as determined from radial velocities, upon proper motion. The position of the solar apex and of the solar velocity appear to vary with the proper motion of the stars used in the determination. Such variations point ultimately to some form of rotary or spiral motion among the stars.—C. **Barus**: Channelled grating spectra obtained in successive diffractions. A brief abstract of work presented by the author to the Carnegie Institution of Washington.—R. **Pearl**: The effect of parental alcoholism (and certain other drug intoxications) upon the progeny in the domestic fowl. Out of twelve different characters for which there are exact quantitative data, the offspring of treated parents taken as a group are superior to the offspring of untreated parents in eight characters. The results with poultry are in *apparent* contradiction to the results of Stockard and others with mammals, but the contradiction is probably only apparent.—G. H. **Parker**: The effectors of sea-anemones. It seems clear that among the muscles in sea-anemones there are not only independent effectors and tonus muscles associated with nerve-nets, but neuromuscular combinations that exhibit true reflex action.—G. H. **Parker**: Nervous transmission in sea-anemones. There is evidence not only for the assumption of independent receptors, but of relatively independent transmission tracts, a first step in the kind of differentiation so characteristic of the nervous organisation in the higher animals.—G. H. **Parker**: The responses of the tentacles of sea-anemones. The tentacles, in contradistinction to such appendages as those of the arthropods and vertebrates, contain within themselves a complete neuromuscular mechanism by which their responses can be carried out independently of the rest of the animal.—A. van **Maanen**: Preliminary evidence of internal motion in the spiral nebula Messier 101. The mean rotational motion is 0·022″ left-handed; the mean radial motion is 0·007″ outward. There is perhaps a small decrease of the rotational motion with increasing distance from the centre. The annual rotational component of 0·022″ at the mean distance from the centre of 5″ corresponds to a rotational period of 85,000 years.—Symposium on the exploration of the Pacific:—(*a*) W. M. **Davis**: The exploration of the Pacific; (*b*) J. F. **Hayford**: The importance of gravity observations at sea on the Pacific; (*c*) L. J. **Briggs**: A new method of measuring the acceleration of gravity at sea; (*d*) C. **Schuchert**: The problem of continental fracturing and diastrophism in Oceanica; (*e*) J. P. **Iddings**: The petrology of some South Pacific islands and its significance; (*f*) G. W. **Littlehales**: In relation to the extent of knowledge concerning the oceanography of the Pacific: (*g*) C. F. **Marvin**: Marine meteorology and the general circulation of the atmosphere; (*h*) W. H. **Dall**: The distribution of Pacific invertebrates; (*i*) W. G. **Farlow**: The marine algæ of the Pacific; (*j*) J. W. **Fewkes**: The Pacific as a field for ethnological and archæological investigation; (*k*) H. A. **Pilsbry**: Mid-Pacific land snail faunas; (*l*) D. H. **Campbell**: Some problems of the Pacific floras. The symposium contains a summary of some of the results obtained in past exploration of the Pacific and an outline of the importance to many sciences of further systematic and continuous exploration of the Pacific.

CAPE TOWN.

Royal Society of South Africa, June 21.—Dr. L. Péringuey, president, in the chair.—J. D. F. **Gilchrist**: Protective resemblance in post-larval stages of some South African fishes. In *Hemiramphus calabaricus*

the post-larval stages of the fish have the size and colour of fragments of weed, which often are found in the waters which these young fish frequent. When alarmed, the fish become rigid and float about in an apparently inanimate condition. When this occurs, it is difficult to distinguish them from the pieces of weed floating around. In klipfish (*Clinus* spp.) the young are born alive, and they are of a clear, glassy transparency difficult to detect in the water. The contour of the body is probably disguised by a number of minute dark dots. The colour pattern in other young fish is shown to be more marked and considerably different from that of the adult. Some details of this difference are enumerated in the cases of the leerfish and the stockfish and a species of dogfish. It is indicated how this colour pattern of the young fish may be a form of protective resemblance.—H. H. W. **Pearson**: Morphology of the female flower of Gnetum. Much work has been done in recent years on the morphology of the flower of the Gnetales, and very diverse views have been put forward. These are discussed, summarised, and compared in this paper, with special reference to recent investigations by the author and to the conclusions of MM. Lignier and Tison, both as published and as discussed in correspondence with the author. Investigations have tended of late to emphasise the Angiosperm characters of the Gnetales, and MM. Lignier and Tison even reach the conclusion that the innermost envelope of the female flower in Gnetum and Ephedra, and of both flowers in Welwitschia, is a plurilocular ovary containing a single naked ovule. They derive their evidence partly from the anatomical structure of the envelope, partly from its form, terminating as it does in "a long style and a stigma." The anatomical evidence they adduce is discussed in detail, and it is shown that the apparent traces of a vascular system do not necessarily prove the envelope to be an ovary, as well-developed vascular systems are present in the ovular integuments of Cycads and a number of the lower Angiosperms. Regarding the resemblance of the envelope to a carpel with style and stigma, it is pointed out that, external appearances to the contrary, there is no evidence that it is a reduced form of a functional stigma. Its present function is to facilitate the dispersal of pollen by attracting insects, and there is no sufficient reason for supposing that it has ever been concerned in the collection of pollen. The question of the cauline or foliar nature of the Gnetalean ovule arises in this connection; this is discussed in detail, and it is shown that recent investigations tend to confirm the opinion that it is cauline. Finally, the new knowledge furnished by MM. Lignier and Tison for Gnetum is summarised, and their comparisons of the Gnetalean and Angiosperm flowers are reduced to tabular form and correlated with those of other investigators, figures being given to render the comparison and correlation clear.—P. A. v. d. **Bijl**: Heart rot of *Ptaeroxylon utile* (sneezewood) caused by *Fomes rimosus*, Berk.

BOOKS RECEIVED.

The Bearings of Modern Psychology on Educational Theory and Practice. By C. M. Meredith. Pp. 140. (London: Constable and Co., Ltd.) 1*s.* 6*d.* net.

Color and its Applications. By M. Luckiesh. Pp. xii+357. (London: Constable and Co., Ltd.) 16*s.* net.

An Introduction to the Use of Generalized Co-ordinates in Mechanics and Physics. By Prof. Byerly. Pp. vii+118. (London: Ginn and Co.) 5*s.* 6*d.*

Organic Agricultural Chemistry. By Prof. J. S. Chamberlain. Pp. xvii+319. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 7*s.* net.

Practical Mathematics for Technical Students. By T. S. Usherwood and C. J. A. Trimble. Part ii. Pp. x+565. (London: Macmillan and Co., Ltd.) 7*s.* 6*d.*

Historical Synopsis of the Royal Cornwall Polytechnic Society for the Years 1833–1913. By W. L. Fox. Pp. 80. (Falmouth: J. H. Lake and Co.)

Journal of the Institute of Metals. Vol. xv. No. 1. Pp. viii+392. (London: The Institute of Metals.) 21*s.* net.

The Investigation of Rivers. Final Report. Special. (London: Royal Geographical Society.) 3*s.* 6*d.* net.

Preservatives and other Chemicals in Foods: Their Use and Abuse. By Prof. O. Folin. Pp. 60. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 2*s.* 6*d.* net.

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