NATURE

THURSDAY, JUNE 16, 1921.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

The Safeguarding of Research.

THE fact that the Bill for the Safeguarding of Industries has passed its second reading in the House of Commons has directed renewed attention to the manner in which its provisions will react on the prosecution of scientific research in this country. It will be remembered that the supply of scientific apparatus and chemicals was the subject of a discussion in our correspondence columns about a year ago, and we have received many further letters showing the importance of the question. In NATURE for June 9, p. 457, attention was directed to the formation of a committee of the British Science Guild to report upon the matter. We hope that all our readers who have knowledge of facts bearing on the problem, or suggestions to offer, will give this committee the benefit of their views.

Our concern here is for the advancement of scientific discovery, which is the only real basis for the safeguarding of all industrial development. For this reason we think that the point of view of the user and consumer, more particularly that of the worker in science, should receive chief attention. Certain documents that have been issued suggest rather that the interest of the manufacturer is to be the primary consideration. Although British men of science are undoubtedly desirous of supporting the industries of their country, even if they have to pay a somewhat higher price for the goods, it is clearly their duty to see to it that the main object of their work does not suffer thereby. Great improvements have been made in British laboratory ware, but there are still difficulties in obtaining a sufficient supply of apparatus and chemicals on which reliance can be placed.

Users would be saved no small waste of time and receive encouragement in their purchase of British goods if they knew how far they could really depend on these being what they profess to be. Prof. Cohen's experience with propyl alcohol, as given in NATURE for March 3, p. 12, is to the point here. It is not meant to imply that even the best German chemicals are beyond reproach, although some workers appear to be under the impression that if they use Kahlbaum's preparations no further control of purity is needed. Excellent glass and porcelain is certainly being made here, and our optical and electrical apparatus is second to none. But the price is often very high, and there are still uncertainties in the uniformity of the supply. There appear to be no difficulties in the manufacture of articles for domestic use, and if manufacturers do not find it worth while to put good workers on to scientific apparatus, which has a comparatively small sale, why do they not give it up? The suggestion has been made that purchasers should return any unstamped glass ware, while payment might be refused for goods the origin of which is not stated.

The problem is to discover how best to enable manufacturers to perfect their processes and to protect them from loss while this is being done. It is superfluous to say that the great need is for more and more research, and any legislation that tends to remove the opportunity for this is to be deprecated. The manufacturers appear to dread the competition of countries of which the currency is depreciated. But it is to be noted that the Bill applies to Allied and neutral countries as well as to Germany. Moreover, as was evident in the discussion in the House of Commons, the opinion of many competent speakers is that such competition is exaggerated, and that in any case a depreciated currency is of no real advantage in the world markets, and will continue until normal trade relations are restored. The bankers' manifesto points out that the only satisfactory way of dealing with the situation is to allow trade complete freedom to develop on its own initiative. Artificial attempts to remedy conditions that can right themselves only by the greatest expansion of trade in all directions delay any real solution. This is very far from saying that nothing is to be done at all. The most effective way of avoiding dumping is surely to aim at raising depreciated money value, rather than to restrict trade by import duties.

So far as makers of scientific apparatus are concerned, we believe they are not satisfied with import duties, and want prohibition of import for a time, with permits to import in special cases. Many consumers have stated their preference for a system of subsidies to enable prices to be low enough to compete with foreign goods. Such a scheme naturally offers difficulties, and there would need to be assurance that efforts at improvement are being made. There seems to be no reasonable objection to the price being made as nearly as possible equal to that of the foreign article, so that the competition should become one of quality. The Bill, however, will probably be passed, although it may still be possible to insert provisions to enable free import to recognised scientific institutions. Such permits must be of a general character, not requiring renewal, and not demanding the intervention of the Customs or other Government Department. No special licences for individual cases would be satisfactory.

How obstructive to scientific progress the Customs regulations may be is shown by letters that have appeared in these columns. The question of books is a very serious one. Incidentally, reference may be made to the increasing difficulty of publication of scientific papers, which seems to be greater in England than in other countries. But here again what is wanted is a general fall in prices, and this can be brought about only by a return to normal trade relations throughout the world.

Much stress was laid by certain speakers in the House of Commons on the necessity of our industries as a national insurance in case of future war. The only remark that need be made in this place is that the most important matter is to keep abreast of scientific work in other countries. Restriction of research is likely to do more harm than the more or less ineffective artificial protection of a few industries would do good. It is to be hoped, therefore, that institutions in which such scientific research is carried on will be placed beyond the effect of the new restrictions on import.

Steam and Thermodynamic Theory.

Properties of Steam and Thermodynamic Theory of Turbines. By Prof. H. L. Callendar. Pp. xi+531. (London: Edward Arnold, 1920.) 40*s*. net.

IN this substantial volume Prof. Callendar has set his seal to the experimental and theoretical investigations of the properties of steam on which he has been engaged for many years. By these investigations, which have done much to advance technical thermodynamics, Prof. Callendar has made the engineering world his debtor. It is twenty-one years since he first published, in the Proceedings of the Royal Society for June, 1900, his paper on "the thermodynamical properties of gases and vapours as deduced from a modified form of the Joule-Thomson equation, with special reference to the properties of steam."

With the publication of the book now under review Prof. Callendar's theory comes of age. The book leads up to, and includes, his steam tables, which were issued separately five or six years ago and are accepted as the standard tables, at least by English engineers. Here the author describes, much more fully than before, the basis of the tabular work, discusses its agreement with the latest results of observation, and replies to objections that have been taken to his method on the part of some American writers. Into this controversial matter there is no need to enter here: the replies will have answered their purpose if they succeed in removing misconceptions regarding the scope and character of Prof. Callendar's fundamental work, which, indeed, his own earlier papers can scarcely be said to have presented in a form that made its meaning very clear or its importance obvious.

Perhaps for that reason engineers were slow to appreciate the practical bearing of Prof. Callendar's treatment of the properties of steam. The first of them to do so was Prof. Mollier, of Dresden, himself distinguished for original contributions to technical thermodynamics, who in 1906 published a set of tables and diagrams for steam based on the Callendar characteristic equation. Shortly afterwards the methods of Prof. Callendar and the tables and diagrams of Prof. Mollier were brought to the notice of English engineers by the present writer in the third edition of his book on "The Steam-Engine and other Heat-Engines."

Prof. Callendar's own tables, published in 1915, embody the results of a more complete application of his methods, and make use, in some particulars, of later data. They give all the necessary figures for properties of steam throughout the range of temperature and pressure which is usual in the practice of steam engineering. It is the essence of Prof. Callendar's method to secure results which will be thermodynamically consistent with one another, and will also agree with the results of experiment within a limited but sufficient range. His characteristic equation makes no pretension to be applicable outside that range.

In this respect it differs from characteristic equations such as those of Van der Waals or Clausius. But within the range of its application it gives results the agreement of which with the results of direct observation is as close as the agreement of one set of observations with another.

Prof. Callendar treats steam as a gas the deviations of which from perfection may be expressed by writing the characteristic equation in the form

$$V = RT/P - c + b,$$

where RT/P is the ideal volume of a perfect gas, b is the "co-volume," or volume occupied by the molecules—a volume which is not reducible by lowering the temperature—and c is what he calls the "coaggregation volume," which is the volume lost by the interlinking or pairing of molecules. He treats c as a function of the temperature only, within the range of temperature and density to which the equation applies, making c vary as $1/T^n$. He makes the further assumption that when the pressure is indefinitely reduced the specific heat of the gas is not altered by changes of temperature within that range. These assumptions not only accord with the results of experiment; they also have the great practical advantage of yielding expressions that are easily integrable for all the properties of steam with which the engineer is concerned, such as the total heat, the internal energy, the entropy, the specific heat, the Joule-Thomson cooling effect, and the thermodynamic potentials of Willard Gibbs. Prof. Callendar shows that, by help of his equation and of the assumption which has been stated, expressions for all these quantities are readily obtained by applying the usual thermodynamic relations, and, being so derived, the resulting numerical values, which he calculates for his tables, are necessarily consistent amongst themselves. It was the absence of mutual consistency that was perhaps the gravest defect in earlier tables of the properties of steam.

The range through which the Callendar characteristic equation is applicable may conveniently be described as the range through which the Amagat isothermals (of PV and P) are sensibly straight lines. The slope of these lines depends on the values of the quantities b and c in the characteristic equation: it is, in fact, equal to $b - c$. But to determine the constants of the equation Prof. Callendar relies mainly on experiments of the porous-plug type, which measure the cooling effect produced by forcing the gas through a constricted orifice. In his own experiments of this kind he employed an ingenious differential device which, with his platinum thermometers, went far to eliminate sources of error that affected the somewhat discordant results obtained by other observers. When a gas passes a throttling orifice of any kind, under conditions which prevent loss or gain of heat by conduction, there is one function of its state that undergoes no change, namely, the function which Willard Gibbs represented by the symbol χ. This function is equal to the internal energy *plus* the thermal equivalent of the product PV. It is now usually called the "total heat"—a name first applied to it by Prof. Callendar himself. Its value in technical thermodynamics was emphasised by Prof. Mollier, who introduced charts exhibiting the total heat in relation to other functions of the state, notably the entropy. The "heat-drop," or loss of total heat which the working fluid undergoes in passing through a turbine or engine of any type, is the basic quantity in all calculations of thermodynamic performance. It is equally useful as a means of analysing the reversed thermal cycle that is gone through by a refrigerating machine, for which purpose tables or charts are needed of the total heat of such working substances as carbonic acid and ammonia.

Besides his detailed tables of all the properties of steam, saturated or superheated, within the usual working range, Prof. Callendar gives in this volume an empirical table of the properties of saturated steam up to the critical point, to "serve as a guide for future work." In the extended table the critical temperature is taken as 374° C., in accordance with the results of Traube and Teichner, and the latent heat is calculated by a formula of the Thiesen type, which makes it vanish at the critical point. The critical volume becomes 3·25 c.c. per gram. The critical state lies, of course, far outside the region within which Prof. Callendar's characteristic equation is applicable. He deals with it in a separate chapter, which includes an interesting discussion of recent experiments on carbonic acid by Jenkin and Pye.

Another section of the book deals with the theory of flow through nozzles and of the steam turbine. In this field also Prof. Callendar's work has been of fundamental importance by showing that the conditions of adiabatic flow are not, in general, equilibrium conditions, but involve complications due to supersaturation. By taking account of the effects of supersaturation he has brought the theory of steam-jets into harmony with the results of observation, removing what had been a puzzling discrepancy and explaining why it is that the measured discharge from a nozzle is actually greater than the limit which, according to the older theory, would be found even under frictionless conditions. The same considerations are here applied to the analysis of what occurs in the steam turbine as a whole.

The book is completed by three appendices; the first is on general thermodynamic relations, and the second is on the use of a steam diagram in which the co-ordinates are the total heat and the logarithm of the pressure. The third appendix gives the steam tables in the same form as that in which they were separately presented in his earlier publication.

It is not a book for beginners: it will be intelligible only to those who have a working knowledge of general thermodynamics and are fairly familiar with the use of partial differential coefficients. But engineers and physicists who have this equipment will find it a valuable work of reference. They will welcome so detailed a statement of original views and methods from one whom they gratefully recognise as a leader and a pioneer. Prof. Callendar writes with the authority of an investigator whose knowledge of steam and its properties is probably unique.

J. A. EWING.

Ore Deposits of Utah.

The Ore Deposits of Utah. By B. S. Butler, G. F. Loughlin, V. C. Heikes, and Others. (U.S. Geol. Surv. Professional Paper 111.) Pp. 672+lvii plates. (Washington, D.C.: Government Printing Office, 1920.) 1½ dollars.

THE series of monographs in preparation by the Geological Survey of the United States to summarise existing knowledge of the ore deposits of the separate American States will render readily available much valuable information now dispersed through a voluminous and scattered literature. The first of the series was on New Mexico (1910). The second deals with Utah, an area of special interest as regards both its geological structure and the variety of its ore deposits. The study of Utah has introduced many new conceptions into structural geology; some of them, like that of the laccolite, a term introduced for the Henry Mountains by Gilbert, have been fully confirmed; others, such as the support to antecedent rivers by the oft-quoted case of the Green River, have been set aside by fuller knowledge of the facts, or, like the igneous sequences proposed by Dutton and Spurr, are dismissed as too uncertain.

Utah has given exceptionally clear evidence of the importance of block faulting in determining the existing relief, and of the cause of such faulting by subsidence after long periods of igneous activity and earth movement. The views of le Conte and Suess, based on the earlier studies of Utah, are fully justified by the latest contributions to its geology. The tectonic history of the region presents a significant coincidence with that of Africa in the importance of east-to-west folds in the late Cretaceous, and of subsequent north-to-south faults that may be even still in progress.

The economic geology of Utah is especially instructive on account of the remarkable variety of its ore deposits. Some, such as the silver sandstones, are well known owing to the controversy as to the origin of the ores; the authors of this survey adopt Lindgren's conclusion that they were sedimentary grains concentrated by hot water in consequence of the igneous intrusions. Probably the most valuable general conclusion in the volume (pp. 196–201, and the instructive diagram, Fig. 31) is that the quantity of the ore deposits beside masses of intrusive igneous rock depends on the lowering of the surface by denudation. This principle had been previously used to explain the contrast between the gold veins in the adjacent fields of Bendigo and Castlemain in Victoria, and also the fact that the ores beside the granites of Burma are richer beside narrow than beside the wider outcrops. It receives its fullest and most authoritative expression in this volume. The clearness of the diagrammatic figures of the ore bodies and tectonic structures is an especially notable feature of this important and well-executed monograph.

Medical Science and Practice.

(1) *Obstetrics: Normal and Operative.* By Prof. G. P. Shears. Third edition, revised by Dr. P. F. Williams. Pp. xxii+745. (Philadelphia and London: J. B. Lippincott Co., 1920.) 35s. net.

(2) *Principles and Practice of Operative Dentistry.* By Dr. J. S. Marshall. Fifth edition. Pp. xxix+711+xvi plates. (Philadelphia and London: J. B. Lippincott Co., 1920.) 35s. net.

(3) *Diagnosis and Treatment of Brain Injuries: With and Without a Fracture of the Skull.* By Prof. W. Sharpe. Pp. vii+757. (Philadelphia and London: J. B. Lippincott Co., 1920.) 35s. net.

(4) *Lippincott's Quick Reference Book for Medicine and Surgery.* By Dr. G. E. Rehberger. (Philadelphia and London: J. B. Lippincott Co., 1920.) 63s. net.

MESSRS. LIPPINCOTT'S series of textbooks on medical subjects is well known in this country. Many of the volumes, as is the case with two of the four under review, have already reached the third or later editions.

Like nearly all American books, they are copiously illustrated, and most of the pictures are helpful. A great many are borrowed, as may be judged from a list of between two and three hundred acknowledgments in Prof. Shears's book. Among these figures are four of a condition which, says the author, "one reads about but does not see"! Prof. Sharpe in his work uses photographs abstracted from kinematograph series to illustrate the stages of an operation and also the gait in spastic palsies of cerebral origin; the method is interesting and perhaps useful. The reproductions of microphotographs of dental tissues, normal and diseased, given by Dr. Marshall in his work on dentistry are really very good.

(1) and (2). Two of these books, those on obstetrics and dentistry, are text-books "for the student and practitioner," and both suffer a little from their dual aim. Whilst not large enough for works of reference, there is a tendency to include mention of methods or procedures but little used or of doubtful value, lest the author should appear "not up to date." The practitioner, therefore, must make use of larger or more specialised works, while the student is distracted from essentials and perhaps conceives wrong ideas of proportional values. The fault is by no means peculiar to these volumes—it pervades very many similar publications—which are, in fact, both very readable, for they are founded on extensive personal experience. With them as guide the student will not go far astray in practice, but it is just questionable whether the British student would do well to face his examiners without other help.

(3) Prof. Sharpe's book is not quite in the same category. It, too, is founded on personal experience; it embodies a large number of case records and might almost be called a thesis on the use of subtemporal decompression as a routine treatment in the presence of undue intracranial tension. In this country Harvey Cushing is looked upon as the exponent of this operation as to both indications and technique, and it is a little surprising not to find here a more ample acknowledgment of his pioneer work. The author's advocacy of the operation, at any rate in the birth palsies of children, in preference, apparently, to attack nearer the known site of the lesion, will scarcely suffice to secure a verdict in his favour from a jury of British surgeons. His documents, however, demand and deserve study by specialists. He is probably right in his view that recent severe injuries of the brain are too often treated on the principle of wait-and-see, but his method of demonstrating a long-persistent, high cerebro-spinal pressure seems a little inadequate. The accepted physiological view of the maintenance of normal pressure and of the feasibility of modifying it by surgical measures must be altered, if the operation of decompression undertaken months or years after the injury be indeed sufficient to accomplish so much amelioration of symptoms. Nevertheless it makes a very interesting book.

(4) The last book on the list is a little difficult to place, at least for the British public, if not for the American. It is a large and expensive work, alphabetically arranged in eleven sections which are indicated by lettering in incised spaces at the free margin. The frontispiece is a folding manikin of value only to the layman, whilst the eleventh section consists of a hundred pages of pharmacology and therapeutics of use only to the practised and practising physician.

There is necessarily a lavish use of cross-referencing which is sometimes irritating; to be sent from "myotonia congenita" to "amyotonia congenita" only to be referred to "dystrophy" is annoying. It is obviously impossible to cover the whole range of medicine, surgery, and the specialties, such as eyes, skin deformities, nasal and aural surgery, gynæcology, obstetrics, and genito-urinary diseases, in one volume, however bulky it may be.

After all these complaints, when one comes to the subject-matter it is impossible not to appreciate the skill with which the "quick reference" book has been compiled, or to overlook the immense industry that has enabled Dr. Rehberger to skim the cream of all recent work and to present a mass of information in which it is difficult to detect a serious error. Moreover, when a controversial statement slips in, there is always a name or a reference to take the onus.

Compendia are not looked upon with much favour by those responsible for teaching, but probably there is a demand for such a book by busy practitioners, and it would not be surprising if even the well-informed and well-read should find it handy.

Our Bookshelf.

Chemie der Hefe und der alkoholischen Gärung. By Prof. H. Euler and Prof. P. Lindner. Pp. x+350+2 Tafel. (Leipzig: Akademische Verlagsgesellschaft m.b.H.: Gustav Fock, 1915.)

HORACE BROWN, in his charming reminiscences, maintains the thesis that it is to the study of the processes of brewing and other fermentation industries that we owe many of the advances which have so greatly extended our knowledge in the domains of preventive medicine, modern surgery, and sanitation. Be this as it may, and there is much to be said for it, there can at any rate be no doubt that yeast has been more thoroughly studied than any other micro-organism—and from the most diverse points of view. The book under review gives a clear and comprehensive account of these investigations, written by men who are peculiarly fitted for the task by their long experience in different branches of the subject. To Prof. Lindner fall the chapters on morphology, classification, and cultivation, whilst the remainder of the subject—the chemistry of the cell contents, the enzymes, and the energy relations—is dealt with by Prof. Euler.

Turning over the pages and remembering that the date of the book is 1915, one cannot help being struck by the great activity which is still being shown in research on this subject, and by the many notable additions which will have to be included in any new edition. The stream of work which has flowed uninterruptedly since Buchner laid bare the secret of zymase shows no signs of shrinking, but rather increases in volume year by year. Fresh facts are constantly being discovered and fresh light thrown on related subjects. At the moment the centre of interest and discussion is shifting from alcoholic fermentation, over which it has long rested, to the important problems raised by the nutrition of yeast and by the abundant production in the yeast-cell of one of those mysterious dietary essentials, the vitamins. In this connection many early observations were made concerning yeast, culminating in the experiments of Wildiers, who in 1901 postulated the necessity for a substance of unknown nature—which he termed "Bios"—for the growth of yeast. Some investigators have identified this with the vitamin B (water-soluble B factor) of McCollum, and an interesting controversy has arisen over the question. Another instance of the inexhaustible vitality of the subject is thus afforded, and it can be asserted with confidence that we are far from the end, perhaps rather only at the commencement, of the biochemical discoveries originating in the study of yeast. A. HARDEN.

The Man who Did the Right Thing: A Romance of East Africa. By Sir Harry Johnston. Pp. vii+444. (London: Chatto and Windus, 1921.) 8*s.* 6*d.* net.

THE man who did the right thing, and (except for one moral lapse, not of his own seeking) continued to do the right thing to the end of the chapter, was, as one might expect from a narrative so naïvely autobiographical as this "romance," an African pioneer, explorer, naturalist, and proconsul. The scene is laid in East Africa, mainly in the missionary field, and the period covered in the narrative dates back to the entry of Germany into the race for territory that led to the partition of Africa. Apart from the underlying love-story, which does duty for the sub-title, this novel of adventure (in treatment as well as in action) is remarkable for its fidelity to detail and its trenchant analysis of character. To those who know something of the environments and are acquainted with the types of the leading actors in this story—not excluding the author—the interest is unflagging and the appeal irresistible. Truly it is a section cut out of real life, transparent and convincing. Names are unnecessary. The mordant criticism of officials in "the Service" (F.O. and C.O.), frankly contrasting with efficient German representatives, in the opening up of East Africa to European diplomacy, is further emphasised by the hero taking service as director (Herr Direktor!) in an Anglo-German undertaking for the exploitation of a certain concession, known as "The Happy Valley," somewhere in the Kilimanjaro region, and thereby achieving a remarkable success.

It is a book well worth reading for its information no less than for the story it tells. We confess, however, to some irritation at the originality of the author's treatment in places—*e.g.* his abrupt changes of mood and tense, and the actual "staging" of some of his lengthy dialogues, as in a play. A. S. W.

Artificial Light: Its Influence upon Civilization. By M. Luckiesh. (The Century Books of Useful Science.) Pp. xiv+366. (London: University of London Press, Ltd., 1920.) 12*s.* 6*d.* net.

MR. LUCKIESH, who is well known as the author of a number of works upon illumination of a somewhat technical nature, has in this new volume written an interesting popular account of the development of artificial lighting. The influence of light upon civilisation is a fascinating subject. The author traces its early origins in the initial chapters of the book, which are illustrated by photographs of primitive pine-splinters, oil lamps, etc., and alludes particularly to its use as an element in religious ceremonial. Other chapters deal with early gas lighting, electric incandescent lamps and arcs, and the "light of the future." Later various applications of light—domestic, industrial, and spectacular—are discussed, and a chapter is devoted to artificial light in warfare. The type and paper are excellent, and there are insets of some remarkable photographs of lighting installations. The concealed lighting of the statue of Liberty in New York harbour forms an appropriate frontispiece, while several of the views of street lighting are striking; perhaps the most pleasing of all is a view of the Panama-Pacific Exposition at night. Generally speaking, the author has dealt with developments and applications of lighting in a popular manner rather than attempted a detailed analytical study of its effect upon civilisation, though the figures tracing the progressive diminution in the cost of light and its influence on health, safety, and efficiency are instructive. In the final chapter, entitled "Light—A Fine Art," the author writes with enthusiasm on the applications of light and colour for spectacular and decorative purposes. At the end of the volume a series of references to works on illumination and an adequate index are provided.

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.*]

Human and Other Tails.

IN NATURE of February 24 last, p. 845, there appears a report of Prof. Arthur Keith's remarks at the meeting of the Royal Anthropological Institute held on February 8. It may be that the Journal of the institute will contain a more detailed paper on the same subject, and that the fuller paper will somewhat modify the dicta put forward in the report as it appears in NATURE. But in the absence of any further details it seems worth while to note some of the points raised by Prof. Keith which appear open to criticism.

My right to criticise may perhaps be sustained by the reference on p. 846 to Tarsius and to my published views concerning its systematic position. Prof. Keith's rather far-reaching generalisations were called forth by the examination of one of those fleshy sacral appendages commonly known as human tails. It is obvious from every sentence in the article cited that Prof. Keith believes that the human tail was lost because man became an orthograde—that is, adopted a vertical instead of a horizontal poise for his body. No doubt that is a very well justified position to take up, and, in so far as a human orthograde poise implies a cessation of tail utility, I entirely agree with him. But when Prof. Keith says, "With the evolution of the upright posture the pelvic muscles which act on the tail had to bear the steady burden of the abdominal viscera—had to be in action as long as the orthograde posture was maintained. They could not serve in the support of the viscera and the movements of the tail at the same time," I dissent from him altogether. Indeed, to me it seems a remarkable thing that one who is in constant association with the museum of John Hunter could possibly believe that, if this dual duty of support of viscera and production of tail movements were thrust upon them, the muscles would fail in one respect or the other. We need, as a matter of fact, go no further afield than the kangaroo to see how an animal which is typically orthograde may support its abdominal viscera in the upright posture, and yet possess a tail which is one of the most wonderful of muscularly controlled caudal appendages met with among the mammals.

Man has not lost his tail because the caudal musculature is incapable of undertaking the dual *rôle* of visceral support and caudal mobility. He has lost it because it has ceased to be of any use to him. For the same reason the gibbon, the orang, the chimpanzee, and the gorilla have lost theirs. For the same reason certain "pronograde apes" (which Prof. Keith appears to assume possess uniformly "basal or pelvic," as well as "free or terminal," portions of their tails) have lost theirs. Cynopithecus possesses no more than a button, the Barbary ape still less, and, indeed, the reduction of the tail is seen to the best advantage in the most typically pronograde group (the baboons) of the Primates. Because the tail has ceased to be of any functional use certain of the lemurs have also lost it, and so have a host of other mammalian forms belonging to other orders. Did it not appear flippant, one might ask if Prof. Keith imagines the guinea-pig lost its tail because its caudal musculature could not fulfil a dual *rôle*. Recession of the tail has been effected, and prehensile tails have been developed, over and over again in the mammalian phylum. But one may not argue phylogeny, or the limits of the possibilities of muscular adaptation, to account for these things. No argument which bases the loss of the tail on the grounds cited by Prof. Keith carries the least conviction or bears any interpretation which may be distorted into human phylogeny.

Prof. Keith further goes on to state that "in pronograde apes the pelvic visceral musculature is attached to the peculiar chevron-like bones (hæmal arches) placed beneath the pelvic vertebræ of the tail; the reappearance of the hæmal arches in the human embryo during the second and third months of development may be regarded as definite proof that man comes of a pronograde ancestry." This is a common type of argument, one that has been current far too long, and one against which I have been attempting to teach for some time past. Apart from the confusion that may be caused by identifying "hæmal arches" with definite "chevron bones" is the gross fallacy involved in the argument that because hæmal arches are present in pronograde apes and in man, therefore man is developed from a pronograde ape. Hæmal arches are a primitive vertebrate heritage, but they are no more; they have no more to do with the pronograde poise *per se* than have the neural arches or the gill bars. We all know that the pronograde habit is typical of lower vertebrates, and we need not quibble about a pronograde vertebrate ancestry for man. But to argue that the pronograde simian ancestry of man is evidenced in the "reappearance of the hæmal arches in the human embryo during the second and third months of development" is sheer nonsense. Hæmal arches are developed in birds, and one would have as good justification for saying that this proved that man descended from a volant ancestor as Prof. Keith has, by the parallel argument, for claiming man's descent from a simian pronograde ancestor. Both arguments are fallacious and stupid.

Whilst the whole trend of Prof. Keith's remarks appears to be directed towards a vindication of the pronograde simian ancestry of man, he seems, in the end, to disagree with the ancestral position of "*Tarsius spectrum,* for which Prof. Wood Jones claims a special human relationship." Yet of this animal he says: ". . . in its tail and tail-musculature Tarsius is a pure pronograde Primate." I should be sorry to destroy the last bridge by which Prof. Keith's views might be reconciled with my own; but I have no hesitation in saying that Tarsius is certainly not a pure pronograde, and that, moreover, no living animal the habits of which are open to observation should be judged as a pronograde by an examination of the musculature of its tail. F. WOOD JONES.

The University, Adelaide, South Australia,
April 10.

TWENTY-FIVE years ago it was my privilege to teach Prof. Wood Jones; he now repays me with interest and with some degree of vigour. The matter wherein we differ has a very direct interest, not only for those who are seeking to unravel the history and relationships of man by means of anatomical evidence, but also for every zoologist who relies on structural details for arranging animals in a natural or evolutionary series. In man and in the four anthropoid apes—the gorilla, chimpanzee, orang, and gibbon—the tail has undergone a peculiar transformation—a sacralisation it may be named—for its vertebræ have become a mere submerged appendix of the sacrum. The depressor muscles of the tail have become spread out to form a muscular hammock on which the pelvic viscera are supported. With this sacralisation of the tail there are numerous correlated changes in the vertebræ and muscles of the spine, in the musculature of the body-wall and thorax, and in the shape and arrangement of the viscera of the body-cavities.

As will be seen from his letter, Prof. Wood Jones is of opinion that each member of this orthograde group of Primates—man, gorilla, chimpanzee, orang, and gibbon—has acquired the sacralisation of the tail independently of each other; in his opinion we are dealing with remarkable resemblances produced by convergence. On the other hand, it seems to me a more rational explanation to believe that evolution is true, and that all the orthograde Primates are the progeny of a common stock—the primitive orthograde stock—and that we are therefore dealing with a common inheritance. Seeing that all have a nervous system cast in a common mould, with vascular, alimentary, muscular, and bony systems which differ only in detail, we do much less violence to what we know of the laws of evolution by adopting my explanation than if we accept that offered by Prof. Wood Jones. In no other Primate, save the five mentioned above, has the tail undergone sacralisation. The guinea-pig, the Barbary ape, and Cynopithecus have no bearing on the point in question; their tails have not undergone sacralisation. To compare the posture and method of progression of the kangaroo to man or an anthropoid ape is of the nature of burlesque.

In my original paper on vestigial tails I made special allusion to Tarsius because Prof. Wood Jones has misled public opinion as to the structural relationship that exists between anthropoid apes and man. He holds, on what I consider a flimsy basis, that man has been evolved from a Tarsius-like ancestor, and that between this ancestor and man there must be a series of undiscovered links. Tarsius has a particularly long tail; in no sense can its posture or method of progression be said to be like that of the orthograde Primates. In the manner in which its tail-muscles are arranged Tarsius resembles pronograde or dog-like apes. It has no claim to be called humanoid, whereas in this, as in a thousand other structural characters, the anthropoid apes can claim, not a resemblance, but an identity.

ARTHUR KEITH.

The Stationary H- and K-lines of Calcium in Stellar Atmospheres.

IT has been noticed by many observers that the space surrounding early B-classes of stars (*e.g.* δ Orionis) often show absorption of H- and K-lines of calcium, which do not share in the Döppler displacements of the other absorption-lines of the stellar spectra. This suggests that these stars are enveloped in an atmosphere of calcium vapour which does not partake in the orbital motion of the stars (NATURE, April 21, p. 247).

There is, of course, naturally a difficulty in realising why calcium, alone of all elements, should be found to occur in the attenuated atmospheres surrounding a stellar system. Very closely connected with this phenomenon is the observational fact that in the flash-spectrum of the sun the longest arcs are those corresponding to calcium H- and K-lines, indicating that in the sun also the outermost layers (according to Mitchell, 14,000 km. above the solar disc) are composed of calcium. Hydrogen, the lightest of elements, which we should expect to occur in the highest layers, disappears at a much lower level (8000 km., according to Mitchell).

The problem is naturally a complicated one, but I think that a way to solution is afforded by the theories of selective radiation-pressure and of the temperature-ionisation of gases advanced by me in the following papers:—"On Radiation Pressure and the Quantum Theory" (*Astrophysical Journal*, September, 1919); "On Selective Radiation Pressure, etc." (Journ. Coll. of Science, Calcutta, 1920); "Ionisation in the Solar Chromosphere, etc." (*Phil. Mag.*, vol. xl., 1920); and "On a Physical Theory of Stellar Spectra" (Proc. Roy. Soc. Lond., May, 1921).

According to these papers, the H- and K-lines are the resonance-lines of Ca^+, *i.e.* of a calcium-atom which has lost one electron. The resonance-line of neutral calcium is the *g*-line, $\lambda=4227$. In the Fraunhofer spectrum we get H, K, and *g*, showing that in the solar photosphere calcium is largely ionised owing to the high temperature prevailing there. At higher levels, owing to diminution in concentration, the ionisation becomes complete, so that the *g*-line disappears entirely, leaving only the H- and K-lines.

The sun is a dwarf star of the Go class, corresponding to a surface temperature of 7000–7500° K. When we consider the spectra of the still hotter stars, classes F, A, and B, we find that the *g*-line becomes fainter and fainter, until it disappears altogether from the B8A class. In the still hotter stars we have only the H- and K-lines, showing that they do not contain neutral calcium at all, but only ionised calcium.

This explains the varying behaviour of the *g*-line and of the H- and K-lines, but we have still to determine the force which drives Ca^+ to the outermost layers. It is natural to conclude that the forces which are responsible for driving calcium absorbing H and K to the greatest height in the solar atmosphere are also responsible, in the case of stars having a larger surface temperature, for driving calcium to the surrounding parts of space. Now what can this force be, and why should this show a preference for calcium?

In the case of the sun I have attempted to show that this force is furnished by the pressure of radiant energy from the solar disc acting in a selective way upon the Ca^+-atoms. The term "selective" is most important here, and requires an explanation. Radiation-pressure is due to absorption, and therefore, in the case of a gas illuminated by white light, only those pulses which the gaseous atom is capable of *most frequently absorbing* are effective in producing pressure. A gas can usually absorb lines of the principal series alone, but the lines of the subordinate series are absorbed only in exceptional circumstances, and even then to a much smaller extent; so that the maximum lifting effect of radiation-pressure is to be expected only in the case of atoms absorbing the resonance-lines. (For more detailed arguments see the papers above-mentioned.) In addition to this, the lifting force would depend on the intensity of the region corresponding to the absorbed lines in the spectrum of the continuous background of white light, and on the solid angle subtended at the atom by this background.

In the case of the sun the surface temperature is 7300–7500° K (Biscoe, *Astrophysical Journal*, vol. xlvi., p. 355), so that, according to Wien's law, $\lambda_m T=b$, the maximum of emission lies at $\lambda=3920$ Å.U., very close to the H- and K-lines of Ca^+. Also these lines are the resonance-lines of Ca^+, so that we have here the maximum effect of selective radiation-pressure. The resonance-line of hydrogen is at $\lambda=1216$ Å.U., and therefore the effect of radiation-pressure is extremely small.

It is not possible to say whether the lifting power of selective radiation-pressure alone is capable of neutralising the force due to the gravitational attraction of the sun, but it looks very much as if this were so. Without being dogmatic on this point, we can work out the consequences of this assumption. In the case of stars having a much larger surface temperature, say 14,000° K, B8A class, the value E_λ for H- and K-light would be much larger, so that the radiation-pressure is still greater, and in some cases preponderates over the greater value of gravitational force on these stars. Thus Ca+-atoms would be driven very far into the surrounding space. They will be prevented from absolutely leaving the system, because with increase of distance the solid angle subtended by the disc of the star at the atom would diminish, and a condition of equilibrium would at last be reached.

The same phenomenon occurs to a smaller extent, in the case of the sun, with Sr+ and Ba+, which have their resonance-lines near the spectral region of maximum intensity, but owing to their greater atomic weight the compensation is not so marked. Still Sr+ is very prominent in the chromospheric spectrum, rising to a height of 6000 km.

The question may be asked: Why do we not obtain the same phenomenon in the case of the other light elements? These can be divided into two broad groups: (1) non-metals like H, He, N, O, Ne, and A, having a high ionisation-potential, of which the resonance-lines lie in the extreme ultra-violet—*e.g.* for H, at $\lambda=1216$ Å.U.; for He, at $\lambda=585$ Å.U. (Lyman and Fricke, *Phil. Mag.*, May, 1920)—and can be detected only by subordinate lines—for helium, by D_3, $2p-md$; for hydrogen, by the Balmer lines. Naturally the effect of selective radiation-pressure is small on these elements. (2) Elements like Na, K, Mg, Al, Sc, Ti, Fe, which have an ionisation-potential varying from 5 to 8 volts. Under the conditions treated here these are mostly ionised, but the resonance-lines of these ionised elements lie mostly outside the region available for observation, *e.g.* the resonance-lines of Mg+ are $\lambda=2795\cdot5$, $2802\cdot7$. The resonance-lines of Na+ and K+ have not yet been discovered, and probably lie in the extreme ultra-violet. Sc+ and Ti+ are represented by prominent lines in the chromospheric spectrum, but it is not yet known whether these are resonance-lines of these elements.

The hypotheses thus appear to be promising, but nothing final can be said before we can calculate the absolute value of the selective radiation-pressure on an atom. According to Eddington (Monthly Notices, R.A.S., 1920, vol. lxxx., p. 723), the absolute value of the radiation-pressure is too small to account for the total neutralisation of gravitational force on the sun; but in that paper the consequences are worked on the basis of the continuous theory of light. The foregoing line of investigation at least brings out the intimate connection between the stationary character of the H- and K-lines in the space round the stars and the great prominence of these lines in the chromospheric spectrum. It shows that the higher chromospheric levels, as well as the space round B- and A-stars, may probably contain, besides Ca+, also Na+, K+, Sc+, Ti+, and Mg+, but owing to the fact that our observations have to be limited between $\lambda=3000$ Å.U. and 6000 Å.U., and that none but the resonance-lines of Ca+ lie within this region, we can detect nothing but Ca+. But if some day we can overcome the limitation imposed by atmospheric absorption, probably we shall be able to detect Li+, Na+, Mg+, K+ in the atmospheres surrounding B-stars which show stationary H- and K-lines.

MEGH NAD SAHA.

Berlin, May 8.

Biological Terminology.

MY gentle touch has started an avalanche indeed, but I remain unmoved. Sir Archdall Reid asks (NATURE, June 2, p. 425): "Is not all systematic zoology and botany founded on this kind of classification?"—a classification based on definite, concrete facts of structure, in which there is "little or nothing" based on causes, on antecedents and consequents, or on hypothesis. The answer is in the negative. May I illustrate briefly some kinds of interpretation that a systematist has to employ?

There lie before me some mushroom-shaped objects from the Permian of Timor, clearly echinodermal, and actually described as the swollen spines of a sea-urchin. Such a spine is normally attached to the shell of the urchin by a ball-and-socket joint. These bodies, however, present at the end of the stalk three articular facets, each with a straight fulcral ridge, so placed that the fulcral ridges form an approximately equilateral triangle. Now, setting all resemblances aside, it is obvious that a single appendage cannot be attached to an immobile base by three facets so disposed, because the result of such an arrangement is immobility. It follows, from equally clear mechanical principles, that each facet must itself have borne a single appendage. Consequently the mushroom-like body is not an appendage, but a base which once bore three appendages. In short, it must be the cup and base of a crinoid. Having reached this conclusion by the application of mechanical principles, one attempts to apply some test, even if not a crucial test in the strict sense. The stereom of a spine is relatively light, and the meshwork in the axial region is still more open; the stereom of a fused crinoid base is dense. Sections across the Timor fossil show that its stereom is of the latter character. Not until all the facts have thus been interpreted can we proceed to apply the methods of a postal address and deliver our fossil at its proper street and number in Crinoid-town.

But there are cases in which the address is almost illegible, or has been so often crossed through and re-written that recourse must be had to skill higher than that of a letter-carrier. I am at the moment trying to identify some fossil Blastoids from North America. Of recent years the rocks in which these genera are found have been so minutely subdivided and the species have been so finely discriminated that the ordinary descriptions and keys (postal directories) cease to be of much help. In this class, as in others, the same forms appear to recur at intervals of time, and a correct interpretation demands a close study of the development in correlation with the chronology; by applying, as others have done, the theory of recapitulation we may unravel the tangle. It is not only fossils that furnish such problems to the philosophic interpreter; Dr. Annandale was showing me yesterday some Gastropods from Asiatic lakes that have to be dealt with in just the same way.

If we turn to the broader divisions of systematic zoology we derive still less aid from those simple rule-of-thumb methods which represent to Sir Archdall Reid the principles of taxonomy. At every step the modern systematist is considering origins; for him the truth or falsity of such principles as "the irreversibility of evolution" is of vital importance; his very diagnoses embody speculations. But the systematist recognises the metaphysical nature of his classifications, and he is perpetually seeking some crucial instance that shall give them a more secure basis of fact. He prophesies, for example, the existence of some connecting type at a certain period, and then he goes and finds it.

So much for the systematist! As for the biologist at large, I do not believe he is averse from employing crucial tests. His difficulty in the manifold processes of life is to formulate tests that really are crucial. Sir Archdall Reid thinks it an easy matter, and he takes recapitulation as an instance. At the moment when his letter was published some of us were discussing that very question at the Linnean Society, and Sir Archdall Reid, had he been present, would have seen that the issue was far from being the simple one that he imagines. F. A. BATHER.

June 4.

A New Acoustical Phenomenon.

WHEN living near Croydon aerodrome during the earlier part of the war, I noticed that the higher-pitched sounds apparently given out from an aeroplane flying nearly overhead varied with the height of my ear above the ground; thus, by bending down to one-half one's normal height, the pitch of this higher note rose an octave. I have on many recent occasions confirmed this result. This phenomenon is most noticeable when standing on a smooth road or lawn, and is scarcely distinguishable on a rougher surface, such as a hayfield; the logical conclusion is therefore that it is due in some manner to reflection from the ground. The pitch of the note varies also with the angle of elevation of the aeroplane, and is not generally audible unless this is more than about 45°. Since the pitch rises continuously as the head is lowered, the apparent explanation is that the note is due to the interval between the arrival of the direct and reflected waves from impulses radiated from the aeroplane—that is to say, no note of this definite pitch comes through the air from the aeroplane, only a regular, or irregular, succession of impulses, the time periods of which have no relation to the observed note, for it is obvious that merely bowing to the aeroplane could not alter the pitch of any note it might be giving out. (It is well known that a note of much lower pitch, due to the engine, is always present, but it is not in this sound that the variation takes place, although it is possible that these are the waves from which the variable high note is produced by reflection.) The pitch of the sound with which we are concerned is thus due to the fixed interval between the arrival of the direct and reflected impulses, and thus depends upon the height of the observer and the angle of elevation of the aeroplane. An interesting deduction from the discovery is that the ear is able to appreciate pitch from a succession of double impulses, if the interval between the elements of each double impulse is constant.

The phenomenon is not in any way peculiar to aeroplane noises; I have observed it with equal distinctness, though the sound was fainter, when standing under an aspen tree in a light breeze. Through the rustle of the leaves could be distinguished a note of quite definite pitch, which, as before, rose to its octave on lowering the head to half one's height.

In support of the explanation I have given, it may be remarked that the pitch of the note observed seems to correspond with the interval of time between the arrival at the ear of the direct and reflected impulses as calculated from the velocity of sound in air.

From the physiological point of view it would be interesting to make a laboratory test, using a disc siren with the holes pierced in groups of two, all pairs being similar to one another, but grouped at unequal spaces on the circumference; thus the passage of each pair would give a double puff, but the double puffs would be in an irregular succession. This would, no doubt, give a definite note corresponding in pitch to the interval between members of a pair of holes, and would be a further confirmation of my explanation.

That two impulses alone appear to give a sense of definite pitch is interesting, and seems to indicate the existence of a resonating system in the ear. Experiments such as I have suggested, with a disc siren, might therefore help in the solution of the much-discussed problem of the function of Corti's organ. Another and more general series of experiments would have the object of finding whether, as is indicated by my observations, all sounds when heard by an observer near a reflecting surface have, in addition to the incoming fundamental note, a note of a pitch depending on the distance of the observer from the reflector. This phenomenon is known to have occurred, as regards electric waves, in Hertz's classical experiments. Unfortunately press of other research work prevents me from carrying out tests in this fascinating subject, but perhaps someone more directly interested may find time to develop it further.

J. ERSKINE-MURRAY.

Directorate of Research,
Air Ministry, Kingsway, London, W.C.2.
June 7.

Herons and Fish.

IT was commonly believed and asserted by old-time writers on natural history that from the feet and legs of the common heron exuded an oil with a peculiar odour which attracted fish within striking distance of the bird's powerful beak. Anglers used to mix the fat of a heron with flour and other matter and anoint their baits with it, whereby, says John Jonston in his "Historia Naturalis" (1657), "mirifice pisces illiciuntur."

I have never regarded this theory as of greater value than many others propounded by medieval empirics, but it was recently brought vividly to mind by what has taken place in the garden of one of my country neighbours. In this garden there is a rectangular pond measuring about 30 ft. by 20 ft. The sides are of dressed masonry, which extends under 9 in. of water so as to form a continuous ledge a yard broad, beyond which the depth drops suddenly to between 3–4 ft., wherein some of Marliac's water-lilies are grown. The pond was stocked with goldfish, which throve well until a heron found its way there, and has succeeded in exterminating them. The owner of the garden, a good observer upon whose statement I can rely, tells me that the bird always took its stand in one corner of the pond, on the ledge covered by the shallow water, and that the goldfish moved out of the deep water into the centre and congregated round the heron, who picked them up at leisure. Had the fish remained in the deep water which they usually inhabited, of course the heron could not have reached them.

Although I draw no inference from this incident, it seems worth mentioning. It would be interesting to hear of an authentic parallel case.

HERBERT MAXWELL.

Monreith, Wigtownshire.

Why do Worms Die?

MANY times during the last twenty years I have been tempted to make the following communication. My house backs on to, and is partly built into, the old cliff at St. Leonards-on-Sea, and my back door opens on to a road cut into the face of the cliff. The road is well tar-macadamed and watertight. The esplanade at St. Leonards is wide, tar-gritted, and watertight, and it contains a number of ornamental flower-beds surrounded by low brick and cement walls, surmounted by cornices which overhang 2–3 in. The surfaces of the beds are about 12 in. below the top of the walls.

On certain occasions I find worms in the back street, generally of medium to a rather large size, which have the appearance of being "drowned," although it is very rarely that life is extinct. On the esplanade they are present in large numbers. They occur at all points between the beds and the sea-wall, over which many of them must pass, for one can find them on the watertight stone undercliff. One naturally expects worms to rise after rain, but in a wet season I have known eleven wet days in succession without a single worm appearing, while on the twelfth day large numbers were to be found on the pavements, the road, and the back street. On the other hand, I have known them to occur after a rainstorm following dry weather. In several years the dates in November and January have coincided. The first thing that strikes one is that the phenomenon occurs only at long intervals, and then such large numbers participate in it. At other times one may never see a single worm. I have often wondered if it were in response to a migratory instinct.

The mystery is how these worms mount a wall 12 in. high and negotiate the overhanging cornice. On several occasions I have known quantities of "whitebait" and other things that occur at the surface of sea-water similarly strewn upon the esplanade and roads, and I have been tempted to ask if these worms have not been caught up similarly and returned to earth with the rain. W. J. LEWIS ABBOTT.

I THINK Sir Ray Lankester (NATURE, June 2, p. 424) will agree with me that earthworms when underground must frequently or usually be in contact with other moist surfaces. My impression is that in dry weather, when the upper layers of soil contain only adsorbed water and are what we call "dry," earthworms seek the lower layers where the particles are moist—that is, are surrounded by a surface film of liquid water, however thin this may be. When in such a moist layer the surface of the worm must at many points be obtaining its air-supply through the medium of water which is not part of itself. The air, as Sir Ray Lankester says, reaches the worm through the porous soil, and I think in part through the moisture on the surface of the particles. The statement in my letter in NATURE of May 19 can admittedly be read as implying that the worm was partly dipped in slime or mud, but this was far from my meaning. J. H. COSTE.

Teddington.

Vitality of Gorse-seed.

BY way of supplementing my letter to NATURE of September 26, 1918 (vol. cii., p. 65), on the above subject, it may be of interest to record the fact that the seedlings arising from seed which has lain dormant in the soil for a quarter of a century have produced vigorous plants. A small part of the 20-acre field was not reploughed owing to its steepness, and the gorse seedlings which came up on it after the war-ploughing of the winter 1917–18 have been allowed to grow. They are now in their fourth season of growth, and are good-sized bushes averaging 2 ft. in height, which have been this spring a mass of bloom, like the gorse generally in this district and, I believe, throughout the country.

I can also add another year, making twenty-six in all, to the vitality of buried gorse-seed; the field in question, save for the above-mentioned steep slope, was reploughed in the winter 1918–19, with the result that a fresh crop of gorse seedlings appeared the following summer. The field has now reverted to grass, and these two-year-old seedlings are being grubbed up. JOHN PARKIN.

The Gill, Brayton, Cumberland, June 3.

Habits of the Hedgehog.

IN the article on the hedgehog which appeared in NATURE of May 19, p. 375, mention is made of the widespread belief that hedgehogs suck the teats of cows. Although farmers have assured me that they have found evidence of milk on the hedgehog, I do not think that any credence can be given to the statement. The belief probably arises from the extrusion of the contents of the vesiculæ seminales of the buck hedgehog when crushed, kicked, or otherwise injured. The vesiculæ seminales are, when full, extraordinarily large in proportion to the size of the animal, and the milky fluid can easily be mistaken for cow's milk, especially when the hedgehog has rolled itself up for defensive purposes and the face has become smeared with the seminal fluid.

That hedgehogs will eat young birds I have had personal experience, but I doubt if they do much damage to game in this way.

In 1906 and 1907 several albino hedgehogs were found at Goathland, Yorkshire. I attempted to cross an albino doe with a normal buck, but when placed together the latter promptly attacked and killed it. In attempting to breed them in semi-captivity, *i.e.* in a large walled garden, I found that the bucks harried the does a good deal, thus rendering it difficult to secure a litter, and that if the nest was disturbed the mother would frequently eat her young. This proved a real difficulty in the experiments.

G. A. AUDEN.

Birmingham, May 29.

Principles of Picture-hanging.

THERE is no need for picture-wire (NATURE, May 19, p. 362; May 26, p. 395; June 2, p. 438) if the principle is adopted described in the *Times Engineering Supplement* of April, 1919, of the application of Kelvin's Five-Point principle to the picture-hanging.

A rail, say of black enamelled electric conduit tube, is supported along the wall at an appropriate height on bracket-hooks fixed in the wall, and the pictures are hung on the rail by two bent iron hooks fastened on the back of the upper edge of the frame. This gives four points of contact, and the fifth is made by a round-headed screw in the lower edge to set the face at an appropriate cant. One degree of freedom is still left of a motion of the picture sideways into the desired place. A picture is lifted off in a trice and thrown out of the window in case of fire, as of a gallery of portraits in an old mansion; and the pictures can be hung over each other, two and three deep if space is limited, as in the Royal Academy.

The principle is appropriate in a modern physical workshop for the support of apparatus, however heavy, bracketed out from the wall, if a plate is built into a course with a projecting lip. A nail cannot be driven into the glazed-brick wall, but a picture-board can be kept for that purpose and placed where required. The difficulty is avoided of the suspension of apparatus from the roof or ceiling.

The principle seems to have been employed in the Pinacotheca of the ancient Acropolis of Athens.

G. GREENHILL.

1 Staple Inn, W.C.1, June 6.

Oersted—the Discoverer of Electro-magnetism.[1]

ON July 21, 1820, Hans Christian Oersted, of Copenhagen, announced his great discovery to the world in a circular letter in Latin, "Experimenta circa effectione conflictus electrici in acum magneticam." He describes in detail the apparatus he employed, emphasising the fact that "the galvanic circle must be complete, and not open, which last method was tried in vain some years ago by very celebrated philosophers," gives a list of distinguished men who had witnessed the new effect, and then writes:—

"Let the straight part of this wire"—*i.e.* the wire uniting the two poles of the battery—"be placed horizontally above the magnetic needle, properly suspended and parallel to it; if necessary the uniting wire is bent so as to assume a proper position for the experiment. Things being in this state, the needle will be moved, and the end of it next the negative side of the battery will go westward. If the distance of the uniting wire does not exceed three-quarters of an inch from the needle, the declination of the needle makes an angle of about 45°. If the distance is increased, the angle diminishes proportionally; the declination likewise varies with the power of the battery."[2]

A later communication[3] states that "he discovered by continual experiments during a few days the fundamental law of electro-magnetism, viz. that the magnetical effect of the electric current has a circular motion around it."

The Royal Danish Society of Sciences is celebrating the centenary of Oersted's discovery by the issue of a collected edition of his scientific papers, and the work before us is an essay by Mrs. Kirstine Meyer, forming the first volume of the collection.

H. C. Oersted was born at Rudkjobing in 1777. His father was an apothecary, and Hans Christian and his younger brother, A. C. Oersted, afterwards a distinguished jurist, received their early education from a German wigmaker and his wife, who taught them to read and speak German, but whose knowledge of arithmetic was limited to addition and subtraction; an older schoolfellow taught them multiplication; a friend of the family, division. From their eleventh and tenth years respectively they helped their father in his pharmacy. In 1794 they went to Copenhagen to finish their preparation for their first academic examination, which they passed with honours. As undergraduates they were admitted to Elers College, founded in 1691, which still provides free residence and a small scholarship for needy students. They went through the university course together with distinction, studying mathematics and chemistry, and being greatly interested in philosophy. Kant's teaching was then expounded in Copenhagen by Prof. Riisbrigh, and his lectures markedly influenced them. The lectures on astronomy and physics attracted H. C. Oersted to the study of science; his brother became distinguished for his philosophical writings; but throughout Hans Christian's life we can trace the effect of his early philosophical studies in his work. In 1798 he writes: "I promised you in our last conversation to give you an account in letters of the systematic part of chemistry. . . . I keep my promise with pleasure both for your sake and for that of science, which you know I find so much pleasure in communicating to others." The same year the brothers became members of the editorial staff of a short-lived journal, a philosophical repertorium, the chief object of which was to defend Kant's works.

As regards experimental work, the elder Oersted was limited mainly to the chemical training received in pharmacy where he was employed; the university had no physical equipment. He was helped, however, by Prof. Manthey, professor of chemistry, and owner of the Lion Pharmacy. Manthey was abroad during 1800 and 1801, and Oersted managed his pharmacy. Volta's discovery of the galvanic battery had just been published, and Oersted's earliest experiments were connected with the behaviour of various forms of cells and with the testing of a theory, advanced by Ritter, to account for the decomposition of water by a current: that water *plus* negative electricity produced hydrogen, while water *plus* positive electricity produced oxygen. He measured his currents for these experiments by the aid of a voltameter arranged to collect in a graduated tube the products of the decomposition.

In 1801 Oersted had hopes of a professorship or readership in the university, but he was then looking forward to the prospect of a journey abroad, rendered possible by a grant from "Cappel's Travelling Legacy"; and in a letter to Manthey he says that he would rather resign any post than give up the prospect of the journey. He started in the summer of 1801, and was away until the end of 1803. For a time the world was at peace. Napoleon was First Consul; the war between France and Austria was stayed temporarily by the Peace of Lunéville (February, 1801). The victory of the Nile, 1798, and of Aboukir Bay, 1801, ruined the French plans for an attack on India through Egypt, while access to the Baltic and the defeat of a combination of the Northern Powers against England were secured by Nelson's victory at Copenhagen in April, 1801. The Peace of Amiens followed in March, 1802, and intercourse between men of science of all nations was at once renewed. To us, in 1921, the rapidity with which this took place is somewhat surprising.

Oersted went first to Weimar. At Göttingen he was introduced to Ritter, whose electrical re-

[1] "Scientific Life and Works of H. C. Oersted." By Kirstine Meyer. (From H. C. Oersted: "Scientific Papers," vol. i.) Edited by the Royal Danish Society of Sciences. Pp. clxvi. (Copenhagen: Andr. Fred. Høst and Son, 1920.)

[2] Thomson's "Annals of Philosophy," vol. xvi. (1820), translated from a Latin account sent by the author.

[3] "Edinburgh Encyclopædia," vol. xviii. (1830).

searches impressed him greatly. From Weimar he went to Berlin, where he heard Fichte and Schlegel lecture. At Weimar he had become acquainted with a work by Winterl, "Prolusiones ad Chemiam Decimi Noni," and set himself to make this more widely known, publishing in 1802 a book, "Materialen zu einer Chemie des neunzehnten Jahrhunderts," the object of which was to show the common origin of physical and chemical forces. The book was severely criticised everywhere, and Winterl's chemistry, founded on two mysterious substances, Andronia and Thelycke, has long since been consigned to the oblivion it deserved; but the root-idea, the common origin of most natural forces, lay at the basis of much of Oersted's future work.

From Berlin Oersted went to Paris, visiting Ritter at Weimar on the way, and taking part in some of his experiments. On describing these in Paris, especially the invention of what was probably the first storage battery—a storage column, Ritter called it: a pile of copper plates separated by discs of moist cardboard, which retained a charge for some time after it had been connected to a battery, and was capable itself of giving out a current when its extremities were connected by a wire—Biot asked him to write and advise Ritter to compete for a prize of 3000 livres offered by the First Consul for the most important electrical or galvanic experiment which might compare with the invention of the voltaic pile.

Oersted re-wrote in French the essay Ritter sent in, but the author had stated that his storage column, when placed in a vertical position, became charged through the electrical influence of the earth. Experiments at Paris failed to verify this, and the prize went elsewhere.

Oersted returned to Copenhagen in January, 1804, and was disappointed at not receiving the professorship of physics, which had been vacant for some time. The warden of the university considered him a philosopher rather than a physicist, and it was not until 1806 that he became professor extraordinarius. In 1807 he repeated and extended Chladni's work on vibrating plates, using Lycopodium in place of sand. He noted, but could not explain, the action of the Lycopodium in collecting in the places of maximum vibration; that was left for Faraday.

In 1812 and 1813—the years of Moscow and Leipzig—Oersted again visited Berlin and Paris, and, encouraged by the reception he met with, published his "View of the Chemical Forces of Nature," in which, while expressing his indebtedness to Ritter and Winterl, he dissociates himself in many respects from their theories. He avows his continued belief in the essential unity of natural forces, and, while his views are often vague and unsatisfactory, he proposes that "the experiment should be made whether electricity in one of its most latent forms could act on the magnetic bodies as such." The answer came in 1820. The book was well received everywhere. Thomson writes in the "Annals of Philosophy, 1819," dealing with a later French edition: "The book is highly worthy the perusal of all those British chemists who aim at the improvement and perfection of their science. It is rather surprising that a work of such originality and value should have remained for these four years quite unknown in this country."

In the years which followed, Oersted was busily occupied with routine work. In 1815 he became secretary of the Society of Sciences, and in 1817 professor ordinarius. In this capacity he delivered a series of monthly lectures to advanced students on the progress of science, and it was at one of these in the spring of 1820 that his great discovery was made. His own description of this will be found in the article in the "Edinburgh Encyclopædia" already referred to. After stating that the luminous and heating effect of the electrical current goes out in all directions, "so he thought it possible that the magnetical effect could likewise eradiate"; and after referring to magnetic effects produced by lightning, he continues: "The plan of the first experiment was to make the current of a little galvanic trough apparatus commonly used in his lectures pass through a very thin platina wire which was placed over a compass covered with glass. The preparations for the experiment were made, but, some accident having hindered him from trying it before the lecture, he intended to defer it to another opportunity; yet during the lecture the probability of its success appeared stronger, so that he made the first experiment in the presence of his audience. The magnetical needle, though included in a box, was disturbed; and as the effect was very feeble, and must, before its law was discovered, seem very irregular, the experiment made no strong impression on his audience." Nothing further happened for three months; he delayed his researches until a more convenient time, when a large battery, constructed by his friend Esmark and himself, was available, and then, during a few days in 1820—July 15–20—he made the series of experiments which was announced in the Latin circular letter of July 21 already quoted.

A letter from his pupil Hansteen to Faraday, printed in Bence Jones's "Life of Faraday," gives a fuller account of the original discovery: "At first he had placed the wire at right angles to the direction of the magnet, and found no effect. After the end of the lecture he said: 'Let us now once, as the battery is in activity, try to place the wire parallel to the needle'; as this was made, he was quite struck with perplexity by seeing the needle make a great oscillation almost at right angles with the magnetic meridian. Then he said: 'Let us now invert the direction of the current,' and the needle deviated in the contrary direction. Thus his great detection was made, and it has been said, not without reason, that he tumbled over it by accident. He had not before any more idea than any person that the force should be transversal. But, as Lagrange has said of Newton on a similar occasion: 'Such accidents only meet persons who deserve them.'" Hansteen's remark would appear to do less than justice to his master, and has proved rather unfortunate, lending colour to the impression that the whole discovery was due to chance. This was far from being the case. Oersted had for years been seeking a connection between electricity and magnetism, and the discovery was the result of his search.

Not the least instructive part of Mrs. Meyer's very interesting book is a series of sheets reproduced in facsimile from notes, mostly in his own handwriting, found among Oersted's papers, which give in detail the experiments with the large battery during July, 1820. Not only did he experiment with a straight wire, but also with one bent into a loop so as to form one complete turn of a circuit, which thus had its north and south face. Oersted saw that such a circuit acted like a magnet. The effect of replacing the magnet by needles made of non-magnetic material was tried, and it was found that they were not disturbed by the current.

The results, announced to all centres of scientific activity, at once produced a great sensation. The paper was published in various journals, and among others in Schweigger's *Journal* for July, 1820, and the same number contains an account of further experiments of importance. Oersted showed in this second communication that the effects "do not seem to depend upon the intensity of the electricity, but solely on its quantity"—in modern words, on the current, and not on the e.m.f. of the supply. Further, he showed, by suspending by a fine torsion wire a small battery and the circuit through which the current passed, that the effect is reciprocal: on bringing a magnet pole up to one face, the circuit is repelled; on bringing the same pole up to the other face, it is attracted.

But while Oersted's experimental work is admirable and his demonstration complete, it is not easy to follow his theoretical ideas. He speaks continually of the "conflict of the electricities" which constitutes a current. The positive and negative electricities flowing in opposite ways round the circuit come into conflict, and it is through their struggle that the various effects are produced. It would almost appear as though he thought that the heat and light radiated from a glowing conductor needed some violence for their origin—violence provided by the struggle between the positive and negative electricities. "He did not consider," he writes himself, "the transmission of electricity through a conductor as a uniform stream, but as a succession of interruptions and re-establishments of equilibrium in such a manner that the electrical powers in the current were not in equilibrium, but in a state of continual conflict." To this conflict he attributes also the magnetic action which originally he anticipated would be radiated outwards from the wire, like heat and light. Experiment proved otherwise; the magnetic action showed itself effective in directions at right angles to the wire, but he did not grasp the idea of a current of electricity flowing in the wire accompanied by a field of magnetic force arranged in circles round the path of the current. In his view, the electricity acted directly on the poles of his magnet, and as the force was due to the electric conflict, this conflict took place, not only in the wire, but also throughout the surrounding space through which the electricity flowed in a series of flat spirals encircling the wire itself. There was a transference of electricity in the direction of the wire; the path, therefore, of the current could not be a circle in a plane normal to the wire, but a spiral giving rise to a component of the motion parallel to the wire. According to his first ideas, though he modified these later, "negative electricity repels the north pole, but does not act on the south pole," while positive electricity acts on the south pole, but not on the north.

In 1828 Oersted writes thus, possibly after he had become aware of Faraday's work: "The electrical stream has a magnetic circulation about its axis. Every act of decomposition due to an electrical current in a given direction is accompanied by a circulation. Through this electrical stream, which, as I have shown elsewhere, is propagated by alternations of positive and negative electricity, there is brought about a series of charges and discharges of particles in the direction of the stream, and a circulation in planes at right angles to it."

The importance of this discovery was recognised everywhere. In Germany, at a somewhat later date, an attempt was made by Gilbert and others to lay stress on its accidental nature. "Was alles Forschen und Bemühen nicht hatte geben wollen das brachte ein Zufall Herrn Professor Orsted in Kopenhagen," he wrote in his *Annalen* in October, 1920, and this view was accepted by many of his contemporaries; but elsewhere Oersted received full and generous credit. The French physicists, led by Arago and Ampère, took up eagerly the investigation of the new phenomena, and in a few months Ampère established the laws of the mechanical action between electric currents. "The whole theory and experiment," writes Maxwell, "seems as if it had leaped full grown and full armed from the brain of the 'Newton of Electricity.' It is perfect in form and unassailable in accuracy, and it is summed up in a formula from which all the phenomena may be deduced, and which must always remain the cardinal formula of electro-dynamics." Ampère's brilliant work somewhat overshadowed Oersted's merit, which, however, the French investigators fully recognised.

In England Sir Humphry Davy was the first to repeat the experiments, using for the work "the great battery of the London Institution, consisting of 2000 plates of zinc and copper"; he showed at an early date that the arc between two charcoal electrodes was altered in shape when a magnet was brought near. In April, 1821, Faraday wrote an historical survey of the growth of the subject up to date, stating that Oersted's results "comprise a very large part of the facts that are yet known relating to the subject," and pointing out that his constancy in the pursuit of his inquiries respecting the identity of chemical, electrical, and magnetic forces "was well rewarded in the winter of 1819 by the discovery of a fact of which not a single person besides himself had the slightest suspicion, but which when once known instantly drew the attention of all those who were at all able to appreciate its importance and value."

From the autumn of 1822 to the summer of 1823 Oersted was in Germany, France, and England. He is less enthusiastic than in the past about the German men of science whom he met. "Schweigger at Halle has brains, but is a reed shaken with the wind. His experiments are not of much importance. Kastner at Erlangen writes thick volumes compiled with much toil but without all judgment. Yelin at Munich makes indifferent experiments and lies much. But I have found much that was instructive with Fraunhofer at Munich, so that I have been able to occupy myself with benefit there for about a fortnight."

To the Frenchmen he is more kindly. "My stay here grows more and more interesting to me every day. The acquaintances I have made grow every day more cordial and intimate," he writes to his wife from Paris in February, 1823. He saw Biot, Fresnel, Pouillet, Ampère, Arago, Fourier, Dulong, and many others: such was the brilliant list of physicists then at work in Paris. With Ampère he had many discussions as to their rival theories; at one time he thought he had disproved the existence of the molecular currents which in Ampère's view constitute a magnet. Mrs. Meyer quotes from another letter an amusing account of a three hours' discussion which took place after a dinner given by Ampère. Among the guests were two of the host's pupils, and of them Oersted writes: "Even Ampère's two disciples declared that my theory was able to explain all his phenomena. They declare that so will Ampère's, and as his theory is nothing but the reverse of mine, he having removed the circuits of forces discovered by me from the conductor to the magnet, it will no doubt be difficult to find an entirely decisive objection to his theory."

The experiments which Ampère arranged for his benefit were not successful. "On the 10th I was at Ampère's by appointment to see his experiments. He had invited not a few. . . . He had three considerable galvanic apparatus ready; his instruments for showing his experiments are very complex; but what happened? Hardly any of his experiments succeeded. He is dreadfully confused, and is equally unskilful as an experimenter and as a debater." Somehow this is hard to believe; some at least of the confusion existed, we may suspect, in the mind of the narrator. Ampère's own descriptions of his work are models of clearness; his formula remains, as has been said above, "the cardinal formula of electrodynamics."

Oersted lived for some thirty years after the discovery of 1820, engaged almost to the last in physical work. During part of the time he was greatly interested in measurements of the compressibility of liquids. Details of some of these are given in a letter to Brewster dated December 30, 1826. He was one of the first to realise the necessity of allowing for the expansion of the vessel containing the liquid, and a piezometer which he described in the Proceedings of the Danish Society of Sciences for 1821 has been frequently employed for measurements of the kind, though Oersted was mistaken in thinking that it avoided all the difficulties arising from the expansion of the containing vessel.

Under date 1845 we have the following suggestion for a moving coil galvanometer: "A metal wire bent as a multiplier and able to revolve easily round two points is placed opposite the poles of a strong magnet in such a way that it will be deflected as soon as it is traversed by electricity."

In 1848 Denmark was at war, and in a letter of that date Oersted alludes to the fact that thirty years earlier he had experimented on the use of electricity for firing mines, and makes the suggestion of "burying in a road to be taken by an attacking enemy, under a comparatively thin layer of earth, small reservoirs filled with gunpowder and earth or small fragments of stones which could be fired by a communicating wire on a given signal and that in a shorter time than one second after the signal."

More will be found in Mrs. Meyer's excellent volume about the activities of a remarkable man; she has done her work admirably, and we are indebted to her for her labours in producing this most interesting work. The book, which is printed in English, has been published in Copenhagen under the editorship of the Royal Danish Society of Sciences, and is in every way a worthy memorial of perhaps the most distinguished member of that society.

R. T. G.

Native Life in the Loyalty Islands and Southern Nigeria.[1]

By HENRY BALFOUR.

(1) MRS. HADFIELD'S book on the Loyalty Islands is the outcome of a long residence in this group, in connection with the work of the London Missionary Society. The greater part of the time was spent on Lifu Island, but eight years were spent on the smaller island of Uvea. The account which she gives of the natives is unpretentious and straightforward, written in an easy and attractive style and with a vein of humour. She reveals her sympathy with the natives, with whom she became on excellent terms, and much

[1] (1) "Among the Natives of the Loyalty Group." By E. Hadfield. Pp. xix+316. (London: Macmillan and Co., Ltd., 1920.) 12s. 6d. net.
(2) "Among the Ibos of Nigeria: An Account of the Curious and Interesting Habits, Customs, and Beliefs of a Little Known African People by One who has for Many Years Lived amongst Them on Close and Intimate Terms." By G. T. Basden. Pp. 315. (London: Seeley, Service, and Co., Ltd., 1921.) 25s. net.

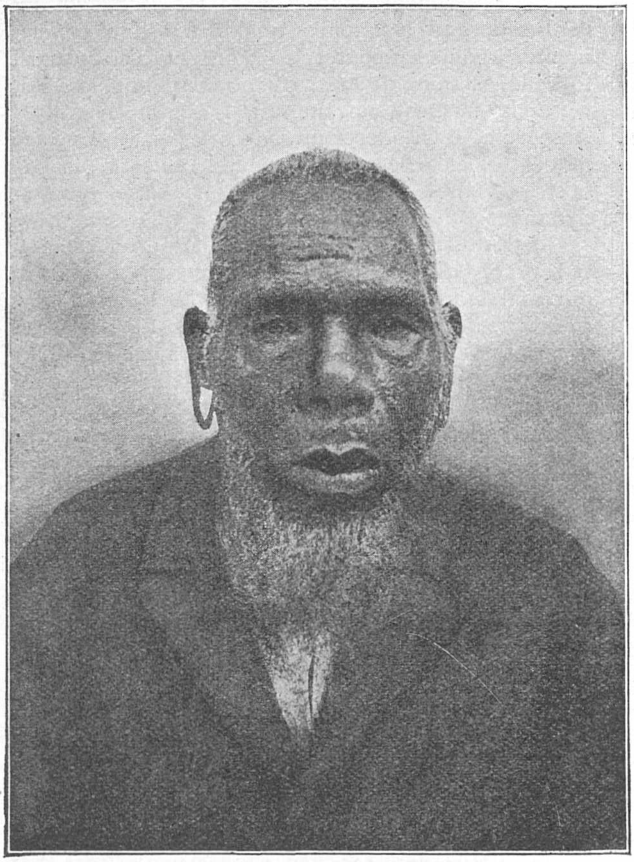

FIG. 1.—Type of Uvean native, Loyalty Islands. From "Among the Natives of the Loyalty Group."

of the information acquired regarding their habits, customs, and ideas was the reward of having gained the confidence of the islanders. Although but some sixty miles separate the Loyalty group from New Caledonia, the natives of the former, with their cheery disposition and laughter-loving habit, differ markedly from the dour, sullen natives of the latter. The tradition that Uvea was peopled partly by immigrants from the Polynesian Wallis Island (also called Uvea), lying about 1000 miles away, is borne out by the fact that Uvea boasts of two languages, the original "Iaian" and a distinct and apparently intrusive language spoken in the north and south of the island. This Polynesian intrusion explains, perhaps, the temperamental difference which is noticed between the Loyalty Islanders and the more strictly Melanesian New Caledonians, and also accounts for certain customs and appliances which exhibit Polynesian affinities.

The account given by Mrs. Hadfield of the mentality, daily life, useful and æsthetic arts, and also of the customs, social ethics, and legends of the Loyalty Islanders, is very concise and full of interest. One cannot but recognise how rapidly the old indigenous culture is disappearing. The author dwells upon their many good qualities, and endeavours to account for those characteristics which civilisation deems undesirable and bad. Allowances must be made for the native point of view and for the environment, though the former is always difficult of diagnosis. Even in war a system of sportsmanlike etiquette prevailed, and certain unwritten laws were studiously observed. Due notice was given of an impending "state of war," and operations were not commenced until after the expiry of a period of several days. The heads and noses of children were modified by pressure in order to induce the orthodox, fashionable shape, a practice which is of much interest owing to its wide dispersal over the world, but is disconcerting to the ethnological craniometrist.

The natives exhibit skill and boldness in surgery, though their methods are necessarily of the crudest. Trepanation was freely resorted to, and with success; fractures were dexterously reduced. Hygienic principles are practically non-existent, and the spread of infectious diseases is rapid. The intro-

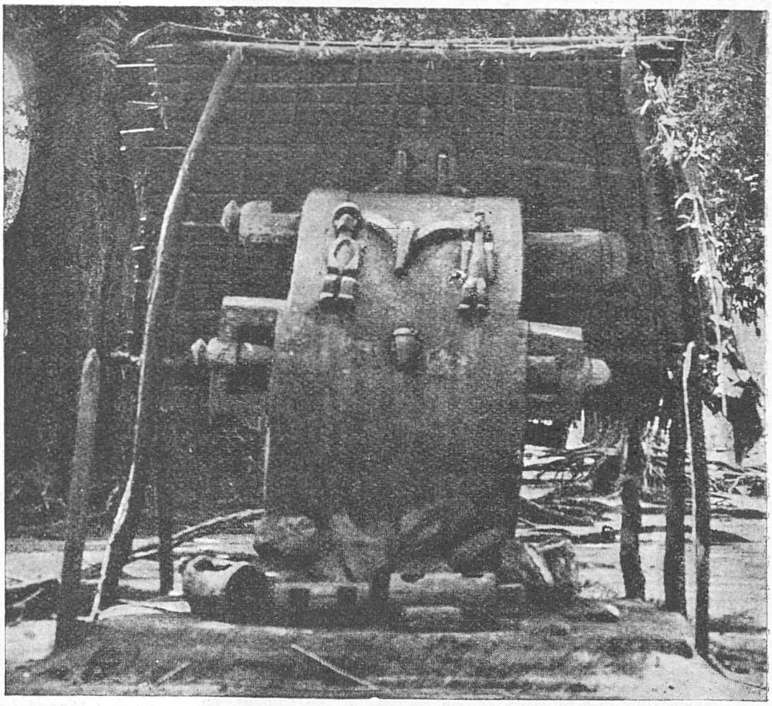

FIG. 2.—The wonderful wooden gong of Umu-nze, the maker of which was murdered lest he should make an even finer one for another town. From "Among the Ibos of Nigeria."

duction of foreign diseases has had a disastrous effect, accentuated by the imported vices, which are usually more attractive and more easily assimilated than are the white man's virtues. Fear of death does not appear to weigh heavily upon the natives. A number of native legends is given at the end of the volume, affording useful material for comparative study.

It may seem ungrateful to express the wish that Mrs. Hadfield's descriptions of industries, appliances, and habits might have been more detailed, since the production of a complete text-book was not her intention. In asking for more, one does so in full recognition of the praiseworthy and useful work performed by the author in giving us this very readable and well-illustrated book, which deserves fuller notice than can here be given.

(2) Another product of many years of missionary intercourse with natives, involving close personal contact, is the Rev. G. T. Basden's volume dealing with the Ibos of Southern Nigeria. The author has aimed at giving a fairly detailed, though popularly written, account of these interesting natives, and has succeeded in producing an instructive and attractive volume. He sounds a note of caution which may well be taken to heart by globe-trotters and stay-at-home amateurs who, with little or no experience, write books about native ideas and beliefs. He writes: "The longer one lives amongst West African natives, the more one is convinced that it is a practical impossibility for the European to comprehend fully the subtleties of the native character. Some white men claim to have done this, but my experience leads me to think that the claim can rarely, if ever, be substantiated with definite assurance."

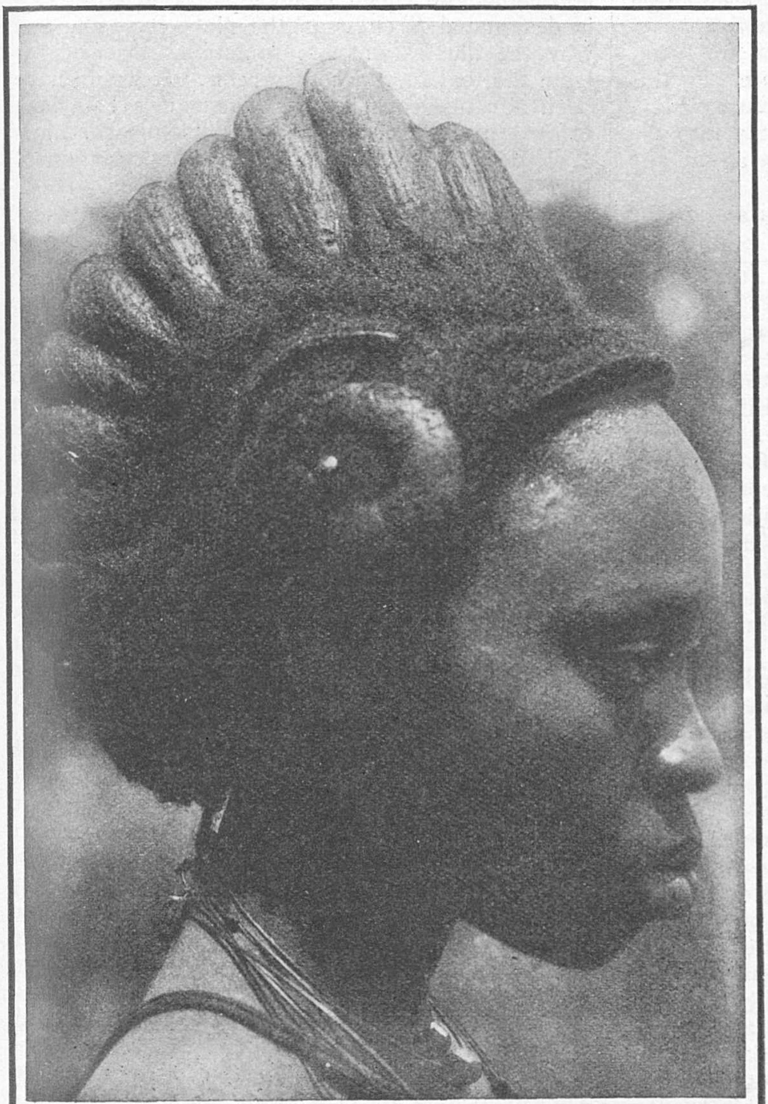

FIG. 3.—Hair-dressing as a work of art. From "Among the Ibos of Nigeria."

This is an honest admission on the part of one who has lived long enough among the natives to realise the difficulties involved in the diagnosis of their mentality, and to recognise the fundamental difference between their "philosophy" and ours. The Ibo people, who form nearly one-half the population of Southern Nigeria, occupy the country lying mainly between the Niger and Cross rivers, a huge tract extending from the coast to 7° N. lat. There is a westerly extension across the Niger. The Ibos are not homogeneous, important variations occurring in the extensive area occupied. The environment varies considerably, from the low-lying swamps of the Delta to the higher land around Onitsha.

The book is a timely one, since the indigenous customs are very rapidly undergoing changes, though in 1900, when Mr. Basden arrived there, primitive conditions still largely persisted. The general life of the Ibos is well presented. A man's greatest desire in life is to advance in social status, and many crimes are committed in order to promote this advancement. Theft (to obtain the necessary funds), murder, and head-taking (as a sign of prowess) are very usually the outcome of this craving for higher titles. Cannibalism has been rampant, human flesh being regarded as a valuable food product. Polygamy is favoured equally by both sexes, and will be suppressed only with great difficulty. The first wife takes precedence of all the others, and is regarded as the legal wife, *anasi,* who is priestess of the household gods. Belief in the survival of the soul prevails, and adequate burial of the dead is a matter of great concern. A first, necessarily hurried burial takes place soon after death, but a second more elaborate and very costly "burial" by proxy is performed later, with the view of keeping the spirit of the deceased in contentment. Failing this propitiation, the spirit may become restless and malignant. Reincarnation is believed in. Children are well treated and thrive, and although their treatment is often very drastic and appears cruel, the parents evince great fondness for them. Twins, however, are held in abhorrence. In this respect the Ibos differ from the neighbouring Ekoi, who welcome twins. Boys are initiated into the mysteries of the Ayakka secret society at the age of ten.

The secret societies are dealt with by the author in detail, and the religion and superstitions are well, if briefly, described. The chief deity is Abwala, and at her shrine oracles are sought and "trials" are conducted. The priests, in consequence, exercise a great controlling influence, as is so often the case in Africa. The arts and crafts and the trading methods are interestingly dealt with, and one feels that the author has command of more information than could be published in a single volume. The illustrations are excellent and fairly numerous. One wonders why the household god called in the text *Ikenga* (p. 219) is designated *Skenga* on the plate (p. 120), and why the illustrations are sometimes inserted far from the text to which they refer. It would have been advantageous if all native names had been printed in italics. Such minor blemishes, however, do not materially lessen our appreciation of this very useful and instructive volume. Both the author and his readers may be congratulated.

Obituary.

Peter Donald Malloch.

ARDENT naturalists in humble ranks of life during last century, such as Edwards, of Banff, and Robert Walker, of St. Andrews, in zoology, and Sergeant Sim, of Perth, in botany, have not been rare in Scotland, but few showed more acute penetration, combined with artistic skill and fitness for administration, than Peter Donald Malloch, the premier angler and skilful taxidermist, as well as the originator and able administrator of the Tay Salmon Fisheries Co.

A native of the neighbourhood, Malloch spent most of his life in the Fair City, taking the foremost place, after the death of Mr. Lamb, as a taxidermist (many examples of his skill being now in the Perth Museum), then well known for his remarkable success as a practical angler, and, lastly, as manager of the salmon syndicate just mentioned. It was in Perthshire that the artificial hatching of the salmon at Stormontfield ponds first attracted the attention of men of science in the fifties and early sixties of last century, and the work of Robert Buist, Wm. Brown, and John Dickson made it widely known. Malloch, however, following these, and in the unique position he held on the finest salmon-river in the country, one which carries the largest body of fresh water to the sea, was able to clear up certain ambiguities, and though he had no training in science he grasped the information derived from an investigation of the scales of the salmon, sea-trout, and other fishes, and worked out their life-history with great accuracy and acuteness. In 1910, indeed, he collected all his information in an interesting work entitled "Life-history and Habits of the Salmon, Sea-trout, and other Fresh-water Fish," a work illustrated by as many as 239 exquisite life-like photographs —mainly by himself.

Malloch's observations on the various classes of salmon ascending the rivers, and a comparison of their movements with those of the sea-trout (the latter feeding in fresh water, whilst the salmon does not), are of great interest and value in this complex subject. He believed that almost all salmon in the sea make for the rivers where they were born. He had some hesitation in accepting the view that some of the parr become smolts at the end of their first year, but old "Peter of the Pools" at Stormontfield would have strengthened the case by demonstrating that many of the year-old parr reared there grew apace, assumed the silvery coat, passed down the rivulet to the pen near the river, and would even leap over its edge in their eagerness to migrate seaward.

Malloch's efficient marking of the smolts with silver wire gave him much information as to the rate of growth of the salmon, irregularity in spawning, and other points. His wide experience of the Tay and other rivers and of numerous lochs enabled him to corroborate Dr. Gunther's opinion as to bull-trout, and so with his remarks about yellow fins and whitling, the young of the sea-trout. Further, the acuteness of his observations is shown by his finding a new char (*Savelinus Mallochi,* Tate Regan) in a lake in Sutherland. That he was able to accomplish so much in the midst of strenuous commercial fisheries work, comprehending the Tay from Stanley to the sea, the surveying of rivers and lochs, and the letting and sale of highland estates, shows that his capacity was of no ordinary kind. Perth has always been the centre from which has emanated much of the life-history of the salmon, and Malloch enhanced and extended that reputation. He died toward the end of May at the age of sixty-eight years.

W. C. M.

WE much regret to see the announcement of the death, from heart failure, on June 5, of DR. A. M. KELLAS, of the Mount Everest Expedition.

Notes.

THE Albert medal of the Royal Society of Arts for 1921 has been awarded to Prof. J. A. Fleming in recognition of his many valuable contributions to electrical science and its applications, and especially of his original invention of the thermionic valve, now so largely employed in wireless telegraphy and for other purposes.

NOTICE is given by the University of London that the advanced lectures by Prof. A. D. Waller and Mr. J. C. Waller on "Experimental Studies in Vegetable Physiology and Vegetable Electricity," announced for delivery on June 15, 22, 29, and July 6, cannot now be given.

THE Importation of Plumage (Prohibition) Bill, as amended in Standing Committee, was read a third time in the House of Commons on June 10.

THE grant of 5000*l.* a year promised by the Government for five years to the Empire Cotton Growing Corporation (on condition that 90 per cent. of the cotton industry should agree to contribute by means of a voluntary levy on every bale of cotton imported into England, which agreement has now been obtained) is to be replaced by the grant of a capital sum of 1,000,000*l.* to the corporation. This announcement was made by Mr. Winston Churchill in Manchester on June 7. The capital sum in question is about a quarter of the total profits made by the British and Egyptian Governments from their joint control of the cotton supply during the war. These profits are being shared equally between the two Governments, and half the British Government's share is to be utilised for the promotion of Empire cotton.

THE Minister of Agriculture has announced the gift to the nation by Lord Lee of a large estate of 1300 acres, being part of the Chequers estate, of which 700 acres is farmland and the remainder woodland. The Ministry proposes that the main farm should be conducted as an example of the stock-rearing farm, showing how land of that character could be improved so as to produce the maximum output of livestock consistent with sound commercial agriculture. It is considered that the farm could be made a valuable demonstration of the growth and value of improved varieties of cereals and fodder crops and of the amelioration of grassland to be utilised for the intensive breeding and rearing of livestock, without departing from the prime economic purpose of any farm which is intended to guide the practice of the working farmer. At the same time it is hoped to come to some arrangement with the Bucks County Council, under which the Dropshort Farm could be utilised for more definitely educational purposes as the holding attached to a farm institute. It is a hopeful augury, and one not without significance, that future Prime Ministers should be able to see at their doors an example of agricultural education in being. Lord Lee's munificent donation adds to the debt of gratitude which the nation already owes him, and gives the agricultural authorities an opportunity of carrying out work which has long been needed, and which they have long desired to do.

THE fifth International Rubber Exhibition was opened on June 3 by Sir Owen Philipps, M.P., at the Royal Agricultural Hall, Islington. Notable exhibits of rubber and other tropical produce were shown by commercial firms and by British overseas and foreign Governments, the colonial exhibits of the latter being particularly good. From the scientific point of view the display illustrating the mycological work which is being carried out under the auspices of the Rubber Growers' Association, and the fine exhibit of the Java rubber research stations, call for special mention. The most important feature of the exhibit of the Rubber Growers' Association was the effectively arranged demonstration of the discovery by the Botany Department of the Imperial College of Science and Technology that, in all probability, "brown bast" (the most serious disease of *Hevea brasiliensis*) is essentially a question of phloem necrosis. Sanderson and Sutcliffe (the latter a former student of the college), in their investigation of the anatomy of burr-formation, which is the principal external symptom of brown bast, had shown that the burrs result from the inclusion of areas of diseased laticiferous tissue in stone-cell "pockets" formed by the activities of wound cambiums. The recent work at the Imperial College, however, focusses attention upon the probability that the disease has its origin in an affection of the sieve-tubes (phloem), the symptoms described by Sanderson and Sutcliffe being a secondary development. The important information now available should be a step forward to the discovery of the causative factors of this baffling disease. Another series of preparations demonstrated the action of certain fungi (Diplodia, Nectria, and Fusarium) as wound parasites; cultures of fungi obtained from Hevea trunks were also shown. A further exhibition of the department comprised a series of seed-germination experiments, which showed that rubber seed which had failed to germinate was already infected with Diplodia, a fungus known to cause a disease of Hevea seedlings. Reference must also be made to the interesting exhibit illustrating the course of instruction in rubber technology which is being conducted at the Northern Polytechnic Institute, Holloway.

THE British Cast-Iron Research Association has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of the association is Mr. Thomas Vickers, Central House, New Street, Birmingham.

AT the anniversary meeting of the Linnean Society of London, held on May 24 last, the following officers were elected:—*President:* Dr. A. Smith Woodward. *Treasurer:* Mr. H. W. Monckton. *Secretaries:* Dr. B. Daydon Jackson, Prof. E. S. Goodrich, and Dr.

A. B. Rendle. *Members of Council:* Prof. Margaret Benson, Prof. V. H. Blackman, Mr. E. T. Browne, Mr. H. Bury, Mr. S. Edwards, Prof. E. S. Goodrich, Dame Helen Gwynne-Vaughan, Sir Sidney F. Harmer, Dr. B. Daydon Jackson, Mr. C. C. Lacaita, Mr. G. W. E. Loder, Mr. H. W. Monckton, Mr. R. I. Pocock, Capt. J. Ramsbottom, Dr. A. B. Rendle, Lord Rothschild, Dr. E. J. Salisbury, Mr. C. E. Salmon, Mr. Thomas A. Sprague, and Dr. A. Smith Woodward.

THE nineteenth annual meeting of the South African Association for the Advancement of Science will be held at Durban on July 11–16, under the presidency of Prof. J. E. Duerden, of Rhodes University College, Graham's Town. As in previous years, the association will meet in six sections, the presidents of which are as follows:—Section A (Astronomy, Mathematics, Physics, Engineering, etc.), Dr. J. Lunt, of the Royal Observatory, Cape of Good Hope; Section B (Chemistry, Geology, Geography, etc.), Dr. J. Moir, Chemist to the Mines Department, Johannesburg; Section C (Botany, Forestry, Agriculture, etc.), Prof. J. W. Bews, of Natal University College, Maritzburg; Section D (Zoology, Physiology, Hygiene, etc.), Prof. H. B. Fantham, of University College, Johannesburg; Section E (Anthropology, Philology, etc.), Dr. C. T. Loram, of the Natal Education Department; and Section F (Education, Sociology, History, etc.), Prof. W. A. Macfadyen, of Transvaal University College, Pretoria. The general secretaries of the association are Dr. C. F. Juritz, Department of Agriculture, Cape Town, and Mr. H. E. Wood, Union Observatory, Johannesburg. Capt. H. A. G. Jeffreys, P.O. Box 6894, Johannesburg, is acting as assistant general secretary. It is announced that the 1922 meeting will be held at Lorenço Marques under the presidency of Dr. A. W. Rogers, Director of the Geological Survey of the Union of South Africa.

EVIDENCE of considerable interest in relation to the character and distribution of Iron-age culture in the Balkan Peninsula has been obtained by Mr. Stanley Casson in the course of a journey through parts of Macedonia. This journey was undertaken under the auspices of a research committee, of which Sir William Ridgeway is chairman, of the British Association, appointed to excavate early sites in Macedonia. Starting from Dedeagatch, the port at the mouth of the Maritza River, Mr. Casson worked westward through Enos, Drama, and Cavala. He also visited Vodena and Ostrovo. Excavations were undertaken at Chauchitsa, which during the war was one of the railheads on the British Doiran-Vardar front. The "finds" included bronze ornaments, pottery, some gold, and a number of iron knives. The results of Mr. Casson's investigations of this area, of which little is known archæologically, will be described in full in the Anthropological Section at the Edinburgh meeting of the British Association in September next.

THE lectureship established to commemorate the work of Mr. Moncure Conway was held this year by Dr. A. C. Haddon, who selected as his subject "The Practical Value of Ethnology." After a preliminary survey of the relations of sociology and history to anthropology, Dr. Haddon proceeded to discuss the relations of peoples of the higher to those of the lower culture under the heads of Conduct, Control, and Care. In regard to "conduct," he urges that dealings between groups, as well as those between individuals, should be conducted with the greatest possible consideration for their several sentiments and prejudices. Under the head "control" he considers the value of the knowledge of anthropology to the statesman and administrator. By "care" he means the efforts which can be made to check the evil results which arise from the contact of the higher with the lower civilisation in the prevention of epidemics, the problem of the dying-out of native races, the avoidance of meddlesome interference, and so on. Problems of this kind are familiar to all ethnologists, but Dr. Haddon's exposition of the subject is admirable, and it is illustrated by an interesting selection of facts drawn from his wide knowledge of anthropological literature and practical experience as a traveller. The lecture deserves the careful attention which it is sure to receive from all who are interested in the advance of our common humanity.

AN interesting phase of the social life of Roman society in the Ciceronian age is described by Messrs. A. W. Van Buren and R. M. Kennedy in a paper contributed to the *Journal of Roman Studies* (vol. ix., part 1) on Varro's aviary at Casinum. Marcus Terentius Varro, author of the famous work on agriculture, "De Re Rustica," gives a long account of this building, which is here quoted and translated. It contained fish-ponds and duck-houses, the latter enclosed by fine gut nettings, and spaces shut off by nets for songsters, such as nightingales and blackbirds, supplied with water by means of a small channel, while food was thrown to them under the net. Several of the elements which enter into the arrangement of Varro's aviary recur in a contemporary Pompeian painting from the villa of Julia Felix.

THE American Museum of Natural History has set a good example in founding a new journal for the publication of preliminary announcements and the description of new species. It is to be known as the *American Museum Novitates.* No. 1, which has just reached us, is devoted to an extremely interesting and stimulating survey of the evolution, phylogeny, and classification of the Proboscidea by Prof. H. F. Osborn, who within the compass of a few pages has provided food for thought and much debate for some time to come. All interested in palæontology will note with satisfaction that the author frankly rejects his earlier views in regard to Mœritherium, and subscribes to the opinion originally started by Dr. C. W. Andrews, of the British Museum, that it is to be regarded as an indubitable proboscidean. But they will probably fail to grasp the precise meaning of the author's contention that "the enlargement of the second upper and lower incisor teeth . . . presents a firm ground of affinity with a still unknown primitive Lower Eocene proboscidean-stem form. There the resemblance ends." We venture to think that when Prof. Osborn's studies of this remarkable fossil are completed he will still further modify his conception as to the ancestral position of this animal, when the system of proboscidean classification proposed in this essay will be materially changed.

THE annual report of the Smithsonian Institution for the year ending June, 1918, contains as usual, in addition to the secretary's report, a valuable general appendix consisting of twenty-seven papers illustrating the more important developments in physical and biological science, among them being translations of contributions by foreign men of science. In one of these, "On the Law of Irreversible Evolution," Dr. Branislav Petronievics sets forth an exposition based on Lewis Dollo's own works of the principle that "an organism cannot return even in part to a previous condition already passed through in the series of its ancestors." Another translation is "The Fundamental Factor of Insect Evolution," by S. S. Chetverikov—a paper which was first published in Russian. The opposite direction of the paths of evolution of vertebrates and invertebrates is accounted for by assuming that the chitinous skeleton of insects enabled them to diminish continuously the size of the body and so to obtain for themselves an independent place among terrestrial animals while increasing in endless variations of form. The third translation included in the volume is "The Psychic Life of Insects," by E. L. Bouvier—a paper in which the author attempts to show that the predominance of instinctive activity among insects is due to the multiplicity of appendages, and that, in consequence, their main psychical task consists in engraving on their memory and in repeating instinctively the acts to which these organs are adaptable.

EXCELLENT photographs of the skull, mandible, cervical vertebræ, and fore and hind feet of the giant extinct marsupial Nototherium, found last year at Smithton, Tasmania, are published by Messrs. H. H. Scott and Clive E. Lord in their account of the specimen, which is now in the Tasmanian Museum, Hobart (Proc. Roy. Soc. Tasmania, 1920). Nototherium seems to have borne a dermal horn on the nose, and may have played the part of a rhinoceros in the marsupial fauna of the Australian region. Its feet, however, are peculiar, and closely resemble those already known in Diprotodon. Messrs. Scott and Lord discuss these features specially, but their use of English words and their style of composition are so unfamiliar that it is difficult to grasp their meaning.

IN the *Brooklyn Museum Quarterly* for January, Mr. R. C. Murphy, the curator of natural history, continues his account of "The Sea-coast and Islands of Peru," dealing here with the Chincha Islands, and including a narrative by Dr. F. A. Lucas, who spent three months there on a guano ship in 1869.

PART 2 of the Quarterly Journal of the Geological Society for 1920 (vol. lxxvi.) is occupied by palæontological papers. Mrs. Eleanor Mary Reid describes two pre-Glacial floras from beneath the Boulder Clay of Castle Eden, on the Durham coast. By a careful comparison with French and Dutch deposits, the author assigns one to the Middle and the other to the Upper Pliocene. She follows with "A Comparative Review of Pliocene Floras based on the Study of Fossil Seeds," the inspiration for which came from the work carried on by herself and her husband, the late Mr. Clement Reid, between 1904 and 1915. The general conclusion is that at the opening of Pliocene times a flora existed in western Europe which was closely allied to the living floras of far-eastern Asia and of North America; but this gradually disappeared, until, in the Upper Pliocene bed of Cromer, it was represented by only 0·74 per cent. of the plants examined. The succession of the floras is Pont de Gail (Cantal), which is practically Miocene; Reuverian (from Reuver, north-east of Roermond, Holland); Castle Eden (Durham); Teglian (from Tegelen, on the Meuse, south of Venlo, and north-east of Reuver, in Holland); and Cromerian (Norfolk). In the same issue of the journal Dr. F. J. North publishes a detailed study of the brachiopod genera Syringothyris and Spiriferina, which he finds to be unrelated. He establishes a new genus, Tylothyris, for McCoy's *Spirifera laminosa*.

IN a paper on "The Nature of Palæozoic Crustal Instability in Eastern North America" (*Amer. Journ. Sci.*, vol. l., p. 410, 1920) Dr. C. Schuchert connects considerable epochs of diastrophism with the close of geological periods. He urges that the latter are determined by changes of fauna, and the "quickened evolution of the earth's plants and animals" is a response to altered conditions of the surface. Hence the unconformities after epochs of disturbance, such as the "Nevadian" epoch of mountain-building at the close of the Jurassic period, which affected the whole region from Lower California to Alaska, may fairly be taken as stratigraphical boundaries. It may be remembered that similar reasoning was put forward by Prof. T. C. Chamberlin in the *Journal of Geology* for 1909. Dr. Schuchert hesitates, however, at closing the Mesozoic era in America with the top of the Jurassic, and it is obvious that a review of the contemporary faunas throughout the world is necessary for a reasonable delimitation of the groups and systems.

THE utilisation of the artesian water resources of Western Australia is making progress. An article on the subject by Mr. A. G. Maitland appears in the Mining Handbook (Geological Survey Memoir, No. 1) issued by the Minister of Mines. Mr. Maitland maps the location of five artesian basins in Western Australia which vary much in size and importance. Most significant, as bearing on the pastoral possibilities of the State, is the so-called desert basin in the north-west covering the area usually known as the great sandy desert. The disposition of the rocks gives ideal artesian conditions, the water being, in the main, derived from the rainfall of the Kimberley district. The six or seven bores which have been sunk in this desert area have been sufficiently successful to give high promise for further operations. North of the Great Australian Bight artesian conditions seem to be favourable in the Eucla basin, but more investigation is required. In five out of thirteen bores the water rose freely.

AT the request of the American Geographical Society, Sir John Scott Keltie has prepared a short report on "The Position of Geography in British Universities" (Research Series No. 4). Sir John Keltie, in addition to giving some details for each university, reviews briefly the history of geographical education in Great Britain, and shows that considerable progress has been made in this country since his well-known report on the subject in 1885. At that date geography was practically unrecognised in British universities, while at present there are only two universities in England and one in Scotland in which there is no separate department in geography. Despite this progress, much remains to be done. In many universities the departments are understaffed, and the subject has a hard, and not always successful, fight to find its due place in the curricula. There is diversity of opinion regarding the scope of the subject and methods of treatment. In a few universities the subject is in both the faculties of arts and sciences, but in some it is only in arts. The addition of degrees in commerce has resulted in increased demand for geography, but on somewhat restricted lines, which cannot do justice to the subject. Sir John Keltie thinks there is need for geography to limit the field of its operations and to avoid the embarrassment of overcrowding.

THE Ministry of Finance, Egypt, has recently issued a Blue Book embodying the programme and policy of the Egyptian Government in regard to the development of the oil resources of that country. The chief point of interest in the publication is the defence put forward by the Under-Secretary of State for Finance, Mr. E. M. Dowson (under whose name the book appears), in support of the policy of State boring for oil determined upon in 1919. In other words, the justification of the expenditure of public money on petroleum mining in Egypt is pleaded in view of the growing scarcity and enhanced price of oil fuel as a measure of internal economy and as an attempt to further the scientific development of the oil resources of the country. State enterprise in such a risky business as oil-finding is usually to be deplored, but there are certain factors to be recognised in the political elements here engendered which not only warrant some co-ordinated efforts to deal with a difficult situation, but also make it essential that some authoritative scheme should be adopted to stabilise the oil industry of the country. The present policy includes the reservation of certain likely petroliferous areas for the Government as a result of a preliminary geological survey; such areas include Abu Durba, the west coast of Sinai, several isolated areas in northern Sinai, two smaller areas on the west coast of the Gulf of Suez at Ras Dib and Zeit Bay, and a larger area at Abu Sharr adjoining the better-known Hurghada field. The location of a commercially productive field in any one of these areas would justify, at any rate from a Government point of view, all the expenditure entailed in obtaining, transporting, refining, and distributing the oil. Failure, on the other hand, will be severely criticised, not only at home in Egypt, but also abroad. The scientific results accruing from the borings, however, must have considerable value in the task of assessing the oil potentialities of the country, but ultimately it will be for the Egyptian people to pass judgment on a policy the merits or demerits of which as yet remain to be substantiated.

IN the *Radio Review* for May Mr. T. L. Eckersley concludes his inquiry as to whether the errors in the apparent bearings of radio stations from which messages are received at night can, in whole or in part, be explained by the existence in the atmosphere of an outer conducting layer which he calls "the Heaviside layer," at the under-surface of which the electric waves are reflected. He thinks that the existence at night of such a reflected wave-train must now be taken as proved, and proposes to determine by measurement whether there is any component of the electric force horizontal and perpendicular to the plane of propagation. If this proves to be the case, the surface of the conducting layer at which reflection takes place cannot be taken as horizontal. Mr. Eckersley is disposed to think that in many cases the reflection is of this kind. The influence of the layer in the daytime is less marked, as it extends down to the ground and produces absorption of the waves propagated through it. In the night it has a more or less sharp under-boundary, at which reflection can take place and the waves are confined almost entirely to the layer of air underneath.

THE February issue of *Radium* contains a report of the Leonard prize for research recently instituted by the American Röntgen Ray Society. The prize, which commemorates the name of Dr. C. Lester Leonard, a victim to X-rays, is for the best piece of original research in the field of X-rays, radium, or radio-activity, and is of the value of 1000 dollars. This competitive award is open to anyone living in the western hemisphere. In the same issue notice is given of a correspondence course in the physics of radio-activity suitable for the needs of biologists and surgeons as well as of physicists. The course is being arranged by Dr. N. E. Dorsey, of Washington, consultant to the National Bureau of Standards.

DR. C. E. K. MEES, director of the research laboratory of the Eastman Kodak Co., Rochester, N.Y., contributes to the Journal of the Franklin Institute of May 21 an excellent summary of the present knowledge of the structure and many of the properties of photographic films before and after use. Concerning the unexposed emulsion, the silver bromide particles are crystals belonging to the regular system. They show evidence of strain, perhaps because there is absorbed in them some other substance, such as silver iodide, soluble bromide, or gelatine. The sizes of the crystals are determined during the formation of the silver salt when making the emulsion, and their diameters range from ultra-microscopic particles below $0{\cdot}1\mu$ to occasional grains up to 10μ. The curve relating the sizes of grains to the number of each size present is probably closely related to the "characteristic curve" of the emulsion. Grains of the same size may vary in sensitiveness, and the sensitiveness of grains of different sizes in the same emulsion may vary from group to group. A geometric relation between the sensitiveness of grains of different sizes is sufficient to account for the properties of emulsions prepared in different ways. The author treats of the character of the developed image, and distinguishes between the graininess due to the individual particles of silver, the aggregations of these particles, and the agglomeration of these primary aggregations. The sharpness of the image is discussed, curves showing the quantitative values of these properties are given, and the methods by which these properties have been investigated are described.

YEAR BOOK No. 19 of the Carnegie Institution of Washington contains the nineteenth annual administrative report of the president, together with the reports on investigations and projects submitted by the various departments of the institution. Two sections of the presidential address, the financial records and the list of the institution's publications for the year, disclose some interesting facts. The total income available for the year ending October 31, 1920, was roughly 388,000*l*., and of this sum about 278,000*l*. was allotted to the various departments. The Department of Terrestrial Magnetism received the biggest grant, some 51,000*l*., while Mount Wilson Observatory received 45,000*l*., and the Geophysical Laboratory the notable sum of 31,000*l*. Another large item in the expenditure was the production of the well-known publications of the Carnegie Institution, of which twenty-two were issued and a further eight authorised for publication during the course of the year; this work absorbed some 17,000*l*. The bulk of the Year Book is devoted to reports showing the progress of investigations carried on during the year; reports of directors of departments are given first, followed by reports of recipients of grants for other investigations, the latter being arranged according to subject.

THE latest catalogue (No. 415) of second-hand books offered for sale by Mr. F. Edwards, 83 High Street, Marylebone, W.1, deals with works relating to British and foreign birds, and natural history voyages and travels. It contains nearly 400 items, many formerly the property of the late Dr. F. du Cane Godman, and several choice and scarce works. It will appeal to ornithologists. The catalogue is to be obtained upon application.

Our Astronomical Column.

DR. HILL'S CUSPED ORBIT.—Dr. Hill in his "Researches on the Lunar Theory" described a certain case of satellite motion in which the orbit of the satellite relatively to the primary was cusped at first and last quarter. The period of such a satellite in the earth's case would be 205 days. Dr. Hill supposed that this was the orbit of maximum lunation, but M. Henri Poincaré later showed that still larger orbits were possible, with loops replacing the cusps.

Astr. Nach. No. 5101 contains a paper by Prof. T. J. J. See quoting results of the late Dr. John N. Stockwell, in which the latter claimed to have shown that Dr. Hill's cusped orbit was erroneous and should be replaced by a flattened oval with a period of lunation of $247\frac{3}{5}$ days. He further asserted that Jacobi's integral (used by Dr. Hill) was based on incorrect mechanical principles. Both Prof. See and Dr. Stockwell appear to have overlooked a paper by R. Moritz in Mon. Not. R.A.S. for November, 1917, in which the latter re-investigated the cusped orbit of Dr. Hill by the method of mechanical quadratures used by Dr. P. H. Cowell for the eighth satellite of Jupiter and for Halley's comet. Needless to say, this method is independent of Jacobi's integral, and involves nothing beyond the elementary principles of accelerated motion. The result has led to the detection of a few unimportant numerical errors in Dr. Hill's work, but the accuracy of the cusped orbit is substantially verified. If Dr. Hill's figures had been rigorously exact, the minimum distance of the satellite from the earth would have been attained when the angle of motion relatively to the sun was exactly 90° from the cusp. The actual figures given by the quadrature method are 90° 6′ 51″. The error is mainly due to the small errata in Dr. Hill's work, though a little may be ascribed to the inevitable cumulative error of mechanical quadratures. It would therefore appear that Dr. Stockwell's method must involve some fallacy, since the orbit that he gives for a period of $208\frac{3}{4}$ days is of quite a different shape from the cusped orbit, and differs little from an ellipse.

STONYHURST COLLEGE OBSERVATORY.—We have received the annual report of this observatory from the director, the Rev. A. L. Cortie, S.J. The regular observation of the sun has been continued, and the results show a steady decline in spot-activity, the disc being without spots on four days in September last for the first time since 1916. The director communicated a paper to the British Association at Cardiff on the connection between faculæ and calcium flocculi, showing that the correlation of the two is so close that the faculæ are probably the bases of the flocculi.

It will be remembered that on a former occasion Father Cortie dwelt on the importance of the latitude of sun-spots as an index of their magnetic effect on the earth. This was borne out by the spot of last month, which, although not at all abnormal in its extent, passed very near the centre of the disc, producing great magnetic disturbance and extremely bright auroræ.

The report contains an obituary notice of Bro. W. McKeon, S.J., who died on May 18, 1920. He was on the observatory staff for forty-two years, the majority of the drawings of spots made at the observatory being his work.

"L'ASTRONOMIE ET LES ASTRONOMES."—M. Auguste Collard, librarian of the Royal Observatory of Belgium, has published a useful bibliography under this title, which forms a brochure of 119 pages. It is divided under the headings: (1) Dictionaries and Encyclopædias of Astronomy; (2) Biographies of Astronomers; (3) Treatises on Astronomy, subdivided into many sections; (4) Histories; (5) Bibliographies; (6) Atlases; (7) Reviews; and (8) Tables.

The works under the various headings are not arranged in alphabetical order, but there are alphabetical indices at the end. There are also in many cases brief notes summarising the scope of the work, which are a useful supplement to the mere statement of the author's name and the title. The book promises to be useful; it is one of a series of similar works of reference published by G. Van Oest et Cie, National Library of Art and History, Brussels.

Prof. Einstein's Lectures at King's College, London, and the University of Manchester.

THE most noticeable circumstance in the lecture which Prof. Einstein delivered on June 13 at King's College on "The Development and Present Position of the Theory of Relativity" was the beauty and simplicity of his account of the theory. He made no attempt to enliven it by introducing any of the delightful illustrations which, however illuminating and attractive they may be to the popular mind, surround it with a halo of scientific romance. On the other hand, he found no occasion to have recourse to the blackboard, and he entirely omitted anything which required mathematical formulæ for its expression. He seemed, too, with earnestness and obvious sincerity to disclaim for himself any originality, and he deprecated the idea that the new principle was revolutionary. It was, he told his audience, the direct outcome and, in a sense, the natural completion of the work of Faraday, Maxwell, and Lorentz. Moreover, there was nothing specially, certainly nothing intentionally, philosophical about it. The whole theory was experimental in its origin, and the satisfaction it brought was simply in the fact that it put us in possession of a method of scientific research which not only did not bring us into conflict with observed facts, but also positively accorded with them.

The most absorbing part of the lecture was the exposition of his concept of our universe as being spatially a closed system and yet boundless. In this connection he referred to the work of Ernst Mach, who had been the first to direct attention to a distinct point in which the Newtonian theory of motion is unsatisfactory. It led Mach to endeavour to alter the mechanical equations so that the inertia of bodies should be attributed to their relative motion with reference, not to Newton's fictitious absolute space, but to the sum total of all other measurable bodies.

Prof. Einstein's modesty served only to give force to the impression which all received, and which Lord Haldane (who presided) admirably expressed, that we were welcoming not only one who is himself a man of genius, but one whose discovery is to be ranked with those of Newton, Galileo, and Copernicus—discoveries which in revolutionising thought have turned scientific inquiry in a new direction and enlarged the scientific horizon. In one aspect, as Lord Haldane pointed out, Einstein's revolution is more profound than that of the greatest of his predecessors, for while Copernicus and those who followed him corrected our deductions from phenomena within a generally accepted framework, Einstein has shown us the need of reconstituting our conception of that framework itself. It is not of choice, but of necessity, that the principle of relativity has raised a problem, and that the profoundest problem, in metaphysics—the problem of the relation of reality itself to knowledge.

After the public lecture Prof. Einstein was the guest of the Principal of King's College at a dinner given in the college. The Principal's guests included Lord Haldane, the Dean, the Vice-Principal, and many of the professors of King's College, the Astronomer Royal, Prof. Eddington, Prof. Lindemann, Prof. Whitehead, and others. In responding to his health, Prof. Einstein made an interesting revelation of his attitude to the quantum theory. This theory was, he said, presenting a difficult problem to physics, but the very nature of the difficulty served to bring into relief the attractiveness and satisfaction of the principle of relativity. That principle had served to give a simple and complete explanation of experimental facts which under any other aspect were discordant. In the quantum theory as it stood at present we were faced with discordant experimental facts, and were searching for the principle on which to interpret them.

The Adamson lecture was delivered at the University of Manchester on Thursday, June 9, by Prof. Einstein, who had been invited by the council in accordance with a Senate recommendation passed on February 3. At the opening of the proceedings the honorary degree of D.Sc. was conferred on Prof. Einstein. The lecture, which was delivered in German without an interpreter before a very large audience, was on the theory of relativity, and dealt in particular with the relation between geometry and physics. Prof. Einstein described how geometry had developed from a collection of individual theorems discovered empirically to a body of doctrine in which the logical connection between these theorems is perceived and explained. The logical structure required as its foundation a set of axioms, which constitute the residue of empiricism in the theory. The axioms of Euclid acquired such authority that in time they came to be regarded as necessities of human thought owing to the inherent nature of the mind, and thus the illusion was created that Euclidean geometry is free from anything empirical or arbitrary. On applying geometry to physics the tacit assumption was made that lengths measured by and on solid bodies correspond to lengths in Euclidean geometry. Prof. Einstein showed how the gradual discovery, through physical experiment and observation, of the fact that for objects of astronomical dimensions the axioms of Euclid do not hold good, had led first to the special, and then to the general, theory of relativity. He devoted the latter part of his lecture to the exposition of a non-Euclidean geometry (interpreting geometry in the sense of the theory of the possible positions of objects in space) in a plane, the objects in the plane being shadows of circular "beetles" inhabiting a sphere, the source of light being on the sphere, and the plane being a tangent plane at the opposite end of the same diameter.

Physico-chemical Problems Relating to the Soil.

THE Faraday Society held a general discussion on May 31 on physico-chemical problems relating to the soil. Sir Daniel Hall, in taking the chair, said that the papers to be presented would show that physico-chemical studies of soil were now as necessary as those of a purely chemical or physical nature.

Dr. E. J. Russell, director of the Rothamsted Experimental Station, in opening the discussion, gave a general review of the phenomena associated with the four main headings into which the subject was divided:—Soil moisture, organic constituents of the soil, adsorption phenomena, colloidal phenomena, etc.

The section on soil moisture was opened by Mr. B. A. Keen (Rothamsted), who dealt with the system soil–soil moisture, and pointed out that it was necessary to assume a complex colloidal coating over the soil-grains. The paper concluded with an account of the quantitative relations brought out by the freezing-point method of examining soil solution. Prof. Sven Odén (Stockholm), in a note on the hygroscopicity of clay, showed that the hygroscopicity of soils was not necessarily proportional to the total surface area of the particles. Prof. Hoagland (University of California) and Prof. Shull (University of Kentucky) forwarded papers dealing with the relation between the soil solution and the plant. The former dealt mainly with the seasonal variations of the salts in the soil solution and with the absorption of nutrient elements by the plant, and the latter with the mechanism of osmotic phenomena associated with the root-hairs of the plant.

In the discussion of this group of papers Dr. Hackett dealt with the capillary rise of water in soils, and Mr. Wilsdon mentioned some interesting experiments on hygroscopicity and osmotic pressure.

The second group of papers, on the organic constituents in the soil, opened with a review by Mr. H. J. Page (Rothamsted) of the nature and properties of the organic matter and its influence on soil moisture, soil temperature, and the reaction, composition, and concentration of the soil solution. Prof. Odén gave an account of his important researches on humus from peat soils, in which he has shown that the term "humic acid" is chemically correct. Dr. E. J. Salisbury (University College, London) described experiments on the relations between organic matter and the vertical distribution of acidity in natural soils.

In the discussion Dr. Ormandy directed attention to the necessarily complex nature of the material used in Prof. Odén's experiments, and suggested that parallel experiments on a simpler substance like china-clay would be useful.

In the third section—adsorption phenomena—Mr. E. M. Crowther (Rothamsted) dealt with the measurement of the hydrogen-ion-concentration of acid soils, both electrometrically and with the indicators used by Clark and Lubs. Mr. E. A. Fisher (Leeds University) critically discussed the application of the adsorption formula to soil problems, in view of the empirical nature of the equation and the facility with which, by numerical modifications, it can be used to fit experimental data of phenomena which cannot be related. He showed that the modified form of Way's chemical theory, which assumes exchange of bases by double decomposition between silicates and added salts, would account for the observed phenomena.

Dr. Russell in the course of the discussion referred to the necessity for taking account of the colloidal material known to exist in soil and the consequent difficulty of accepting an exclusively chemical explanation of base exchange.

A paper in this section by Mr. C. T. G. Morison (School of Rural Economy, Oxford) on pan formation was taken as read, as was also Dr. Mellor's introductory paper in the concluding section—colloidal phenomena—on the plasticity of clays from the ceramic point of view. Prof. Odén gave an account of his work on clays as disperse systems. He described the apparatus employed, which consists essentially of a balanced plate on which the suspended particles slowly settle, the gradual increase in weight being automatically recorded. Mathematical analysis of the data enables a distribution curve to be constructed, giving the percentage of particles present between any specified range of diameters.

Mr. N. M. Comber (Leeds University) dealt with his suggestive experiments on the flocculation of soils, in which the difference between silt and clay was shown, and the conclusion drawn that clay is protected by an emulsoid of a siliceous nature.

In the concluding paper Mr. G. W. Robinson (University College, Bangor) indicated certain physical constants of soil which would be of great help when employed statistically in soil surveys.

The forthcoming publication of the papers and discussion by the Faraday Society will be of use not only to soil investigators in general, but also to members of bodies such as the Association of Economic Biologists and the Agricultural Education Association, which, among others, were invited by the Faraday Society to co-operate in the discussion.

B. A. K.

British Science Guild.

NOTABLE VIEWS ON PRESENT-DAY PROBLEMS.

WELL-KNOWN leaders of scientific thought discussed the difficult and pressing problems of the times with hopefulness, sagacity, and insight at the fifteenth annual meeting of the British Science Guild, held at the Goldsmiths' Hall on Wednesday, June 8. The president (Lord Montagu of Beaulieu) was in the chair, and there was a large and representative assembly, which welcomed with much gratification the announcement that his lordship had consented to occupy the presidency for another year.

The president, in opening, expressed their sincere sense of loss at the death of Sir Norman Lockyer, who not only took a great interest in the work of the Guild, but was also one of its most distinguished founders. They had also sustained another serious loss in the death of Sir William Mather. During the past year the Guild had given consideration to many matters of importance to scientific workers. They held that civil servants in these days ought, at any rate, to be of scientific mind or appreciate science, even though they might not be highly educated in science itself. The work of the State year by year needed more and more scientific handling and treatment, and the Civil Service as a whole should be encouraged to consult scientific men and to have recourse to scientific advice when occasion demanded. They had tried to spread their influence from London to the provinces, and so far had been very successful. They were doing their best to bring in great provincial centres, which in many ways were more promising scenes for scientific education than London itself. He was sorry they could not announce that day what they hoped last year would be the case—a conference with the representatives of Labour. They thought they had better wait for a calmer state of things before they asked either Capital or Labour or representatives of the State to consider their mutual relations to each other and to science. He thought they ought to ask themselves in regard to the generally unsettled state of the country, in fact of nearly all civilised countries to-day, whether it was possible to go on putting up our scale of living for all classes and to reduce our hours of work at the same time; and, what was more serious in many cases, reduce the output more than in proportion to the number of hours put in. It was quite certain that in this country, if we were to compete with the world and maintain a high standard of living at the same time, we must increase our output per man of machine work even if we worked shorter hours. That was a very difficult problem to solve, but he did not despair with the help of science, in some trades at any rate, of its solution. Then they had to aim at the better education of all classes in scientific facts and inculcate more and more the scientific habit of mind. But our system of education must be less of the parochial and insular kind and more scientific, broad, and world-wide in outlook. The difficulty to-day, he thought they would agree, was that in many of the great subjects which they had to consider facts were very difficult to get at. Science aimed at the truth, and in social and political matters, as well as in scientific matters, if they knew the real facts, a solution was not always easy, but at any rate it was made much easier. Education was the great hope of the future, and in that education science must play a prominent part.

The annual report of the executive committee having been adopted, on the proposition of Lord Avebury, seconded by Sir John Cockburn, Dean Inge delivered a striking address entitled "The Road to Ruin and the Way Out." It was obvious, he said, that the first half of the subject was easier than the second. The road to ruin was the road along which we were travelling; the way out was not easy to find, and possibly difficult to follow. It was useless to utter mere jeremiads, and it took a great deal to destroy a powerful nation. Medical science taught that the more acute and violent the disease, the more vigorous was the production of anti-toxins, and it added the comforting assurance that if the constitution survived an invasion of poisonous microbes the patient would probably have acquired immunity for a considerable time to come against that particular disease. Perhaps it might be so in our social and political life. Very few politicians and sociologists allowed nearly enough for the swing of the pendulum. The false doctrine of continuous progress had led most of us to treat the flowing tide as a permanent encroachment of the sea. The direction in which the tide was flowing was called "progress," the opposite direction "reaction." History should have taught us better. Political experiments were welcomed enthusiastically until they had been tried; when they were in operation disillusionment began at once. The more revolutionary the change, the quicker was the process of conversion, so that it was almost a commonplace that the young firebrands of a revolutionary age—men like Wordsworth, Coleridge, Southey, Carlyle, and Ruskin—often ended as uncompromising Tories. We had not by any means done with aristocracy and monarchy in Europe. Human nature remained the same, and it tried one way after another to misgovern itself and mismanage its affairs. The first thing necessary was diagnosis. It was obvious that the most ruinous feature of modern society was the strike. This country depended for its very existence on being able to export manufactures to pay for imported food, and our power of exporting manufactures was rapidly disappearing. No scheme of "redistributing" property, however drastic and iniquitous, could have the slightest effect in preventing the starvation of a country which could not feed itself and would not work under economic conditions. There were two forces available which could bring a country out of the worst of holes. These were science and religion. They in that Guild were chiefly concerned in the application of scientific knowledge and scientific method to British industry. We were always abusing ourselves for being behind the time—so unlike the Germans, for example. That was the British lion's little way; he was always lashing himself with his tail and calling himself a fool and a slacker, until foreign nations came to believe him. When they tried conclusions with him they found that he was by no means such a fool as he looked, and they complained that it was very unfair. Still, he had no doubt that this Guild would continue to find plenty to do. But behind scientific method there was something deeper—scientific faith and the scientific temper. They must not shut their eyes to the fact that science had many enemies; science as such was disliked by many people. But science had one enormous advantage over its old enemies—it had the nature of things on its side, and wherever it was disregarded and disobeyed it did not talk, but struck. Dame Nature was a good teacher, but her fees were high. It was worth a great deal to impart the scientific way of looking at things—the scientific conscience (should he call it?) in education. He was himself an enthusiastic humanist, and he should be sorry indeed if science were to oust humanism in our education; he should be sorry for the sake of science itself, for a man could scarcely be a scientific worker without being also a humanist; but science we must have as a part of everyday training. Only he would suggest that the faith and temper and conscience of science were a more important acquisition than any mere facts. We wanted to teach the next generation to respect all facts wherever they might find them. A scientific training marked a man who would not commit his soul and his conscience to the keeping of anyone, whether priest or Labour official. We needed this independence badly; some whole classes were in danger of losing it. The other force that might help us out of the mud was religion or, as he should prefer to say, Christianity. The fundamental message of Christianity was that we must get our values right, and that if we got our values right nothing else would be seriously wrong. Science was daughter to one of the absolute and eternal values—truth; art paid its homage to another—beauty; and morality to the third—goodness. Religion consecrated and endeavoured to humanise those three absolute values which it regarded as revelations of the nature and character of God. Our generation might be very stiff-necked and perverse, but sooner or later wisdom would be justified of her children. They must just go on giving their testimony, whether men would hear or whether they would forbear. "The mills of God grind slowly, but they grind exceeding small."

Sir Richard A. S. Redmayne (chairman of the Imperial Mineral Resources Bureau) next spoke on "The Importance of Research in the Development of the Mineral Industries." He remarked that the cessation of hostilities was succeeded almost at once by a period of feverish industrial activity—it would be erroneous to apply the words "general prosperity" —to be followed by a cycle of great depression. The demand for goods was great, but production was falling. What was the explanation? It lay, he thought, in a combination of circumstances:—(1) A feeling of insecurity due to unsettled political and financial conditions. Hence a disposition to conserve rather than to utilise in commercial ventures such capital as is available. (2) The incidence of the rate of exchange. (3) The high cost of production consequent on the high cost of living and the higher standard of comfort demanded by the labouring classes (and rightly so demanded) than formerly obtained. (4) The lower, and still apparently decreasing, productive power of Labour. The first two conditions would in part right themselves in process of time as the various political problems were solved, or partly solved, and rates of exchange would then tend towards the normal; but a very great deal depended upon the last two conditions, as the future position of production was not easy to forecast. Higher and cheaper production were difficult desiderata to obtain in view of the high rate of wages now ruling and the diminishment in working time either achieved or claimed by the manual workers of the day, and these were demands which were not likely to show much abatement in the future. What was the solution? The answer he ventured to give was "research," to discover by research cheaper means of production, and, by research, to create new outlets. How should research be organised and carried out? Empirical investigations must be based upon a scientific foundation if they were to be of ultimate and practical value. It had, however, been well said that if an investigator did not possess the inventive as well as the purely scientific faculty, the value of the work was apt to be largely lost. The discovery of new things was one matter, and was a characteristic of the academic type of mind; the discovery of new uses for things was another matter, and was typical of the commercial mind. In this work of research the universities were peculiarly fitted to take an important—a leading—part. The research should not necessarily be pursued along definite lines with a definite object in view; the great discoveries were not made in that way. The Department of Scientific and Industrial Research might well endow university scientific research on chemical, metallurgical, and engineering work, supervising and co-ordinating and publishing the results. Effort was largely commensurate to the prize offered, and the discoverer should be rewarded for his labour and genius; but that would be a matter easy of arrangement. Research associations undoubtedly performed useful, even highly valuable, functions, but the wind of science bloweth where it listeth, and the time was ripe for a realisation of the fact that scientific research could not profitably be hampered by restrictions confining the efforts of those who were employed therein. It was of the essence of research that it should be free and untrammelled.

Sir Richard Gregory proposed a vote of thanks to the speakers, and remarked that the addresses of their two distinguished new vice-presidents were of a very inspiring and instructive character. Dean Inge had referred to the fact that a disease produced in the organism an anti-toxin to fight it, and the anti-toxin, Sir Richard suggested, that existed now for certain social diseases was the British Science Guild. It was really a British Efficiency Guild, and in the forefront of its activities must be the promotion, not only of research, but also of the application of research. We had numerous scientific societies, each of which was concerned with adding to scientific knowledge by research, but there was no society or organisation in the kingdom which existed, as the Guild existed, to see that knowledge thus gained was made good use of for national welfare. That was why the Guild could perform a most useful service in bringing before the public the value of research, science, truth, and righteousness to a nation that desired to maintain a leading position in the world. The trade unions referred to by Dean Inge and Sir Richard Redmayne were not trade unions, but wage-unions. If they were really trade unions, and if Labour were united with science to increase production instead of merely scrambling for pence on a Tom Tiddler's ground, then together they would be the greatest force in our Constitution.

On the proposition of Lady Lockyer, hearty thanks were also accorded to the Warden and Court of Assistants of the Worshipful Company of Goldsmiths for the use of their hall. Lady Lockyer paid a graceful tribute to the munificence of the Goldsmiths' Company in educational and other directions, and made an appeal to those who were not members of the British Science Guild to become associated with it, whether they were scientific workers or not.

University and Educational Intelligence.

CAMBRIDGE.—Mr. E. K. Rideal, Trinity Hall, has been appointed to the Humphry Owen Jones lectureship in physical chemistry. Dr. L. Cobbett, Trinity College, has been re-appointed University lecturer in pathology.

The Rede lecture was delivered on June 9 by Sir Napier Shaw on "The Air and its Ways." The lecturer likened the atmosphere to a steam-engine, for which the heated surface of the earth and sea acted as boiler, the cold polar regions and the cold upper air as condenser, and the normal winds and cyclonic depressions as flywheel. The normal winds were the equatorial belt of air passing westwards and the circumpolar motion of the upper air travelling eastwards. Between them were the anticyclonic circulations which, like the driving-belts of tanks, carried forward the westward moving air of the equatorial, and the eastward moving air of the polar, circulation.

MANCHESTER.—At the meeting of the council of the University on June 8 the following appointments were made:—Miss Winifred S. Clarke, lecturer in education; Miss May A. B. Herford, lecturer in classical archæology; Mr. S. Williams, assistant lecturer in botany; Mr. W. Cartwright, assistant lecturer in metallurgy; Mr. P. I. C. Gibson and Mr. A. Haworth, demonstrators in pathology; and Miss Georgina May Duthie and Mr. R. C. Shaw, demonstrators in anatomy.

Mr. W. E. Alkins has resigned his appointment as lecturer in metallurgy as from September 29 next.

OXFORD.—Mr. W. Brown, Christ Church, has been elected Wilde reader in mental philosophy.

ST. ANDREWS.—The honorary degree of LL.D. is to be conferred on July 12 upon the following:—Prof. W. M. Bayliss, Sir William Henderson (chairman of Dundee Technical College), Emeritus Prof. D. Macewan, and Prof. A. N. Whitehead.

THE University of Wales has decided to confer the honorary degree of D.Sc. upon Prof. T. W. E. David, Sir J. J. Dobbie, and Prof. A. Gray.

MR. R. J. PYE-SMITH, formerly professor of surgery in the University of Sheffield, has bequeathed the sum of 1000*l*. to the University in question for a chair in surgery.

MR. A. MACCULLUM, of Edinburgh, who gave 25,000*l*. during his life towards the erection of the new Royal (Dick) Veterinary College buildings in Edinburgh, has bequeathed, under certain conditions, on the death of his wife, a further sum of 10,000*l*. for equipping and furnishing the college buildings.

THE following appointments have been made in connection with the Royal College of Surgeons of England:—Dr. F. W. Edridge-Green, Mr. V. Z. Cope, and Prof. T. Swale Vincent, Arris and Gale lecturers; Prof. S. G. Shattock, Erasmus Wilson lecturer; Sir Arthur Keith, Arnott demonstrator; and Sir Charles A. Ballance, Thomas Vicary lecturer.

THE London School of Economics and Political Science is prepared to award one or more post-graduate studentships, of value up to 200*l*. a year for one or two years, to suitable candidates who wish to combine research with a certain amount of teaching at the school, or to follow approved courses of study with the view of qualifying themselves for such teaching. Applications, stating qualifications and giving two references, should be made as soon as possible to the Director, London School of Economics and Political Science, Clare Market, London, W.C.2.

THE Selborne Society has issued a list of lectures, most of them illustrated by lantern-slides, which its lecturers are prepared to give during the coming winter season. The officers of the society deliver five lectures dealing with its objects and activities, *e.g.* Gilbert White and Selborne, the Brent Valley bird sanctuary which the society has recently secured, the value of science to the community and suggestions for the organisation of natural history societies, and archæological and historical rambles. Beyond these official lectures there is available a long list of lecturers who cover a wide range of subjects. Prof. J. R. Ainsworth-Davis lectures on science and agriculture; Capt. W. H. S. Cheavin on nature study, particularly in its microscopic aspects; the Rev. J. T. W. Claridge on stars and comets, and he also gives a historical lecture entitled "Some Famous Astronomers"; Mr. O. H. Latter deals with the nature study of sand dunes, wasps, and evidences of evolution; Prof. J. T. MacGregor-Morris lectures on electricity in home-life and in nature; Mr. F. Martin-Duncan deals with the natural history of the sea and the forest, and particularly with the insect world; Mrs. R. A. Proctor lectures on astronomy in everyday life and the story of the moon; Mr. J. J. Ward deals with pond-life, insects, animal life and evolution, and the wonders of wild and garden flowers; Mr. W. M. Webb, in addition to the lectures on the objects of the Selborne Society, which as general secretary of the society he delivers, also gives lectures on evolution in dress and plumage, mimicry, and protective resemblance in animals. Such is a selection from the list of the better-known lecturers. Further information regarding the lectures can be obtained from Mr. P. J. Ashton, extension secretary, 72 High Street, Bromley, Kent.

IN view of the announcement made in NATURE of April 14 last, p. 220, that the Finsbury Technical College will not be closed in July next, it is of interest to read the correspondence which passed during last winter between the City and Guilds Institute and the London County Council on the subject. It has been published in full in the forty-first annual report of the council of the City and Guilds Institute, and is preceded by a statement by the council on the circumstances under which it was decided to close the college. In the face of the decision of the London County Council to make the Northampton Polytechnic its engineering school and the tendency of the policy of the Board of Education to substitute public for private effort in education, it was not considered feasible or practicable to raise the 13,000*l.* per annum required in excess of pre-war expenditure. However, towards the end of last year the education authorities of the London County Council reviewed the matter, and decided that since a depletion of the facilities for technical education was highly undesirable they would assist the college. Various minor conditions have been imposed, but in effect the London County Council will contribute a sum of 10,000*l.* per annum for five years provided that the City and Guilds Institute finds 3500*l.* per annum for a similar period for the maintenance of Finsbury Technical College. The council of the City and Guilds Institute expresses the hope that the City Corporation and the contributory livery companies will continue to give their support in order to make possible the development of their educational schemes. An interesting list in the report is that showing the contributions made yearly to the institute since 1878. The Goldsmiths' Company heads the list with contributions amounting to 275,508*l.*; then come the Clothworkers', Fishmongers', and Mercers' Companies with gifts ranging from 152,000*l.* to 101,000*l.* The remainder of the report is devoted to a review of the academic activities of the City and Guilds (Engineering) College during the year 1919–20.

Calendar of Scientific Pioneers.

June 16, 1889. Gaetano Cacciatore died.—The able director of the Palermo Observatory, in which position he succeeded his father in 1843, Cacciatore extended the observatory and contributed memoirs to the Società degli Spettro-scopisti.

June 18, 1816. Thomas Henry died.—Henry was a Manchester apothecary, the translator of Lavoisier's chemical essays, and the first to observe the use of carbonic acid to plants. In 1781 he became the first secretary of the Manchester Literary and Philosophical Society, and in 1807 was chosen president.

June 18, 1905. Per Theodor Cleve died.—Professor of chemistry in the University of Upsala, Cleve was well known for his researches on the rare earths. He investigated the compounds of yttrium, erbium, thorium, lanthanum, and didymium, and he showed that scandium, discovered by Nilson, was identical with the ekaboron of Mendeléeff.

June 19, 1715. Nicolas Lemery died.—The contemporary of Mayow and Homburg, Lemery wrote a "Cours de Chimie," which was translated into various languages and passed through thirteen editions in his lifetime. This work, from which the fancies of the alchemists were excluded, was one of the first in which chemistry was divided into organic and inorganic. Lemery was a Paris apothecary.

June 19, 1820. Sir Joseph Banks died.—For more than forty years president of the Royal Society, Banks was indefatigable in his exertions on behalf of natural science. He made four oversea journeys himself, assisted various expeditions, founded the African Society, and advised George III. as to the Kew Gardens. His library and collections were bequeathed to the British Museum.

June 19, 1844. Etienne Geoffroy Saint-Hilaire died.—The pupil of Daubenton and Haüy and the friend of Cuvier, in 1793 Saint-Hilaire became professor of zoology in the Musée d'Histoire Naturelle. In 1798 he accompanied Napoleon to Egypt. Admitted to the Academy of Sciences in 1807, he afterwards became professor of zoology and comparative anatomy in the Faculty of Sciences. Among his most important works was his "Philosophie Anatomique" (1818–22).

June 20, 1794. Félix Vicq d'Azyr died.—The successor of Buffon in the Paris Academy of Sciences and physician to Louis XVI., Vicq d'Azyr wrote an important work, "Discours sur l'anatomie," in which he stated in a masterly way the methods of biological science.

June 21, 1846. James Marsh died.—The assistant to Faraday at the Royal Military Academy, Woolwich, Marsh invented electromagnetic apparatus, and also the quill percussion tube for ships' cannon, and in 1836 discovered the Marsh test for arsenic.

June 21, 1857. Louis Jacques Thénard died.—Born in poor surroundings, Thénard was assisted by Vauquelin, and gradually rose to a high place among French chemists. He held chairs at the Ecole Polytechnique, the Collège de France, and the Sorbonne, and though he did important work on the compound ethers and discovered hydrogen peroxide, he was, above all, a great teacher.

June 21, 1874. Anders Jons Ångström died.—Ångström held the chair of physics in Upsala University and was secretary to the Royal Society there. He did pioneering work in spectroscopy, in 1862 discovered the existence of hydrogen in the sun, and in 1868 published his map of the normal solar spectrum. Knut Johan Ångström (1857–1910), also a well-known physicist, was his son.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, June 9.—Prof. C. S. Sherrington, president, in the chair.—Prof. C. S. **Sherrington**: Break-shock reflexes and "supra-maximal" contraction-response of mammalian nerve-muscle to single-shock stimuli. The maximal twitch-contraction of tibialis anticus muscle (cat) evoked by a single break-shock applied to the cut motor nerve exceeds the contraction evoked reflexly (spinal preparation) by a single break-shock applied to an afferent nerve. This is due to the reflex response being tetanic in nature. If the break-shock is strong it excites, even when applied to the motor nerve, a response of tetanic quality. The so-called "over-maximal twitch," now termed "supra-maximal response," is a response of this kind. A reaction of like kind probably obtains in the afferent nerve when the single-shock applied to it is of comparably high value. In this case there is also a tetanic reaction from afferent nerve-fibres themselves. With weaker break-shock stimuli the origin of the tetanic character of the reflex discharge lies in the centre itself. It arises there from a "charge" process which is relatively long-lasting in comparison with the cycle of a nerve-impulse, and increases in intensity and duration with the number of afferent fibres excited.—R. J. **Ludford** and J. B. **Gatenby**: Dictyokinesis in germs-cells, or the distribution of the Golgi apparatus during cell-division. Maturation mitoses in the germ-cells of Cavia, Mus, Helix, Limnæa, and Stenobothrus were examined. In all cases the Golgi apparatus breaks up into its constituent granules, and these are distributed haphazardly to the two daughter-cells at mitosis. In no case examined are they divided between the daughter-cells as equally as are the chromosomes. Hence the Golgi apparatus takes no important part in the transmission of factors from cell to cell.—Dr. F. W. **Edridge-Green**: The effect of red fatigue on the white equation. A white equation is formed by means of a mixture of a red of λ6670–6770 Å., a green of λ5144–5156 Å., and a violet of λ4250–4267 Å., matching a simple white. When the eye is fatigued with light viewed through a red glass, or with pure spectral light in the region of λ6700 Å., and the equation is again made, about half the amount of green is required. The white equation and its match cannot be due to similar physiological processes, or both would change in the same ratio. When the fatiguing light is in the region of λ7800 Å., no difference is seen between the mixed and simple white.—E. **Ponder**: A method for investigating the hæmolytic activity of chemical substances. The relation between the time taken by a given quantity of hæmolytic substance and the temperature at which it acts is expressed by a hyperbola. The relation between the constants of such a hyperbola and the quantity of hæmolytic substance to which it applies are given. Certain general relations hold for all substances examined. Experimental and calculated results are compared.—W. H. **Pearsall**: The development of vegetation in the English lakes, considered in relation to the general evolution of glacial lakes and rock basins. The English lakes are of the same age (glacial), of similar origin, and lie among rocks possessing relatively uniform characters. The differences they show are due to variations in the rates of erosion and sedimentation of the lake basins; therefore it becomes possible to describe the stages in the post-glacial development of a rock basin, and also of its vegetation. The differences observed between primitive and evolved lakes are regarded as being dependent upon their physical condition.

Association of Economic Biologists, June 4.—Sir David Prain, president, in the chair.—F. L. **Engledow**: The problem of increasing the yield of cereal crops by plant breeding. Aspects of experimental investigation, such as breeding for disease resistance, non-lodging, or high intrinsic yield, were considered, and the great difficulty of obtaining any simple criterion for so complex and elusive a total resultant as "yield" was emphasised. Bevan's studies on the migration coefficient as an index of yield were destructively criticised. The relation of yield to the weights of individual grains, to the number of grains per ear, to the number of ears per plant, and to the tillering of the plant was considered. At present comparative estimates are based on "yield per acre," but the author's work suggests that "yield per tiller" may, perhaps, be a better measure, "yield" itself being estimated in terms of starch, carbon, or some other chemical criterion, in place of the commercial standards now accepted.—C. B. **Saunders**: Problems of seed testing. The technique adopted at the official seed-testing station for the testing of purity and germinative capacity was described. Many problems arise in this work of both a mechanical and biological nature. Simple and effective instruments for sampling and non-selective counting are required, as well as selective mechanical devices for the extraction of dodder and other seeds from a mixture. Biological problems largely concern the relation of seed germination to environmental factors, and the apparent inconstancy shown in this relation. Thus seeds of apparently the same kind may under standardised conditions differ considerably not only from year to year and from month to month, but also from sample to sample, and may show periodicities and external factor relationships which give rise to a very great complexity of varying combinations. The whole technique is empirical, and much fundamental research is needed.

CAMBRIDGE.

Philosophical Society, May 16.—Prof. A. C. Seward, president, in the chair.—Dr. E. H. **Hankin**: The soaring flight of dragon-flies. From observation it appears improbable that undiscovered wing-movements or ascending currents of air can be accepted in explanation of soaring flight. Alterations in the amount of sunlight, even when slight, make considerable differences in the flight of dragon-flies. Lowering of the abdomen as a brake on speed in catching prey, etc., is a common phenomenon. Dragon-flies, flying-fishes, and birds all exhibit soaring flight, and in each class evidence is accumulating that low-speed flight depends on the presence of sunshine and high-speed flight on the presence of wind. If not identical, the speeds attained in the three classes are comparable.—C. G. **Lamb**: Note on secondary sexual characters in the Diptera, with a description of a novel type. The author discussed some points in the structure of the hypopygium in flies, and gave a description of some secondary characters in a new genus of Dolichopodidæ which were situated centrally instead of peripherally.—L. A. **Borradaile**: A note on the mouth-parts of certain Decapod crustaceans. Some Decapods, as Hapalocarcinus and Porcellana, seize food-particles directly; others, as Pinnotheres and the Pontoniinæ, take it from sessile organisms. The mouth-parts of the former are modified for their mode of feeding. Similar modifications are not found in the latter, possibly because their food reaches them entangled in strings of mucus. Porcellana has no such jaw-reduction as is found in Hapalocarcinus, and this is as yet unexplained.—J. **Gray**: Hermaphrodite sea-urchins.—A. B. **Appleton**: (1) Preliminary note on the development of muscle, bone, and body-weight in sheep. A summary was given of some results obtained in conjunction with Mr. J. Hammond over a number of years. The data brought forward referred to parts much utilised in the judging of sheep, viz. "hind-limb," "loin," "behind the shoulder," and "over the shoulder." In normal rams the muscles increase in weight after birth faster than the associated bones, while the ratio found in adults is nearly attained at the age of three months. From birth onwards the carcass forms an increasing proportion of the live-weight of the animal. The development of the hind-limb proceeds as a wave of growth passing upwards from below. Histological examination of the muscles in the prize animals shows that a very large amount of fat is present between the muscle-fibres in addition to that between muscle-bundles. Fat in the popliteal space and around the pelvis was notably increased. The characteristic "feel" and appearance of prize animals appear to be due to bone reduction as well as to fat and muscle increase. (2) The alleged inheritance of an acquired character in man. Photographs were shown of ankle-joints of new-born English children. Features are present which, from their presence in the newly born natives of India, have been claimed as the inheritance of a character acquired by their parents through adoption of the squatting posture. This cannot be the case in the English child. The features found in the new-born child are held to be the anatomical outcome of the normal attitude of the fœtus. (3) The so-called gluteus maximus of Tarsius. This is stated to be a compound muscle, since it includes the femoro-coccygeal and caudofemoral muscles. This is the interpretation given of the position of the great sciatic nerve, which passes through the gluteus maximus. In lemurs and in the primitive insectivore Tupaia a similar condition was found.—H. P. **Waran**: The effect of a magnetic field on the intensity of spectrum lines, ii. The earlier work of Kent and Frye on the subject is discussed and the invalidity of conclusions obtained under adverse experimental conditions proved by proper control experiments. Further study of the phenomenon conducted in a quartz tube are described. The enhancing effect of the magnetic field on the negative glow bands of nitrogen and the Balmer series of hydrogen are described, and the Balmer series is suggested to be mainly the radiations of the atom while the gas is at a high pressure. Experiments with a condensed discharge have proved the difference between its effect and that introduced by the magnetic field.—C. G. F. **James**: The theoretical value of Sutherland's constant in the kinetic theory of gases.—T. S. **Yang**: Orthogonal systems and the moving trihedral.

DUBLIN.

Royal Irish Academy, May 23.—Prof. Sydney Young, president, in the chair.—G. A. J. **Cole**: The problem of the Bray series. The stratigraphical position of the series of quartzites and slates that form Bray Head and Howth in the Dublin district has always seemed obscure. While the few organic remains indicate a Cambrian age, these rocks appear in places to overlie Ordovician strata, and they have suffered no invasion or metamorphism by the closely adjacent Leinster granite. Examination of the successive MS. notes in records of the Geological Survey of Ireland shows how the problem was under discussion between 1855 and 1865. In the present paper it is suggested that the Bray series has been brought into position along a thrust-plane from the south-east during the later phases of the Caledonian folding, and that the outlying mass of Carrickgallogan is a "klip" resting, as Du Noyer believed, on Ordovician slates.

PARIS.

Academy of Sciences, May 23.—M. Georges Lemoine in the chair.—C. **Moureu**, M. **Murat**, and L. **Tampier**: Acrylic acid and acrylic esters. Halogen propionic acids and esters. Starting with pure acrolein, now readily obtainable in quantity, a method of preparing acrylic acid is described based on the intermediate production of β-chloropropionic acid. The acrylic acid was purified by repeated fractional crystallisation, and its physical constants were determined. The pure acid combines quantitatively at the ordinary temperature with the halogen acids.—A. **Blondel**: The topographical representation of the couples of alternating-current motors.—**Prince of Monaco**: Official visit to the United States.—C. **Guichard**: The 3I systems all the right lines of which belong to a linear complex.—M. Jean Massart was elected a correspondant for the section of botany in succession to the late M. Pfeffer.—G. **Julia**: The discontinuities of the solutions of certain Fredholm's equations.—P. **Humbert**: Hypergeometrical polynomials.—P. **Lévy**: Some questions of the functional calculus.—E. **Esclangon**: The aurora borealis of May 14–15, 1921, observed at Strasbourg.—M. **Luce**: Chemical reactions and radius of curvature. A continuation of work previously published on the same subject. It is shown that the influence of the curvature of a solid is the same in liquids as in gases, and that the data in both cases can be expressed by a similar formula.—M. **Bridel**: The application of the law of mass action to the results obtained in the reaction of β-galactosidase on galactose in solution in propyl alcohol. The application of the law of mass action to this reaction shows that in many cases equilibrium had not been reached when the experiments were stopped. For the stronger alcohols it would be necessary to prolong the experiments for months, or even years, to attain equilibrium.—A. **Tian**: A cause of dispersion of the colloid in an important class of hydrosols.—A. **Boutaric** and M. **Vuillaume**: The flocculation of colloidal arsenic sulphide. Principle of a method of study. The opacity of the solutions was measured in a Féry spectrophotometer; absorption curves are given showing the influence of time, of excess of hydrogen sulphide, and of excess of arsenious oxide. To have strictly comparable flocculation the colloidal solution must contain neither free sulphuretted hydrogen nor arsenious oxide.—E. **André**: Contribution to the study of the oil from grape pips. The chemical and physical constants of eleven samples of oil from different sources are given; the figures show great divergences, and it is evident that the composition of this oil varies considerably with the kind of grape.—P. **Gaubert**: The artificial coloration of crystals obtained by the solidification of a fused substance and on crystalline diffusion.—F. **Ehrmann** and J. **Savornin**: The stratigraphical scale of the Kabylie des Babors.—R. **Dongier**: The simultaneous oscillations of the pressure and wind at the top of the Eiffel Tower, and their relation with the squall surface (J. Bjerkness) of a depression. A reproduction of the curves of the recording instruments, showing the atmospheric pressure, wind velocities at the summit and base of the tower, and temperatures on September 15, 1906. The conclusions resulting from a detailed examination of these diagrams are in agreement with the theory of J. Bjerkness.—Ad. **Davy de Virville** and R. **Douin**: The modifications of form and structure of liverworts submerged in water. Seven species have been studied, and were found to adapt themselves to the new medium, undergoing remarkable changes in development, size, and structure.

If these forms had been met with in Nature, without knowing their history, they would have been described as varieties, and even as new species.—P. **Choux**: A new leafless Asclepias from the north-west of Madagascar.—S. **Jonesco**: Contribution to the study of the physiological *rôle* of the anthocyanins.—A. **Lumière** and H. **Couturier**: Anaphylaxy in plants. Experiments are described and illustrated by reproductions of photographs proving definitely that an anaphylactic state can be established in plants.—R. **Courrier**: The interstitial gland of the testicle and secondary sexual characters in fishes.—Mlle. **Larbaud**: New technique for the inclusions and microscopical preparations of vegetable and animal tissues. The use of butyl alcohol instead of ethyl alcohol is proposed for dehydrating the tissues. It has the advantage of dissolving paraffin wax, thus rendering unnecessary the use of xylene or toluene, and the number of treatments can be reduced from six to two.—G. **Truffaut** and N. **Bezssonoff**: Increase in the number of *Clostridium pastorianum* in soils partially sterilised by calcium sulphide.—R. **Poisson**: Researches on the determinism of the loss of the faculty of flight in the aquatic Hemiptera.

ROME.

Reale Accademia nazionale dei Lincei, April 3.—V. Volterra, vice-president, in the chair.—Papers by fellows:—G. **Castelnuovo**: Abelian functions, iii.: Jacobi's varieties.—C. **Segre**: The principal lines of a surface of S_5 and a characteristic property of Veronese's surfaces, i.—F. **Severi**: Theory of simple integrals of first species belonging to an algebraic surface, ii.—Communicated through fellows:—G. **Rovereto**: Erosive development considered as starting from a fundamental surface.—C. **Jucci**: Metabolism of true royal forms in the society of the Termites, ii.—Prof. Corbino read an account of the life and work of the late Prof. Augusto Righi, who died on June 8, 1920, and a similar notice relating to the late Prof. Michele Rajna, who died on September 29, 1920, was contributed by Dr. Legge. Among additions to the Academy library were mentioned treatises on dynamics of systems by Prof. Maggi and on statics of dams for lakes and science of construction by Prof. Guidi, presented through Prof. Levi Civita, in addition to several mathematical works.

Books Received.

Solvency or Downfall? Squandermania and its Story. By Viscount Rothermere. Pp. xi+160. (London: Longmans, Green and Co.) 2*s*.

Dairy Bacteriology. By Prof. Orla-Jensen. Translated from the second Danish edition by P. S. Arup. Pp. xii+180. (London: J. and A. Churchill.) 18*s*. net.

Tables, Factors, and Formulas for Computing Respiratory Exchange and Biological Transformations of Energy. Prepared by Thorne M. Carpenter. (Publication No. 303.) Pp. 123. (Washington: Carnegie Institution.) 2 dollars.

Index to United States Documents relating to Foreign Affairs, 1828–61. By Adelaide R. Hasse. (In three parts.) Part iii.: R to Z. (Publication No. 185, part iii.) Pp. 1331–1980. (Washington: Carnegie Institution.) 7 dollars.

Principes de Biologie Végétale. By Prof. Noël Bernard. (Nouvelle Collection scientifique.) Pp. xii+212. (Paris: F. Alcan.) 8 francs net.

Microbiology: A Text-Book of Microörganisms General and Applied. Edited by Prof. Charles E. Marshall. Third edition, revised and enlarged. Pp. xxviii+1043+1 plate. (London: J. and A. Churchill.) 21*s*. net.

From a Modern University: Some Aims and Aspirations of Science. By Prof. Arthur Smithells. Pp. 124. (London: Oxford University Press.) 12*s*. 6*d*. net.

The Commercial Apple Industry of North America. By J. C. Folger and S. M. Thomson. (Rural Science Series.) Pp. xxii+466+xxiv plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 18*s*. net.

L'Astronomie et les Astronomes. By Auguste Collard. Pp. viii+119. (Bruxelles: G. Van Oest et Cie.)

Pneumatic Conveying: A Concise Treatment of the Principles, Methods, and Applications of Pneumatic Conveyance of Materials. By E. G. Phillips. (Pitman's Technical Primers.) Pp. xii+108. (London: Sir I. Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Tanning Materials. With Notes on Tanning Extract Manufacture. By Arthur Harvey. Pp. vii+182. (London: Crosby Lockwood and Son.) 15*s*. net.

Perfumes, Essential Oils, and Fruit Essences Used for Soap and other Toilet Articles. By Dr. Geoffrey Martin. (Manuals of Chemical Technology, X.) Pp. vii+138. (London: Crosby Lockwood and Son.) 12*s*. 6*d*. net.

Elements of Practical Geometry. A Two Years' Course for Day and Evening Technical Students. By P. W. Scott. Pp. v+185. (London: Sir I. Pitman and Sons, Ltd.) 5*s*. net.

A Geological Excursion Handbook for the Bristol District. By Prof. S. H. Reynolds. Second edition. Pp. 224. (Bristol: J. W. Arrowsmith, Ltd.; London: Simpkin, Marshall and Co., Ltd.) 5*s*. net.

Exponentials Made Easy; or, The Story of "Epsilon." By M. E. J. Gheury de Bray. Pp. x+253. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

A Text-Book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. Vol. ix., part ii.: Iron and its Compounds. By Dr. J. Newton Friend. (Griffin's Scientific Text-books.) Pp. xxv+265. (London: C. Griffin and Co., Ltd.) 18*s*.

Tuberculosis: Its Prevention and Home Treatment. By Dr. H. Hyslop Thomson. (Oxford Medical Publications.) Second edition. Pp. ix+99. (London: H. Frowde and Hodder and Stoughton.) 4*s*. net.

Year-Book of the Royal Society of London, 1921. (No. 25). Pp. iv+201. (London: Harrison and Sons, Ltd.) 7*s*. 6*d*.

Library of Congress. A List of Geographical Atlases in the Library of Congress, with Bibliographical Notes. Compiled under the direction of Philip L. Phillips. Vol. iv. Pp. clxiii+639. (Washington: Government Printing Office.) 1.25 dollars.

Biochemistry: A Study of the Origin, Reactions, and Equilibria of Living Matter. By Prof. Benjamin Moore. Pp. vii+340. (London: E. Arnold.) 21*s*. net.

Fabre, Poet of Science. By Dr. G. V. Legros. Translated by Bernard Miall. Second impression. Pp. 352. (London: T. Fisher Unwin, Ltd.) 8*s*. 6*d*. net.

Oxford University Junior Scientific Club. Electrons and Ether Waves. Being the Twenty-third Robert Boyle Lecture, on May 11, 1921. By Sir William Bragg. Pp. 14. (London: Oxford University Press.) 1*s*. net.

Oxford and the Rural Problem. Being the First Sidney Ball Memorial Lecture, December, 1920. By the Right Hon. Sir Horace Plunkett. (Barnett House Papers, No. 6.) Pp. 18. (London: Oxford University Press.) 1*s*.

Hyperacoustics. By John L. Dunk. Division ii.: Successive Tonality. Pp. xi+160. (London: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co.) 5s. net.

Greek Medicine in Rome. The Fitzpatrick Lectures on the History of Medicine, delivered at the Royal College of Physicians of London in 1909–10, with other Historical Essays. By the Right Hon. Sir T. Clifford Allbutt. Pp. xiv+633. (London: Macmillan and Co., Ltd.) 30s. net.

The Psychology of Industry. By Dr. James Drever. Pp. xi+148. (London: Methuen and Co., Ltd.) 5s. net.

Motya: A Phœnician Colony in Sicily. By Joseph I. S. Whitaker. Pp. xvi+357. (London: G. Bell and Sons, Ltd.) 30s. net.

Diary of Societies.

THURSDAY, JUNE 16.

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital), at 4.30.—Prof. W. Bulloch: Use and Abuse of Scientific Medical Literature.

ROYAL SOCIETY, at 4.30.—Prof. H. B. Dixon, Dr. C. Campbell, and Dr. A. Parker: The Velocity of Sound in Gases at High Temperatures, and the Ratio of the Specific Heats.—Prof. J. R. Partington: The Ratio of the Specific Heats of Air and of Carbon Dioxide.—Dr. A. B. Wood and Dr. F. B. Young: "Light Body" Hydrophones and the Directional Properties of Microphones.—Dr. A. B. Wood and Dr. F. B. Young: The Acoustic Disturbances produced by Small Bodies in Plane Waves transmitted through Water, with Special Reference to the Single Plate Direction Finder.—M. A. Giblett: Some Problems connected with Evaporation from Large Expanses of Water.—F. C. Toy: The Photographic Efficiency of Heterogeneous Light.

LINNEAN SOCIETY, at 5.—Dr. N. Annandale: The Vegetation of an Island in Chilka Lake on the East Coast of India, considered as a Preliminary to a Study of its Fauna.—Col. Godfery: The Fertilisation of Cephalanthera.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. L. Golla: The Objective Study of Neurosis (Croonian Lecture).

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Prof. B. Moore: The Natural Photo-synthetic Processes on Land and in Sea and Air, and their Relation to the Origin and Preservation of Life upon the Earth (Hugo Müller Lecture).

RÖNTGEN SOCIETY (at Royal Photographic Society), at 8.15.—Major G. W. C. Kaye and Others: Discussion on the Physics of the X-ray Tube.—Exhibition of Modern X-ray Tubes.—British Thomson-Houston Co., Ltd.: Demonstration of New Portable Coolidge Outfit.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.15.—Lecture.

ROYAL SOCIETY OF MEDICINE (General Meeting), at 8.30.—Sir Thomas Horder, Dr. G. C. Anderson, Mr. Clayton-Greene, W. S. Dickie, B. Harman, Dr. A. F. Hurst, Dr. Drury Pennington, Sir Humphry Rolleston, Dr. Gilbert Scott, and Dr. M. Wright: The Problem of the Private Clinic System in Great Britain.

FRIDAY, JUNE 17.

ROYAL ASTRONOMICAL SOCIETY, Geophysical Discussion, at 5.—Changes of Level in the British Isles, opened by H. L. P. Jolly, followed by Col. Sir C. F. Close and O. G. S. Crawford. Chairman: Col. Sir G. Lenox-Conyngham.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual Meeting), at 8.15.—Major R. Knowles: The Mechanism and Treatment of Snake-bite in India.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—J. C. Warburg: Foregrounds.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at Kensington Town Hall), at 8.15.—Dr. C. Addison: The Part of the State in the Prevention of Disease (Cavendish Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir J. J. Thomson: Chemical Combination and the Structure of the Molecule.

MONDAY, JUNE 20.

ROYAL SOCIETY OF MEDICINE, at 5.—Special General Meeting.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Dr. W. F. Hume: The Egyptian Wilderness.

TUESDAY, JUNE 21.

ROYAL HORTICULTURAL SOCIETY, at 3.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. L. Golla: The Objective Study of Neurosis (Croonian Lecture).

ROYAL SOCIETY OF MEDICINE (General Meeting), at 5.

ROYAL STATISTICAL SOCIETY (at Surveyors' Institution), at 5.15.—Mrs. W. J. Barton: Women's Minimum Wages.

MINERALOGICAL SOCIETY (at Geological Society), at 5.30.—Prof. H. Hilton: Note on Crystal Measurement.—A. Brammall: Reconstruction Processes in Shales, Slates, and Phyllites.—A. Richardson: The Micro-petrography of the Rock-gypsum of Nottinghamshire.

WEDNESDAY, JUNE 22.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—F. Dixey: The Norite of Sierra Leone.—Dr. C. T. Trechmann and F. L. Spath: The Jurassic of New Zealand.

FARADAY SOCIETY (at Chemical Society), at 8.—C. J. Smithells: High Temperature Phenomena of Tungsten Filaments.—E. Hatschek: A Simple Apparatus for Determining the Coagulations Velocity of Gold Sols.—Prof. A. W. Porter: Variation of Surface Tension with Temperature.—S. M. Neale: The Influence of the Solvent upon Ionisation and the accompanying Heat Effect.—A. McKeown: The Potential of the Iodine Electrode and the Activity of the Iodine Ion at 25° C.—E. Kilburn Scott: Demonstration of the Transmission of Sounds by means of Rochelle Salt Crystals.

THURSDAY, JUNE 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Dr. E. F. Armstrong and T. P. Hilditch: A Study of Catalytic Actions at Solid Surfaces. VI. Surface Area and Specific Nature of a Catalyst: Two Independent Factors controlling the Resultant Activity.—Sir J. B. Henderson: A Contribution to the Thermodynamical Theory of Explosions, Part I.; and (with Prof. H. R. Hassé) Part II.—S. Butterworth: Eddy Current Losses in Cylindrical Conductors, with Special Applications to the Alternating-current Resistances of Short Coils.—E. S. Bieler: The Currents induced in a Cable by the Passage of a Mass of Magnetic Material over it.—Dr. G. Barlow and Dr. H. B. Keene: The Experimental Analysis of Sound in Air and Water: Some Experiments towards a Sound Spectrum.—Dr. G. Barlow: The Theory of Analysis of an Electric Current by Periodic Interruption.

FRIDAY, JUNE 24.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—S. Butterworth: Capacity and Eddy-current Effects in Inductometers.—Dr. E. Griffiths: New Specific Heat Apparatus.—Prof. A. O. Rankine: Encounters between Non-spherical Gas Molecules.—Dr. C. Chree: An Electro-culture Problem.

MONDAY, JUNE 27.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—K. Fry: The Dental Treatment of Congenital and Other Perforations of the Palate.

TUESDAY, JUNE 28.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—L. H. Dudley Buxton: The Ancient and Modern Inhabitants of Malta.

CONTENTS.