THURSDAY, MAY 20, 1909.

THE UNIVERSITY TEACHING OF CHEMISTRY.

Leçons sur le Carbone. La Combustion. Les Lois chimiques. By H. le Chatelier. Pp. xiv+456. (Paris: Dunod and Pinat, and A. Hermann, 1908.) Price 12 francs.

THIS is a book which is likely to have a most important influence on the teaching of chemistry, certainly in France, and probably in other countries. The fact that it is the first general treatise on chemistry from the hand of M. le Chatelier is sufficient in itself to attract the attention of chemists. But it is much more than this; it is an attempt to lead a reform of a far-reaching character, to part from traditions honoured by time, and to show university teachers a more excellent way of presenting the essential science of chemistry to the ever-increasing number of students who come to them for guidance. It is very rarely that a book on general chemistry appears which exhibits anything like the individuality that is to be found in M. le Chatelier's new work, one that is at the same time so free from extravagance in developing a new idea, and one, it may be added, that is so entirely worthy of study by all who have the duty of teaching chemistry.

According to M. le Chatelier, the system of teaching inorganic chemistry in France has been completely unchanged for three-quarters of a century. In 1825, Gay-Lussac and Thénard inaugurated what was then a new treatment of the subject, and this was stereotyped in the text-book of Regnault founded on his notes of Gay-Lussac's lectures. Whilst Lavoisier had treated chemistry primarily as a body of principles and generalisations, the new system regarded it primarily as a classification and description of substances. The only attempt to break away from the tradition is due to Mendeléeff, whose treatise is arranged on an entirely special plan. In pleading for a change of our methods, M. le Chatelier admits that chemistry cannot be placed in the same position as physics. It is impossible merely to lay down general principles and tables of constants; chemistry must still include the enumeration of a host of detailed facts, methods of preparation, methods of analysis, methods of manufacture. It is to be remembered that this is not in itself science, but mere documentation, and that it is the body of chemical principles which really constitutes the science of chemistry. Since 1825 a revolution in chemical knowledge has taken place by the discovery and application of the laws of chemical mechanics, and to this full effect should be given in the courses of chemical instruction. Special chapters dealing with these matters are, indeed, commonly included in the text-books, but whereas the subsequent detail of the books is permeated by the laws of quantitative composition, no such general application is made of the laws of chemical dynamics.

There is a second matter of importance that leads the author to depart from established custom. Higher scientific teaching to-day has not, he says, the exclusive aim of training future teachers; the majority of students will spend their lives in quite different fields—medicine, agriculture, industry. The instruction given in universities ought to be so conceived as to fit people for doing their best for themselves and their country in the particular sphere they will occupy. It is necessary, above all, to form *des ésprits pratiques*. It is often said with some justice that scientific teaching does not develop good sense; it produces too often, not men of action, but *théoriciens, des ésprits faux*. Scientific instruction is, in fact, essentially analytic; it regards things too much in one aspect at one time. In speaking of the electric conductivity of copper we ignore deliberately its other properties, and yet in all the electrotechnical uses of copper we cannot get rid of the existence of mass, specific heat, tenacity, &c., nor prevent them from exhibiting themselves sometimes in a most embarrassing manner. Some examples of industrial science should be introduced into a scientific course to direct the attention of students to the complexity of the actual phenomena, to the importance of applying the details of knowledge and sifting them according to their relative practical importance for achieving the end in view. The usual superficial description of industrial processes is not enough; it is merely a part of general culture.

"Il faut avoir vu, sinon en nature, au moins en image, un haut fourneau, une chambre de plomb, une cornue Bessemer, au même titre que des tableaux de Raphaël, l'arc de Triomphe, ou la Tour Eiffel, mais ces descriptions rapides n'ont aucune valeur didactique, elle ne peuvent contribuer ni à la formation intellectuelle, ni au développement des aptitudes professionelles."

M. le Chatelier insists again and again on the fruitfulness of a close association between theory and practice. Lavoisier, he says, was led to his great work by taking part in an open competition for a better system of lighting Paris. His constant preoccupation with practical questions—the making of plaster of Paris, the exploitation of coal mines, the metallurgy of iron, the manufacture of gunpowder, the organisation of hospitals, agriculture—enabled him to escape without effort from the fictions and conventions amid which the chemists of his day simply marked time. Similar remarks apply to Carnot, Deville, Pasteur, and others.

M. le Chatelier has some trenchant and timely remarks to make about another aspect of chemistry. The science, he says, is suffering from a very grave malady, *le surmenage*. Since chemistry has begun to afford a remunerative calling, chemists have betaken themselves to an intensive cultivation, seeking at all costs to make discoveries which shall create a title to promotion—quantity, from their point of view, superseding quality. To happen upon a substance sufficiently devoid of interest to ensure that, in all probability, no one else will examine it for a decade, procures a situation free from all anxiety; the mistakes will not be discovered before the published work

has produced its useful effect. From this point of view, organic chemistry, with its innumerable compounds, offers precious opportunities, but inorganic chemists also, though less favourably situated, are too often led into this artificial adding to the number of real substances. Taking a large general treatise on chemistry, M. le Chatelier hazards the opinion that at least half the substances described have never had any existence. It is, therefore, of great importance to give young chemists a timely respect for exactitude, to accustom them, not only to make measurements, but to discuss their degree of precision and to criticise systematically every experimental result.

With regard to the use of hypotheses, M. le Chatelier is no less decisive. He dispenses with all hypotheses relating to the constitution of matter. These hypotheses, he says, can render great service to a trained mind that will use them as tools, to be cast aside when they are no longer useful; in the instruction of young minds they are dangerous, as tending to *imprecision*, which is the most redoubtable enemy of science. Too often one comes to believe firmly in these products of imagination, to bandage one's eyes and blind oneself to the most evident experimental facts. When we see what has become of the two fluids of electricity, of the projectiles of the emission theory of light, of the india-rubber molecules of Berthollet, of the indivisible atoms of Dalton, we have a right to entertain some anxiety about the future in store for ions and electrons.

The text of M. le Chatelier's book is a verbatim report of his first course of lectures on general chemistry in 1907–8, given at the Sorbonne, where he occupies the place of Moissan. Probably few chemists would care to have their wisdom offered to the world in this way, and it is to be hoped that few will do so. But it is not too much to say of this particular case that one can only rejoice in the author's lack of time to give the book the revision which he contemplated, for its supreme value lies in the reflection it gives of the living teacher. It is a good deal to say of a book on chemistry that it is human, at least in any other respect than in being tinged with error, but M. le Chatelier's book is human in exhibiting, not only the mind, but something of the personality of one of the greatest contemporary chemists, and assuredly of a very exceptional and inspiring teacher.

The aim of the book is to use carbon and some of its inorganic compounds as a vehicle for imparting the essence of modern chemistry. The chapters bear the following headings :—Henri Sainte-Claire Deville—Moissan; propriétés physiques et chimiques; combustibles; chauffage, pouvoir absorbant, allotropie; carbures métalliques; acide carbonique; carbonates métalliques; oxyde de carbone; combustion des mélanges gazeux; origines de la chimie; résumé des lois de la mécanique; lois de la mécanique chimique; lois pondérales de la chimie; poids moléculaires et poids atomiques; détermination expérimentale des poids moléculaires.

The treatment of these topics is in accordance with the general principles which have already been indicated. The choice of carbon as the central subject is, of course, arbitrary. It may be defended on several grounds, and doubtless it may be criticised on others, but it must be remembered that M. le Chatelier lays down no law about such choice. It is the method and spirit of the treatment that are all-important, and in choosing carbon the author brings himself into the region where his own researches have given him quite exceptional knowledge and authority. We feel that we are reading something altogether different from the compilations to which we are so inured, and that the author is imparting what he has made his own. It is for this reason that it is impossible in the present notice to give any adequate idea of the quality of the book.

No doubt there is much left out in the way of facts that many people would consider very important, but M. le Chatelier has boldly faced a problem that confronts every teacher, and has refused to carry on the burden of teaching all that convention sanctioned a generation ago along with the vast accumulation of new things that have since come to light. Much of the old matter of chemical books and chemical lectures has become relatively unimportant, and may well be left to take care of itself. Nowadays a man may be an excellent chemist, and withal profoundly ignorant of cadmium and its compounds, of the various formulæ proposed for bleaching powder, of the methods of analysis of German silver, and of a thousand other things which were the common stock of his immediate scientific ancestors.

The criticism, exhortation, and censure to be found in M. le Chatelier's book are no doubt primarily addressed to his own countrymen, but they are applicable elsewhere. Perhaps more has been done than M. le Chatelier implies to alter the form and substance of introductory university courses of chemistry. Prof. Ostwald's "Inorganic Chemistry" and Prof. Alexander Smith's recent work are, perhaps, the most notable books indicative of a movement that is probably existent in many university centres, but to judge from examination papers the old order still largely prevails.

There is no doubt a national genius which exhibits itself in science as in other domains of thought and action. M. le Chatelier's book displays this scientific genius of his country in its classic form.

"Les uns," he says, "ne trouvent à la vérité toute sa grâce que lorsqu'elle est parée d'ornéments à la mode du jour, d'autres préfèrent admirer sa fière beauté dégagée de tous voiles. À chacun la liberté de prendre sa joie où il la trouve."

The Frenchman, with a language incomparable for expository uses, can tell us the plain truth without the chill that is associated with our own "dry light." He is apt, perhaps, to lay a little disproportionate weight on the achievements of his own countrymen, and this tendency appears in M. le Chatelier's book to an extent that may provoke some readers. But in all other respects there can be no question that a strict fidelity to facts characterises the book from cover to cover.

ARTHUR SMITHELLS.

THE FLOWERING PLANTS OF AFRICA.

Die Blütenpflanzen Afrikas. Eine Anleitung zum Bestimmen der Gattungen der Afrikanischen Siphonogamen. By Franz Thonner. Pp. xvi+672; with 150 plates and 1 map. (Berlin: R. Friedländer und Sohn, 1908.) Price 10 marks.

THIS is not the first attempt by the author of making keys on a large scale. In 1895 we had from him an "Analytical Key to the Natural Orders of Flowering Plants," in 1901 an "Excursionsflora von Europa," essentially a key to the genera of the flora of Europe, and now we find him directing his energy in the same way to the whole of the phanerogamic flora of Africa and the African islands. If we consider that this flora includes 262 families and 3648 genera, the formidable character of the task becomes at once apparent. No one can possibly claim an intimate knowledge of so vast a number of genera, and if some one came near to it he would probably be the last to care for the work. In fact, if the thing is to be done it is just as well that the author should not know too much of the details and of the real complexity of the problem. General and rather extensive than intensive familiarity with the families, sound judgment in the selection of the authorities which supply the material for the key, method, good memory, and infinite patience will further the work more than anything else.

The book is distinctly one of those which must be tried, and frequently tried, before it is possible to judge whether they serve their purpose or not. In this instance the object aimed at is to provide the traveller or colonial in Africa, as well as the student outside Africa, with a key for the easy and correct determination of the generic names of the African plants. A general inspection of the book and occasional checking on some of the more puzzling genera have certainly created the impression that the author, to a considerable degree, possesses the qualities necessary for the task he has set himself. There are, of course, blemishes and weak points; but they are practically unavoidable, and it would be ungracious to insist upon them. On the whole, the key—or, rather, the system of keys—works well enough. Nobody expects more than a certain amount of guidance from a key of such dimensions, particularly when applied to a flora so rich and in many aspects still imperfectly known. The difficulties with which the key-maker has to contend arise mainly from the overlapping and the varied combinations of characters, the sexual heteromorphism and the dicœcism of flowers, and the so-called anomalous forms; they are smaller towards both ends of the taxonomic ladder, but really formidable where the families are concerned. This accounts, no doubt, for the fact that dichotomous keys to families on a large scale have so seldom been attempted. To devise such a key purely on the basis of affinities, and so that the units follow the same sequence as in the system, is impracticable, and the author has very wisely not hesitated to break up the families whenever necessary, and to let them or their components come in where the characters which were found most workable bring them in. But if twenty-seven families of Choripetalæ are cut up, each into from six to fourteen parts, and therefore appear in as many different places in the key, one cannot help thinking that the author has gone too far. The same applies to a still higher degree when we find relatively so homogeneous families as the Ericaceæ, Apocynaceæ, and Convolvulaceæ each in eight to ten places, and the small families of the Pedaliaceæ and Plantaginaceæ in six and seven places respectively. It ought to be possible to focus, if I may say so, those families far better. The author has freely used combinations of characters, and, although much more rarely, conditional alternatives. The key-links are in this way apt to run into several lines, and we may occasionally get impatient over having to read through them; but it pays in the end, whilst those terse and trim apodictic keys which play with pairs of contrasting characters, and allow barely one line to each link, generally break down in practice.

In establishments with large herbaria, where the naming of African plants is part of the regular routine, there will probably be little demand for the book. On the other hand, it ought to prove very useful where the workers, without being especially familiar with the African floras, have occasionally to "run down" members of those floras, and particularly so when the plants belong to families which have been dealt with in the early volumes of the "Flora of Tropical Africa" and the "Flora Capensis," volumes which for completeness have long been out of date. It is, however, a very different question whether the ordinary botanically inclined traveller or colonial will benefit very much by the book. As it covers Africa from Algiers to Cape Town, and from the Canaries to Madagascar, a very great portion of the work must for either of them necessarily remain ballast, and the traveller especially will feel little disposed to burden himself with an extra 4½ lb. on the chance of worrying out a few generic names which he can, after all, not verify on the spot. There remains of field-workers only the professional collector, and he will probably find it quite worth his while to take the volume with him, provided he grasps the purely German terminology, which, with the Latin equivalents, is explained in a glossary at the end of the book.

The conception of the families and genera is, as might be expected, that of Engler's "Natürliche Pflanzenfamilien," and in so far quite up to date, whilst the recent English literature has perhaps been considered less fully, witness, for instance, the retention of the West Indian genus Biovularia. A peculiar feature of the work is the addition of not fewer than 150 plates representing types of as many distinct families. They are throughout originals, and many, if not most of them, portray species which had not been figured previously. The habit figures which we owe to the skilled and artistic draftsmanship of Herr J. Fleischmann are as charming as they are exact. They alone are worth buying the book for. Analyses are added in all cases. They are, on the whole, satisfactory; but the absence of all lettering

of parts, even in cases of complicated figures, will occasionally be felt as a great drawback. The volume also contains a map of Africa, with Engler's "Florengebiete und Provinzen," and a census of the African flora, as compared with that of the whole world. The figures, especially for the species, are, of course, mostly approximate, but even so the totals are interesting enough to be quoted, namely:—Genera (of Siphonogams or Phanerogams) for the whole world 9942 (species 136,000); Africa 3486 (species 38,600); North Africa 981 (species 4850); Tropical Africa (continental) 2185 (species 18,300); Mascarenes and Madagascar 1266 (species 5950); South Africa 1393 (species 13,300).

The publishers deserve great credit for the excellent get-up of the book and the astonishingly cheap price. Taking the book as a whole, it is remarkable as a feat of painstaking industry, and it bears witness to the extraordinary development of the botanical exploration of Africa during the last twenty or twenty-five years, and to the general interest in its flora; but, after all, on laying down the book one cannot quite resist a suspicion that so much labour, so much skill, and last, not least, so much knowledge, might have been applied to a more lasting purpose than the making of a stupendous key which in five or ten years may be out of date.

OTTO STAPF.

SOCIAL PSYCHOLOGY.

Völkerpsychologie, eine Untersuchung der Entwicklungsgesetze von Sprache, Mythus und Sitte. By Wilhelm Wundt. Zweiter Band, Mythus und Religion, Dritter Teil, 1909. Pp. xii+792. Price 18 marks. Dritter Band, Die Kunst, second edition, 1908. Pp. x+564. (Leipzig: W. Engelmann.) Price 12 marks.

THIS encyclopædic work, of which we have here two volumes, is a prolegomena to sociology. Wundt is tracing the evolution of language, art, myth, religion, and custom from their beginnings to the civilisation of the present day. In his own phrase, he is giving us a study of the development of "mental communities," those "changing pluralities of mental unions which are interlaced in the most manifold ways and become more and more numerous as development progresses."

The basis of such development is language.

"The prime necessity of every mental community at its beginning, and a continually operative factor in its further development, is the function of speech. This is what makes the development of mental communities from individual existences psychologically possible. . . . It becomes the indispensable form for all the common mental contents. These common contents, or the mental processes which belong to the whole community, may be divided into two classes, which are merely interrelated components of social life. . . . The first of these classes is that of the common ideas, where we find especially the accepted conclusions on the questions of the content and significance of the world—these are *the mythological ideas*. The second class consists of the common motives of volition, which correspond to the common ideas and their attending feelings and emotions—these are *the laws of custom*."

The whole mental development of man in society is thus schemed out, with language as its essential condition, into mythology and religion, decorative, pictorial, and plastic art, epic, lyric, and romantic literature, dance, music, opera, mime, and drama; the result is a philosophy of culture based on the latest psychological principles.

The greater part of the study naturally is occupied with the earlier stages of development, but each form of mental activity is followed right up to the present time. In one volume, for instance, we may find an exposition both of primitive magic and of latter-day pragmatism and modernism.

The author omits nothing of importance; recent and ancient theories are assigned positions according to their relevance; the facts selected are generally well chosen. The whole work, encyclopædic as it is, has the unity of one mind—that of the greatest of psychologists.

It is significant to compare the author's treatment of ethnographical data with that of the majority of anthropologists to-day, and with that of Tylor and Spencer some years ago. Spencer applied the exact psychology of his time to the data for his sociology; Tylor treated the data for his primitive sociology in an acute but inexact method, the result being that the conclusions of the amateur have outlasted those of the professed psychologist. In the interval of thirty years or so psychology has been revolutionised and become more and more an exact science. It is, of course, the only concrete science. Its predominant importance to-day is due to Wundt himself above all. In these volumes we have, for the first time since Tylor and Spencer, a scientific analysis of the development of culture; carried out by a psychological instrument far surpassing theirs in exactness and precision, the analysis is correspondingly a great advance. Comparing it with the anthropological work of the day, it is to be regretted that so much of the latter has no psychological value. The author shows on every page—*solvitur ambulando*—that the only sound results producible for anthropology are those which are based on psychological evidence. He has pointed out to anthropologists "the only way."

At the same time, the anthropologist may regret that the author has not driven his analysis more deeply and more searchingly in various directions. To do so is more than can be expected of one man, but perhaps a reduction of the historical description and an amplification of the psychological analysis would have been more useful to science. For instance, a closer analysis of the facts of animism and fetishism is much to be desired. There is considerable obscurity about the origin of these tendencies. They are, as a rule, slurred by students, or receive an additional superstructure to crown an edifice built upon misconception and pseudo-science. The author should be better able than any man to give a final explanation of spiritism, but he has not done so.

Again, in reference to the mythologic process, his position is that in the function which gives rise to all mythological ideas we have a characteristic kind of apperception belonging to all naïve consciousness, and suitably designated by the name personifying apperception.

"Myth-making or personifying apperception is not to be regarded as a special form or even as a distinct sub-form of apperception. It is nothing but the natural inceptive stage of apperception in general."

There is nothing to complain of here, in this illuminating identification of primitive mythological impulse with primitive apperception, except the term "personifying." For the sociological amateur the term "personification," and its connotation to the effect that early man assigned a human personality, with sensations, feelings, and volitions, all human, to everything in nature, from the mammoth and the lion to the humblest insect, and not only this, but to all inanimate objects, all processes, from the sun and the moon to the sand on the sea-shore, from the thunder and lightning to the rustling of a leaf—this has been an intellectual fetish for too long. But unless the author's meaning has been misunderstood, it would seem that he has not reached the true explanation, simple as it is, of the facts which gave rise to this easy result of "mythology in science." We still need an exact demonstration by psychology of the mental habits of early man in the direction of animistic and personificational beliefs.

The content of the social mythological consciousness is huge. Wundt, we are glad to observe, emphasises the predominance of the motive of "luck" in *Märchen*, fable, and saga. Here the free mental activity connects with the economic basis of life, which, by the conditions of the work, is not brought forward to any great extent. The hypothesis of an original monotheism or crypto-monotheism is rejected. The complex origin of religion is fully discussed, and its development is traced to the present day. Popular Christianity as tritheism, Christianity as a religion of feeling and will in contrast to intellectualistic systems like Buddhism, are among the interesting side-issues which the author follows out.

The origin and function of art supply a peculiarly fruitful field for psychology. It is interesting to notice that from Aristotle onwards the criticism of this expression of mind has been in striking contrast to that of other expressions in its freedom from metaphysical prejudice. The theory of art has been studied more or less empirically from the beginning.

"Play," as Wundt remarks, following the well-established opinion, "is the mother of art." As a motor-expression of ideas art is in interesting connection with cult and custom. Like everything else, it has its historical and its psychical origin. Thus, the Greek drama has its historical origin in the religious play, its psychical origin in imitation and catharsis. Aristotle gives us both; we mention his explanation by way of directing attention to the modern development in psychology of his original idea. He would recognise in the present analysis of the play-impulse his own germ-idea in a complete differentiated form.

In the description of early forms of art, significant tendencies are well illustrated. Its momentary character and its frequent bondage to assimilation are interesting peculiarities. For instance, the double-formed objects of Egyptian and Assyrian art are equally prevalent in savagery. The curious tables made out of animals with flat backs; the decorative motive of the alligator in Chiriqui art; the Gorgon series in Greek sculpture, are well-chosen types.

The dramatic magical plays of the Central Australians deserve analysis. Is not also the theory of sexual selection still to be reckoned with in the origin of art?

These are but "requests for more" where so much is given. Science owes a debt to one of her greatest intellects for this application of his psychology to the concrete mental history of the world.

A. E. CRAWLEY.

THE RIDDLE OF OLD AGE.

The Problem of Age, Growth, and Death: a Study of Cytomorphosis. By Prof. Charles S. Minot. Pp. xxiii+280. (London: John Murray, 1908.) Price 6*s*. net.

FROM the time of Cicero, perhaps before, the problems of longevity and of the cause of old age have again and again been subjects of speculation. Not long ago, Metchnikoff, in his optimistic work, "The Nature of Man," ascribed old age to a poisoning by bacterial poisons developed as a result of fermentations occurring in the large intestine. The effect of this poisoning is to produce a weakening of various cells and tissues, which then become a prey to the scavenging cells of the body, the phagocytes.

Prof. Minot, in the work under review, develops another conception of the nature of "growing old." Although in old age a condition of atrophy is frequent, and various degenerations of cells and tissues are usually present, in particular of the arterial system, so that it has been said "a man is only as old as his arteries," Prof. Minot combats the view that old age is a kind of disease, and regards it as a necessary consequence of the changes in the cells of the body, which are inevitably progressive from birth to death; this succession of cellular changes is termed "cytomorphosis." In the development of his subject, the author first discusses the rate of growth in the embryo and in the young after birth. The rate of growth, very rapid at first, becomes slower and slower, and with the progress of growth various structural changes in the cells can be demonstrated to occur. These changes always progress, and ultimately end in degeneration and death, so that even at the period when the body is most vigorous, cellular death is of constant occurrence. The rate of growth is instructively illustrated by tables and curves of the height and weight of boys and girls, and of the weight of rabbits, guinea-pigs, and chicken at various age periods. It is shown that the greatest

percentage increase of weight after birth occurs in those animals which are born least mature. Thus in the guinea-pig, which is born in a relatively mature state, the daily percentage increment of weight just after birth is 5 per cent., while the rabbit, which is born much less mature than the guinea-pig, daily adds 17 per cent. to its weight. In embryonic life, cellular division and increase in weight are still more marked, and Prof. Minot estimates that 98 per cent. of the original growth power has been lost at birth, and the power of growth becomes less and less as age advances.

Differentiation and rejuvenation of cells are next considered. In the embryo the cells differ but little from one another; they do not display structural differentiation, whereby it could be said from what part of the embryonic body they were derived; while in the adult the microscopic characters of a cell generally suffice to determine its place of origin. Moreover, with the differentiation of cells with age, the protoplasm increases in amount relative to the nucleus. The conception is therefore reached that the growth and differentiation of the protoplasm and relative diminution of nuclear matter are the cause of the loss of the power of growth.

If cells suffer from old age as their protoplasm increases and becomes differentiated, a general and progressive process in the individual, there should be some mechanism for rejuvenation; this the author regards as accomplished by the segmentation of the ovum, during which process an *increase* of nuclear matter takes place at the expense of the protoplasm. The author believes that there is no satisfactory evidence that the progeny of old cells (other than of the ovum) can resume the primitive state and undergo re-differentiation. In cases in which regeneration of excised parts, &c., is effected in the individual, *e.g.* in planarians and ascidians, the regenerated part is always the product of undifferentiated cells, and is not derived by the growth of the old tissues.

The usual method of rejuvenation adopted by nature is by the separation of cells in the primitive and undifferentiated condition, and their isolation as the germ or sex cells. Age then represents the result of a progressive cytomorphosis of which death is the culmination. Longevity, the duration of life, depends, therefore, upon the rate of cytomorphosis, which varies much in different species, and perhaps in different individuals of the same species. Whether rejuvenation can be improved and senescence delayed are questions to which the author gives no definite answer, though he surmises that in the future it *may* be possible to increase the activity of nuclei and prolong the younger system of organisation. Death he regards as acquired during the process of evolution in consequence of cytomorphosis. As organisation becomes higher and higher, the need for differentiation becomes greater; this involves the end, and death is the price we have to pay for the differentiation which exists in us, and to which we owe our great array of faculties!

This, in brief, is the argument of Prof. Minot, which is presented in an attractive form with many appropriate illustrations, and we have perused this work with considerable interest. Finally, a suggestion of some importance is made. The author develops the conception that not only physical but also psychological development is most rapid in early life, and progressively declines as age advances. He suggests, therefore, that the tendency there is in some quarters to postpone the period of learning is wrong, and that as much use as possible should be made of the early years of life. R. T. H.

THE SONGS OF BIRDS.

Kunst und Vogelgesang in ihren wechselseitigen Beziehungen von naturwissenschaftlich-musikalischen Standpunkte beleuchtet. By Dr. B. Hoffmann. Pp. ix+230. (Leipzig: Quelle und Meyer, 1908.) Price 3.80 marks.

THIS is the most interesting book on the songs of birds that has appeared since the late Mr. C. A. Witchell published his "Evolution of Bird-song" in 1896, and it excels that work both in soundness of judgment and in knowledge of music. Its object, however, is not quite the same as that of Mr. Witchell's volume (which does not seem to have fallen into Dr. Hoffmann's hands); the latter was an attempt to trace the development of song from call- and alarm-notes, and also from imitation of natural sounds, while Dr. Hoffmann's work may be described as an essay on the relation between the music of birds and the music of art.

For dealing with this subject the writer is evidently well qualified; he is clearly a close observer of all sounds made by birds in their wild state, and wisely abstains from making use of the music of birds in captivity, and at the same time he is quite at home in the subtleties of the musical art. The result is that we have here no foolish attempt to represent the music of birds on our musical scale, except in a few cases where it is possible to do so as a means of illustrating certain points rather than as an exact reproduction of the notes of the singer. For Dr. Hoffmann is well aware that the great majority of singing birds do not use the intervals of our scale, though he is right in claiming that a few occasionally do so. So, too, in a very interesting section on rhythm in song, he denies that it is to be found in any sense in a great number of songs, while rightly asserting that it is present in those of certain species, such as quail, great tit (Kohlmeise), wood-pigeon, and song-thrush.

In another section (pp. 99–122) he asks the question how the bird comes by a sense of rhythm, and, rejecting Bücher's theory that rhythm in music can be traced to the movements of the body, he is disposed to think that in the case of birds it has its origin in the action of the heart; but this is a delicate question, for which the reader must be referred to the author's own statement of it. Dr. Hoffmann also discusses the question of "Metrik" in bird-song, *i.e.* Can the strains sung by any birds be divided into feet or bars? On p. 84 foll. he maintains that in the song of the nightingale, the most highly

developed singer of all, this quality can be found as well as rhythm and invention. Whether we agree with him or not in some of these details, it is a pleasure to be able to say with confidence that all he writes deserves careful study, for which every conscientious ornithologist will be the better.

The only thing that seems wanting is a discussion of the *quality* of tone (not quantity) in various species. Thus the formal likeness between the songs of the chaffinch and the willow-wren is noticed (p. 31), but nothing is said of the fact that they are produced by totally different instruments. To the ear of the present writer the songs of both species of redstart are "played" on an instrument which no other bird possesses. We would suggest that Dr. Hoffmann should add a section on this subject in another edition, and shorten, if need be, the discussion at the end of the volume on the use made by musical composers of the songs of birds, which is only of incidental interest. Before leaving this interesting work, which well merits translation into English, it may be as well to say that the author is disposed to reject Darwin's theory of the development of song by sexual selection, and to hold that the root of it is to be found in the enjoyment of life and the love of play, especially, but not entirely, in the breeding season. W. W. F.

OUR BOOK SHELF.

The Scientific Aspects of Luther Burbank's Work. By D. S. Jordan and V. L. Kellogg. Pp. xiv+115. (San Francisco: A. M. Robertson, 1909.) Price 2 dollars net.

THIS is a small book, consisting of two papers reprinted from the *Popular Science Monthly*, describing and appreciating the work of the great American plant-breeder. It is attractively illustrated by photographs, and is intended for the general as well as the scientific reader.

Luther Burbank was born in 1849, and after a local education started life in his uncle's plough factory. He soon gave this up for market gardening, and in 1875 moved to Santa Rosa, California, where he has since worked on a large scale, and produced many new and important varieties, both of fruits and flowers. He has discovered no new laws, but his results are so obviously successful that it is interesting to know the methods by which they have been obtained. Like most practical men, he is a firm believer in the heritability of the direct effects of environment, but he makes most use of the indirect ones—the "indefinite variations" of Darwin—and recognises as their chief cause the re-combination of characters consequent on hybridisation, and, in a lesser degree, on cross- or self-fertilisation.

The first step in the method usually followed is the inducing of these variations by nutritive changes or by the crossing of forms as widely separated as is compatible with fertility. The useful variations are then accumulated by stringent selection until they become fixed. Mr. Burbank finds that six generations are generally sufficient to accomplish the process. He holds that there is practically no limit to the results which can be obtained by unassisted selection, and many of his size and colour varieties of flowers have been obtained by this method alone. Sometimes, on the other hand, a new variety is produced by the careful propagation, without much selection, of one individual which showed a fortunate mutation. The Burbank stoneless plum is an example of the effective combination of the three processes of searching for natural mutations, hybridising, and selection. A plum was found in a small wild species with only part of a stone. This species was crossed with the French prune, and some of the offspring found to be quite stoneless. Further selection is still increasing the proportion of stoneless, and at the same time large, fruits. The desirable qualities of two varieties can generally be combined by crossing; indeed, some of the offspring often possess a quality in a higher degree than either of their parents. Some of the photographs illustrating the increase of size in fruits show this in a striking manner.

We do not for a moment doubt that Mr. Burbank has "a broad intelligence and a sensitive soul." If he is also "as sweet, straightforward, and as unspoiled as a child," it is just possible that he can stand being told so. But his portrait is so singularly charming that it might have been left to speak for itself.

Text-book of Petrology, containing a Summary of the Modern Theories of Petrogenesis, a Description of the Rock-forming Minerals, and a Synopsis of the Chief Types of the Igneous Rocks and their Distribution, as illustrated by the British Isles. By Dr. F. H. Hatch. Fifth edition, revised and rewritten. Pp. xvi+404. (London: Swan Sonnenschein and Co., Ltd., 1909.) Price 7*s*. 6*d*. net.

THIS new edition of a well-known text-book for students marks a decided advance on its predecessors. It is clearly written, well illustrated, and has, as a rule, been brought up to date.

There is a brief but readable account of the eutectic theory of the process of crystallisation of igneous rocks, as well as of the different explanations which have been offered of the formation of porphyritic crystals.

The descriptions of the rock-forming minerals are in most respects accurate and sufficient. The author disclaims any intention of dealing with the optical determination of minerals, but as he makes use of the interference colours for the purpose of estimating the birefringence, he might with advantage have gone a little further and shown how easily an approximate quantitative determination of the relative retardation and birefringence may be made. Such expressions as "weak," "moderate," "very strong," "polarising in grey tints," "brilliant chromatic polarisation," though commonly employed, have very little scientific value, especially when the variation in thickness of rock-slices, even by good makers, is considered. In the same way, if the angle of extinction be employed for determinative purposes, the student should be taught to discriminate between the positive (slow) and negative (fast) directions of extinction. The statement that "between crossed nicols the rhombic pyroxenes extinguish of course straight" is too sweeping. Certain directions of section show quite an appreciable angle of extinction.

The author adopts analytical formulæ for the rock-forming minerals, a procedure which is justified by the clearness with which the composition is indicated and the ease with which it is remembered, but it may be noted that the abbreviation "Ab" for albite represents, not $Na_2O.Al_2O_3.6SiO_2$ as stated, but half that formula.

The primary classification of igneous rocks into plutonic, hypabyssal and volcanic, which is adopted, is sanctioned by almost universal usage, though it is as unreasonable as a fundamental division of the vegetable kingdom into roots, stems, and leaves. Each class of rocks is separated into families and types,

with the definition of which little serious fault is, in most cases, to be found, though there may often be room for difference of opinion.

Perhaps the most valuable feature is the section which describes the distribution of igneous rocks in the British Isles, and the maps, mostly taken, by permission, from well-known papers, with which it is illustrated.

The work may be safely recommended as a text-book for students, but they should be warned against the employment of the numerous little-known and unnecessary rock-names to be found in its pages. In almost every case the same idea can be more happily expressed by prefixing a word or phrase to a well-established name. Their presence, however, undoubtedly increases the value of the book as a work of reference. J. W. E.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. vii. Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xv+709; plates cviii–cxxii; 184 text-figures. (London: Printed by Order of the Trustees, 1908.)

IN no group of animals and plants is the enormous increase in our knowledge more conspicuous than in insects. Thus, at the time of the publication of the twelfth edition of Linné's "Systema Naturæ" (1767), we find only 112 species described under Noctuæ. Sir George Hampson now divides the family Noctuidæ into fifteen families, of which the first three are Agrotinæ, Hadeninæ, and Cucullianæ, the species belonging to each being described in vols. iv.–vi. of the general "Catalogue of Moths" respectively, and vol. vii., now before us, forms the first of three volumes intended to be devoted to the fourth subfamily of Noctuidæ, the Acronyctinæ, and includes descriptions of species numbered from 2748 to 3590, a considerable number of which (and also many genera) are described as new by the author.

It is possible that all the remaining families of Noctuidæ may not require a whole volume apiece, and it would be difficult to estimate the total number of Noctuidæ which the present work is likely to contain when completed, but it can scarcely be less than 20,000 species, and may well be 30,000, or even more, as against the 112 species which were all that were known to Linné, the most learned entomologist of his time, in 1767.

We notice no alteration in the general arrangement of the work, and the usual high standard of letter-press and illustrations is fully maintained in the present volume.

Physikalische Musiklehre. Eine Einführung in das Wesen und die Bildung der Töne in der Instrumentalmusik und im Gesang. By Dr. Hermann Starke. Pp. viii+232. (Leipzig: Quelle and Meyer, 1908.) Price 3.80 marks.

THIS little work on the physical theory of the nature and production of musical sounds is almost entirely free from mathematics, and may be regarded for the most part as an abstract of the simpler portions of Helmholtz's great classic, "The Sensations of Tone." The text is, however, freely illustrated by cuts, many of which, the author acknowledges, are borrowed from other books; thus at every few pages may be found an old and familiar figure.[1]

The treatment is divided into five parts or chapters. Of these the first and second are occupied with the origin and propagation of waves and sound, while the third describes musical tones, intervals, and scales. The fourth chapter consists of four parts, dealing respectively with (i.) stringed instruments, (ii.) wind instruments, (iii.) vibrating bodies with inharmonic overtones, and (iv.) human speech and song. The last chapter is devoted to consonance and dissonance, and after giving Helmholtz's theory concludes with a *résumé* of more recent work on the subject. This part includes notices of intermittence and variation tones, and of the work and theories of C. Stumpf.

To those who wish for a bright, readable treatment of this borderland between music and physics, free from mathematics, but with the opportunity of improving their conversance with German, this book is heartily recommended. E. H. B.

[1] Perhaps it is this practice which has led to the representation of a metal *strip* vibrating like a *string* (p. 22), for the same error occurs in Tyndall's "Sound" (p. 128), 1895.

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.*]

Electrons and the Absorption of Light.

ON the theories of dispersion given by Drude and Lorentz, an absorption band in the spectrum corresponds to the free period of an electron, and, if we assume that only one electron in each molecule is concerned with an absorption band, it is theoretically possible to calculate e/m for this electron from the values of the coefficient of extinction throughout the band. I have made this calculation, apparently for the first time, using the formula

$$\frac{e}{m} = 1{\cdot}297\ \nu R \frac{\lambda_1 - \lambda_0}{\lambda_0^3},$$

which may be derived on both the above theories. R is the maximum value of the coefficient of extinction, λ_0 the position of the maximum, λ_1 the wave-length, for which the coefficient of extinction has a value equal to half its maximum, and ν the index of refraction. The following table gives some results:—

Substance	λ_0	e/m	Source of data
	$\mu\mu$		
Fuchsin in alcohol	550	$1{\cdot}8\ 10^7$	Stanislaw Kalandek
Phloxin in water	515	$1{\cdot}4\ 10^7$	
Crystal violet in alcohol ...	575	$4{\cdot}9\ 10^7$	*Phys. Zeit.*, 9 Jahr., s. 128–35
Corallin in alcohol	465	$1{\cdot}6\ 10^6$	
Methylene blue in water ...	665	$5{\cdot}4\ 10^6$	
Water blue in water	575	$8{\cdot}1\ 10^6$	
Eosin in water	515	$6{\cdot}9\ 10^6$	
Eosin in water	516	$9{\cdot}2\ 10^6$	Georg. J. Katz
Cyanine in alcohol	587	$5{\cdot}8\ 10^6$	Inaug. diss., Erlangen, 1898
Cobalt chloride in water ...	504	$2{\cdot}5\ 10^3$	Houstoun and Russell
Uranyl nitrate in water ...	486	34	Proc. Roy. Soc. Edin., vol.
	473	75?	xxix., part ii., p. 68
Three glasses coloured with CoO	644	$5{\cdot}0\ 10^4$	R. Zsigmondy, *Ann. d. Phys.* (4), 4, 1901, s. 60
	631	$3{\cdot}0\ 10^4$	
	640	$3{\cdot}0\ 10^4$	Figures taken from curves
Two glasses coloured with Cr_2O_3	620	$3{\cdot}2\ 10^4$	
	655	$1{\cdot}2\ 10^4$	
Three glasses coloured with NiO	640	$1{\cdot}3\ 10^4$	
	640	$1{\cdot}0\ 10^4$	
	610	$1{\cdot}1\ 10^4$	

For the anilin colouring matters e/m is of the order 10^7, whereas for the glasses and inorganic salts it is of the order 10^4 and under, showing that in the one case we are dealing with electrons and in the other with ions. A calculation made by Drude from the dispersion of solid cyanine in the neighbourhood of its band gave $e/m = 8{\cdot}5 \times 10^6$. If there are two electrons for each of the original molecules of the colouring matter the values of e/m should be halved, or if there is only one electron for two molecules the value of e/m should be doubled. According to Kalandek, corallin probably undergoes some change in solution. This may account for the low value of e/m.

These results cannot be obtained on Planck's theory.

I hope shortly to publish a full account of the assumptions involved in this calculation, together with additional results. R. A. HOUSTOUN.

Physical Laboratory, University, Glasgow, May 14.

Dimensional Changes produced in Iron and Steel Bars by Magnetism.

WHILE engaged on research work of an engineering nature, I came upon some facts with regard to the behaviour of magnetism on iron and steel bars in the semi-plastic state beyond the yield point that I am unaware have been noted before. I propose, therefore, to give a brief account of the experiments carried out and the results obtained, on the chance that they may prove of interest to others who have time to pursue the matter further.

A specimen of mild-steel about 18 inches long, ¾-inch diameter, and 8 inches between gauge points, having been fixed in the jaws of the testing machine, was surrounded by a solenoid, and a current supplied sufficient to cause magnetic saturation. The specimen had then a tensile load applied to it in the usual way until it ruptured, the magnetism being kept at the saturation point all the time. Other bars were then tested, with and without magnetism, and in the result it was found that the magnetised bars were distinctly less in length between gauge points than the unmagnetised—in other words, that the elongation was less in the first case than in the second.

In order to make the comparison as fair as possible, and to eliminate the effects of difference of composition and of manufacture, the specimens for each experiment (consisting of the rupturing of one unmagnetised and one magnetised specimen) were each cut from the same bar. A few of the results are given in the table below. These were taken at random from a large number of examples, and will serve to give some idea of the nature of the changes. The material in each case (with the exception of experiment No. 10, in which it was wrought iron) was ordinary mild-steel taken from bars about 12 feet long, just as they were delivered to the laboratory.

No. of experiment	Diameter of specimen (inches)	Extension on 8" length bar Unmagnetised	Extension on 8" length bar Magnetised	Decrease in extension	Percentage decrease in extension	Breaking load (a) Unmagnetised (b) Magnetised	Maximum load (a) Unmagnetised (b) Magnetised
1	¾	2·6	2·19	0·41	15·8	(a) 18,680 (b) 18,845	(a) 26,185 (b) 25,910
2	¾	2·5	2·25	0·25	10·0	(a) 18,080 (b) 18,800	(a) 26,115 (b) 26,040
3	¾	2·5	2·25	0·25	10·0	(a) 18,960 (b) 18,970	(a) 26,170 (b) 25,930
4	¾	2·5	2·25	0·25	10·0		(a) 26,240 (b) 26,100
5	¾	2·65	2·35	0·30	11·9	(a) 20,030 (b) 20,130	(a) 26,580 (b) 25,400
6	¾	2·45	2·25	0·20	8·2	(a) 18,630 (b) 18,120	(a) 26,770 (b) 26,290
7	⅞	2·55	2·43	0·12	4·7	(a) 23,030 (b) 23,000	(a) 33,300 (b) 33,000
8	⅝	2·5	2·35	0·15	6·0	(a) 12,950 (b) 13,010	(a) 18,500 (b) 18,400
9	1	2·5	2·25	0·25	10·0	(a) 38,680 (b) 36,210	(a) 51,360 (b) 50,515
10	⅞	2·2	2·15	0·05	2·3		(a) 30,900 (b) 30,900
11	1	2·5	2·31	0·19	7·6		
12	¾	2·4	2·25	0·15	6·2		
13	¾	2·38	2·28	0·10	4·2		
14	1	2·63	2·35	0·28	10·6		

Units = inches and pounds.

The results may be summarised as follows:—

(*a*) The amount of the decrease of elongation caused by the magnetism varies from about 3 per cent. to 16 per cent.

(*b*) The composition of the steel, its hardness, &c., affect the amount of the decrease of elongation.

(*c*) The average maximum load without magnetism seems higher than the average maximum load with magnetism.

(*d*) The average breaking load without magnetism seems lower than the average breaking load with magnetism.

(With regard to (*c*) and (*d*), nothing definite can be put forward, as it is an extremely difficult matter to gauge the maximum and breaking points to a hundred pounds or so on a 70-ton testing machine.)

(*e*) Careful measurement shows that, after rupture, the magnetised specimen is thicker all over its length than the unmagnetised, but that the greatest difference is at the place of local extension. This points to the likelihood that the magnetism hinders the flow of the metal, and that this hindering action begins just after the yield point is reached, and attains its maximum value at local extension. This is also brought out in the case of the experiment with wrought iron (No. 10), which shows on fracture numerous planes of cleavage that no doubt hindered the formation of "waist," and caused the relatively small decrease of elongation.

The following are readings, taken inch by inch, between 8-inch gauge points on ¾-inch mild-steel specimens cut from the same bar:—

After Rupture.

	1st inch	2nd inch	3rd inch	4th inch	5th inch	6th inch	7th inch	8th inch
Unmagnetised ...	1·24"	1·26"	1·30"	1·38"	1·70"	1·36"	1·24"	1·20"
Magnetised	1·20"	1·23"	1·28"	1·50"	1·50"	1·26"	1·24"	1·20"

The unmagnetised specimen broke almost exactly between the fourth and fifth inches, and the magnetised at the end of the fourth inch.

It was thought possible that if the diminution in elongation were due to the magnetism hindering the flow of the metal, tests on a Brinell hardness testing machine might give some results, but though many were carried out, nothing decisive was obtained. A few compression tests were also made, but insufficient to give trustworthy data. W. J. CRAWFORD.

Municipal Technical Institute, Belfast.

"Blowing" Wells.

IN a village about three miles from Norwich, and situated about 140 feet above sea-level, there are three of these "blowing" wells. They are, roughly, about 100 yards apart, and each is 3 feet in diameter and from 70 feet to 80 feet in depth. When last opened, some years back, they were found to be empty of water. One of them was then domed over with an iron dome, which after a time blew off owing to the pressure of air (or other gases) within the well. The other two wells have since been domed over in a similar manner, but it was necessary to insert a 3-inch ventilation pipe into the dome in each case because of the great pressure of air that sometimes accumulates within.

Observation shows that this pressure is sometimes positive for several consecutive days, and that the air then comes out of the ventilation pipe with considerable force, so much so that, in the case of one well which has a grating over the end of the pipe, the well "roars" so loudly that it can be heard for a distance of several yards. At other times the pressure in the well is negative, and then leaves and other débris get sucked into the grating. There is a strong belief, locally, that an accurate forecast of the weather can be gauged by the intensity of the "blowing." I have never heard or read of similar "blowing" wells, and it is difficult to assign an adequate explanation for this alternating positive and negative pressure in the well. Can there be any connection between the blowing and changes in atmospheric pressure, as is locally supposed, or do the rise and fall of the level of the water in the river Yare (which is about two miles distant, and is at this point only about 4 feet above sea-level) have any possible effect on this curious phenomenon?

Norwich, May 3. SYDNEY H. LONG.

THE USES AND DATES OF ANCIENT TEMPLES.

I PROPOSE in the present article to make some very general statements concerning the work so far done on the orientation of ancient temples, and to bring together some of the chief conclusions to which it has led.

I may begin by stating that the inquiry has been carried on at intervals during the last nineteen years—that is, since March, 1890—when I observed the magnetic bearing of the temple axis of the Parthenon. From 1891 to 1894 the research was almost entirely limited to Egypt. "The Dawn of Astronomy," published in 1894, gives the result.

The first definite conclusion arrived at deals with the use of the temples; why they were built, and for what purpose. It was found that the Egyptians carefully built their temples so that the rising and the setting of certain stars, and of the sun at certain times of the year, could be watched along the temple axis by the priest in the sanctuary.

It was not until after my first winter in Egypt that I learned that Nissen, of Bonn, had anticipated me in suggesting that this might have been so, and that several references to the practice which I had made out occur in the inscriptions.

One of the chief difficulties in the Egyptian work arose from the fact that in most cases the date of the foundation of the temples was unknown. There were, however, some notable exceptions where the results of the orientation theory could be compared with records, and in these there was a perfect agreement, which also enlightened us on the method employed by the Egyptian astronomer-priests for reducing to a minimum the disadvantageous effects of the change of the places of stars brought about by the precessional movement.[1]

The next conclusion dealt with the actual astronomical observations made by the ancient Egyptians. They were of three classes:—(1) To determine the time at night. The stars used for this purpose I have called "clock-stars." (2) To observe a star rising or setting "heliacally"—that is, about an hour before sunrise on the chief festivals. (3) To determine when the sun had reached a certain part of its yearly path at which the festivals occurred.

For (1), as they had no instruments, they used a star rising near the north point of the horizon, and watched its movement round the pole; one quarter of its path would, of course, represent six hours, and so on. The stars so used were the brightest ones in the Great Bear and the Dragon. Stars rising near the south point of the horizon were also observed, and, doubtless, for the same purpose. For (2) any bright star rising or setting at the proper time between the north and south points would do; as a matter of fact, they used Capella, Spica, the Pleiades, Sirius, α Centauri, Canopus, and others. For (3) they commenced with a year beginning in May—the "May year," the first used in Britain, and still determining the quarter-days in Scotland; later they passed to the "solstitial" year, June 21, the beginning of the Nile rise and the longest day, being the *new* new year's day. This is the origin of our present English year.

The inquiry thus begun in Egypt was subsequently carried on in Greece by Mr. Penrose with admirable results, because there he was able to deal with temples the foundation dates of which are known within narrow limits.

The first attempt to apply the orientation theory to British monuments was made by Mr. Penrose and myself in 1901 at Stonehenge.

At the first blush there appears to be no resemblance between the Egyptian and Greek temples and the British stone monuments, but a careful study of both shows that this view is an erroneous one.

The study of the British monuments from the astronomical point of view has enabled us to grasp one object which, in spite of their varied forms and complexities, they all had to fulfil. It also enables us to *classify* them, and this classification not only suggests the order of their evolution, but shows their strict relationship to the Egyptian temples. This was the next advance. The demonstration is as follows.

The simplest of our ancient British stone monuments is represented by what is called a stone-row or avenue; good examples of these are to be seen at Merrivale; one is a single line of stones; the other is a compound avenue consisting of two double lines of stones running parallel with each other at some distance apart. The most famous compound avenue in our own country is that of Challacombe, on Dartmoor, which consisted once of eight rows of stones. I am sorry to say only two or three rows now remain.

Avenues were in some cases built of earth instead of stones; one at Stonehenge can still be studied; it extends towards the north-east from the centre of the temple and naos.

The next form we have to consider after the avenue is the cromlech or dolmen—that is, the skeleton of an old barrow. Here again we get the gradual elaboration from a single cromlech to compound ones. A good example of the former is that at Trevethy, in Cornwall. In this, which consists of very large stones, the only entrance into the chamber is provided by a small portion cut out at the bottom corner of one of the stones. There is another very good example called the Devil's Den, near Avebury, which is rather more simple than the cromlech at Trevethy. It consists of one big stone supported by three others.

Another kind of monument called a cove must be regarded as an uncovered cromlech. It consists of three stones occupying three sides of a square, the open side indicating the direction; the finest example is at Avebury.

Cromlechs do not always occur singly. At times they are compounded into pairs or triplets, as at Plas Newydd.

We next find a combination of the avenue and cromlech. In this form the direction of the opening of the cromlech is defined by marking and extending it with a double line of stones. We thus get a creep or alley-way, or *allée*, as the French archæologists call it, and this may be either open or covered—*allée ouverte* or *allée couverte*; fougou is the Cornish term for the latter form.

The best example that I have seen of this combination of avenue and cromlech in Britain is that at Bryn Celli Ddu. This, like the avenue at Stonehenge, looks out to the north-east of the horizon; in fact, it is practically parallel to that avenue. The most perfect example of a barrow containing a cromlech with an alley-way is at Maeshowe, in the Orkneys. The cromlech is in the centre of a still existing mound; it is a very elaborate one, with side

[1] In two instances of the dedication of the same temple to different stars at widely different epochs, the orientation theory tells us that the temple of Denderah was built either to observe the rise of the principal star in the Great Bear in 4950 B.C. or the principal star of Draco in 3100 B.C. or both; the inscriptions tell us that the temple was founded in the times of the Shemsu Heru before Mena, whose date, according to Budge's "History of Egypt," was 4400 B.C., and was afterwards restored by Pepi, whose date, according to the same authority, was 3233 B.C.

At Annu there was a restoration of an old temple by Usertsen (2433 B.C.). The story is told in a roll still extant. The theory tells us that, as at Denderah, this restoration was undertaken to watch the rise of the principal star of the Dragon in 2500 B.C., the restored temple having been originally founded to watch the rise of the principal star of the Great Bear in 5200 B.C.

(sleeping) chambers and a small chamber at the end, and a long alley-way which points to a menhir not far away called the "Barn Stone," and to the place of sunset in December, twenty days from the winter solstice.

The most compound example of avenues and cromlechs that I know of as yet is one of which photographs and particulars have recently been sent to me by Captain Devoir, of the French Navy; in it we have three cromlechs and three alley-ways, using the same outlook, and, doubtless, once covered by one barrow.

One alley-way is directed to the sunrise in May, another to sunrise at the winter solstice, and there is another directed to a "clock-star" rising near the north point, so that, in association with one barrow, we have three distinct and well-marked alleys in directions with which we are perfectly familiar.

This oneness of aim which the orientation theory enables us to discover leads us further.

In the avenues, alley-ways, and cromlechs we are absolutely face to face with the ground-plan of Egyptian temples, so much so that there can be no question that those who built those magnificent monuments in Egypt some 2000, 3000, or 4000 years B.C. got their ideas of the buildings they wished to erect from the traditions of people who built cromlechs and who had lived in and used them.

A general plan of Thebes shows how in Egyptian architecture, in a country of wonderful civilisation, large population, and infinite wealth, we get a tremendous elaboration of the avenue; each temple is provided with one, long or short, leading outwards from the pylon.

The avenue, which in our case is built of rough stone, is elaborated into long lines of beautifully carved sphinxes, and, further, if we study the most elaborate Egyptian temples, we see there are, in the temple itself, very many openings in one straight line in various walls; in some places we have an *allée ouverte*, and in others an *allée couverte*.

These all lead to a closed chamber at the end, a darkened chamber, the naos or the holy of holies, which is nothing but a glorified cromlech.

The temple access never pierces the end of the closed chamber any more than the wall was pierced at the back of the cromlech, but it led to a darkened chamber, so that here we have the closest possible relationship from the architectural point of view between the British cromlech and the most elaborate temples at Thebes, while from the astronomical point of view the similarity of use is obvious.

So much, then, for the intimate connection between the avenue and the cromlech, however simple or complicated either may be, and the strict relationship of both to the Egyptian temples.

But there is another and completely different set of ancient monuments still to be classified. I refer to circles, which, like the avenues and cromlechs, may be simple or compound. Archæologists so far have not noticed the close relationship of circles with avenues and cromlechs, for the reason that the circles to which their attention has been almost entirely confined only represent one part of the apparatus. When we consider a circle *and its outstanding stone indicating a certain direction*, the strongest astronomical resemblance to the alignments of avenues and cromlechs is at once apparent.

There is no doubt that the circle represents an enormous advance in astronomical knowledge, possibly, to a certain extent, connected with the building conditions brought about by the poverty or the economical ideas of the people who constructed them. In densely populated and rich Egypt a temple was devoted to the rising or setting of one heavenly body, whether star or sun, the place of rising or setting being indicated by the long temple axis, and each sacred place contained many such temples, because there were many heavenly bodies to be watched. The temple of Amen-Ra, if contracted for now, could not, I fancy, be built for less than 5,000,000*l.* sterling, and it might take ten or fifteen years to erect. But it simply had one outlook, one use.

Now, to carry on this method of observation and worship where the population was scarce, the best and cheapest thing to do would be to build a bank or set up a line of stones to represent a temple axis, or to build a circle to represent a sanctuary, and from its centre to imitate various temple axes by sight-lines marked out by a stone or barrow at some distance outside the circle. Six such outstanding marks, each of stone set up in a day or two, would then replace, and quite effectually from the astronomical point of view, six majestic temples taking tens of years to build, and the elaborate system of avenues and cromlechs represented by all the temples at Thebes or in any other locality, however numerous.

Only the holy of holies as a dark chamber would have to go; the centre of the circle would replace it as the priest's place. That was a matter for the priests, and had nothing to do with astronomy. In any case, *from the astronomical point of view*, what was done by the Theban priests by building all these majestic temples could be done by one circle with properly arranged outstanding stones, so that the circle represents a distinct advance over the idea connected with the avenues and the cromlechs.

We shall not, then, be far wrong in supposing circle building to represent a later development, and this view is strengthened by the fact that there are no circles in Egypt, where the avenue-cromlech system is most developed.

The next upshot of the inquiries arrived at, soon after I had measured several stone monuments in Cornwall and on Dartmoor, was that the directions indicated by the avenues, cromlechs, and circles with outstanding stones were certainly not helter-skelter. When they were classified it was found that only a small number of directions was used—that is to say, directions embracing sunrise and sunset throughout the year, and directions to the north or south parts of the horizon which the sun never reaches.

Next it was found that these directions were practically the same, and had the same uses, as those I had previously studied in Egypt—in short, that the British avenues and stone circles bear precisely the relationship to the Egyptian temples indicated above. The "clock-stars" used in the British monuments were the precise equivalents of the stars in Ursa Major and Draco used by the ancient Egyptians, when we take the difference of latitude between Egypt and Britain (25°) and the effect of the precessional movement on the declination of the star into account. The same may be said of the "morning stars" they employed.

These "morning stars" were of very great importance. We are familiar with them from Bible references. These were stars which rose about an hour before the sun itself rose. In the earliest times there were sacrifices, and the morning sacrifice was a very elaborate affair, which required about an hour for its preparation, so that unless the priest could get some idea of the time of the actual sunrise some hour or so before the sun itself rose, he might go very wrong, and be either too early or too late at the moment of the rise of the great luminary. When the align-

ments to the places of the sun at different periods of the year were investigated, another conclusion of first-rate importance was arrived at.

At first the all-important positions of the sun, as indicated by the alignments, were not the solstices or the equinoxes, but at intermediate points when the sun occupied the declinations 16° 20′ N. and S. The year was thus defined by the sun's stations in May, August, November, and February.

This I have called the "May year," a vegetation year. I think it must be acknowledged that one of the most important results of the new method of looking at monuments has been the demonstration of the existence in early times in Britain of a year which began in May or November and ended in November or May; and this, one of the teachings of the monuments touching our early history, will in the future greatly help folklorists and others interested in antiquity and the dawn of the so-called Celtic literature. There is now no doubt, after the researches of the Rev. J. Griffith, that the Welsh Gorsedd circle brings before us, in stone, traditions of a time when the May year was in vogue.

The reason that we had that year before we had the real astronomical year, which works from the solstices in June and December to the equinoxes in March and September, is that the worship and *use* of the sun began before the length of the year had been made out, and that the worship was at its highest in Babylonia and Egypt at the time the sun was giving to us the most that it could give—that is to say, the harvests of the fruits of the earth.

The earliest temple that I know of directed to the May sun is at Memphis, which must date from some 4000 years B.C., and it may well be that at that time little was known about the length of the year, because it looks very much as though the Theban cult was established at Thebes as opposed to Memphis some 2000 years after the date I have mentioned, simply because the Egyptian astronomers had then found out the length of the year and had begun to use it.

One reason why they reckoned their year from solstice to solstice, which is what we do now, was probably because at the solstice the sun rises at the same place on the horizon for three days, whereas the determination of the exact position of the sun on May 6 or March 21 is a matter of difficulty as compared with the determination of the solstice. When Mr. Penrose and myself were making observations, we were led to the belief that the present Stonehenge, with its complete sarsen stone circles, is relatively a modern affair, and that there had been at Stonehenge, long before the sarsen circles were erected, an old temple directed to the "May year." I have since found in many cases traces of the "May year" anticipating the solstitial year. The solstitial cult in Britain followed the "May year" cult, just in the same way as in Egypt the solstitial cult at Thebes followed the "May year" cult at Memphis and Heliopolis.

In relation to the sun's seasonal times, then, we find temple axes, avenues, and circles with outstanding stones indicating the direction in which sunrise or sunset was to be looked for at the critical times of the year—that is, the beginning of May, August, November, and February, dealing with the May year, and the longest and shortest days of the solstitial year.

In connection with these solar alignments, evidence is forthcoming that in some cases warning was given of the chief festivals by erecting stones marking the sun's sunrise place from some twenty-one days before they occurred. It is thus possible that the structure of the Roman calendar with the 21 *dies ante calendas* and the ecclesiastical period of Lent, which was originally of three weeks' duration, may have had their origin in the stone-circle practices.

The next main conclusion derived from the work has to do with the dates of erection of the various monuments. With regard to these, I limit myself now to Britain.

The determination of dates is rendered possible by the change of the declination of the sun at the solstices and of stars, brought about by astronomical causes into which we need not now enter. This declination, indeed, is constantly changing, but we have, thanks to the researches of Stockwell and Dr. Lockyer, tables of the declinations of the solstitial sun and of the principal stars, century by century, as far back as 4000 B.C. It is fortunate that, to determine the declination to which the direction of each monument corresponds, very simple observations alone are required. It is as well to recapitulate them here. First, the exact direction of the temple axis or avenue, or of the outstanding stones or barrows, as seen from the circle, in astronomical terminology their azimuth, is obtained by measurements made at the actual monument or on the 25-inch Ordnance map. The angular height of the horizon on this line has next to be measured. With these *data* and the latitude, the declination (that is the distance from the equator) of the body observed along the sight-line indicated can be calculated. The solar group of monuments practically does not help us with regard to dates, for the reason that the change in the position of the sun every succeeding 1000 years is very small, but the change in the position of the stars every 1000 years, or even 300 years in some cases, is considerable, so that in the matter of dates we are thrown back almost entirely upon the stars. Still, there is one solar temple so perfectly arranged at Stonehenge that it has been possible to suggest the date for it within something like 200 years; the measures of that, quite independently of any view determined from other considerations, gave us about 1680 B.C. for the erection of the solstitial sarsen stones at Stonehenge.

Observations have been made at a large number of monuments in Britain during the course of the last three or four years, by the help of a great many friends in different regions, who find it a very pleasant occupation for their holidays. Already something like 140 or 150 alignments of avenues or of cromlechs, or of outstanding stones, have been measured, and 113 results have already been tabulated. These are as follows:—

SUN	May	15
	November...	9
	Summer solstice	17
	Winter solstice	11
STARS	North clock-stars Arcturus	24
	,, ,, Capella	13
	South clock-star α Centauri	6
	Warning stars Pleiades	16
	,, ,, Antares	2
	Total ...	113

It will be seen how overwhelming the evidence is becoming that blind chance had nothing to do with the setting out of the various alignments, how they all fall into a few definite groups, and how the large mass of evidence now accumulated entirely justifies the conclusions derived from those first placed on record.

With regard to the dates given later on, all

are approximate only; there is nothing perfect about them. The Welsh Commission and the other commissions will, I hope, make measures, using solar instead of magnetic methods, and determine the height of hills in minutes instead of half degrees, and if they do that these dates will certainly be changed, though they cannot be changed very much.

I have already shown that the May year and the solstitial year had temples sacred to them in Egypt. I may now add that in the Egyptian temples we found one set for the northern stars, the equivalents of Arcturus and Capella, and another set for the southern stars, among them α Centauri. One of the most recent results of this inquiry has been that we have found a number of avenues, *not circles*, in Brittany and in different parts of Britain, *not in Cornwall*, the equivalents of the Egyptian temples aligned to the southern stars. The probable alignment corresponds with the southern star α Centauri. There is the Challacombe avenue on Dartmoor, the Borobridge avenue near Harrogate, and others at Avebury and Shap.

Now if we deal with the "clock-stars" in order of date, α Centauri comes first, B.C. 3600–2700. This is followed a thousand years later by Arcturus, B.C. 2600–1350, and Capella, B.C. 2250–1250. In all these cases there is a complete series of dates from one end to the other. Now these are the "clock-stars."

Coming to the warning stars, it will be noted that the Pleiades were observed rising, and Antares setting, heliacally—that is, about an hour before sunrise. The dates are:—Pleiades, B.C. 2120–1000; Antares, B.C. 1720–1310.

We see that about the same dates are involved as those found in connection with the northern "clock-stars," and this, of course, strengthens the view that we are really dealing with alignments set out for a definite purpose at a definite time. The story, then, is that astronomer-priests familiar with Egyptian methods began work here by building avenues in different parts of Britain about 3600 B.C.

The star employed as a "clock-star," then, was α Centauri, one of the stars used in Egypt. This cult was succeeded by another, in connection with which circles were introduced and northern "clock-stars" were used. This was the chief cult in Cornwall from 2600 B.C. onwards.

If we accept the dates thus astronomically revealed by the stellar alignments, several interesting consequences follow. The British circles were in full work more than a thousand years before the Aryans or Celts came upon the scene, if the time of their arrival favoured by archæologists is anything like correct. Stonehenge began as a May temple—a British Memphis—and ended as a solstitial one like that of Amen-Ra at Thebes. Another conclusion is that, whatever else went on some four thousand years ago in the British circles, there must have been much astronomical observation and a great deal of preparation for it. Some of the outstanding stones must have been illuminated at night, so that we have not only to consider that the priests and deacons must have had a place to live in, but that a sacred fire must have been kept going perpetually, or that there must have been much dry wood available. The question, then, is raised whether dolmens, chambered barrows and the like were places for the living rather than for the dead, and, therefore, whether the burials found in some do not belong to a later time.

The determination of dates, in conjunction with the conclusions arrived at concerning the various kinds of monuments, opens up another point of view which possibly in the future may lead to fruitful inquiries.

Why have we in different temple regions such great differences in the relative numbers of avenues, cromlechs, and circles, the extreme case being that only one class is represented?

When the order of the evolution of the different classes of structure is settled, the geographical distribution of them may lead us to further conclusions. The tremendous development of avenues in Brittany and in some parts of Britain where circles are almost entirely absent suggests that a people came here who knew nothing about circles, but did know much about avenues. These in Britain to which I refer were on a scale almost rivalling that of the Brittany avenues. The avenue at Shap was more than a mile long, that at Borobridge was nearly a mile long, and some of the stones were more than 20 feet high. The avenue at Challacombe must, when complete, have been a most stupendous monument. Further, the builders of all these worshipped a southern star; they were not miners, they did not go to Cornwall, and there is a difference of more than 1000 years in the dates derived from these avenue-builders and from the circle-builders of Cornwall and South Wales.

It may be worth while to refer briefly to some of the objections still urged against the orientation theory by those who are either unwilling or incompetent to test it by actual observations.

One is that there are so many stars that any alignment is certain to hit the rising- or setting-place of one of them. The fact that, with all the host of heaven to choose from, only six stars were used, and those among the brightest visible in these latitudes, and, further, that a good reason has been found for using those particular stars, is a strong argument against this objection.

Another objection made is that the theory demands a much greater knowledge of astronomy than the early temple-builders were likely to possess.

Those who put forward this objection entirely forget the conditions under which early man lived and moved and had his being. The conditions now are so different that we must not be astonished at the early peoples apparently behaving like astronomers; they could not behave like any other kind of men. The movements of the sun by day and the movements of the stars by night were the only things they could learn about, and it was imperative that they should learn about them.

People without almanacks and without any idea of the length of a year would find life absolutely impossible, at all events from the agricultural operations point of view, unless they could get, somehow or other, a general means of telling when they should plough and sow and reap. That depends upon the time of the year, and the time of year is written out very large indeed to anybody who will take the trouble to note where the sun rises. Similarly, if these people wanted to know about the flow of time at night, they would be under very great difficulties. In the first place, they had no clocks, so that unless they could get some idea of the time at night by observing the stars they would be entirely out of it so far as the lapse of time during the obscured part of their lives was concerned.

It no doubt is difficult for the average Englishman of the present day, unless he happens to be a sailor, to picture to himself a townless world without artificial light and any useful purpose served by looking at the sun by day or the stars at night. Calendars,

almanacks, clocks, and watches have done away with the necessity of using his eyes in this direction, and the modern priest, like the modern layman, though he prates about the heavens declaring the glory of God and the firmament showing His handiwork, too often does not know that the sun rises to the eastward, and, if he does, he imagines that it rises in the same place all the year round; *natura rerum* does not interest him.

The ancient priest need not have been a profound astronomer to build the monuments, which were simply calendars. I do not mean to say they were calendars and nothing more, but they were, from an astronomical point of view, simply calendars, enabling people to know and recognise from past experience the different parts of the year by the place of sunrise or sunset, and they were also night-dials, enabling them to differentiate between the early and the late hours of the night.

In my inquiry I have not confined myself to the astronomical side of the question. I have tried to dip into the folklore and tradition already garnered in relation, not only to the sacred stones, but to the sacred wells and sacred trees.

From what I have learned I am convinced that much light will be thrown on both when an attempt shall have been made to picture what the lives of the first British astronomer-priests must necessarily have been.

It is interesting to note that, while the astronomical side of the inquiry suggests a close connection with Egyptian thought, the folklore and traditions, when studied in relation with the monuments, indicate a close connection between the ancient British and the Semitic civilisations.

I do not wish for one moment to suggest that the work in all these various kinds of monuments was limited to practical astronomical purposes. Our traditions render that view impossible. There was worship in its highest forms, perhaps in its lowest forms; there was magic, there were all sorts of things going on in relation to the wants of the people, and it was because there were some people who did know all that was required to meet general and special needs, including their agricultural wants, that they eventually became priests, because they were the *men who knew*, and that I believe to be the origin of priestly power throughout the world.

This work, if subsequently confirmed by other investigators, has the double advantage of supplying us pretty accurately with the date of erection of the monuments and of indicating the methods of observing the movements of the sun and stars employed in Britain in prehistoric times; and if risings and settings were so abundantly utilised—for utility as well as priestcraft was certainly at the bottom of it—in Britain four thousand years ago, the remarkable testimony to the knowledge and wisdom of the "Druids" given by Cæsar and Pomponius Mela two thousand years nearer their time is now seen to be amply justified.

Multa praeterea de sideribus et eorum motu, de mundi magnitudine, de rerum natura, de deorum immortalium vi ac potestate disputant et juventuti tradunt.—Caes. De Bello Gallico, VI., c. 14.

Hi terrae mundique magnitudinem et formam, motus coeli ac siderum, ac quod dii velunt scire, profitentur.—Pomp. Mela, II., c. 2.

The "Druids" of Cæsar's time were undoubtedly the descendants of the astronomer-priests some of whose daily work has now perhaps at last been revealed.

NORMAN LOCKYER.

RECENT STUDIES ON ANIMAL AND PLANT LIFE.[1]

(1) THE second volume of "Nature-study" consists of three parts. The first of these is composed of chapters by Mr. O. H. Latter on sundry disconnected topics—some insects, centipedes, spiders, a mussel, and a snail. The second, written by Miss Newbigin, treats of fresh-water and marine aquaria. The last describes the haunts of animals and methods of field observation. It is due to Prof. Arthur Thomson. With such able coadjutors, the editor could hardly fail to produce a work of permanent value and of practical suggestiveness. The articles, taken singly, are excellent. The subjects are treated with accuracy and first-hand knowledge; practical difficulties are faced and often solved; lines of thought are suggested from a single fact. The only thing lacking is a better coordination between the topics, and the want of it has led, in this volume, to a regrettable amount of repetition. Mr. Latter describes, for example, the water-beetle and its life-history. Miss Newbigin repeats the story in connection with aquaria, and Prof. Thomson refers to it again in dealing with fresh-water faunas. Thus we have five figures of the same beetle and four of its larva (not always consistent). It is called Dyticus at first and Dytiscus afterwards. Repetition also occurs in text and figure as regards the gnat, the pond-mussel, certain fish and hydroids. The text in other respects is not edited with care. Thus, with respect to the keeping of the pond-mussel, two of the contributors make contrary statements. These blemishes apart, the work is one that will give much pleasure and information to students of animal life, and stimulate to closer observation. The illustrations are of unequal merit, and many might have been saved or greater variety employed by a keener editor. The anatomical diagram at the commencement represents the structure of the pond-mussel.

(2) Prof. Kellogg, following in the footsteps of Fabre, gives a delightful series of episodes in the life of American insects. These have been told so well by his predecessors that it is difficult to introduce any novelty or charm to the description. But the visitations of insect pests in America give the author an opportunity for some new matter on scale-bugs and locusts. We can heartily recommend this little book for reading aloud to children.

(3) Mr. Farrer's rock-garden in Yorkshire is famous, and his advice will be most welcome to all who pursue this attractive form of imitating nature. In the present volume, a continuation of his former work, his experience and zeal are continually manifested, for Mr. Farrer has travelled far to watch and gather his alpines. Most amateur gardeners know too little of the principles on which rock- and bog-gardens are best planned, or of the natural habitats of the plants employed for stocking them. One of the great charms of this work is the way in which Mr. Farrer takes his readers into the resorts of his favourites, and describes the varying fortunes that have followed his attempts at acclimatisation. There is, for example, a description of the alpines near Arolla. The author's experience should be of great assistance to those who wish to know the best sites and conditions under which this class of plants can

[1] (1) "The Book of Nature-study." Edited by Prof. J. Bretland Farmer, F.R.S. Vol. ii. Pp. viii+202. (London: Caxton Publishing Co., n.d.) Price 7*s*. 6*d*.

(2) "Insect Stories." By Vernon L. Kellogg. Pp. vii+298. (London: G. Bell and Sons; New York: Holt and Co., 1908.) Price 5*s*.

(3) Alpines and Bog Plants." By Reginald Farrer. Pp. xii+288. (London: Edward Arnold, 1908.) Price 7*s*. 6*d*. net.

(4) "Life-histories of Familiar Plants." By John J. Ward. Pp. xx+204. (London: Cassell and Co., Ltd., 1908.) Price 6*s*.

be cultivated. Those who possess his earlier volume will require the supplementary one, and those who do not will, on reading this one, be anxious to possess it. The illustrations are very well executed, but have, as a rule, little connection with the text. The latter part of the book (dealing with bog-plants) is of especial value to those who are attracted to the practice of this frequently misunderstood style of decorative work. Among the alpines most heartily commended are *Saxifraga peltata*, *Oxalis enneaphylla*, *Hypericum reptans*, and *Hypericum coris*. The index contains several misprints.

(4) This book is a series of detached simple essays on problems presented and solved by familiar plants. In matter and plan, the book compares somewhat closely with the delightful essays by Prof. Miall. The constitutional advantages of such weeds as camomile

Hairs from Body of a Bee, showing Pollen Grains entangled. From "Life-histories of Familiar Plants."

and coltsfoot, the relation between insect fertilisation and floral adaptations, the markings of leaves and the fertilisation of grasses, the evolution of the buttercup order, and the movements of sensitive leaves are some of the topics which Mr. Ward discourses upon pleasantly and illustrates clearly. On some points, indeed, he offers new hypotheses, and it is with them that we shall chiefly deal, premising that the whole volume is full of suggestion, and is based upon close observation.

Among the problems of diverse form and detail with which the book deals, the diverse behaviour of certain composites at nightfall is one to strike the most casual observer. Daisies mark the oncoming of night by closing, camomile by opening more widely. The explanation here given is the protection of the nectaries from dew- and rain-depletion of their store. The outer florets only successfully protect the disc of the flower from rain if they can cover it. If this is beyond their span, the method of acting as spouts to carry off the surplus moisture is an alternative rendered effective by the more horizontal position of the central florets on a raised disc. It is this adaptation which camomile effects, and such an explanation, whether new or not, is eminently a feature of the educational value of this work.

The relative evolutionary order and efficacy of colour and scent in relation to insect pollination of flowers is a point still in dispute; indeed, the dictum about cross-fertilisation being so eminently superior as a racial stimulus over self-fertilisation is coming up again for consideration. Most entomologists would, we think, consider scent of primary importance, and floral decoration as a means of directing the attracted insects to the right spot. The author, we notice, takes the view that the eye of the insect is caught first. It is, of course, almost impossible to write popularly on this subject without assuming a broad general conclusion as to its efficiency, which is, perhaps, hardly warranted. At least, the tendency to become dogmatic may blind us to a further explanation of these intricate associations between insects and plants that is as yet unknown. In this connection, we notice that, without stating definitely what insect pollinates the primrose, the author refers to the bee or the moth as doing it, in a misleading way. He would have been wiser to ask readers to notice what insect is really effective in the case of this plant. Neither honey-bees nor moths are known to be so. An interesting chapter is given to the markings of spotted orchis-leaves.

"The exposed part of the olive body of the viper, striped and spotted with dark markings . . . was almost identical with the appearance of some of the leaves of the orchis when similarly placed."

This resemblance is said in a footnote to be borne out by the occurrence of unspotted leaves of the plant in Ireland, where, of course, the viper is absent. But at present the suggestion, instead of throwing light on the subject, makes it more mysterious than ever, for it is surely more to the point to regard the viper as assimilating to the spotted leaves than *vice-versâ*, and for that there is as yet no particle of evidence. We could have wished for more information on grasses. We notice also the strange word "trinary." The illustrations are very good.

REFORM AT CAMBRIDGE.

FOR the last eighteen months the University has been inquiring into its management and constitution with the view of reform. At the end of his first year of office in October, 1907, the then Vice-Chancellor, the Rev. E. S. Roberts, the Master of Gonville and Caius College, spoke these words to the Senate:—

"I venture to touch now on dangerous ground. It is a matter of common knowledge that in a recent debate of the House of Lords some of the speakers urged His Majesty's Government to appoint a Royal Commission to inquire into the endowment, government, administration, and teaching of the Universities of Oxford and Cambridge and of their constituent colleges, in order to secure the best use of their resources for the benefit of all classes of the community. The Government, through their spokesman the Earl of Crewe, held that the moment was not opportune for appointing such a Commission, nor did he encourage the idea that a Royal Commission should be appointed in the immediate future.

"The attitude of neutrality incumbent by a whole-

some tradition on my office forbids that I should in any way prejudice or anticipate any opinion to which the University, or any part or parts of our body, may give expression formally or informally during what may be called years of grace. But I think I may hazard one observation. I believe that there is hardly a single suggested change which could not be effected by existing statutory powers, by internal reorganisation, and by cooperation of colleges. The opportunity is a unique one; shall we miss it?"

Since this address a considerable number of the members of the Senate who take an interest in the affairs of the University have been periodically meeting to consider how far a common basis can be arrived at for reform in the Constitution and Government of the University.

Cambridge has thus proceeded on different lines from Oxford. Within the last six months the Hebdomadal Council has from time to time brought forward Graces suggesting alterations in the Constitution of Oxford University. These have in almost all cases been thrown out. Now they are confronted with a comprehensive scheme, due to the energy and statesmanlike thought of a single mind, that of their Chancellor. The Council has accepted nine-tenths of his suggestions, and it now rests with Convocation and Congregation to see how many of these will be carried into effect.

Cambridge, on the other hand, has sought to find a point of reform which would be accepted by what we might term the moderate conservative. The leaders of both parties are agreed on certain questions, and it may be that, as the *Times* of May 10 says, "We are much mistaken nevertheless if at the present time the Cambridge method has not made more real and more substantial progress than that" of Oxford. Some reforms which Lord Curzon's "scarlet letter" suggests were long ago effected at the sister University, but in many of the most important features there is still a large margin for change at Cambridge, and we cannot but regret that the suggestions now put forward, however likely to be carried into effect, do not go a little farther.

The first of the three committees which has had these matters under consideration had as its duty the consideration of the Constitution and the Government of the University, and it has limited its report to two questions, (1) the reconstruction of the Electoral Roll, and (2) the functions of the Senate and of the Electoral Roll as reconstituted. Its object was to suggest a scheme which would give to the body of residents engaged in teaching, research, and administration a larger share than it at present possesses in the legislative action of the University. It is proposed that two houses should be established, one a body of residents, the other the Senate as at present constituted. Excepting in certain formal matters, and matters of wide and great importance, all kinds of business would come, in the first instance, before the residents; but in every case an appeal would lie to the Senate as a whole, provided that a sufficient number of the opponents of the proposal submitted were prepared to take the necessary steps. Should this reconstruction of the Electoral Roll be carried into effect, it is suggested that the smaller body should be termed "Congregation," and its decisions should be entitled "Graces," whereas the decisions of the larger body, the Senate, should be termed "Decrees."

Elaborate and careful regulations have been drawn up for the suggested alterations. They are full of detail, and need not be considered here. The main feature of the proposal is entrusting much greater powers to the resident members of the University actually engaged in teaching than his hitherto been the case.

The second committee dealt with the question of scholarships, both of the colleges and the University. But as, at the present time, the question of college scholarships is under consideration by an intercollegiate body in conference with the Oxford colleges, Committee No. 2 confined itself to the question of university scholarships, and its resolutions are now being considered by the Special Board for Classics.

The third committee was appointed to consider the relation of the colleges to the University and to one another. It has dealt with the following questions:—(A) The teaching for honours examinations. On this subject its suggestions involve (1) The reconstitution of the Special Boards of Studies so as to make them more fully representative of the teachers. (2) More detailed and careful consideration of the list of lectures in order to prevent overlapping. (3) An attempt to grade lectures so as to adapt them to students of different ability and attainment. (4) Some closer agreement than at present obtains as to the date of the students' return at the beginning of each term and the commencement of lectures.

Although at the present there is much cooperation between certain groups of colleges, the committee feels that this might be rendered more effective without interfering with the legitimate freedom of the colleges in arranging their own teaching. It also suggests that combination between colleges might be rendered more effective if the governing bodies informally consulted each other in making elections to fellowships or lectureships. In this way the needs of the different subjects might be more frequently and more fully taken into account.

In the last twenty years the number of professors in the University has risen from thirty-nine to forty-seven, of readers from six to twelve, of university lecturers from thirty-two to fifty-six. The number of demonstrators and teachers has also largely increased. In spite of this several wants remain unsatisfied, and others will certainly arise, and the committee refers to methods which it has discussed of raising money for further endowment.

The same committee has also (B) before it the question relating to the contribution of colleges to the common University fund. It is of opinion that colleges which contribute money for university purposes should be entitled to deduct from their taxable income any sum voluntarily so paid. It also holds that colleges in which fellowships are held by professors who are not professorial fellows, or by ex-professors, or by readers, or by certain university lecturers, should be entitled to deduct from their taxable income the sum of 200*l.* in respect of the fellowship held by each of such officers; and it makes other suggestions which would lighten the tax on colleges which are directly supporting University work. The committee is further of opinion that it is desirable that colleges should have power under their statutes to attach conditions to fellowships, such conditions to be defined within a specified time from the date of election; that in general a fellow should in the first instance be elected for a term of three years, and should be eligible for re-election for a further term of three years.

The same committee has also considered the necessary expense incurred by a student at Cambridge, and, after prolonged investigation, is of the opinion that the expenses of a careful student need not exceed 120*l.* for the academic year. This, of course, does not include expenses incurred in the vacation, for travelling, or for clothes. If this calculation errs, it

is on the side of under-estimating. The amount must be somewhat increased for students of medicine and engineering, and for a non-collegiate student somewhat lowered, say to 80*l.*–90*l.* per annum.

Finally, although, perhaps, not carrying the weight of a document which has been considered by a representative committee, a circular issued by the Bursar of Trinity is regarded by many of the members of the Senate as one of the most important and valuable contributions to reform in the University. The matter with which it deals is difficult to explain shortly, but roughly it amounts to this:—A graduate, in taking his degree, pays high fees for the degree of B.A. and M.A.: after graduating, if he wishes to continue a member of the University and the college in which he was educated, he has to pay an annual sum to keep his name on the boards of the University or the college. It has always been a little difficult to explain to the young B.A. to what purposes this latter sum is devoted, and what, beyond a vote for the University Members of Parliament, advantages accrue to the graduate who remains a member of the University. There is thus a slight sense of irritation amongst those who keep their names on the boards, and in the case of those who do not compound this irritation recurs annually. On the other hand, those (and they are a large majority) who do not remain officially connected with Cambridge have the feeling that they have been "shown the door," and that no longer are they officially and technically members of the institution in which many of them spent the happiest years of their lives.

Mr. Innes's proposal is to reduce the degree fees to a nominal amount, and to abolish the fees for keeping names on the boards. If this were done, there would undoubtedly be a large increase in the numbers of graduates proceeding to the M.A. degree, and every graduate would remain a member of his college and of the University. To compensate for the loss of the fees which would thus be lowered or abolished, it is proposed that an additional charge should be imposed upon the student whilst in residence. If this could be effected, the whole body of graduates would become, and would remain, members of the Senate, and would, one cannot help believing, be more loyal and enthusiastic members of the University than is the case with those who have technically ceased to belong to their *Alma Mater*.

THE ROYAL SOCIETY'S CONVERSAZIONE.

A LARGE company assembled in the rooms of the Royal Society at Burlington House on Wednesday, May 12, on the occasion of the first of the two conversaziones given annually by the society. The visitors were received by the president, Sir Archibald Geikie, K.C.B., and great interest was shown in the exhibits of apparatus and results of recent scientific investigations. During the evening short demonstrations were given by Dr. A. E. H. Tutton, F.R.S., and Dr. Hans Gadow, F.R.S. Dr. Tutton's subject was crystals and colour: the revelation of crystal structure by polarised light. He gave a demonstration of the use of a new form of lantern polariscope to illustrate recent progress in knowledge of the internal structure of crystals. Magnificent colours were projected upon the lantern screen, though no coloured materials whatever were used to produce them, all the crystals employed being colourless. A new method of performing the Mitscherlich experiment with gypsum, without any extraneous heating of the crystal, was also shown. Dr. Gadow gave an account of the fauna, flora, and native races of Mexico.

The subjoined notes on the exhibits have been summarised from the official catalogue, and are here classified according to related subjects:—

Dr. G. E. Hale, For.Mem.R.S.: Photographs illustrative of work at the Mount Wilson Solar Observatory. (1) Three photographs of the sun, taken at the Mount Wilson Solar Observatory, April 30, 1908, showing (*a*) the photosphere, with sun-spots and faculæ; (*b*) the flocculi of calcium vapour; (*c*) the flocculi of hydrogen, at a higher level in the solar atmosphere. The hydrogen photographs, which are made with the spectroheliograph, reveal the existence of cyclonic storms or vortices associated with sun-spots. (2) Photograph of the sun, taken on Mount Wilson, October 7, 1908, with the red line of hydrogen. The vortices surrounding two large spots in the northern and southern hemispheres appear to rotate in opposite directions. (3) Six photographs, showing the mounting of the 60-inch reflector of the Mount Wilson Solar Observatory and the mode of transporting the tube to the summit on a motor-truck. (4) Blue print, showing design for tower telescope, of 150 feet focal length, now under construction for use on Mount Wilson. An image of the sun, 16 inches in diameter, will be formed in a laboratory at the base of the tower. The spectrograph for studying this image will have a focal length of 75 feet, and will be mounted in a well beneath the laboratory.—*Solar Physics Observatory, South Kensington:* (1) Photographs and diagrams illustrating researches in solar physics and its relations with terrestrial meteorology. (2) Astrophysics. (i.) Spectrum of ϵ Ursæ Majoris; (ii.) spectra demonstrating temperature differences, or similarities, of typical stars; (iii.) laboratory spectra—(*a*) oxygen (vacuum tube); (*b*) erbium (arc); and (*c*) tungsten (spark); (iv.) spectra showing identification of hitherto unknown lines in the spectrum of ϵ Orionis.—*Mr. A. Fowler:* Spectroscopic comparison of the star Mira Ceti with titanium oxide; to illustrate the origin of the characteristic bands of the Antarian or third-type stars.—*Mr. C. P. Butler:* Thorp-Butler concave replica-grating spectroscope. Some years ago several applications of the Thorp plane replica diffraction gratings were exhibited, notably their use with an opera-glass for eclipse work. Recent experiments have shown that concave replica gratings can be made to give very satisfactory results, and by slight modifications of the design of mounting, this form of spectroscope may be employed for any investigation for which the ordinary spectroscope is fitted.—*The Astronomer Royal:* (1) Photographs and diagrams of the observations of the distant satellites of Jupiter and Saturn. (2) Photographs of comet *c*, 1908 (Morehouse), taken with the 30-inch reflector at the Royal Observatory, Greenwich. (3) Tabular diagram showing the number and distribution of stars in the Greenwich section of the Astrographic Chart and Catalogue. The Greenwich section covers 2088 square degrees from the Pole to 26° N.P.D. Two series, each of 1149 photographic plates, were taken, one for the chart, with an exposure of forty minutes, and the other for the catalogue, with exposure of six minutes and twenty seconds, and the number of stars shown with each exposure has been counted. The total numbers are:—(*a*) with forty minutes, 719,000; (*b*) with six minutes, 178,600; (*c*) with twenty seconds, 38,373. The diagram shows the distribution of these stars in different parts of the area photographed, and the resulting star density.

Dr. W. J. S. Lockyer: Cloud photographs taken from balloon.—*Dr. Chree, F.R.S.:* Antarctic magnetic records and results.—*Prof. J. Milne, F.R.S.:* Seismograms of the Messina earthquake of December 28, 1908. These records were obtained at Shide, in the Isle of Wight, from two Milne horizontal pendulums. One of these recorded north-south motion and the other east-west motion.—*Prof. E. Hull, F.R.S.:* Admiralty charts along the coast of Europe and the British Isles, showing the continuation of the river-valleys under the ocean to depths of about 1000 fathoms (6000 feet).

Prof. J. Norman Collie, F.R.S.: A curious property of neon. Perfectly pure neon, when enclosed in a glass tube with mercury and shaken, glows with a bright orange-red colour. As neon does this at ordinary pressures, it appears to be different from other gases.—*Sir William Ramsay, K.C.B., F.R.S.:* Liquid radium emanation.

Radium emanation, produced in a week from about half a gram of radium bromide, is frozen with liquid air, freed from hydrogen by pumping, and introduced into a fine capillary tube. This is connected with an apparatus for compressing the gas; at ordinary temperature the gas liquefies to a colourless liquid of high density, which phosphoresces strongly—more strongly than the gas. At about 70° the liquid freezes to a solid, which, when further cooled, phosphoresces with remarkable brilliancy. *The Rev. H. V. Gill, S.J.:* A new kind of glow in vacuum tubes (see p. 358).—*The National Physical Laboratory:* (1) Electrically heated laboratory muffle furnace (*Mr. W. Rosenhain*). The special feature of the furnace is the high degree of heat insulation aimed at, together with ready access to the working parts. The muffle attains a temperature of 920° C. with a current consumption of 9 amperes at 105 volts, and the platinum winding shows no signs of deterioration after months of continuous use. (2) Quadrant electrometer for alternating current power measurements of high precision (*Mr. C. C. Paterson and Mr. E. H. Rayner*). (3) Standard non-inductive water-cooled manganin tube resistances of 0·001, 0·002, and 0·04 ohms respectively, to operate with currents of 2500, 1000, and 100 amperes respectively (*Mr. C. C. Paterson and Mr. E. H. Rayner*). (4) Metallic filament electric glow-lamp for photometric substandard (*Mr. C. C. Paterson and Mr. E. H. Rayner*). (5) Apparatus for testing definition and for determining the variation of light intensity in an image due to diffraction (*Mr. J. de Graaff Hunter*).

Prof. W. F. Barrett, F.R.S.: (1) Apparatus (*a*) for determining the light-threshold of the eye, and (*b*) for measuring the amount of light irregularly reflected from rough surfaces. (2) New form of optometer for the examination and measurement of defects in vision. Optometers have hitherto been defective owing to the impossibility of preventing involuntary accommodation of the observer's eye. In the present instrument this difficulty is overcome by the use of an inclined semi-transparent mirror in the eye-piece. By changing the attachment both pupillometric and entoptic examination of the eye can readily be carried out.—*Prof. Silvanus P. Thompson, F.R.S.:* (1) Experiments on the contraction, by heat, of india-rubber. India-rubber, under tensile stress, contracts strongly when its temperature is raised. Work is done by its contraction at the expense of the energy of the heat. Hence, it would be possible to construct a thermal engine in which the working substance is india-rubber, instead of steam or hot air, and operating by contraction, instead of expansion, of the working substance. (2) Standard magnets for quantometric work.

Mr. T. H. Laby and Mr. Horace Darwin, F.R.S.: A string electrometer, used to measure minute quantities of electricity, and as an oscillograph.—*Mr. T. H. Laby:* The counting of α particles (electrically charged helium atoms) by Prof. E. Rutherford's method. By an electrical method a deflection of an electrometer is obtained as each α particle passes into a cylinder. A wire is supported in the axis of this narrow metal cylinder, from which it is electrically separated by a guard-ring insulator. This ionisation chamber is enclosed in a sealed glass tube, and the air exhausted to a small pressure (4 mm.). A tap admits α particles from uranium, which pass into the cylinder and ionise the air in it. To detect these ions, Prof. Rutherford multiplied them by producing others from them by collision. The field between the cylinder (−) and the wire (connected to the electrometer) is adjusted of such intensity that the first-formed negative ions travelling to the wire produce others by collision with the air molecules. Thus, when an α particle travels through the cylinder lengthwise, many negative ions reach the wire, and so the electrometer, the string of which is suddenly deflected, but returns, as it is connected to earth through a high resistance of thin rubber.—*Mr. A. W. Porter:* Electric splashes on photographic plates. A photographic plate is backed by a plate-electrode, and a single spark discharge is allowed to pass over the plate from a second electrode in front; the plate is then developed. The new effects exhibited are brought about (1) by diminishing the pressure of the surrounding atmosphere; (2) by replacing it with other gases; (3) by placing the plate in a magnetic field.—*Dr. C. V. Drysdale:* (1) Vacuum tube model, showing the propagation of alternate currents in a helix (see *Phil. Mag.*, November, 1908); (2) stroboscopic apparatus for measuring speed, frequency, slip, and other periodic phenomena.—*Mr. A. Wright:* An electrical device for evaluating algebraical formulæ and equations. The device consists in the combination of special rheostats attached to slide rules and a Wheatstone bridge, by which quantities can be multiplied, divided, added, or subtracted simultaneously, and by which complicated algebraical expressions or equations can be evaluated or solved with an accuracy comparable with that attainable by ordinary slide rules.

Mr. C. E. S. Phillips: The flow of sand through tubes. The rate at which the free surface of a column of sand descends in a vertical tube, owing to the escape of powder from an orifice at the lower end, is independent of the head of sand above the opening.—*Mr. A. Mallock, F.R.S.:* Engine worked by stretched india-rubber. The model illustrates a method whereby a long stretched india-rubber cord can be made to produce mechanical work (see p. 358).—*The Daimler Company, Coventry:* A 38-horse-power Daimler engine. A sectional "valveless" engine, bore 124 mm., stroke 130 mm., showing action of piston, sliding sleeves, and other working parts.

Mr. S. Cowper Coles: (1) Specimens of metallic parabolic reflectors, made by electro-deposition, and specimens of electro-deposited metals showing their crystalline structure; (2) working model of an apparatus for uniting aluminium by means of the formation of a flexible skin of oxide.—*Messrs. Strange and Graham, Ltd.:* A process of making ribbon metals. The molten metal is caused to flow through one or more nozzles in a thin stream upon the periphery of a rapidly rotating water-cooled drum. The metal solidifies immediately, and is thrown off from the surface of the drum in the form of a continuous and uniform ribbon. It is possible to obtain metal as thin as 1/1000 inch, and half a mile to a mile of ribbon can readily be obtained from each nozzle per minute. Ribbons of aluminium, lead, zinc, tin, copper, silver, gold, &c., were shown.—*Mr. C. E. Larard:* Cylindrical specimens twisted to destruction. These specimens (principally of mild steel and a 3 per cent. nickel steel) were before testing divided into unit distances by circular divisions, and in addition six generating lines were painted and scribed at equal distances along the surfaces. The final configuration of the cylindrical surfaces after fracture, as revealed by these division lines, shows clearly the surface flow of the material during the plastic stage of the test.—*Sir Robert Hadfield, F.R.S., and Messrs. Hadfield, Ltd.:* Elements and alloys used in steel manufacture; high-speed tool steel, caps for projectiles, &c.

Prof. Threlfall, F.R.S.: Curves, showing that the spontaneous combustion of cargoes of coal loaded in English, Scotch, and Welsh ports practically occurs only with summer loadings. It was shown by the New South Wales Royal Commission on the Spontaneous Combustion of Coal Cargoes (1897) that ships the cargoes of which took fire had mostly been loaded in summer. In view of the high summer temperature of Newcastle, New South Wales, this was only what might have been expected, but it does not seem to have been noticed that a similar relation might obtain for cargoes loaded in the temperate climate of the United Kingdom. An analysis of 4898 long voyage shipments in the years 1873, 1874, and 1875—presented to the English Royal Commission of 1876—shows unmistakably that it is only cargoes loaded in summer which are liable to spontaneous combustion.—*Prof. H. B. Dixon, F.R.S.:* Photographs showing the generation and nature of "explosion-waves" in gases. The photographs were taken on films moving with a uniform downward velocity (between 50 metres and 80 metres per second). The explosions, started by electric sparks, travelled along horizontal glass tubes. The photographs obtained are thus compounded of the horizontal movements of the flame and the vertical movement of the film. This analysis reveals (i.) the slow initial movements of the flame; (ii.) the sudden setting up of the "explosion-wave"; and (iii.) the remarkable effects of "reflected waves." Explosive gas mixtures were also fired by rapid compression with a

steel piston. The photographs show that the gases are fired at a point, and are not fired instantaneously throughout.—*Dr. F. D. Chattaway, F.R.S.:* Ammonium perhalides. Although derivatives of ammonia in which hydrogen attached to trivalent nitrogen is replaced by halogen, such as nitrogen chloride, NCl_3, and nitrogen iodide, $NI_3{=}NH_3$, are violently explosive, the ammonium perhalides, which contain complexes of three halogen atoms attached to pentavalent nitrogen, are perfectly stable. They are highly coloured substances, which crystallise well from water, in which they are very soluble.—*Mr. Francis Fox:* Pitchblende, or radium ore, from Trenwith Mine, Cornwall (St. Ives Consolidated Mines, Cornwall). In 1843 Prof. Henwood, F.R.S., drew up a report on the Trenwith Mine with reference to its unproductiveness as a copper mine. He reported that the mine contained large quantities of pitchblende, at that time considered to be valueless. Records exist describing the position of the pitchblende in the mine, and vigorous steps are now being taken for clearing the mine of water and working it for pitchblende. The richer specimens contain 33 per cent. of uranium oxide (U_3O_8), and from 150 to 200 milligrams of radium per ton of ore.

The Director, Royal Gardens, Kew: (1) Experiments with Cyclamen seedlings. Cyclamen seedlings normally have only one cotyledon; if this be entirely removed the second cotyledon will develop. If only the lamina be cut off a new lamina will bud out from the side of the leaf-stalk near the apex, and on the removal of this second lamina a third can be induced to grow out from its stalk just below the apex. If the lamina be mutilated, and not wholly removed, new growths will also be formed. (2) Flowers of Sebæa (Gentianaceæ) with two stigmas. The flowers of the genus Sebæa (Gentianaceæ) from South Africa have been found to have two stigmatic surfaces on the same style, one above and one below the position of the anthers. The lower stigma has been fertilised after removal of the normal one, and from the seeds thereby formed seedlings have been raised at Kew.—*Prof. J. W. H. Trail, F.R.S.:* Preparations to illustrate the retention of colours, especially of green, in botanical specimens exposed to light. The method employed is described in the *Kew Bulletin*, 1908, No. 2.—*Dr. G. H. Rodman:* A series of photomicrographic transparencies of pollen cells.—*Mr. C. E. C. Fischer:* A parasitic fungus on beech (*Armillaria mucida*, Schrad).—*Mr. W. Fawcett:* Drawings of Jamaica orchids.—*Mr. R. A. Robertson:* Photographs for identification purposes of the transverse surface of timbers.

Marine Biological Association of the United Kingdom: The bottom deposits of the southern part of the North Sea. The charts and sections illustrate the great predominance of fine sand in most parts of the area, and the marked contrast between the broad stretches of sand off the Continental shores and the irregular but coarse ground along the English coast. They also show that the finest materials increase towards the north.—*Mr. W. Bagshaw:* (1) Photomicrograph showing abnormal striation of the diatom, *Navicula lyra*; (2) Frustule of diatom, exhibited under the microscope with 1/12 oil-immersion lens.—*Dr. H. Gadow, F.R.S., and Mrs. Gadow:* Rare specimens of natural history from Mexico.—*Mr. L. Doncaster:* Case of *Abraxas grossulariata* (currant moth) illustrating sex-inheritance.—*Dr. E. F. Bashford:* Recent advances in knowledge of cancer (see NATURE, December 31, 1908).—*Lieut.-Colonel W. B. Leishman:* The transmission of tick fever. This relapsing fever of man, widespread in Africa, is due to the *Spirochaeta duttoni*, which is inoculated by the bite of a tick, the *Ornithodorus moubata*. Infected ticks may transmit the virus through the eggs to the second and even to the third generations, which, in their turn, may infect man by their bites. The mechanism of this hereditary transmission is not certain, but it appears possible that spirochætes ingested by a tick undergo a change of form, and, in this altered form, penetrate the young ova and infect the next generation, developing anew into spirochæte form under certain conditions of temperature.—*Dr. A. F. Bilderbeck Gomess: Cheyletus eruditus* as an entozoon in man.—*Dr. A. D. Waller, F.R.S.:* Demonstration of the electrical variations of the human heart and of the dog's heart on Einthoven's string galvanometer.—*Mr. S. G. Shattock:* A microscopic section of the aorta of King Menephtah, traditionally regarded as the Pharaoh of the Exodus, showing senile calcification. The mummy was found in 1898 by M. Loret in the tomb of Amenhotep II., at Biban el Muluk, Thebes. It was unwrapped in 1907 by Dr. G. Elliot Smith (acting on the instructions of M. Maspero). The mummy was wrapped in a sheet of fine linen, on which the name was written in hieratic characters. The microscopic sections show the presence of calcareous particles in the middle coat of the artery, such as are met with in senile degeneration.

Mr. H. R. Knipe: Drawings of extinct animals, by Miss Alice B. Woodward.—*Dr. A. Smith Woodward, F.R.S.:* Ramus of mandible and teeth of a herbivorous dinosaur, Trachodon, from the Upper Cretaceous of Wyoming, U.S.A.—*Dr. H. Gadow, F.R.S., and Mrs. Gadow:* Ethnological specimens from Mexico. (1) Prehistoric implements from the States of Chihuahua and Michoacan; (2) throwing sticks, used by the Tarasco Indians of Lake Patzcuaro.—*Dr. C. G. Seligmann:* Photographs of the Veddas of Ceylon and of their ceremonial dances. The Veddas are now limited to the sparsely settled country between the central hill *massif* and the eastern coast. A few still subsist on game, yams, and honey, and live in rock shelters, but the majority build huts and practise a little rude cultivation. Their ceremonial dances are essentially religious, and are performed to obtain the assistance of the spirits of their dead, who are called the Nae Yaku, or of certain long dead Vedda heroes, of whom the most important is the great hunter, Kande Yaka, who is also Lord of the Dead.—*Prof. Karl Pearson, F.R.S., Mr. E. Nettleship, and Mr. C. H. Usher:* Illustrative plates to a forthcoming monograph on albinism (Drapers' Company research memoirs).—*University of London, Francis Galton Laboratory for National Eugenics:* Pedigree work in man.—*Sir Benjamin Stone, M.P.:* Photographic studies of Constantinople and neighbourhood.

NOTES.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 5.

PROFS. YVES DELAGE and M. G. Retzius have been elected foreign members of the Linnean Society.

THE Bessemer medal of the Iron and Steel Institute was presented to M. A. Pourcel at the meeting of the institute last week.

THE Wolcott Gibbs memorial lecture of the Chemical Society will be delivered by Prof. F. W. Clarke at the meeting of the society on Thursday, June 3.

THE annual conversazione of the Royal Society of Arts this year will be held at the Natural History Museum, South Kensington, on Tuesday, June 29.

A *Times* correspondent at Winnipeg reports that an earthquake shock, lasting from thirty seconds to a minute, was felt there and for 500 miles to the west at 10.17 p.m. on May 16.

THE Royal Scottish Geographical Society has decided to award the Livingstone gold medal of the society for the current year to Lieut. Shackleton, for his work in the Antarctic.

DR. G. A. GIBSON, 3 Drumsheugh Gardens, Edinburgh, who has undertaken to edit the medical and scientific papers and articles of the late Sir William Tennant Gairdner, and to preface the collection with a biography, will be glad to know of any letters or other literary remains possessed by friends of the late professor.

THE central committee of the Austrian Alpine Club, we learn from *La Nature*, has, by the liberality of the authorities of Munich, just been put in possession of a large building with excellent accommodation, and well situated on the banks of the Isar. The club proposes to inaugurate an Alpine museum in its new building specially concerned with everything related to the study of the Alps from every point of view.

WE learn from the *British Medical Journal* that the Harben lectures of the Royal Institute of Public Health will be delivered this year by Prof. R. Pfeiffer, director of the Hygiene Institute, Breslau. The first lecture, on the importance of bacteriolysins in immunity, will be given on Monday, June 21; the second, on endotoxins and anti-endotoxins, on June 23; and the third, on the problem of virulence, on June 25.

THE ninety-second annual meeting of the Société helvétique des Sciences naturelles will be held at Lausanne on September 5–8, under the presidency of M. Henri Blanc. On September 6 and 8 the subjects and openers of discussions will be:—the Jura, E. de Margerie; aërodynamic foundations of aviation, S. Finsterwalder; comparative psychology: determinism and theory of memory, A. Forel; history of the animal life of Ceylon, F. Sarasin; some recent results of astronomical photography, R. Gautier; and natural history impressions of Greenland, M. Rikli. The secretaries of the congress are MM. H. Faes and P. L. Mercanton, Lausanne.

AT the last annual meeting of the Royal Institution of Cornwall, held at Truro, it was announced that fitting accommodation has now been secured for the valuable collections in its charge. The scheme of adding to the existing museum has been abandoned, and a new building standing in its own grounds, free from the danger of fire, and occupying a conspicuous and accessible position, has been secured. The work of adapting this to form one of the best scientific museums in the west of England is now in progress; of a total estimated cost of 5000*l*., sufficient has been collected to warrant the council in proceeding with the scheme, and there is every reason to believe that the appeal for the balance will meet with a gratifying response.

THE Nature Study Society has organised an exhibition of aquaria, vivaria, and other means of observing animals, with photographic and microscopic illustrations, to be held at the Royal Botanic Gardens, Regent's Park, on Friday and Saturday, June 4 and 5. Exhibits of the following character will be acceptable:—aquaria, fresh water and salt water; vivaria containing reptiles, Amphibia, snails, caterpillars, and other animals; flight cages containing butterflies, dragon-flies, and other insects; ants' nests, wormeries, means of keeping minute forms of life; microscopic exhibits illustrating minute forms of life; photographs bearing directly upon any of the above matters. Intending exhibitors should communicate before May 25 with the honorary secretary of the exhibition, Miss Winifred de Lisle, 58 Tyrwhitt Road, Brockley, S.E.

WE notice with regret the death, on May 12, in Munich, of Prof. Heinrich von Ranke. Prof. von Ranke was born on May 8, 1830, and was educated in the universities of Erlangen, Berlin, Leipzig, and Tübingen. From the obituary notice in the *Times* we learn that he acted for a year as assistant to the biologist Johannes Müller, and later worked at Tübingen with Hugo Mohl. He took his M.D. degree in 1851. Prof. von Ranke gained much experience in various branches of medical science from his army work under the English Government during the Crimean War, and in later years on the battlefield of Bohemia during the Austro-Prussian War of 1866. In 1874 he was appointed to an extraordinary professorship, dealing with the treatment of children, in the University of Munich. In addition to much work in public hygiene, von Ranke devoted his attention to scientific agriculture, making a model farm of a portion of his estate near Munich. He served as vice-president of the Agricultural Society of Bavaria. His literary work included many pamphlets on his scientific researches and practical experience in medicine; he also wrote on archæological subjects.

AT the invitation of the Mayor and Corporation of Winchester, the annual congress of the South-Eastern Union of Scientific Societies will be held at that town on June 9–12 inclusive, under the presidency of Dr. Dukinfield H. Scott, F.R.S. The following papers will be read:—prehistoric memorials of Hampshire, W. Dale; leaf-mining insects, A. Sich; the evolution of our southern rivers, W. F. Gwinnell; fungus-hunting in Hants, J. F. Rayner; local Lepidoptera, Rev. G. M. A. Hewett; and nature-study for teachers, Prof. Cavers. Messrs. Griffin and Lowne will give a demonstration of plant-pressing and mounting. Dr. Burge, headmaster of Winchester College, has invited members to a conversazione, at which Mr. R. W. Hooley will lecture on the age of reptiles in Hants and the Isle of Wight. The Mayor and Corporation of Southampton have invited the members to visit that city, on which occasion Prof. Hearnshaw will show and explain the corporation documents and regalia. Various visits to noteworthy spots will be conducted by Sir W. Portal, Bart., Mr. W. Whitaker, F.R.S., Mr. N. H. Nisbett, Alderman W. H. Jacob, and Canon Valpy, the Vice-Dean. There will be a loan museum as usual, under the management of Mr. E. W. Swanton. The local secretary is Mr. W. Norris, 4 Upper High Street, Winchester, and the general secretary is the Rev. R. Ashington Bullen, "Englemoor," Woking, from either of whom further information may be obtained.

THE April number of the *Museums Journal* opens with an article, by Dr. A. H. Millar, on the removal of the Scottish Hunterian Museum from the old college in High Street, Glasgow, to Gilmorehill University, in the same city. In the course of the article, which was originally delivered in the form of an address to the Ipswich Museums' Conference, the author gives an account of the career of William Hunter, and a *résumé* of the history and formation of his museum. The transference of the collection to its present home took place in the early 'seventies.

BIOGRAPHY occupies a prominent position in the May issue of *British Birds*, to which Mr. W. H. Mullens contributes an interesting sketch of the lives and works of William Macgillivray and William Yarrell, together with portraits of both these distinguished ornithologists. Macgillivray's "History of British Birds" has, in the author's opinion, met with unmerited neglect, although it is one of the most valuable treatises on its subject in existence. This neglect is attributed to the supposed extreme technicality of the work, to the long interval between its commencement and its completion, and, lastly, although by no means leastly, to the dominating influence of Yarrell's volumes, which appeared about the same time, but in quicker succession.

TO vol. xxi., part ii., of the Proceedings of the Royal Society of Victoria, Prof. Baldwin Spencer contributes an illustrated account of a problematical organism, of which

several examples were thrown up during a storm in Bass Strait. At first sight the general appearance of these jelly-like organisms, for which the name *Hologlaea dubia* has been proposed, suggested affinity with the Ctenophora, but such a relationship is negatived by the fact that what appear on superficial examination to be ctenophoral bands present no trace of the distinctive features of such structures. At one time its describer was of opinion that these organisms might be detached portions of some larger creatures, but he now considers that they probably represent a stage in the life-history, possibly a nursing-stock, of some type at present unknown to naturalists.

IT is argued by Prof. E. L. Greene, with considerable reason, in a paper published in the Proceedings of the Washington Academy of Sciences (vol. xi., No. 1), that Linnæus was not a dogmatic believer in the doctrine of fixed species. This opinion is based on the notes affixed to certain plants in the "Species Plantarum." Thus it is remarked with regard to *Thalictrum lucidum* that the plant is not very distinct from *Thalictrum flavum*, and seems to be the product of its environment. Again, with reference to *Achillea alpina*, it is suggested that the Siberian mountain soil and climate have moulded it out of *Achillea Ptarmica*. A few other similar examples are cited.

AN interesting epitome of the lines of classification adopted by Dr. T. Wolf in his monograph of the genus Potentilla, and communicated by the author, is published in the *Sitzungsberichte und Abhandlungen der naturwissenschaftlichen Gesellschaft Isis* for 1908. The pistil provides the primary characters of distinction for the sections and subsections. The author also discusses the distribution of the genus, which is in accord with the morphological classification, and concludes with the following enunciation. If it is possible to classify a group of plants so that the morphological relationship of the species coincides with a definite geographical distribution, then the classification is certain to be phylogenetic, and therefore natural.

THE rate of growth of palms forms the subject of an article, by Mr. A. W. Lushington, published in the *Indian Forester* (March). The author observed that a fresh leaf-bud was formed every month in the case of all palms, whether betel, date, palmyra, &c., so that the development of twelve leaves a year appeared to be constant. Reckoned on this basis, a palmyra palm would attain a height of about 28 feet in a century, and would not reach maturity for 300 years. Palms develop the full thickness of the stem below ground before they throw up the aërial shoot; the time required for the palmyra appears to vary from about four to twenty years. It is suggested that increase in thickness, being caused by the expansion of the soft central tissue, continues so long as the vascular tissue of the leaf-sheaths can extend, and this varies with the nature of the soil.

THE greater portion of the *Kew Bulletin* (No. 3) is devoted to the flora of Ngamiland as exemplified by the collections of Major and Mrs. E. J. Lugard. Major Lugard furnishes an introductory sketch of the physical and natural features of the country that is peopled by the Batawana, and includes the northern portion of the Kalahari desert. The flora is subtropical; the trees, which are confined to the river banks, consist of several species of Acacia, notably *Acacia giraffae*, *Copaifera mopane*, *Terminalia pruinoides*, and *Kigelia pinnata*. The collections yielded no fewer than ninety-three new species out of a total of 373. The Leguminosæ, the dominant family, provides three new species of Acacia, an Albizzia, and others. Out of eight species of Grewia, five supply new types. *Habenaria Lugardii* and *Crinum rhodanthum* are two new plants with brilliant flowers.

PROF. SCHWENDENER, of Berlin, is well known as a leader in the investigation of the numerous mechanical problems which arise in the study of plants. Botanists will therefore be indebted to Prof. Holtermann for the publication of Schwendener's lectures in an easily accessible form ("Vorlesungen ueber mechanische Probleme der Botanik," Leipzig, Engelmann). The principal topics, treated rather in sketchy outline, consist of the mechanical system of tissues, theory of leaf arrangement, ascent of sap, stomata, and the various mechanisms connected with motile structures. Prof. Holtermann adds critical notes of his own, dealing with some of the points raised in modern controversy. The booklet is well worth reading, though we cannot help wishing that it had been expanded into a larger work. "Lectures," when published in book form, have often been employed as the means of a full discussion by their author of the subjects on which he is specially qualified to speak. So far as the lecturer himself is concerned, the latter sentence would have eminently applied to Schwendener, but these "lectures" stop a long way short of full discussion.

THE habit of using ancient sarcophagi in modern interments is familiar in the case of Charlemagne, who, after his canonisation in 1165, was interred in a sarcophagus which he himself had brought from Ravenna, and Nelson was buried in a stone coffin which legend says was prepared for Henry VIII. by Cardinal Wolsey. The finest existing examples of sarcophagi used in this way in Roman Churches, that of Cardinal Fieschi in the Church of St. Lorenzo fuori le Mura, and that of the Savelli family in Sta. Maria in Ara Coeli, are described by Mr. J. Tavernor-Perry in the April number of the *Reliquary*. That of Cardinal Fieschi, which probably belongs to the second century of our era, is decorated with a Roman marriage in high relief, a frieze representing the story of Phæton, the angles forming two great masks, unfortunately somewhat injured. The more artistic Savelli monument was probably intended for Luca, Senator of Rome, who died in 1266, and was nephew of Pope Honorius III. This sarcophagus is carved with Bacchic figures, holding festoons, from which rise portrait busts, doubtless intended for the original occupants of the tomb. To this the Savelli family added a beautiful superstructure bearing the inscriptions and family arms, the decoration being of the Sienese school, and the lovely glass mosaic the work of the famous Comati family, who were engaged for six successive generations in the churches of southern Italy. Other examples of their work are described, with fine illustrations, in the same number by Miss E. Stacey.

THE May number of the *Geographical Journal* contains an important article, by Prof. Dr. Eugen Oberhummer, of Vienna, on Leonardo da Vinci and the art of the Renaissance in its relations to geography. From the fresh information now available the reputation for scientific knowledge enjoyed by the great painter is still further enhanced. It is not quite certain that the remarkable map of the world now at Windsor, and dating from the beginning of the sixteenth century, is really his work; but much material of a similar kind was discovered by Jean Paul Richter. It is known that in 1502 Leonardo, then in the service of Cesare Borgia as a military engineer, made a tour through Urbino, Pesaro, Rimini, and other places, where he carried out a survey and constructed maps. The

most interesting of these represent Tuscany and the Pontine Marshes, while he made an accurate plan of the town of Imola in the Romagna, of Milan, and other cities. Besides being a topographical he was also an eminent physical geographer and astronomer. He held that the earth was a planet, and denied that it occupied a privileged position in the universe, thus being one of the forerunners of Copernicus. He must also be regarded as the founder of the modern theory of wave motion, and his investigations of the question of currents and of other hydraulic problems are remarkable. He believed that rocks were of sedimentary origin, and that mountains were accumulations of river alluvium. He held, for his time, advanced views on the subject of the Deluge, and as he laid much stress on the influence of erosion he anticipated much of the modern doctrine of valley formation. He did good service for meteorology by his study of winds, and he was one of the pioneers of Alpine exploration. Dr. Oberhummer follows his account of the scientific work of Leonardo by a description of the world and star maps constructed by Albert Dürer. He gives interesting reproductions of the work of these artistic and scientific men from the originals in the collections at Windsor, the British Museum, and other places.

THE prospect of a short water supply during the coming summer is predicted by the Rev. F. C. Clutterbuck, of Abingdon, in *Symons's Meteorological Magazine* for April. Speaking particularly of the Thames Valley, Mr. Clutterbuck bases his prediction on the measurements of a well in the Upper Greensand of which he has a daily record for the last forty years, this well having always been considered a good test as regards water supply. Only on two occasions has the well been so low as it is now, viz. in the autumn of 1898 and in the spring of 1905, which was a year of very short water supply in the Thames Valley. In the six months October–March inclusive, 1904–5, the rainfall at Abingdon was 9·24 inches; in 1908–9 it was 9·13 inches, almost similar conditions. Therefore, Mr. Clutterbuck concludes, we may expect the same deficiency this year as was experienced in 1905. In an editorial article on the rainfall of the winter half-year it is pointed out that for England and Wales there was a deficiency of more than one-quarter of the normal rainfall. The dry autumn may produce an exceptionally good wheat harvest this year, but, the editor observes, the general dryness of the whole winter half-year cannot fail to cause anxiety as to the yield of wells and the replenishment of reservoirs.

UNDER the title of "Bibliographia Botanica," Messrs. W. Junk, of Berlin, have issued a classified catalogue of nearly 7000 books, journals, and pamphlets dealing with all branches of botany.

IN the *Atti dei Lincei*, xviii. (1), 7, Dr. G. Agamennone describes certain remarkable long waves that were recorded by the seismographs at Rocca di Papa on the occasion of the recent earthquakes of December 28, 1908, and also in the Calabrian earthquake of September 8, 1905. The same slow waves were observed at Göttingen in 1905 by Angenheister.

IN the *Annals of Mathematics* (April), x., 3, Prof. E. B. Wilson gives an exposition of the applications of probability to mechanics. The discussion is presented in the form of an introduction to the study of statistical mechanics. It is illustrated by the consideration of simple examples, and well shows how "mean value" and probability for a continuous function depend on the distribution, or, in other words, on the variable with respect to which the function is assumed to be uniformly distributed.

MESSRS. W. CRAMP AND B. HOYLE, in a paper on the electric discharge and the production of nitric acid by means of it, which appears in the April number of the Journal of the Institution of Electrical Engineers, give a *résumé* of the various methods which have been used in the attempt to produce nitric acid direct from the nitrogen of the atmosphere, and criticise them in the light of their own researches. They have investigated the relative efficiencies of various forms of electric discharge, and of different methods of introducing and withdrawing the gases, and have found that a considerable number of the results obtained are in agreement with the ionisation theory. It is unfortunate that the authors were unable to proceed far enough with their researches to enable them to state definitely the yield of acid per kilowatt hour under the best conditions, and on a commercial scale.

IN the April number of the *Journal de Physique* M. A. Dufour gives a detailed account of the examination of the Zeeman effect for certain bands in the emission spectra of gases, on which he has been engaged for the last two years, and of which he has given short accounts in the *Comptes rendus*. He finds that the bands of the emission spectra of the chlorides and fluorides of the alkaline earths examined, and of the second or molecular spectrum of hydrogen, may be divided into three classes, the first of which show the normal Zeeman effect in the direction of the magnetic field, *i.e.* that component of the doublet which has the shorter wave-length is circularly polarised, the direction of rotation agreeing with that of the electric current producing the field. The second class show no appreciable effect, while the third are abnormal, the direction of rotation being reversed, and the polarisation incomplete. M. Dufour is inclined to attribute this abnormal behaviour to negative electrons moving in complicated paths determined by the whole of the atoms constituting the molecule of the gas, while the normal effect is due to the negative electrons moving in comparatively simple paths in the atoms.

FROM Messrs. Adam Hilger, Ltd., we have received an eight-page catalogue giving illustrated descriptions, and prices, of several of the spectroscopes specially designed for the observation of stellar and solar spectra. For amateur observers the Zöllner star spectroscope, supplied for fifty shillings, is a useful and adaptable instrument. Spectroscopes for prominence and other solar observations range from 4*l.* for a small direct-vision, grating instrument, to the 35*l.* to 60*l.* "Evershed" protuberance spectroscope, which is a most efficient instrument for the observation of sun-spot spectra and prominences. For laboratory researches the Littrow type spectrograph is now largely employed, and a specially designed instrument of this type, having an achromatic objective of 2½ inches aperture and 8 feet focal length, and a 2½-inch Rowland or Michelson grating, costs about 65*l.*

WE have received from Messrs. John J. Griffin and Sons, Ltd., a description of "The York Air Tester," an apparatus for the rapid estimation of carbon dioxide in air. The advantages claimed for this apparatus are that it is simple enough to be placed in unskilled hands and sufficiently accurate for controlling ventilation. It is a minimetric method, resembling in principle the apparatus described by Lunge and Zeckendorf about fifteen years ago. In the latter apparatus a measured volume of a weak solution of sodium carbonate, coloured with phenol-

phthalein, was decolorised by a measured volume of the air under examination, the quantity of air being determined by the number of fillings of a rubber pump. In the York apparatus the rubber ball is replaced with advantage by a metallic pump, and the sodium carbonate solution by baryta solution. With the latter solution the absorption is quantitative under the conditions of use prescribed in the instructions. As to the disadvantages of the York apparatus, the quantity of carbon dioxide measured is based on a preliminary calibration with atmospheric air, assumed in the table as 3·6 parts per 10,000. As in towns the amount may be as much as 4·5, the results may be uncertain by 25 per cent. The stock bottle for the weak baryta solution carries sufficient solution for eighty tests, or two litres. This amount seems too large, and makes the whole apparatus unnecessarily heavy. The mode of working is simple, and should give good results in unskilled hands.

THE claims of reinforced concrete as a suitable material for buildings likely to be subjected to earthquakes are advanced in *Concrete and Constructional Engineering* for May. For such buildings either the very lightest form of wood construction should be applied, as in Japan, or, if permanence and architectural effect are desired, some form of monolithic construction as is obtainable in reinforced concrete. Masonry and brickwork are entirely out of place, and steel frames covered with concrete do not seem to have the advantages possessed by reinforced concrete in its simplest forms. In the opinion of the writer, steel-frame construction has been adopted too freely in San Francisco and elsewhere. Reinforced concrete buildings need not necessarily be eyesores; this is altogether a question of good design, and there are sufficient examples of such buildings now in existence to show that the reproach of the older generation of architects cannot be directed at the productions of a really good designer. The article is of interest in view of the now well-known disastrous effects of the recent earthquake in Messina.

A CATALOGUE of new books and new editions added to Mr. H. K. Lewis's medical and scientific circulating library (136 Gower Street, W.C.) during the first quarter of this year provides a concise summary of the chief works of scientific interest issued in recent months.

THE fifth revised edition of Prof. Max Verworn's "Allgemeine Physiologie" has been published by Mr. Gustav Fischer, Jena. The price of this work, which now occupies 742 pages, is sixteen marks.

THE Bulletin of the Pasteur Institute of Southern India (No. 1, 1908) contains details of several researches carried out by Major Cornwall and Dr. Kesava Pai on rabies, *e.g.* diagnosis of the disease, the Negri bodies, histology of the blood, toxins, &c.

THE commemorative address on Darwin and his work, delivered by Prof. August Weismann at Freiburg in Baden on February 12, has been published in pamphlet form by Mr. Gustav Fischer, Jena. A note upon the address appeared in NATURE of March 18 (p. 75).

PROF. W. JAMES'S "Principles of Psychology" has been translated into German by Dr. Marie Dürr, and published by the firm of Quelle and Meyer, Leipzig, with notes by Prof. E. Dürr. The same publishers have just issued a translation into German, by Prof. A. Kalähne, of M. L. Poincaré's work on "Electricity," already translated into English.

THE report of the sixth meeting of the South African Association for the Advancement of Science, held last year at Grahamstown, has now been published. An account of the proceedings of the meeting appeared in NATURE of August 27, 1908 (vol. lxxviii., p. 395), to which reference may be made for the chief subjects discussed in the volume. The amount of work recorded in the 408 pages of the report is a very creditable record for an association founded so recently, and the officers are to be congratulated upon the success of their efforts to arouse and maintain an interest in scientific work in the South African colonies.

THE Smithsonian Institution of Washington has issued a classified list of Smithsonian publications available for distribution in March, 1909. These publications are supplied by the institution either gratuitously or at a nominal cost as an aid to research. Of the many activities of the Smithsonian Institution, this wide distribution of papers, scientific and otherwise, among original workers for the extension of knowledge is one of the most useful. The list has been prepared in such a way as to conform as closely as possible with the classification methods used by the International Catalogue of Scientific Literature, and will be found convenient for reference.

MR. L. F. COGLIATI, 17 Corso di Porta Romana, Milan, has made arrangements to publish the manuscript of Leonardo da Vinci in the library of the Earl of Leicester at Holkham Hall. The volume will contain a double Italian transcription of the text, be printed on hand-made paper, and contain seventy-two heliotype plates, comprising the entire reproduction of the original manuscript and of its numerous illustrations; it will contain an introduction and index, and include a biography of Leonardo da Vinci by Dr. G. Calvi, the editor of the volume. It may be mentioned that the compilation obtained the Tomasoni prize from the R. Istituto Lombardo di Scienze e Lettere. The manuscript contains the material Leonardo gathered for his treatise on hydraulics, and many of his opinions on questions in cosmography and geology are also to be found in it. Only 160 copies of the volume will be published; the first 100 are offered to subscribers at 3*l.* 4*s.* net (postage, &c., 4*s.* additional), and the remaining volumes will be 4*l.* net.

OUR ASTRONOMICAL COLUMN.

MARS.—A telegram from Prof. Lowell, communicated by Circular No. 108 of the Kiel Centralstelle (May 11), announces that two rifts have appeared in the snow-cap of Mars in longitudes 350° and 240°.

JUPITER.—In Bulletin No. 38 of the Lowell Observatory Prof. Lowell describes the different features of Jupiter observed at Flagstaff during the period March 28 to June 4, 1907. The most interesting feature was the system of wisps, or lacings, between the north and south equatorial belts. These festoons were detected by Mr. Scriven Bolton (see NATURE, No. 2000, vol. lxxvii., February 27, 1908, p. 401), and they form a curious network across the equatorial region of the planet. The individual wisps leave caret-shaped markings in the belts, generally at an angle of 45°, and show increased curvature throughout their length. Mr. Lampland has succeeded in obtaining faint photographic images of these peculiar features.

All the dark belts observed were of a cherry-red colour of varying depths, and even the polar hoods at times showed tints of the same hue. The Great Red Spot was but dimly visible, but many dazzling white spots were, from time to time, made out. The equatorial and tropical belts of each hemisphere were seen to be connected by wisps similar to those described above, and the bright

equatorial belt was divided into two parts by a longitudinal belt practically encircling the planet.

On March 30, at 5h. 55m. (standard mountain time), the shadow of satellite I. was seen to be nearly twice as broad as it was high, and at 6h. 13m. a penumbra to it was observed. Markings were seen on satellite III. on April 2.

THE UPPER LAYERS OF THE SOLAR ATMOSPHERE.—In a paper published in No. 16 (April 19) of the *Comptes rendus* M. Deslandres describes some results obtained with his new spectroheliograph. Photographs obtained previously showed long dark streaks of calcium vapours when the secondary slit was set on the centre of the "K" line; these streaks were named "filaments."

By employing a larger dispersion and an additional slit of an improved form, M. Deslandres succeeded in isolating entirely the K_3 line, and found that these filaments were shown much more definitely than on the earlier negatives, when the light employed was a mixture of the K_2 and K_3 lines. A similar result follows if the Hα line of hydrogen be employed. These dark filaments, then, are the characteristic feature of the sun's upper atmosphere, and differ from Hale's "dark flocculi" in that they are black on both the K_3 and Hα (centre of line) photographs.

In the same number of the *Comptes rendus* Prof. Hale makes some remarks relative to Deslandres's paper, and states that on employing the large spectroscope he found that the relative intensity of the bright and dark flocculi depends upon the part of the line (Hα) employed. With the slit set on the central part of the line the bright flocculi are very intense, but if the light from the edge of the line is exclusively used, the dark flocculi are shown strongly, whilst the bright flocculi are faint or even invisible.

SPECTRA OF SOME SPIRAL NEBULÆ AND GLOBULAR STAR CLUSTERS.—With a specially designed spectrograph attached to the Crossley reflector, Mr. E. A. Fath has succeeded in photographing the spectra of a number of spiral nebulæ and globular clusters, the investigation having been undertaken in order to test the statement that the spectra of the former are continuous. The collimator of the spectrograph has an aperture of 54 mm. and a focal length of 315 mm., and the prism is of light flint glass and 30° angle, whilst the camera objective is composed of two plano-convex lenses of 51 mm. aperture and 155 mm. equivalent focal length. The scale of the spectrum is such that the distance from λ 3727 to λ 5007 on the plate is approximately 3·3 mm.; exposures varying from 3h. 19m. to 18h. 11m.—for the Andromeda nebula—were found necessary.

There is not space here to reproduce the detailed discussion given in Lick Observatory Bulletin No. 149, but the general conclusions are of great interest. No spiral nebula investigated has a truly continuous spectrum, although this is the fundamental feature of all their spectra, which range from those having principally bright lines to those containing only absorption lines of the solar type. The great nebula in Andromeda comes in the latter category, and fourteen absorption lines were measured.

The spectra of the spiral nebulæ are best interpreted by the hypothesis that these bodies are unresolved star clusters with varying conditions of gaseous envelopes. Thus, if the Andromeda nebula were such a cluster in which stars of the solar type preponderated, its spectrum would be sufficiently explained. The exposures on globular clusters showed that clusters in which one spectral type of star predominates do exist. But this question needs a great deal more investigation before the theory can be accepted, and, as Mr. Fath points out, Bohlin's parallax for the Andromeda nebula, 0·17″, would require that, if this object is an unresolved star cluster, the size of the components is, with reasonable assumptions, of the order of that of the asteroids. The difficulty of the investigation lies in the extreme faintness of the objects to be observed. While two minutes' exposure on Arcturus, with the Mills spectrograph attached to the 36-inch refractor, gives a measurable spectrum, it would require about 500 hours to give a satisfactory spectrum of the Andromeda nebula, one of the brightest of the spiral nebulæ.

THE INTERNATIONAL COMMISSION FOR SCIENTIFIC AËRONAUTICS.

THE sixth Congress of the International Commission for Scientific Aëronautics commenced at Monaco on April 1. Thirty-three members were present, representing fourteen countries. The Prince of Monaco, by whose invitation the meeting was held at Monaco, placed the rooms of the new Oceanographical Museum at the service of the commission. Among the members present were Prof. Hergesell (the president), Profs. Assmann, Berson, and Captain Hildebrandt from Germany, M. Teisserenc de Bort from France, Prof. Hildebrandsson from Sweden, Prof. A. L. Rotch from the United States, Generals Rykatcheff and Kowanko from Russia, Colonel Vives y Vich from Spain, Prof. Bjerknes from Norway, Prof. Palazzo and Dr. Oddone from Italy, Hofrat von Konkoly from Hungary, M. Vincent from Belgium, Captain Ryder from Denmark, and Messrs. P. Alexander and C. J. P. Cave from this country.

Prof. Hergesell, in opening the congress, spoke of the extent of the observations now made by members of the commission, and of the work that had been done since the last meeting at Milan. He mentioned particularly the series of ascents made in July, 1907, the full results of which had just been published, and which included a network of observations extending over a great part of the northern hemisphere. The instruments used were very satisfactory, but Prof. Hergesell warned observers to make frequent calibrations to ensure accuracy in the observations. He also mentioned the important work on wind direction and velocity by means of theodolite observations on *ballons sondes* and pilot balloons.

The Prince of Monaco, in welcoming the congress, spoke of the work that had been done by Prof. Hergesell and himself on his yacht the *Princesse Alice*, and of the finding of *ballons sondes* at sea. By means of observations to determine the trajectory, Prof. Hergesell was able to determine the point of fall with such accuracy that balloons are now found at sea more easily than on land.

At the morning meeting on April 2 Prof. Assmann read a paper on rubber balloons, and spoke of the improvement that had lately been made in their manufacture; it had been found possible to eliminate small foreign particles in the rubber, which consequently could be stretched far more before bursting occurred. M. Teisserenc de Bort spoke of goldbeater's skin for captive balloons, and mentioned that, by a system of elastic lacing, expansion could be secured during the ascent and "pocketing" avoided during the descent. Prof. Hergesell spoke of the rapid deterioration of rubber balloons owing to the effect of light, especially in the tropics; to guard against this Prof. Assmann uses a yellow covering for captive rubber balloons.

Prof. Assmann then read a paper on a method of ventilating the instrument for a short time during an ascent, when, owing to decrease of vertical velocity, insolation might cause too high a temperature to be recorded; the apparatus consists of a polished metal sphere containing compressed air, which can be opened by an electric contact actuated by the barometer at any desired height. He spoke of the doubts that had been expressed, particularly in England, on the reality of the isothermal layer, or "stratosphere" as it has been named by M. Teisserenc de Bort, and hopes that his apparatus may definitely set these doubts at rest. Mr. Cave said that no one in England who is working at the study of the upper air has any doubts as to the reality of the stratosphere; Prof. Hergesell cited cases of rapid descents of instruments, and M. Teisserenc de Bort mentioned night ascents as proving the real existence of the phenomenon. Prof. Hergesell noticed that no member present doubted the fact, and asked the secretaries particularly to note this agreement of opinion.

Prof. Hergesell showed a new meteorograph for use with manned and captive balloons. Prof. Palazzo an apparatus for detaching balloons, and similar instruments were shown by Prof. Hergesell and General Rykatcheff. M. Teisserenc de Bort deprecated the idea of limiting the ascent of a *ballon sonde*.

Prof. Rotch urged that all kite ascents should be tabulated on a uniform plan, and that temperatures on the ground-level should be given at intervals during the flight; he also spoke of the confusion that existed with regard to the sign of the temperature gradient.

Prof. Hergesell announced that a communication had been received by Prof. Köppen, who was unable to attend the congress; he proposed that all measurements of atmospheric pressure should in future be given in absolute C.G.S. units.

At the afternoon meeting on April 2 Prof. Bjerknes read a paper on the theoretical applications of upper-air observations, and spoke of the necessity for further co-operation. He advocated a series of strictly simultaneous ascents at all the stations, and suggested that on certain days observations should be made at 7 a.m., 1 p.m., and 7 p.m. Greenwich mean time. At 1 p.m. ascents of *ballons sondes* and kites should be made, and at the other hours, besides the ordinary barometer and thermometer readings at the ground-level, there should be as many observations of pilot balloons as possible; if possible, *ballons sondes* might be sent up at the other hours, but the mid-day ascent should be the principal one. He also strongly supported Prof. Köppen's proposition, and said that the use of dynamical units for atmospheric pressure would greatly facilitate theoretical work. M. Teisserenc de Bort said that he saw no difficulty in changing the units if there were any real advantage to be gained by the change. Mr. Cave said that the practice had already been introduced in England in the official publication of the upper-air observations in the Weekly Weather Report, and that Dr. Shaw was strongly in favour of the change being generally made.[1] Prof. Bjerknes said that he would publish tables to enable observers to change the old units into the new ones. In regard to the series of simultaneous observations advocated by Prof. Bjerknes, M. Teisserenc de Bort proposed that one of the smaller series of ascents should be set apart to be made on Prof. Bjerknes's plan, and General Rykatcheff suggested that the time of the ascents should remain as at present, but that they should be made strictly simultaneously, and that additional pilot balloon ascents should be made.

M. de Massani then read a paper on the proposed upper-air observations in Hungary, and Mr. Alexander one on the instruction in aërodynamics in the United Services College, Windsor.

M. Teisserenc de Bort read a paper on the results of theodolite observations on *ballons sondes* at Trappes, and the importance of this method in the verification of heights as determined by the barometer. As a result of his observations, he finds that the cyclonic circulation of the air in low-pressure systems does not extend to great heights in the atmosphere, but that the balloon sooner or later gets into a general wind current, mostly from west to south-west in these latitudes; over high-pressure areas the wind is light, and great irregularities in direction are found; there are often several entirely different currents superposed one above the other; this condition had also been observed in the tropics. With regard to the wind in the stratosphere, M. Teisserenc de Bort has often found a small change in direction at its lower limit, but the changes are neither so regular nor so great as might have been expected. In the discussion that followed Prof. Hildebrandsson said that the observations of M. Teisserenc de Bort in low-pressure areas confirmed his own observations of clouds; it was clear that at 3000 metres or so the isobars over a low-pressure area were no longer closed on the polar side. Mr. Cave said that his observations showed only a small change of direction when a balloon entered the stratosphere, but there had generally been a considerable decrease of velocity; his observations had been made at times when the wind velocities in the lower layers were considerably higher than in most of the cases mentioned by M. Teisserenc de Bort. Prof. Hergesell said that he had not found any regular change of wind direction in the upper layer, but he had in general found a diminution of velocity; but this diminution often occurred at some distance above the lower limit of the stratosphere.

Prof. Hergesell gave an account of the experiments he had made to determine the rate of ascent of rubber balloons in still air. From these experiments he has deduced a formula from which, within certain limits, the rate of ascent of a balloon may be calculated from its weight and from its free lift when inflated with hydrogen. Both he and M. Teisserenc de Bort consider that the vertical velocity is constant up to moderate heights; the theoretical increase of velocity due to decreased density of the air is probably more or less balanced by loss of gas from the balloon. If we know the rate of ascent, and determine the heights trigonometrically, we are able to measure vertical currents in the atmosphere. From his own observations Prof. Hergesell concludes that there is almost always some vertical motion, and sometimes he has observed a vertical current downward of as much as 1 metre per second, or even more; but in general a downward movement at one time is more or less counterbalanced by an upward movement at another, and therefore the one theodolite method, when the height of the balloon is taken as a function of the time, gives the wind velocities with very fair accuracy. Some discussion ensued about the theodolites used for the observations, and it was agreed that for accurate work with a base line the theodolites should read to five minutes of arc, but for the one theodolite method less accuracy was needed. A triangular base with three observers was also strongly recommended.

M. Teisserenc de Bort read a paper on the theory of the isothermal layer, which formed the subject of Mr. Gold's recent theoretical investigations (Proceedings of the Royal Society, vol. lxxxii., 1909). Prof. Hergesell said that he had not seen the original paper, but he thought from the account that M. Teisserenc de Bort had given that the theory had much to recommend it. M. Teisserenc de Bort said he thought the adiabatic distribution of temperature in the lower layers was due entirely to the vertical circulation of air in this part of the atmosphere.

On the afternoon of April 5 the Prince of Monaco was present, and Prof. Berson gave an account (which has appeared in NATURE, April 8, p. 171) of his observations on the Victoria Nyanza and off the east coast of Africa. Prof. Palazzo gave an account, illustrated by numerous lantern-slides, of his expedition to Zanzibar and its neighbourhood.

At the meeting on Tuesday morning Prof. Hergesell said that he had received a gift from the Kaiser to the commission in the shape of two portable houses, which could be used as a temporary observatory at any place where an extended series of observations might be useful; it had been proposed to erect them for a year or two on the Peak of Teneriffe, but the Spanish Government had now decided to establish a permanent observatory there. Colonel Vives y Vich gave an account of what it is proposed to do, and said that kite and pilot-balloon ascents would be made; to hasten on the commencement of the meteorological work, the Spanish Government would be willing to accept the temporary loan of the houses under certain conditions until the permanent buildings are ready. It was resolved to send a telegram to the Kaiser thanking him for his gift to the commission and for the interest he had taken in the work, and one to the Spanish Government accepting the conditions as to the houses.

Dr. Assmann spoke of the importance of the study of the upper air for aërial navigation, and thought that the cooperation of aëro clubs and others interested might be obtained, and that by this means a wider study of the subject might be possible. He looked forward to the establishment of more observatories where daily ascents should be made as at Lindenberg, and hoped that in time it might be possible to publish daily synoptic charts giving the isobars at different heights above the surface.

At the last meeting, in the afternoon of April 6, the following resolutions were carried:—

(1) Prof. Köppen's proposal to adopt absolute measures for atmospheric pressure was referred to the International Meteorological Committee.

(2) The July series of observations to be made at 7 a.m. Greenwich mean time, and pilot balloons to be sent up three times a day in accordance with the proposals of Prof. Bjerknes.

(3) M. Vincent's proposal that frequent observations of

[1] See introduction to the Weekly Weather Report, 1909.

the state of the sky should be made on international days was recommended.

(4) The importance of observatories for the study of the upper air to be urged on all countries which do not possess them.

(5) M. de Massani's project to establish an upper-air observatory on the plains of Hungary, near Kecskemét, was endorsed.

(6) It was resolved to bring to the notice of aëro clubs the importance of observations during ascents of manned balloons for sport, &c.

(7) Copies of traces of registering instruments are to be exchanged between members of the commission if required.

(8) Titles of new publications to be sent to Prof. Assmann for publication and analysis in *Fortschritte der Physik*, or to the U.S. Weather Bureau for the *Monthly Weather Review*.

(9) Prof. Rotch's proposition to express the temperature gradient as positive when the temperature decreases with altitude was adopted.

(10) Prof. Rotch's proposal that in the published observations of kite ascents simultaneous observations at ground-level be given was adopted.

(11) The thanks of the commission to be sent to the Austrian Minister of War and to the Vienna Aëro Club for their assistance, and to other Governments which have encouraged the study of the upper air.

(12) The thanks of the commission to be sent to the Spanish Government for its promise to establish an observatory on the Peak of Teneriffe, and to the Spanish military aëronauts and to the German Government for aiding the project.

(13) Various new members were elected—MM. Trabert, Vincent, Kleinschmidt, Bjerknes, Ryder, and Bamler; the directors of the observatories of Irkutsk, Tiflis, and Ekaterinburg; and several military aëronauts, including Colonel Capper.

(14) It was resolved that the next meeting of the commission should be held in Vienna in the autumn of 1912.

Besides the formal meetings of the congress, the members were entertained on several occasions by the Prince of Monaco. A lecture was given by M. Bourée on the oceanographical work that has been done by the Prince on his yacht the *Princesse Alice*, and on April 4 the members were taken by motor to the Nice Observatory by the Corniche Road.

PROBLEMS OF APICULTURE.

ABOUT four years ago a mysterious disease appeared among the bees of the Isle of Wight, and caused great mortality. The most characteristic features were disinclination to work, some distension of the abdomen, frequent dislocation of the wings, and, later, inability to fly. At this stage the bees could only fly a few feet from the hive, and then dropped and crawled about aimlessly on the ground. They could often be seen crawling up grass stems or up the supports of the hive, where they remained until they fell back to the earth from sheer weakness, and soon afterwards died. An investigation was begun by Mr. A. D. Imms, but, as he was unable to continue the work, the Board of Agriculture secured the services of Dr. W. Malden, whose report is issued in the February number of the *Journal of the Board of Agriculture*. He finds that the only organ affected is the chyle stomach, all other organs being normal; there is no paralysis of the wing muscles. The disease is almost certainly infectious, and a plague-like bacillus was frequently found in the chyle stomachs of diseased bees, but not in those of healthy bees. Owing to difficulties of manipulation, it was impossible to establish definitely any causal connection between the disease and the presence of the organism, although the experiments strongly suggest that there is such a connection. It is to be hoped that the investigation may be completed; it promises to be of general importance for the solution of problems connected with infectious diseases of bees.

The whole question of bee diseases needs working out more fully, for little is as yet known with any degree of certainty about the causes of some of them, and few of the disease-producing bacteria have been investigated. An important administrative question is also raised: if a diseased hive is not at once destroyed it becomes a source of infection for surrounding hives, and one careless bee-keeper can in this way do serious harm to others round about him without becoming liable to compensate them for their loss. In a recent Bulletin issued from the United States Department of Agriculture Bureau of Entomology (No. 75), discussing the status of apiculture in the United States, it is urged that bee-keeping should not be popularised, but should be confined, so far as possible, to competent men having a sufficient financial stake in the business to ensure that the bees should have proper attention. "No question in apiculture," says the writer, "at all compares in importance with the control of bee diseases." Two contagious brood diseases already cause serious loss, and there is reason to believe that they are spreading at a rapid rate. The bee industry of the States is quite important enough to deserve consideration; the value of the honey is put at 20,000,000 dollars annually, but the work of the bees in fertilising the blossoms of fruit trees is valued at a still higher figure.

Among other bee problems that are still obscure, few are more interesting than the mating of bees. A host of questions suggest themselves as one watches the wonderful flight of the virgin queens and the drones, but investigation is rendered difficult by the absence of methods. It is no easy matter to arrange that only selected drones shall mate with the queens. Only few cases are on record where mating took place when the bees were caged, even though all the conditions were normal and the cages used were very large—Mr. Davitte's was 30 feet high and of the same diameter. Mr. Miller recently made some experiments, with negative results, at the Rhode Island Agricultural Experiment Station on this subject, and his paper, in the current annual report, affords a good illustration of the difficulties that the investigator meets.

METEOROLOGY OF THE DUTCH EAST INDIES.

WE are indebted to the Royal Observatory of Batavia for the following valuable publications:—(1) meteorological, magnetical, and seismometric observations for 1906, and (2) rainfall observations made at the Netherlands East Indian stations for 1907. It may not be generally known that the establishment of this important observatory was primarily due to a suggestion made by Baron A. v. Humboldt to the Governor-General of Netherlands' India in 1856 (Bayard, Presidential Address to the Royal Meteorological Society, January, 1899). Humboldt pointed out the great value that a magnetical and meteorological observatory at Batavia would be for the promotion of knowledge concerning those phenomena between the tropics. The Amsterdam Academy strongly supported the suggestion, and invited Prof. Buys Ballot to draw up a plan. The proposal of the latter, in 1857, included the organisation of hourly observations at Batavia and the establishment of secondary stations at some places in the East Indian Archipelago, and Dr. P. A. Bergsma was subsequently appointed director of the proposed system. Hourly observations were commenced at Batavia in 1866, and have been continued without interruption down to the present time, with summaries after each five-yearly period, but the establishment of second-order stations was not carried out on account of expense. Wind observations are, however, made at many places by non-official observers, and are collected by the observatory. In 1879 Dr. Bergsma organised a system of rainfall observations throughout the archipelago which has since been regularly continued.

The data for 1907 are published in two volumes, giving (1) daily and monthly amounts, and (2) monthly and yearly amounts and the number of rain-days, together with the results for 1879–1907, at all stations having observations for five years and upwards. At the end of the year the official stations numbered 292, and included Java, Sumatra, Borneo, North Guinea, and the many islands lying between them, some of the principal places being provided

with self-recording gauges. The rainfall over this vast area varies very greatly, according to position and altitude and the strength of the monsoons. On the whole, the amounts for 1907 differed little from the average; in Java the extreme yearly values were about 29 inches and 196½ inches (both in the eastern part), and at outlying stations about 21 inches to 197½ inches (both in Celebes). The results at more than 700 stations in Java, including the observations at non-official stations, for the period 1879–1905, have recently been separately published by Dr. W. van Bemmelen. In addition to the above-mentioned publications, the observatory has issued the results of several valuable investigations relating to seismology, tides, &c., and has completed a magnetic survey of the whole archipelago. Papers have also been published bearing upon the moon's influence on meteorological and magnetical phenomena.

RECENT PAPERS ON FISHES.

A REVIEW, by Mr. E. W. L. Holt, of recent contributions to our knowledge of the life-history of the eel, forms the subject of No. 8 of Irish Fisheries Scientific Investigations for 1907 (1909). After a survey of the development and migration of the species, the author is of opinion that the breeding-resort of the eels of northern Europe is in the deep water outside the 500-fathom line to the south-west of Ireland, where alone their leptocephali have been taken in abundance. It by no means follows from this that all north European eels which reach the sea succeed in arriving at the breeding-area, and possibly Finnish eels never breed at all. If this be so, it becomes a practical certainty that elvers—unlike salmon—do not return to the rivers from which their parents started, as, indeed, is improbable on other grounds, seeing that eels—unlike salmon—are hatched in the sea.

In the second part of vol. xxxi. of Notes from the Leyden Museum, Prof. Max Weber, of Amsterdam, describes a large number of new species of fishes collected by the members of the *Siboga* Expedition in Austro-Malaya. A large proportion of these were taken in littoral or sublittoral waters, but others were captured on coral-reefs or in deep water with nets. Many of the new forms are blennies and gobies, no fewer than seven new species of the type-genus (Gobio) of the latter group being described. The present preliminary notice is published on account of the interest attaching to these fishes from a distributional point of view.

To vol. vii., part i., of *Annotationes Zoologicae Japonenses*, Mr. S. Tanaka contributes two papers on Japanese fishes, one dealing with those inhabiting rock-pools at Misaki, and including descriptions of two new species, while the second is devoted to eight new species from Japan generally, two of these being gobies and one a blenny.

Finally, three new species of cisco, or lake-herrings, of the genus Argyrosomus from the great lakes of North America are described by Messrs. Jordan and Evermann in No. 1662 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 165–172), where a note is appended on the species of white fish (Coregonus) inhabiting the same region.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Sir E. Ray Lankester, K.C.B., has resigned his appointment as Huxley lecturer for the coming session, and Mr. W. Bateson, F.R.S., has accepted an invitation to fill the vacancy thereby caused.

On July 7 the King is to perform the opening ceremony of the new buildings of the University. These buildings, which are situate in the south-west corner of Edgbaston, are about three miles from the centre of the town. They comprise the Great Hall, an imposing structure about 160 feet in length, 80 feet in width, and 60 feet high; two separate blocks devoted to engineering in its various branches, civil, mechanical, and electrical; another block for mining and metallurgy, with additional buildings for the manufacture and working of iron and steel; and a power-station for the generation of electrical power, which is distributed to the different blocks for driving machinery and for lighting purposes. These sections have all been in working order for two or three years; and at the present time there are approaching completion two blocks for the departments of physics and chemistry respectively, and a third structure which will serve the function of a central library. Rising high above all these is the Chamberlain Tower, with its clock and bells, measuring from base to summit about 325 feet, the gift of a local donor as a tribute to the Chancellor of the University.

CAMBRIDGE.—In connection with the Darwin centenary, it is proposed to confer the degree of Doctor of Science, *honoris causa*, upon:—E. van Beneden, professor of zoology in the University of Liège; Robert Chodat, professor of botany in the University of Geneva; Francis Darwin, F.R.S., of Christ's College; Karl F. von Goebel, professor of botany in the University of Munich; L. von Graff, professor of zoology in the University of Gratz; H. Höfding, professor of philosophy in the University of Copenhagen; J. Loeb, professor of physiology in the University of California, Berkeley; E. Perrier, director of the Natural History Museum, Paris; G. A. Schwalbe, professor of anatomy in the University of Strassburg; H. von Vöchting, professor of botany in the University of Tübingen; H. de Vries, professor of botany in the University of Amsterdam; C. D. Walcott, secretary of the Smithsonian Institution, Washington; E. B. Wilson, professor of zoology in the Columbia University of New York; and C. R. Zeiller, professor of palæobotany in the École Nationale Supérieure des Mines, Paris.

The special board for biology and geology has approved a grant of 25*l.* from the Balfour fund made by the managers to Mr. R. C. Punnett, in furtherance of his experiments to investigate the inheritance of certain features in rabbits.

The syndicate on alternatives for the general examination, after consultation with the special boards affected, recommends that the schedules for the first examination for the M.B. degree be adopted for the proposed preliminary examination in science, and that the examinations be conducted by the same examiners and on the same papers. It is proposed to allow that the three subjects of the examination—chemistry, physics, and elementary biology—be taken separately, but all candidates must pass in each subject. Detailed regulations have been issued as regards the amendment of the ordinances which the various suggestions will involve.

The new agricultural buildings are now well advanced, and it is hoped they will be ready for occupation by October. The amount of expenditure already incurred is 14,000*l.*, and it is now necessary to obtain specifications and estimates for furniture and fittings. It is estimated that these, together with the architect's commission and incidental expenses, will amount to 3500*l.* At the present time the building fund amounts to 17,000*l.*, and there is thus a balance of 3000*l.* in hand. A further sum of 2000*l.* has been promised as soon as 18,000*l.* has been subscribed. Strenuous efforts are therefore being made to obtain the 1000*l.* required to reach this amount.

LONDON.—Wednesday, May 12, was Presentation Day at the University. In the absence of the Chancellor (Lord Rosebery), the Vice-Chancellor (Sir Wm. Collins, M.P.) presided. Before the proceedings in the Great Hall commenced, the first general parade of the University contingent of the Officers' Training Corps, which mustered more than 400 strong, was held in front of the University. Addresses were delivered by the Vice-Chancellor and by Sir Henry Mackinnon, Director-General of the Territorial Force. The first report of the new principal, Dr. H. A. Miers, F.R.S., showed continued progress, the number of matriculants having risen from 3277 in 1907–8 to 3886 in 1908–9. A corresponding increase was also reported in the number of first degrees granted (from 1192 to 1336) and of higher degrees (from 64 to 78). In concluding his report, the principal directed attention to the great progress which had been made in the organisation of higher education in London since the re-constitution of the University, and the "appalling deficiencies" which still existed

in certain particulars. "I found a university," he said, "housed in the half of a building which, though splendid, is entirely inadequate and bears another name, without any proper accommodation for its examinations, without even sufficient room for its normal business or for the meetings of its Senate, councils, and committees; a university which sorely needs endowments and buildings for advanced teaching and research; which has no place that can become a centre for the intellectual and social life of the teachers and students belonging to its numerous schools; a university mainly dependent upon examination fees for its existence, while compelled to consume one-half of these fees in the expenses of the examinations themselves." The presentees included 13 Doctors of Science and 261 Bachelors of Science. It is remarkable that the number of B.Sc.'s presented slightly exceeds the number of B.A.'s (254). In addition, 86 B.Sc.'s in engineering were presented.

The new physiology institute at University College, funds for the building of which were provided by the generosity of Mr. Ludwig Mond and Dr. Aders Plimmer and by the bequest of the late Mr. T. Webb, will be opened on June 18 by Mr. Haldane, Secretary of State for War.

THE King has signed the warrant for granting a charter establishing the University of Bristol.

LORD REAY will open the new buildings of the Merchant Venturers' Technical College, Bristol, on June 24.

MR. R. A. CHISOLM has been appointed Greville research student for research in connection with the subject of cancer at Guy's Hospital Medical School.

THE old Galway students of Prof. Senier have just presented him with an address encased in a silver casket, expressing their pleasure at the recent action of the Royal University in conferring upon him the honorary degree of Doctor of Science in recognition of his services to science and to university education in Ireland.

WE learn from *Science* that subscriptions to the C. W. Eliot fund have been received from about 2050 graduates of Harvard University and others, and amount at this time to about 26,000*l*. The committee hoped that the fund would amount to more than 30,000*l*. by May 19, when President Eliot retired. The subscriptions have been placed in the hands of trustees, to invest and hold for the benefit of President and Mrs. Eliot. The fund will eventually pass to Harvard University.

THE Goldsmiths' Company recently offered a gift of 50,000*l*. to the governors of the Imperial College of Science and Technology towards the cost of the proposed extension of the engineering department of the college, and on May 14 the offer was gratefully accepted by the governors. Writing to Lord Crewe, as chairman of the governors, Sir Walter Prideaux, on behalf of the Goldsmiths' Company, pointed out that the gift was irrespective of the company's support to the City and Guilds Institute, and that their subscriptions in the latter direction would not be curtailed. The letter reminded Lord Crewe that the whole of the engineering department of the Imperial College is to be called "The City and Guilds College." The Goldsmiths' Company has expressed the hope that the company will be given separate representation on the delegacy which it is proposed shall administer the entire department of engineering, and the governors of the college have promised that the wishes of the company shall receive immediate attention. The Goldsmiths' Company will pay 10,000*l*. on the day whereon the contract for the work is signed, and the remainder by instalments spread over a period of not fewer than three years.

IN his annual address as president of the Royal Institution of Cornwall, Dr. R. Pearce discussed the attempts made by the society to provide instruction for miners in the subjects connected with their occupation. One of the objects of the institution, founded in 1818, was to establish a mining school, the first of the kind in England. The results were at first unsatisfactory; but in 1859 the school was re-organised with the advice and assistance of Mr. R. Hunt, and at a later date by Sir C. Le Neve Foster. The result has been, not so much to improve the methods of Cornish mining, as to provide students qualified for work in other places. Out of 221 students at the Camborne School only forty-one are Cornishmen, the balance being made up from natives of other parts of the country and several foreigners. The school has supplied mining engineers for the colonies and foreign countries, and the president, summing up the results, remarks:—"We may, I think, congratulate ourselves on the fact that, although Cornwall is not deriving any very important benefit by the application of scientific instruction to its mining industry, our colonies and our colonial mining and metallurgical enterprises are being built up from material furnished from our Cornish mining schools."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 13.—Sir Archibald Geikie, K.C.B., president, in the chair.—Recent solar research; Dr. G. E. **Hale**.—Utilisation of energy stored in springs: A. **Mallock**, F.R.S. The "dynamic worth" of a substance is the work which can be elastically stored in it, divided by its mass. It may be expressed either as the square of the velocity which the stored work could impart to the mass, or, in gravity measure, as the height to which the stored work could raise the weight of the mass. The dynamic worth of india-rubber is more than ten times as great as for any other known substance, and for this reason india-rubber may be used with advantage in certain cases as a source of motive power. It is pointed out in the paper that if the potential energy in the strained material is to be efficiently converted into mechanical work, no frictional contact must occur while the strained material is returning to its original shape. Thus, if the strained material is in the form of a long cord wound on a reel (as the most convenient method of storage), the condition as to the absence of friction during contraction makes it necessary to develop the stored energy in cycles. In the first place, keeping the tension of the cord constant, a certain length must be unwound from the reel and the reel clamped. The cord also must be clamped in two places, first, near the place where it leaves the reel, and again at the extremity of the strained part, to some moving piece of the mechanism. If the part of the cord included between these points is then allowed to contract, the whole elastic work it contained is transferred to the machine. The above cycle may be repeated as long as any stretched cord remains on the reel. Any change of tension, however, in the process of unwinding involves loss of efficiency, due to the sliding of the cord on the reel or on the underlying coils, which must occur if the tension in the wound and unwound parts differs.—A new kind of glow in vacuum tubes: Rev. H. V. **Gill**. The experiments described in the paper were made with the object of investigating the nature and causes of a phenomenon observed by the writer when occupied with a research connected with palladium foil. A piece of palladium foil, or platinum foil coated with palladium black, is heated to a white heat in air at a pressure of about 0·15 mm. A purple-blue glow is seen to surround the hot metal. Between the glow and the palladium there is a dark space. The thickness of the dark space varies with the temperature of the foil. The glow disappears when the tube is heated to a high temperature, and returns when it is cooled. It is shown that the presence of the glow depends on a reaction between the gases introduced into the tube when the palladium is heated and the disintegrated particles of palladium. Water vapour is required to be present in the tube, and the glow can be made to disappear by freezing out the vapour by means of a few drops of liquid air applied to the outside of the tube, or by introducing some phosphorous pentoxide into the tube. The spectrum of the glow shows certain regions which correspond to portions of the spectrum of carbon monoxide gas. It is also shown that carbon monoxide is present in the tube which shows the glow. No effect was observed when electric and magnetic fields were applied to the glow. The probable cause of the luminosity is the luminous union

of carbon monoxide and oxygen brought about by palladium charged with hydrogen in the presence of water vapour. A second effect is also briefly described, which appears to be due to the causes which give rise to thermo-luminosity.—The elastic limits of iron and steel under cyclical variations of stress: L. **Bairstow.** An explanation of the fatigue of materials due to the repetition of stresses of sufficiently great magnitude has been investigated experimentally, and found to agree completely with experiments to destruction. The theory was proposed by Bauschinger in 1886, and states that fatigue occurs when the cycle of stress is so great that the extensions produced thereby are not wholly within the limits of elasticity of the material. For this to be true for the whole of Wöhler's well-known experiments, the inferior and superior elastic limits must be variable, but it must not be possible to vary one limit independently of the other. The experiments dealing with this question have been made in a specially constructed testing machine, the repetitions being produced so slowly that the extensions of the specimen at the extreme loads in the cycle could be observed under the normal conditions of test. This new feature in experiments on fatigue has led to the discovery that iron and steel can be made to yield by the repeated application of a cycle of stress in which the maximum stress is considerably less than the static yield stress. Such yielding accompanies any change in the position of the elastic limits, the change being greater as the amount of the yielding is greater. The position of the elastic limits has been found for a number of ratios of maximum to minimum stress, and the relationship of the results to Wöhler's experiments shown. The well-known Gerber parabola is shown to be only a rough approximation.—Functions of positive and negative type: J. **Mercer.**

Geological Society, April 28.—Prof. W. J. Sollas, F.R.S., president, and afterwards Prof. W. W. Watts, F.R.S., vice-president, in the chair.—The boulders of the Cambridge drift: R. H. **Rastall** and J. **Romanes.** For several years past a large number of boulders have been collected from the Glacial drifts of Cambridgeshire, and from the post-Glacial gravels which have been derived from the drifts. These specimens have been classified geographically, and then subjected to a careful petrological examination, with a view to the determination of their origin. Rocks of Scandinavian origin, and especially those of the Christiania province, are abundant throughout the whole area. Rocks from the Cheviots and central Scotland are more abundant than was formerly believed, and specimens have also been identified from the Old Red Sandstone conglomerates of Forfarshire and from Buchan Ness (Aberdeenshire). Lake District rocks probably also occur in small quantity. Much of the Chalk and flints appear to be of northern origin. It is concluded that an older Boulder-clay, containing foreign erratics, the equivalent of the Cromer Till, once extended over the whole district, but was subsequently incorporated with the Great Chalky Boulder-clay. The Scandinavian ice advanced from the direction of the Wash, bringing with it Red Chalk and bored Gryphæas from the bed of the North Sea, and carrying them as far west as Bedford. Rocks from the north of the British Isles become progressively scarcer from west to east, and the distinctive types are absent to the east of Cambridge. They appear to have been brought by an ice-stream coming from a northerly direction, which probably to a certain extent replaced the Scandinavian ice towards the east.—The nephrite and magnesian rocks of the South Island of New Zealand: A. M. **Finlayson.** The magnesian rocks described in this paper are a disconnected series of intrusive peridotites, forming a more or less defined belt along the western portion of the South Island, parallel to the trend of the island and to the structural and geographic axes of the main Alpine range. The course taken by these rocks apparently follows one of the main Pacific trend-lines, the nature of which will be more fully understood with the further elucidation of the structural geology of the region. The rocks are intrusive into sedimentary strata of ages varying from Ordovician to Jura-Trias, and, so far as can yet be determined, all the exposures appear to be of approximately contemporaneous origin.

Royal Anthropological Institute, May 4.—Mr. J. Gray, treasurer, in the chair.—Some stone circles in Ireland: A. L. **Lewis.** The author described several large circles in the neighbourhood of Lough Gur, co. Limerick. These differ from the British circles, being thick banks of earth faced on each side by large stones, but they are furnished with outlying single stones in a manner similar to that found at many of the circles in England and Scotland; these outlying stones are apparently in the direction of the rising of some star at a very early date. One of the largest circles was "restored" shortly after 1860, and now consists of a wall, 150 feet in diameter and 5 feet high, of stones, backed outside by a bank of earth 30 feet wide, through which there is but one entrance, a passage 3 feet wide, lined with stones on each side; this entrance is in the direction of the rising sun in May. The author suggested that, assuming the restoration of this circle to be correct, it differed in construction from the others, and possibly also in its purpose, and that it might have been used as a pound for wild animals driven into it from outside over the sloping bank, and kept inside to be killed as required. There were also circles of stones without earthen banks, remains of cromlechs or dolmens, locally called "giants' graves," and many other interesting ruins belonging to various ages, and there was also the usual melancholy tale of monuments of all sorts destroyed. In another short note Mr. Lewis directed attention to some concentric circular markings, similar to those found at New Grange and other prehistoric places, faintly incised on a stone on the Rock of Cashel, on which the early kings of Munster were said to have been crowned, and which now serves as a pedestal for a very ancient cross.

Linnean Society, May 6.—Dr. D. H. Scott, F.R.S., president, in the chair.—Some Zoantheæ from Queensland and the New Hebrides: Mrs. L. J. **Wilsmore.**—Two new genera of Thysanoptera from Venezuela: R. S. **Bagnall.**

Mathematical Society, May 13.—Sir W. D. Niven, president, in the chair.—Ternary quadratic types: H. W. **Turnbull.**—Gauss's theorem, and on the semi-convergence of certain force integrals in the theory of attractions: Dr. J. G. **Leathem.**—The continuity or discontinuity of a function defined by an infinite product: J. E. **Littlewood.**

MANCHESTER.

Literary and Philosophical Society, April 20.—Prof. H. B. Dixon, F.R.S., president, and later Mr. F. Jones, in the chair.—The Guatemalan earthquakes and eruption of 1902: W. S. **Ascoli.** The earthquake occurred on April 18, 1902, at about 8.25 p.m., the intensity being greatest in western Guatemala, where the second and richest city of the country, Quezaltenango, was completely destroyed. Many other places suffered greatly, and about 1400 of the 20,000 people living in the disturbed region lost their lives. Six months later, on October 24, 1902, there followed the eruption of the neighbouring volcano, Santa Maria, the ash of which covered an area of more than 125,000 square miles. The region, over which nearly 8 inches of ashes and pumice-stone fell, extended to about 2000 square miles, and within it most of the houses and farm buildings fell in under the weight of the ejectamenta, and in some places were totally destroyed. It is estimated that 6000 persons were killed. The cloud from the volcano was eighteen miles in height, and the detonation was audible at Costa Rica, 500 miles away. The whole of the side of the mountain was blown out, exposing a perpendicular cliff 7000 feet high, and forming a crater seven-eighths of a mile long, three-quarters of a mile wide, and 1500 feet deep.—Apical pigment-spots in the pluteus of *Echinus miliaris*: F. H. **Gravely.** In advanced living plutei of *Echinus miliaris* from the plankton of Port Erin Bay there are present in close association with the apical plate two pairs of pigment-spots, and one pair of tufts of stiff cilia. The anterior pair of pigment-spots is small, and of a transparent red colour. The posterior pair are smaller, and of an opaque yellow. They are situated in the general cavity, closely applied to the inner surface of the apical plate, and are probably composed of the same substance as that of similar cells described by MacBride as being found in other parts of the body—especially in large masses beneath

the four epaulettes—of the pluteus of *Echinus esculentus*. This substance occurs, with a similar distribution, in the pluteus of *E. miliaris*.

CAPE TOWN.

Royal Society of South Africa, March 17.—Dr. Wm. Flint in the chair.—The spectrum of the ruby: J. **Moir.** On placing a ruby before the slit of a spectroscope, using strong illumination, preferably sunlight, a very remarkable absorption spectrum is obtained, which differs from all others in resembling an ordinary *emission* spectrum. The light is cut off except for a sharp narrow red band situated just beyond the B line of the solar spectrum, and this band bears the closest resemblance to the potassium or lithium line as commonly seen in the Bunsen flame when a rather wide slit is used. The limiting wave-lengths of the band are about 6915 and 6945 tenthmetres. Its width is therefore about half its distance from the B line in the solar spectrum. The phenomenon is most easily seen in pale rubies; corundum with even the faintest pink shade generally shows the characteristic line; but even the darkest true rubies show it if the illumination be strong enough. No other pink or red stone—pyrope, almandine, spinel, or tourmaline, for example—shows this line, which would therefore appear to be characteristic of the colouring of the true ruby. In addition to the red line the spectrum contains wide green and orange bands, which are, however, not characteristic.—Remarks on some experiments with the venom of South African snakes: W. **Frei.** The author contends that, from a toxicological point of view, the classification of the snakes in (1) Oglypha, (2) Opistoglypha, (3) Proteroglypha, (4) Solenoglypha, is the most satisfactory.—An upper limit for the value of a determinant. Note on a theorem regarding a sum of differential coefficients of principal minors of a Jacobian: Dr. T. **Muir.**—Note on a Cœnurus of the Duiker bok: L. H. **Gough.** The parasite was found imbedded in the muscles between the scapula and the vertebral column of a Duiker Bok (*Cephalophus Grimmi*).—The evolution of the river system of Griqualand West: A. L. **Du Toit.** The drainage system in the area dealt with consists of the Orange River with its tributaries, the Vaal, Harts, Riet, and Brak rivers, sections of the first three forming the continuous valley facing the edge of the Kaap Plateau from Vryburg almost to Prieska.

DIARY OF SOCIETIES.

THURSDAY, MAY 20.

ROYAL SOCIETY, at 4.30.—Observations on the Urine in Chronic Disease of the Pancreas: Dr. P. J. Cammidge.—*Trypanosoma ingens*, n.sp.: Colonel Sir David Bruce, C.B., F.R.S., and Captains A. Hamerton, H. R. Bateman and F. P. Mackie.—The Incidence of Cancer in Mice of Known Age: Drs. E. F. Bashford and J. A. Murray.—A Method of Investigating the Total Volume of Blood contained in the Living Body: Drs. J. O. Wakelin Barratt and W. Yorke.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.—Some Tests and Uses of Condensers: W. M. Mordey.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on the Zangezour Copper Mines: A. L. Simon.—The Determination of Tungstic Acid in Low-grade Wolfram Ores: H. W. Hutchin and F. J. Tonks.—Cupellation Experiments: the Thermal Properties of Cupels: C. O. Bannister and W. N. Stanley.—The Bessemerising of Hardhead: Donald M. Levy and D. Ewen.—The Use of Standards in Reading Gold Pannings: Stephen J. Lett.—Notes on the Scaling and Sweating of Copper Battery Plates: Sydney F. Goddard.

FRIDAY, MAY 21.

ROYAL INSTITUTION, at 9.—Afforestation: Hon. Ivor C. Guest, M.P.

SATURDAY, MAY 22.

ROYAL INSTITUTION, at 3.—The Secret Societies of the Banks' Islands: Dr. W. H. R. Rivers, F.R.S.

MONDAY, MAY 24.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

TUESDAY, MAY 25.

ROYAL INSTITUTION, at 3.—The Hittites: (2) Recent Discoveries in Asia Minor and Northern Syria: Prof. John Garstang.

ZOOLOGICAL SOCIETY, at 8.30.—Description of a New Species of the Genus Alpheus, Fabr., from the Bay of Batavia: Dr. J. G. De Man.—On the Skull of a Black Bear from Eastern Tibet, with a Note on the Formosan Bear: R. Lydekker.—The Anatomy of the Olfactory Organ of Teleostean Fishes: R. H. Burne.

WEDNESDAY, MAY 26.

GEOLOGICAL SOCIETY, at 8.—The Cauldron Subsidence of Glencoe, and the Associated Igneous Phenomena: C. T. Clough, H. B. Muff, and E. B. Bailey.—The Pitting of Flint Surfaces: C. Carus-Wilson.

ROYAL SOCIETY OF ARTS, at 8.—The Manufacture of Nitrates from the Atmosphere by the Electric Arc: S. Eyde.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Chinese Astronomy: E. B. Knobel.

THURSDAY, MAY 27.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Notes concerning Tidal Oscillations upon a Rotating Globe: Lord Rayleigh, O.M., F.R.S.—The Absolute Value of the Mechanical Equivalent of Heat in Terms of the International Electrical Units: Prof. H. T. Barnes.—An Approximate Determination of the Boiling Points of Metals: H. C. Greenwood.—Some Results in the Theory of Elimination: A. L. Dixon.—The Liquidus Curves of the Ternary System, Aluminium-Copper-Tin: J. H. Andrew and C. A. Edwards.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

INSTITUTION OF MINING ENGINEERS, at 11.—Presidential address: Dr. R. T. Moore.—Electricity in Coal-mines: R. Nelson.—Comparison between the Value of Surplus Gas from Regenerator Bye-product Coke-ovens and Steam produced by the Waste Heat from Bye-product Coke-ovens, with Special Reference to the Evence Coppée new Bye-product Ovens: M. H. Mills.

FRIDAY, MAY 28.

ROYAL INSTITUTION, at 9.—Advances in our Knowledge of Silicon as an Organic Element: Dr. J. Emerson Reynolds, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 10.30.—The Use of Concrete for Mine Support: Prof. W. R. Crane.—Mining in British Columbia: Mrs. Rosalind Young.

SATURDAY, MAY 29.

ROYAL INSTITUTION, at 3.—The Secret Societies of the Banks' Islands: Dr. W. H. R. Rivers, F.R.S.

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