THURSDAY, OCTOBER 3, 1907.

PROBLEMS OF ANCESTRY.

Vorträge über botanische Stammesgeschichte, gehalten an der Reichsuniversität zu Leiden. Ein Lehrbuch der Pflanzensystematik. By J. P. Lotsy. Vol. i., Algen und Pilze. Pp. iv+828. (Jena: Gustav Fischer, 1907.) Price 20 marks.

THE motive inspiring the production of this important work is indicated on the title-page in the "motto" quoted from Coulter:—

"The most difficult as well as most fascinating problem in connection with any group is its phylogeny. The data upon which we base opinions concerning phylogeny are never sufficient, but such opinions usually stimulate research, and are necessary to progress."

Its pages show how stimulating the inquiry has been to the author, and we have seldom met with a book more likely to awaken inquiry in its readers or to suggest further research. Very different values may be placed on the conclusions as to the phylogeny of several of the groups, and on the characters regarded as of chief importance in forming the system of classification, and further information on many points is very desirable; but there can be only one opinion as to the manner in which the information is conveyed to the reader. Under each group is an admirably clear and full, yet concise, statement of the investigations that have been made upon it, and of their results, while an extensive classified bibliography refers the student to the original and full sources of information. Numerous illustrations, original or after those of the best monographs, add greatly to the usefulness of the work, and to its worth as an exponent of the most recent researches into the structure and cytology of the algæ and fungi.

The form of the book appears somewhat artificial, its substance being divided into thirty *Vorlesungen* of very unequal length, *e.g.* that on Exoascineæ (xxvi.) of four pages, and that on Basidiomycetes (xxx.) of eighty-eight pages. As these could scarcely have each been the subject of a single lecture, and as the longer *Vorlesungen* in some cases include several groups, this arrangement does not appear so convenient as the more usual division into chapters and sections.

The course of lectures opens with the discussion of what constitutes a living being, and of the agreements and differences between plants and animals, but very soon passes to the consideration of the simplest organisms as individual "energids," the multiplication of these, and the bodies built up of the combinations of "energids." An outline of the scheme of classification given early in the first lecture derives all plants from Protomastigina, and traces the supposed derivation of the several groups from these early forms, and their relations with one another. The system of classification of the green algæ is stated by Dr. Lotsy to be largely based on that set forth by Blackman and Tansley in 1902 in the "New Phytologist." Great importance is attached to the number and arrangement of the cilia borne by the reproductive cells, or at least by the male gamete; and these characters are employed in tracing the relationships between widely different groups, *e.g.* the Isokontæ are regarded as representing the ancestral condition of the Pteridophytes and seed-plants.

Scarcely less importance is given to the study of the "energids," or very simple units of individual life, the progress being traced from the monoergid to the polyergid organisation within the larger groups, with resultant advance in complexity of structure. That the conception is one of much value in stimulating inquiry cannot be disputed, but it may be questioned whether it is not carried too far in practically identifying the energid with the nucleus. The very different behaviour of the nuclei of the reproductive cells within a single family, and even within a single genus at times, especially among fungi, may well suggest the need of caution in such matters.

It is stated in the preface that the plan of the work was resolved on after perusal of a lecture by Dr. Hugo de Vries, in which a higher plant is regarded as a double organism. Dr. Lotsy was led to endeavour to trace out in theory how the return to the stage of a single organism is effected, and thus arrived at the conception of the two generations denoted as x and $2x$. The book before us embodies the effort to determine the extent of each of these generations, and in which groups of Thallophyta it is possible to detect them, the essential distinction between them being the well-known reduction in the number of chromosomes in the nuclei of the one generation to one-half those of the other. With this as a clue, Dr. Lotsy seeks to determine the relations of gametophyte and sporophyte in the Thallophyta, extending to these the conception of the alternation of generations so familiar in its applications to the Archegoniatæ. He shows a remarkable familiarity with the results of the most recent as well as of the classical researches into the structure and reproduction of the various families, and applies his leading ideas in a very consistent and able manner. We think that the known is still too limited to permit of a secure foundation being laid for the universal employment of such a criterion; but such a theory, applied with the author's thoroughness and width of view, must stimulate further investigation, and thus do excellent service in the study of botany. The doubts that must be felt with regard to the validity of some of the assumptions and conclusions will themselves lead to inquiries that must advance knowledge still more effectively. Several very important discussions of wide interest are introduced in relation to certain groups that illustrate them, *e.g.* that on the asexual cells and the gametes in Chlamydomonas leads to the consideration of the part taken by the nuclei in inheritance and artificial development of the egg under the stimulus of inorganic salts in solutions. Volvox gives further occasion of discussion on heredity, as does also Hydrodictyon, in which the effects of sugar and other substances on the methods of reproduction receive notice, and the relations of the x and $2x$ generations are compared with what occurs in Uredineæ. Illustrations of similar kind are introduced from among animals also. The functions

of the various structures in cells are also discussed; *e.g.* the "vacuole" in Codiaceæ leads to the consideration of its nature, of the "tonoplasts" of de Vries, and of the granules of which protoplasm is built up. So under the bacteria their relations to other organisms as foes or as friends, and their importance in many and different aspects, are well set forth.

But it is needless to multiply examples of the many questions of extreme interest that find a place in the book, such as the existence and significance of "physiological species" among parasitic fungi, the very complex series of forms and relations to their hosts in Uredineæ, and others too numerous to mention.

Nor is it possible in a brief review to attempt to supply any adequate notice of the system of classification employed, or of the links shown or suggested to exist between the groups. The algæ and the fungi are not kept apart, but are grouped together into a system under the ideas explained above. In conclusion, we have to express the hope that this volume may in no long time be followed by the other two, which are to treat of the archegoniate and seed-forming plants. The author has earned the gratitude of botanists by placing within their reach an altogether stimulating book which should do much to win new workers to the absorbingly interesting Thallophyta.

THE COMMERCIAL USE OF PEAT.

Peat, its Use and Manufacture. By P. R. Bjorling and F. T. Gissing. Pp. xii+173; illustrated. (London: C. Griffin and Co., Ltd.) Price 6*s.* net.

THIS book contains a practical account of the different methods of preparing peat for commercial purposes, and of the uses to which peat can be applied. In NATURE of April 18, 1901, the attention of our readers was directed to the peat industry of Sweden, and its use there as fuel for generating steam both for stationary and locomotive engines; also in the number of May 31, 1900, to the exhibits at the Vienna Exhibition of that year of carpets, blankets, and clothing made from this material.

According to the authors of the book now under notice, there are 3½ million acres of peat land in Great Britain and 6 million acres in Ireland. The peat varies in depth from 2 feet to 40 feet. Peat is also abundant in Canada, Denmark, Holland, Germany, Russia, and other countries.

The chief importance of this material at the present time is its value as fuel in districts where coal is scarce. Its great bulk as compared with coal, and its high percentage of water, have, however, hitherto proved obstacles to its extended use. The valuable portion of fuel is its carbon content, and in this respect peat is inferior to coal. An average sample of peat contains 42·7 per cent. of carbon, 4 per cent. of hydrogen, 27·4 per cent. of oxygen, 1·6 per cent. of nitrogen, and 2·4 per cent. of ash. In some specimens the carbon reaches as much as 66·55 per cent. of carbon. Wood contains 52 per cent. of carbon, brown coal 66 per cent., Swedish coal 78 per cent., and English steam coal 81 per cent.

The following results are given of the testing of peat fuel as against coal at Horwich, in Lancashire, under a steam boiler. Coal got up steam to 10 lb. pressure in 2h. 25m., and to 25 lb. in three hours. Peat fuel got up steam to 10 lb. in 1h. 10m., and to 25 lb. in 1½ hours. Twenty-one hundredweight of coal maintained steam at 30 lb. pressure for 9¾ hours, whilst 11¼ cwt. of peat fuel maintained steam at the same pressure for 8 hours.

Peat has been used on the Bavarian railways for more than sixty years, and has been found economical. It is claimed for peat that, being free from sulphur, it has a much less detrimental effect on the heating apparatus than coal or coke. As regards cost, pressed peat costs 7*s.* 4*d.* per ton, Saxony coal 4*s.* 9*d.*, and Ruhr coal 5*s.* 5*d.*; but if cost of carriage be taken into consideration, the peat is 7*s.* 4*d.* against 8*s.* 11*d.* and 9*s.* 8*d.* for the coal.

Experiments were made on the Hartford and Springfield Railway, when a locomotive engine ran in express time 52 miles with 14,000 lb. of peat; and it was found that two-thirds of a ton of peat was equal to one ton of coal for locomotive purposes. Several other trials made with peat for locomotive purposes are given by the authors, and there is no doubt in countries where coal is scarce and peat plentiful the peat bogs may be utilised with very great advantage.

Gas has also been made from peat with very successful results, and in Sweden it has been used for regenerating, puddling, and open-hearth furnaces for the last thirty years. It has also given very satisfactory results for illuminating purposes in Ireland. From a single pound weight of peat one hour's light can be produced; in some peat there is as much as 14,000 cubic feet of gas per ton. In Sweden a ton of peat was found to yield 9295 cubic feet of gas of twenty-four candle-power, a ton of English coal tested at the same time yielding 7063 cubic feet of gas of fifteen candle-power, the by-products being also largely in favour of the peat. Paraffin for candle-making is also distilled from peat.

Another use to which peat has been largely applied is in the manufacture of paper, which dates back in Ireland to 1835. Yarn for weaving purposes is also made from peat. There is now being sold by Messrs. Doré and Son, of London, underwear manufactured from peat. It is also considered an excellent material for bandages and surgical purposes. The other uses to which peat can be applied are numerous, even alcohol being obtained.

The greatest problem encountered in the manufacture of peat fuel is the extraction of the moisture from the peat. There are three general processes in use—air, pressure, and heat. The former is best in a country where a sufficient period of dry weather can be counted on. The various methods resorted to are described by the authors of this book, and illustrations of the machinery given. The latest process for converting peat into fuel is by electricity, which has been tried in Ireland. The peat, after being raised from the bog, is delivered into a rotary hydro eliminator, in which it is subjected to a gradually increasing pressure. The eliminator is

continuous in action, the wet material passing in at the top and leaving it at the bottom in a partially dried condition. It is then passed on to the electrifying machine, where an alternating electric current is passed through it, and is then again passed on to a kneading and moulding machine. The cost of manufacturing fuel by this process is such that it can be sold at a large profit. The fuel produced is hard, dense, and comparatively smokeless. Electro peat coal averages 30 cubic feet to the ton, ordinary coal averaging 45 cubic feet.

BOOKS ON WIRELESS TELEGRAPHY.

A Handbook of Wireless Telegraphy; its Theory and Practice. By Dr. J. Erskine-Murray. Pp. xvi+322. (London: Crosby Lockwood and Son, 1907.) Price 10*s.* 6*d.* net.

Notions générales sur la Télégraphie sans Fil. By R. de Valbreuze. Pp. vi+169. (Paris: *L'Éclairage Électrique*, 1907.)

THERE is a story, probably apocryphal, of a learned professor who undertook to edit the writings of a colleague. At the end of the first paragraph he started to write a footnote, with which he proceeded until he had completed a treatise in several volumes of far superior value to the work he was supposed to be editing. Dr. Erskine-Murray has adopted exactly the opposite system in writing his "Handbook of Wireless Telegraphy," as the following rough summary of its contents will show. He apparently started out with the good intention of writing the book himself, and in the first few pages has succeeded in presenting from a somewhat original point of view the similarities and differences between the various known systems of telegraphy. But on the ninth page appears the first sign of weakness in a half-page verbatim quotation from Sir Oliver Lodge; there is little harm in this, it is true, or in the quotation of equal length from Von Bezold three pages farther on. But it represents apparently the incubation stage of a disease which subsequently develops alarming severity. At p. 17 we find it establishing a firm hold in a five-page quotation from Hertz. Then for a time all goes smoothly, and we read a description of the earlier wireless telegraphy experiments from the author's own pen with feelings of relief. But on the sixty-second page there is a serious relapse in the form of a quotation twenty-eight and a half pages long from a paper on coherers published by Dr. Eccles in the *Electrician*. At the end of this quotation we are told that the results may be summarised in a few words—the summary occupies sixteen lines. We would suggest that in the next edition of the handbook Dr. Erskine-Murray retains only the summary and gives the necessary reference to the original paper.

After such an experience we are not surprised at meeting on p. 100 the first of three successive quotations occupying, with a dozen or so lines of interpolated reference, more than twenty pages; on p. 124 a three-page quotation from a paper by Lieut. Tissot; on p. 129 five pages from a paper by Mr. Duddell. Then, after a brief rest, comes a twenty-page description of the Lodge-Muirhead system from an article by Mr. Marillier in the *Electrician*, and immediately after this twelve pages descriptive of tests on the Fessenden system, including some very uninteresting official correspondence; and so the handbook proceeds to a finish with two more quotations fourteen and fifteen pages long respectively, and nine others varying from one and a half to six pages in length. The only thing that causes surprise in the latter part of the book is that, when Dr. Erskine-Murray refers to Euclid's "well-known work on geometry" in support of his contention that the *surfaces* to be kept clean in relay contacts are "thin, very thin," he resists the temptation to quote at length from that authority (with kind permission of the author).

It is hardly necessary to say that when in a book of 318 pages, 140 are verbatim quotations from other writers, the whole is not particularly coherent. With all due respect to Dr. Erskine-Murray, we submit that this handbook is a striking example of how not to write on wireless telegraphy or any other subject. Books on scientific or technical subjects have a quite definite function to fulfil, distinct from that fulfilled by publications in scientific journals or papers. One does not look to them for new discoveries, or rarely even new theories, but one expects, in a handbook at least, to find a clear *résumé* of existing facts and theories welded together into a consistent whole possessing some sort of literary as well as scientific homogeneity. He who takes up this handbook with such expectations is destined, we fear, to grievous disappointment, though he may find much of intrinsic value and interest, particularly, for example, the seventeenth chapter, on theories of transmission.

M. de Valbreuze's book is of a different stamp; there is nothing in it very novel, either in subject-matter or treatment, but it gives from start to finish a clear and carefully-thought-out account of electric-wave telegraphy. The author starts in a manner rather characteristic of French writers by a fairly full account of the most elementary electrical and magnetic principles. In fact, it is not until half-way through the book that we are introduced to wireless telegraphy proper. Nevertheless, room is left for a summary of the more important researches and descriptions of the leading systems. Though in no sense an advanced treatise, the book is likely to prove of interest to the expert as well as to the beginner; at least, it can be read through without tedium, and can be recommended to all who, possessing little or even no electrical knowledge, are anxious to become acquainted with the leading principles and practice of wireless telegraphy.

We have already, on more than one occasion, commented in NATURE on the number of books which have been written on wireless telegraphy. Each year sees fresh ones added to the list, and still an insatiable public, its imagination fired by the mysterious mechanism of this newest art, is, Oliver Twist like, asking for more. The two volumes before us show how, in different manners, this craving may be allayed.

MAURICE SOLOMON.

OUR BOOK SHELF.

Machine Design. By Prof. Charles H. Benjamin. Pp. vii+202. (London: Archibald Constable and Co., Ltd., 1907.) Price 8*s.* net.

FEW men are more qualified to speak with authority upon the experimental side of machine design than the author of this little book. Indeed, we are inclined to the opinion that it might well have been entitled "Experimental Machine Design," since it deals almost exclusively with Prof. Benjamin's classical experiments upon the behaviour of certain machine parts when tested to destruction. Our general opinion of the book can be summed up in a very few words—"excellent as a sample." We trust, however, that it is but a sample of what the author intends to give to the engineering world in the near future.

Regarded, however, as a general treatise on machine design, we are bound to confess that it is somewhat disappointing, since such a very small portion of the book is devoted to the correct proportioning of even the commonest constituent parts of machinery. The faults of the book are faults of omission rather than of commission; to a large extent the matter given is original and cannot fail to be of great value to designers of machinery. The analytical treatment of some of the problems dealt with is both new and ingenious.

We have noticed a few slips, but they are mostly unimportant. On p. 6 the modulus of elasticity for crucible or tool steel is given as 40,000,000 lb. per square inch. We have tested a great many specimens of such steel, but have never obtained a value of more than 32,000,000 lb. On pp. 11 and 74 the torsion modulus of a square shaft is given as $d^3/4{\cdot}24$, but according to St. Venant, Lord Kelvin and others, this should be $d^3/4{\cdot}81$. The value given for the elliptical section is also in error; it should be $ba^2/5{\cdot}1$.

The experimental investigations of Prof. Benjamin on the bursting strength of cast-iron cylinders, the strength of flat plates, gearing, fly-wheels, and pulleys are of the greatest interest. If only designers of machinery would take to heart some of the lessons taught by these experiments, we should less frequently hear of the disastrous failures of fly-wheels, &c. We trust that he will continue his researches in many directions and incorporate them in a future edition.

On the whole, the illustrations are good. They are clear without giving too much detail, which is so often a fault in many books of this type; but in some instances the diagrams are crude, and are, indeed, incorrect. For example, the stuffing-box shown in Fig. 36 is not such as one would expect to find in a treatise on machine design.

Some of the friction experiments quoted were carried out in a very crude fashion, and the results are liable to be very misleading. For an example of this see p. 107. Except for the minor faults that we have pointed out, we can heartily recommend the book to students and draughtsmen generally.

Flowers and Trees of Palestine. By Miss A. A. Temple. Pp. xii+172. (London: Elliot Stock, 1907.) Price 6*s.* net.

ARISING out of a tour in Palestine, Miss Temple has compiled for the benefit of other travellers a list of the principal plants of the country. The list, which is arranged alphabetically, furnishes the popular and scientific names, also the localities; certain features of some of the genera and species are added, but they are of little determinative value. Preceding the list are four chapters containing an account of the characteristic flowers, thorny, tropical, and subalpine plants, and of the trees. A number of good illustrations are provided which are taken from the author's photographs.

Miss Temple discusses the interpretation of the Biblical names, following as her guides in this matter Canon Tristram and Dr. Post. The interpretations are obscure, although there is unanimity in most cases. The identification of "the lilies" has given rise to controversy. The author favours the view that the flower signified especially as the "lilies of the field," is *Anemone coronaria*; Dr. Post for another reference inclines to the gladiolus; these flowers are more probably signified than *Lilium chalcedonicum* and *Lilium candidum*, which are found, although rarely. It seems unnecessary to introduce Acanthus for any reference to "nettles," and Jew's mallow is generally understood to be *Corchorus olitorius* or *capsularis*, not *Corchorus trilocularis*. Otherwise, except for one or two obvious mistakes, the identifications are acceptable. Although the information in the descriptive chapters is slight and lacks continuity, the reader can, with the help of the illustrations and the list of plants, obtain a fair idea of the brilliant nature of the flora, and the traveller should be able to identify the more conspicuous plants.

Familiar Indian Birds. By Gordon Dalgliesh. Pp. viii+71; illustrated. (London: West, Newman and Co., 1907.) Price 2*s.* 6*d.* net.

THAT many persons in India, especially new arrivals, feel the want of an easy means of identifying the commoner birds of the country is indisputable, and this want the author of the booklet before us has endeavoured to supply—largely in the form of reprints from notes in scientific and other journals. In the main, the notices are interesting and to the point; but there appears a lack of judgment in regard to the species selected for mention. The omission of the adjutant stork is a glaring instance of this; while in the section on herons it is obvious that the egret or "paddy-bird" should have figured as the main heading, in place of the ordinary British heron. Then, again, it is a mistake to have selected such birds as the heron, moorhen, and barn-owl as the subjects for pictorial illustration, when so few characteristic Indian species are depicted. Neither can much be said in praise of the illustrations themselves, that of the myna being specially poor. By the time the book reaches a second edition, it may also be hoped that the author will have learnt to write sentences of a more grammatical type than the one standing second in the account of the jungle-babbler, or the third and fourth (taken together) on the seventh page. R. L.

Progressus Rei Botanicae. Vol. i., part iii. Die Fortschritte der Immunitäts- und Spezifizitätslehre seit 1870. By R. P. van Calcar. Pp. 110 (533 to 642). (Jena: Gustav Fischer, 1907.)

THE third and final part of the first volume of this publication, issued under the auspices of the International Association of Botanists, is assigned to a survey of the study of immunity, compiled by Dr. R. P. van Calcar. Due credit is given to botanists for the early conceptions of the theory, and the gradual evolution of the subject by pathologists is traced up. The author presents an explicit and critical account of the experiments and views elaborated by Metschnitoff, Ehrlich, and Pfeiffer; he describes the phenomena of agglutination, and discusses the arguments in connection with toxins and antitoxins, the taxonomy of the tubercle bacillus and the *rôle* of ferments. Although the field has been explored chiefly from a medical point of view, a knowledge of the general theories regarding the action and nature of bacteria is also required by plant pathologists, and the summary is eminently suitable to a botanical publication.

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.]*

Science and Government.

No one will contest the principle that it is in every way desirable that the State should support liberally such kinds of scientific work as are beyond the means of private institutions or individuals. It is, for example, a scandal that the relatively small sum is not forthcoming which would bring our Ordnance Survey into touch with modern geodesy; but the importance of such matters will not be appreciated until the literary atmosphere in which our statemen and officials are reared is penetrated by a scientific way of thinking. Nor is there at present any widely spread educated opinion which might react on the Government. A member of the House of Commons stated in his place that the sooner coal is exhausted the better, as electricity will do its work. One of our important journals thinks it plausible that the Jamaica earthquake should have been predicted in Europe by the "weather plant," and that telegony may have some bearing on marriage with a deceased wife's sister.

But I am by no means convinced that the *argumentum ad hominem* contained in your issue for September 12 is very helpful. Taking the revenues of the United States and of the United Kingdom as approximately equal, the disparity between an expenditure of (say) $2\frac{3}{4}$ and $\frac{1}{4}$ millions on "science" is at first sight overwhelming; but a little analysis of the figures will, I think, put a somewhat different construction upon them.

Of the total, the Department of Agriculture and that of Commerce and Labour take 2,107,670*l.*, or say two millions. It is assumed that the whole of this goes to scientific work. It would be less inaccurate to describe it as applied to technical purposes; but even that would not quite correctly state the position.

The United States Department of Agriculture publishes an annual report in a bulky volume. Its contents deal largely with purely administrative matters; the rest is mostly educational, even popular, and can scarcely be regarded as adding much to agricultural science. Nor is it intended to do so. The object of the department is rather to disseminate and apply existing knowledge than to add to it by advanced research. The explanation is obvious; agriculture is the fundamental industry of a country which is still largely in the condition of an undeveloped estate, and cultivation is carried on by a population which is to a considerable extent only imperfectly instructed in the art. Agriculture in the United States is far from having reached its intensive stage; this may be illustrated by the fact that while the mean production of wheat in the United Kingdom is thirty bushels to the acre, in the United States it is only thirteen.

The expenditure of the United States Government on Agriculture is rather a political necessity than the outcome of sympathy for science. All other industries are protected by a tariff; but protection is useless for agriculture which has to export its surplus produce, and it is probable that by restricting the imports by which the exported produce is paid for, protection diminishes the exchange value of what the farmer produces. The United States Government is therefore compelled practically to subsidise the farmer in various indirect ways—by the free distribution of seed, for example—as it cannot directly protect him. The writer in NATURE has omitted to set out in comparison what is done for agriculture in the United Kingdom. The Board of Agriculture and Fisheries has a vote of 130,355*l.*, and the Irish Department of Agriculture and Technical Instruction one of 190,146*l.*, or 320,481*l.* in all. Now the area of the United Kingdom is one-thirtieth that of the United States; but our State expenditure is per square mile $4\frac{1}{2}$ times as great. It should be noted that this includes Kew and the Ordnance Survey.

But this is not the only omission on the *per contra* side of the account which appears to me likely to be extremely misleading to foreign readers of NATURE. I shall not attempt to make Table II. complete, as I have not the means at hand. But there is no mention of the Royal College of Science (including the School of Mines) in London or of the similar institutions in Dublin; one of the science museums, the Government Laboratory, the Standards Department, the Patent Office Library, the Oxford Forest School, the Botanic Gardens at Edinburgh and Dublin, and the research work of the Local Government Board. Nor should the ethnographic department at the British Museum (Bloomsbury) be overlooked.

The first three heads in Table I. represent what the United States Government does for pure, *i.e.* for non-technical, science. They amount to 382,690*l.*, after deducting the casual and temporary item of 250,000*l.* for building; but a further deduction of 107,000*l.* must be made for surveying public lands and forest reserves, as these are merely administrative services. This brings the expenditure on pure science down to 175,090*l.*, an amount which does not strike me as anything to be particularly proud of.

The fact is that the attitude to science of American statesmen is not very different from that of our own; indeed, on the whole, I doubt if it be not even less sympathetic. The Smithsonian Institution has become an independent trust something like our British Museum, and the fact may be recalled that it owes its foundation to the munificence of an Englishman. It is by no means liberally subsidised by the Government. Nor has the United States any national botanic establishment on the scale of Kew.

What one would like to find imitated in this country is the noble idealism which impels those who are possessed of great wealth in the United States to place it at the disposal of the community for the advancement of learning. Our own Royal Society might be entrusted with funds which it would know how to apply to purely scientific purposes. This would be more useful than giving of medals and scholarships to distribute. Our ancient universities, Oxford and Cambridge, are in urgent need of endowments, which would enable them to strike out their own line unhampered by the purely educational aims of the colleges; but State aid dries up the streams of private liberality, and brings with it the cramping atmosphere of official supervision.

W. T. THISELTON-DYER.

Witcombe, September 17.

SIR W. T. THISELTON-DYER agrees, at all events, that the attitude of British statesmen towards science leaves much to be desired. Statistics can, of course, be treated in many different ways, but, despite the criticisms in the above letter, the general conclusion of the article referred to remains substantially correct. The data are avowedly incomplete; only those who have attempted to collate the material scattered throughout Government publications appreciate wholly the difficulty of the task.

Although Sir W. T. Thiselton-Dyer maintains that but a small part of the grant to the U.S. Department of Agriculture is devoted to scientific research, the facts of the case seem to support the conclusions of the article. For the fiscal year ending June 30, 1905, the expenditure on investigation work alone, exclusive of the salaries of permanent officials, was at least 201,000*l.* The annual report for 1905–6 of our Board of Agriculture and Fisheries on the distribution of grants for agricultural education and research shows that the grant for agricultural research amounted to 355*l.*! Since "agriculture in the United States is far from having reached its intensive stage," there is surely less need for grants in aid of agricultural research there than in this country.

Grants to colleges and universities were omitted intentionally—and special attention was directed to the omission—since this subject has been dealt with so often in NATURE; consequently, the administration by the Board of Agriculture of the Treasury grant for the purposes of agricultural education, much of the work of the Irish Department of Agriculture and Technical Instruction, the activities of the Royal Colleges of Science in London and Dublin, and the university colleges, fell outside the scope of the article. Had the subject of grants for higher educational purposes been under consideration, an equally great disparity between the amount provided from public funds in the United States and in this country would have been

exposed. The latest report of the U.S. Commissioner of Education deals with the year ending June 30, 1905. The total income for that year of American institutions of university rank, excluding benefactions, amounted to 8,355,000*l.*, an increase of 289,200*l.* over the preceding year, and of this amount 23·6 per cent. was from State appropriations and 6·9 per cent. from Federal appropriations. That is, more than 2,506,500*l.* was provided from American public funds for higher education during the year with which the report deals. A very generous estimate of the amount provided here from public funds for higher education of every kind, including the Royal Colleges of Science of London and Dublin, the universities and the university colleges, would be to place it at a quarter of a million pounds sterling, so that the British case is in no way improved by importing the question of the amounts provided for higher education.

Sir W. T. Thiselton-Dyer is doubtful only about the greater belief of American statesmen in the need for the introduction of scientific methods in the solution of problems of government, but of the need of scientific ways of thinking on the part of our legislators he is quite convinced, and that is really the important matter.

A. T. S.

The Interpretation of Mendelian Phenomena.

APROPOS of the discussion on the interpretation of Mendelian phenomena, may I seek enlightenment on one or two points from your readers? Mendelian phenomena are possible only when reproduction is bi-parental. They cannot occur, of course, when it is parthenogenetic. I believe I am right in thinking that Mendelian workers suppose or hope that they have found a master key to the problems of heredity. Now, I am able to understand that the study of alternative inheritance may ultimately shed a light on the function of sex, but I find it difficult to conceive how it can shed a light on any other biological problem of importance; for example, the problems of the alleged transmission of acquirements, of the causation of variations, of the retrogression of characters which have lost selection value, and of the mode of development (whether or not by the recapitulation of the phylogeny). All these problems are of at least equal importance to the problem of sex. I have sought information from my Mendelian acquaintances, but I am always told that we must await the accumulation of data—a somewhat Micawber-like attitude, as it seems to me. I hope I make myself clear. The information I seek would be contained in the answer to the following question:—If Mendelism has a bearing on any biological problem save that of sex, what is that problem? If, as I anticipate, no one is able to name another problem, I venture to suggest that Mendelians are engaged in nothing more than the investigation of sex.

Mendelian phenomena have been observed principally in crossed artificial varieties of animals and plants. Crossed natural varieties usually blend their characteristics. This is conspicuously the case with man, the animal who, so far as is known, has crossed more often than any other, and whose hybrids may be observed up to the tenth or twelfth generation in South America and elsewhere. It has been said that "human skin-colour is the only character that is known to blend perfectly"; but this statement is certainly incorrect. With the exception of eye-colour, and possibly one or two other traits, such as the Mongolian eyelid, human hybrids appear to blend every character as perfectly as skin-colour. The transmission of no character is Mendelian. Thus mulattos have the black eye of the negro, and when they breed *inter se* continue to reproduce it indefinitely. There is no segregation. May I mention one other fact which is of considerable interest, but which seems to have escaped the attention of Mendelian workers? Crossed artificial varieties usually reveal latent characters in abundance. I am aware that the correctness of the term latency has been disputed, but it will serve to indicate what I mean. So far as I have been able to ascertain, no single instance of a latent character resulting from the crossing of natural varieties has been recorded. Certainly crossed human varieties reveal no such traits. A very significant passage bearing on this matter may be found in "Animals and Plants" (vol. ii., pp. 24–5). It would appear, then, that characters become latent only under conditions of artificial selection, that is, when mutations are selected. It has been maintained that nature also selects only mutations, but, to say the least, this has not been demonstrated as yet.

Bearing in mind, then, the facts that latent characters appear only when artificial varieties are crossed, and that crossed natural varieties usually blend their characters, the question arises whether Mendelians, so far from investigating even the whole problem of sex, are engaged in anything more than the investigation of those abnormalities of sexual reproduction which occur under conditions of artificial selection.

G. ARCHDALL REID.

Southsea, September 17.

On Correlation and the Methods of Modern Statistics.

PROF. KARL PEARSON'S letter in NATURE of September 19 gives me a welcome opportunity of explaining what was not intelligible in the condensed report of my remarks in the discussion at Leicester, on methods of modern statistics.

Prof. Pearson communicated to the Royal Astronomical Society (Monthly Notices, May, 1906) a paper by Miss Winifred Gibson, giving an account of a research conducted in the statistical laboratory of University College, London. The first part of this paper discussed the relation between parallax and magnitude of the stars. I confessed to some misgivings as to the astronomical value of the results, and raised two questions, first, as to the method, and second, as to the matter.

Prof. Pearson thinks that I am on safer ground in the second than in the first. I will therefore examine first his reply to my second point, which was that the parallax material contained in Newcomb's table (appendix to "The Stars") is quite unsuitable for discussion by a general statistical method, since it relates very largely to stars selected for investigation because of abnormal proper motion.

Prof. Pearson "fancies that astronomers have been guilty of a considerable amount of circular reasoning. They start from the hypothesis that magnitude is very closely related to parallax. . . . The fundamental hypothesis that the brighter stars are much the nearer as yet awaits statistical demonstration. . . . Surely the hypotheses of high relationships between magnitude and parallax and proper motion are of sufficient importance to deserve *proof*, rather than to be taken as axiomatic." In this matter Prof. Pearson is under a misapprehension. Astronomers do not believe that magnitude is very closely related to parallax; very obviously it is not. But they do believe that parallax is somewhat closely related to proper motion. There are seventeen stars in the sky brighter than mag. 1·5, and their parallaxes have been determined with the heliometers at the Cape and at Yale. Here are the results.

Seven have proper motions (on a great circle) less than 0″·1 per annum:—

	P.M.	Parallax	Mag.
	″	″	
Canopus	0·00	0·00	1·0
Deneb	0·00	0·00	1·3
Rigel	0·01	0·00	0·3
Betelguese	0·03	0·02	0·9
Antares	0·03	0·02	1·3
Achernar	0·09	0·04	0·5
β Centauri	0·09	0·05	0·8
Mean ...	0·04	0·02	0·6

Six have proper motions between 0″·1 and 1″·0:—

	P.M.	Parallax	Mag.
	″	″	
Aldebaran	0·19	0·11	1·1
Regulus	0·27	0·02	1·3
Vega	0·36	0·11	0·1
Capella	0·43	0·09	0·2
Pollux	0·64	0·06	1·2
Altair	0·65	0·23	0·9
Mean ...	0·42	0·10	0·8

Four have proper motions greater than 1″·0 :—

	P.M.	Parallax	Mag.
	″	″	
Procyon	1·25	0·30	0·5
Sirius	1·31	0·37	−1·4
Arcturus	2·28	0·03	0·3
α Centauri	3·67	0·75	0·2
Mean ...	2·13	0·36	−0·1

It is clear from the first group that low magnitude alone has no very close association with large parallax, and in the other groups Arcturus is the only star with considerable proper motion that has not a considerable parallax, as parallaxes go.

I think that in forming his low estimate of the established relation between parallax and proper motion Prof. Pearson must have been misled by Miss Gibson's results. She has calculated the correlation between parallax and the *separate components* of the proper motion in right ascension and declination, and so has naturally obtained a smaller result than if she had used the whole proper motion in seconds of arc on a great circle, as is usually done.

I have plotted the material used by Miss Gibson in two ways, parallax against magnitude and parallax against proper motion on a great circle, and it seems to me that the second diagram shows considerable correlation.

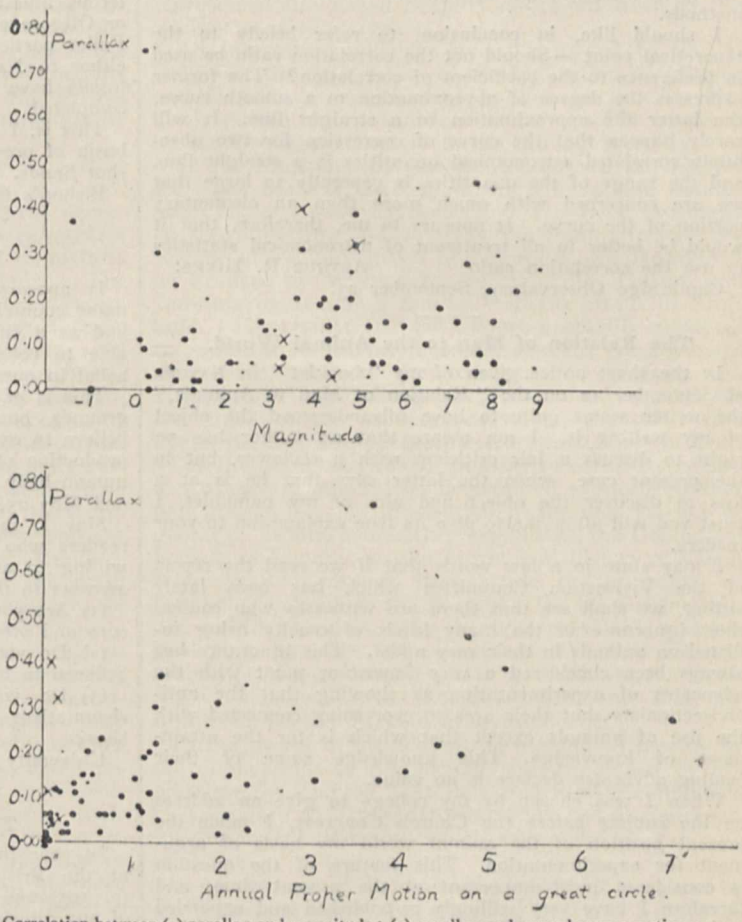
Some of the parallaxes are marked by Newcomb as doubtful; these I have shown by smaller dots. Five which depend on absolute right ascensions observed with the meridian circle may be considered too doubtful for use in this discussion; I have struck them through with a cross.

The seventy-two parallaxes grouped in means by whole magnitudes give a "curve of regression" with three peaks and two valleys, to which Miss Gibson thinks that it might be possible to fit a quartic curve. I suggested a simpler explanation, and Prof. Pearson asks for details of the reason why this curve of regression has such a switchback form if it is not real. It is easy to answer this question. Consider, for example, the second-magnitude group; it contains six stars, only one of which has a moderately large proper motion. Four of the stars were observed in the early days of photography as part of the late Prof. Pritchard's scheme to determine the parallaxes of all second-magnitude stars. One of the stars is Polaris, of small proper motion, observed just because it is Polaris; the sixth is α Gruis, of small proper motion and parallax. The group contains no star specially selected in anticipation of finding a large parallax, and naturally the mean of the group is small, because it is more or less representative of the second-magnitude stars in general.

On the other hand, the fourth-magnitude group includes several stars observed because of large proper motion, η Cassiopeiæ, τ Ceti, 70 Ophiuchi, and is helped out by a large parallax assigned to η Herculis which is certainly spurious. Hence the mean parallax of the group is large.

And so on. It would be tedious to examine each group in detail, but the almost fortuitous value of the mean parallax for each of these small magnitude groups is amusingly illustrated by the first two. The first contains two stars, parallaxes 0″·37 and 0″·00; mean, 0″·19. The second contains five stars; four have parallaxes of 0″·09, 0″·00, 0″·03, and 0″·11, but the group is translated from the valley to the peak because the fifth parallax is 0″·75. This, the largest known parallax, belongs to the double star α Centauri, the components of which have magnitudes 0·4 and 1·9. We might add the fainter component to the second-magnitude group discussed above; this would bring the mean parallax of the group up with a bound from 0″·08 to 0″·18, make a new peak, and remove one of Prof. Pearson's difficulties.

Probably there is no need to justify more minutely my remark at Leicester that a statistician who attacks astronomical problems must be as intimately acquainted with technical astronomy as with the use of his modern statistical tools. If any doubt remains, it will be dispelled by reading further in Miss Gibson's paper. "The next stage in the work was to inquire whether magnitude was more markedly correlated with any other character than parallax. Colour suggested itself as a character for which definite data were available. In vol. ix. of the 'Annals



Correlation between (1) parallax and magnitude; (2) parallax and annual proper motion on a great circle, for the seventy-two stars in Newcomb's Table.

of the Cape Observatory' will be found a catalogue from which the colour of 159 stars can be extracted. . . ." Prof. Pearson quotes in his letter one of the results of this section, "that colour and magnitude are related at least as closely as parallax or proper motion and magnitude." And Miss Gibson concludes "that we have a suggestion, even if it be only of the vaguest kind, that the bulk of the lucid stars may belong to a separate universe within which magnitude is not mainly determined by parallax or distance, but is more closely associated with colour, and thus probably with chemical or physical conditions." On examining the basis of this far-reaching suggestion about the "bulk of the lucid stars," one is struck with the remarkable fact that "white had no frequency in the record"! A search in the Cape volume shows that the list in question is entitled "Coloured Stars observed during the Revision of the 'Cape Photo-

graphic Durchmusterung.'" This revision was chiefly an examination of all cases in which stars found in other catalogues are missing from the C.P.D. Sometimes they were hidden by photographic defects; sometimes they were variable or had large proper motion; in a great many cases they were red, and photographically faint. Hence attention was concentrated upon a particular class of stars, near the limit of the C.P.D., which had escaped registration owing to some abnormality, generally redness. This specially selected material has been further specialised, for at the top of the list we read:—*Very few stars of a lighter shade than deep yellow have been recorded because of their frequency.* And this is the material from which Prof. Pearson and Miss Gibson extract their conclusions about the stars in general.

I think that an astronomer may be allowed to express his dissent from these applications of modern statistical methods.

I should like, in conclusion, to refer briefly to the theoretical point:—Should not the correlation ratio be used in preference to the coefficient of correlation? The former expresses the degree of approximation to a smooth curve, the latter the approximation to a straight line. It will rarely happen that the curve of regression for two absolutely correlated astronomical quantities is a straight line, and the range of the quantities is generally so large that we are concerned with much more than an elementary portion of the curve. It appears to me, therefore, that it would be better in all treatment of astronomical statistics to use the correlation ratio. ARTHUR R. HINKS.

Cambridge Observatory, September 23.

The Relation of Man to the Animal World.

IN the short notice given of my "booklet" in NATURE of September 12 on the "Relation of Man to Animals," the writer seems quite to have misunderstood the object of my writing it. I am aware that an author has no right to discuss a fair criticism with a reviewer, but in the present case, when the latter says that he is at a loss to discover the object and aim of my pamphlet, I trust you will allow me to give its true explanation to your readers.

I may state in a few words that if we read the report of the Vivisection Committee which has been lately sitting, we shall see that there are witnesses who confess their ignorance of the many kinds of cruelty being inflicted on animals in their very midst. This ignorance has always been considered a very important point with the advocates of experimentation as showing that the anti-vivisectionists shut their eyes to everything connected with the use of animals except that which is for the attainment of knowledge. This knowledge some of their leading advocates declare is no value.

When I was chosen by my college to give an address on the subject before the Church Congress, I made the present position of the animal world my basis of argument for experimentation. This feature of the question is considered most important at the present time, and therefore I have very willingly re-published and expanded it in my pamphlet. This is my sole object of writing it. It would be quite out of place to give my own opinion as to our treatment of animals generally; in fact, it would be of no value considering the difference of opinion on the subject, and especially at the present time, when vegetarianism seems largely increasing.

Hampstead, September 27. SAMUEL WILKS.

Meteoric Shower, from near β Aurigæ.

ON September 27 at 9h. 54m. I saw a very swift meteor of about 1½ mag. shooting through Cygnus, and leaving a streak of about 10° near α and γ Cygni. The sky was clouding over at the time, and a portion of the luminous course of the meteor must have been hidden, but the observed path was from 306¼°+45° to 299°+32½°.

The line of flight traced far backwards carries us to the point 88°+43°, and this, I believe, formed the radiant position of the object. There are showers from near β Aurigæ in August, September, and October, and later months also supply indications of activity in the same centre. This particular system of Aurigids appears to be unusually rich from about September 21 to 27. On 1879 September 21 I recorded eight meteors from a radiant at 87°+43°, and on 1878 September 25 the radiant near β Aurigæ was re-determined from five meteors. The members of this stream are exceedingly swift, and they usually leave streaks, their appearance being very similar to that of the Leonids. W. F. DENNING.

Bishopston, Bristol, September 28.

A New Stratigraphical Fact in the Thames Basin.

IT will interest geologists to learn of the occurrence in this neighbourhood, below the Tertiary plateau gravels, of a bed (not a boulder) of marly, lignitiferous, glauconitiferous limestone, full of fossils, about the Upper Eocene or Oligocene age, of which there can scarcely be a doubt. Fuller particulars are reserved for a later communication either to NATURE or the *Geological Magazine*, when the fossils have been exactly identified and the investigation completed.

This is, I believe, the first definite record in the Thames basin of pre-Miocene strata younger than the Upper Bagshot Sands. A. IRVING.

Bishop's Stortford, September 25.

Bees' Stings and Rheumatism.

IT appears to be a familiar and widespread belief in many countries that the stings of bees act both protectively and as a cure for "rheumatism." I have recently been able to collect some definite evidence in support of the belief in question.

This is of interest and importance, not only on general grounds, but also on account of the connection which I believe to exist between rheumatic fever and an abnormal production of formic acid (the acid of bee poison) in the human body (*British Medical Journal*, September 19, 1903, and May 25, 1907).

May I, therefore, be permitted to request any of your readers who possess information on the subject, and are willing to assist the present inquiry, to favour me with answers to the following questions?—

(1) Are you acquainted with the belief that bees' stings cure and prevent rheumatism?

(2) Do you know of any case in which rheumatism is believed to have been cured by this means?

(3) Do you know of any person who suffers from rheumatism although frequently exposed to the stings of bees? E. W. AINLEY WALKER.

University College, Oxford, September 27.

The Country Child in Education.

IN your interesting *résumé* of the educational meetings at the British Association in NATURE of September 12 (p. 505) one could not help being struck by the absence of any allusion, near or distant, to the *country* child.

I suppose it is correct to say that, physically, country children are, or will be, the backbone of the nation. If half as much were done educationally for them as is lavished on the town—and particularly the London—child, they would speedily become the nation's brain.

Manual training in all its branches, cookery lessons, swimming baths—what effect would these not have on our slow but sturdy village youngsters? With them nature-study is coming along—but even gardening lessons on scientific principles are all too rare.

Our school buildings and furniture in country districts slowly improve, but our playgrounds are still mostly loose beach, utterly useless for physical exercises or organised games.

It is time for enlightened educationists to urge the needs and claims of the country child. H. J. GLOVER.

Council School, Westham, Sussex, September 18.

[We hope this matter will not be lost sight of in arranging the agenda for next year's meeting of the Educational Science Section of the British Association.—ED. NATURE.]

THE CENTENARY OF THE GEOLOGICAL SOCIETY OF LONDON.

UNDER the presidency of Sir Archibald Geikie, K.C.B., the celebration of the centenary of the Geological Society of London has been carried out with conspicuous success. While the proceedings throughout were characterised by an air of dignified gravity, a feeling of quiet enthusiasm pervaded the meetings. On no previous occasion have so many illustrious geologists been gathered together from all quarters of the globe, and a noteworthy feature in the assembly was the presence of many women who have achieved distinction in the pursuit of geology.

Although the actual date of the foundation of the society was November 13, 1807, it was necessary to hold the centenary meetings a little in advance of the actual birthday, in order to suit the convenience of the foreign members and correspondents, as well as the visitors from abroad and from all parts of the British Isles, who have university duties that commence in October.

The apartments of the Geological Society at Burlington House had undergone a great transformation. Easy-chairs and lounges, curtains and floral decorations served to make attractive the otherwise sombre-looking chambers. The council room, with its historic geological portraits, was set apart for the ladies. The museum, usually so desolate, was the principal reception-room, and it became a busy and animated scene where conversation and writing were seasoned with the fragrant odour of tobacco. Exhibits of certificates of membership of some of the great geological masters, early MSS. and published maps, and other documents of interest were displayed in cases or suspended from the walls. For all these arrangements so happily carried out, the society was indebted to the indefatigable labours of Prof. Watts and Prof. Garwood, the secretaries, to Mr. Belinfante, assistant secretary, and the other permanent officials, and to Mr. F. W. Rudler.

Thursday, September 26, was fixed for the main centenary proceedings, and the fine meeting-room of the Institution of Civil Engineers was courteously placed at the service of the society for the reception and the president's address. At 11 a.m. the delegates were received in the alphabetical order of their countries, and it was arranged that one representative only of each country should speak. Space will neither permit of the insertion of a full list of the delegates who came, nor of any record of the eloquent and warm-hearted remarks with which they accompanied their presentations of the addresses of congratulation to the president. It was to be regretted that no time or opportunity could be given for the display of these elaborate and beautiful documents, but no doubt a special exhibition of them will be made at some future meeting of the society.

Austria-Hungary was represented by Dr. Tietze, director of the Imperial Geological Survey; the Argentine Confederation by Prof. Aguirre, of the University of Buenos Aires; Belgium by M. Mourlon, director of the Geological Survey; Denmark by Dr. Steenstrup; Egypt by Capt. Lyons, director of the Geological Survey; France by Prof. Gosselet, Prof. Barrois, and Prof. de Lapparent; Germany by Prof. Zirkel, Prof. Credner, and Prof. Rothpletz; Greece by Prof. Skouphos; Holland by Prof. Wichmann and Dr. Molengraaf; Italy by Prof. Hughes (who spoke in the absence of Prof. de Lorenzo); Japan by Prof. Omori; Mexico by Dr. Aguilera, director of the Geological Survey; Norway by Prof. Brögger, and Dr. Reusch, director of the Geological Survey; Portugal by Prof. de Lima; Russia by Dr. Tchernyshew, director of the Geological Survey, Prof. Pavlow, Prof. Lœwinson-Lessing, and Dr. Sederholm, director of the Geological Survey of Finland; Sweden by Prof. Nathorst and Dr. Gunnar Andersson, director of the Geological Survey; Switzerland by Prof. Heim and Prof. Baltzer; United States by Dr. Hague, Prof. Iddings, and Prof. Morris Davis; Canada by Prof. Adams; India by Mr. La Touche; South Africa by Mr. Rogers and Dr. Hatch; Australia by Prof. Hill and Mr. Johnston; New Zealand by Mr. Denham.

Numerous delegates represented the universities, the scientific societies, institutions, and field-clubs of Great Britain and Ireland, and on their behalf Prof. Sollas and Prof. Hughes made brief remarks, the latter speaking in Latin the address of congratulation from the University of Cambridge. Mr. A. B. Kempe represented the Royal Society, and Lord Avebury the Society of Antiquaries.

An interesting incident was the award to Sir A. Geikie of the gold medal of the Institution of Mining and Metallurgy, which was handed to him by Mr. C. J. Alford, in recognition of the services rendered by the Geological Society to the mining industry.

In the afternoon the president delivered his address on "The State of Geology at the Time of the Foundation of the Geological Society." He dwelt especially on the important aid towards the foundation of the science of geology given by Guettard and Desmarest in France, by Werner in Germany, by Hutton and Jameson in Scotland, and by William Smith in England. The results of their labours gradually attracted more and more attention, as did also the controversies that arose between the followers of Werner and Hutton, the one school (the Neptunists) attributing too much to the influence of water, the other (the Plutonists) attributing too much to the agency of heat. Thus it came about that a number of earnest students well versed in mineralogy determined to meet together and gather facts in illustration of the new science of geology. In due course they established the Geological Society of London, to the origin and history of which reference has already been made in the pages of NATURE (September 26, p. 537). G. B. Greenough, one of the founders, was the first president, and his geological hammer with a whalebone handle was exhibited by a relative, Mrs. Bowen-Colthurst, of Dripsey Castle, co. Cork. To this interesting relic Sir Archibald Geikie directed brief attention.

In the course of his address he pointed with pride to the publications of the society, and concluded by expressing the opinion that they might with confidence look forward to a career in the future not less successful and useful than that which they were now met to celebrate.

A hearty vote of thanks to the president, proposed by Prof. de Lapparent, was seconded by Prof. Rothpletz.

In the evening a brilliant assembly gathered in the Whitehall Rooms of the Hotel Metropole for the official banquet. The company numbered 291. The president was supported by two veteran geologists, on his right Prof. Gosselet, and on his left Prof. Zirkel. It is noteworthy that not a single peer, baronet, or bishop was present among the fellows of the society or its guests. A brief grace was said by Prof. Bonney, hon. canon of Manchester, and the company then proceeded to the consideration of the menu. The card was illustrated by portraits of Greenough, the first president, and of Sir Archibald Geikie, but, curiously enough, the date of the meeting was printed 1908 instead of 1907. The toasts were taken without interruption at the conclusion of the dinner. Those of the King and of the heads of foreign States were proposed by the president. Then followed the Geological Society of London, proposed by Prof. de Lapparent, with response by the president;

the Universities and other Educational Institutions by Prof. Bonney, and reply by Prof. Credner; the Academies and Learned Societies by Prof. Miers, and reply by Prof. Barrois; the Geological Surveys by Prof. Lapworth, and reply by Prof. Heim; Engineering and Mining Institutions by Prof. Hughes, and reply by Prof. Beck; the Delegates and other Guests by Dr. Marr, and reply by Prof. Stevenson; and the Ladies by Prof. Watts, and reply by Prof. Walther.

On Friday, September 27, visits were paid to the British Museum at Bloomsbury and to the Natural History Museum at South Kensington, to the Geological Survey and Museum of Practical Geology at Jermyn Street, and to the Victoria and Albert Museum at South Kensington. Demonstrations on objects of interest were given by the officers at these institutions, and especial interest was manifested in the new model of Assynt in the north-west Highlands (recently added to the Museum of Practical Geology), which was explained by Dr. B. N. Peach. A number of the foreign and colonial visitors were also invited to St. Paul's Cathedral, and were conducted through the edifice by Canon Scott Holland and Dr. Grabham (delegate appointed by the Royal College of Physicians). The party was afterwards entertained at tea by Dr. Grabham in the Chapter House.

In the evening the foreign and colonial delegates were entertained at dinner at the Criterion Restaurant by the Geological Society Club. This club was founded in 1824 by Buckland, Fitton, Greenough, Lyell, Warburton, and others, with the object of affording to a limited number of the leading members of the society an opportunity of dining together on the evenings of the society's meetings. The proceedings on the present occasion lacked some of the exuberance and animation that we read of in early records of the club, when Buckland and Sedgwick and other geological giants of old made merry. On the present occasion, however, the proceedings had to be curtailed.

The party, as in the case of the official dinner, was photographed, and a congratulatory telegram was sent to the distinguished veteran and past president, Dr. H. Clifton Sorby, now in his eighty-second year, and still engaged in scientific research. It may be mentioned that other veteran fellows of the society, Prof. T. Rupert Jones, now eighty-eight, and the Rev. Osmond Fisher, in his ninetieth year, bear testimony to the healthy character of geological labour. Nor should we forget the father of the society, the Rev. W. H. Egerton, a brother of the late Sir Philip Egerton, who was elected a fellow in 1832, and at the age of ninety-six is still rector of Whitchurch, in Shropshire. A letter received from him during the present year, in which he mentioned that he had been a pupil of Buckland, was exhibited in the society's museum.

After the club dinner the party proceeded to the conversazione, which was held at the Natural History Museum. There a numerous company was received by the president in the Central Hall, and the proceedings were enlivened by a good programme of music, performed by the string band of the Royal Engineers.

During the week prior to the centenary reception a number of excursions were made with the view of exhibiting to the foreign members, correspondents and others who came from abroad, the main features of British geology. The longer excursions were arranged to occupy a week.

The Palæozoic formations were seen in the English Lake District, famed for the early researches of Sedgwick; in South Wales, where Murchison established some of his Silurian divisions; and at Bristol, Weston-super-Mare, and Cheddar, amid geologic scenes described by Buckland and Conybeare. The Jurassic and Cretaceous rocks were viewed along the Dorset coast at Lyme Regis, Bridport, and Weymouth, a region full of associations with the work of De la Beche and Buckland; and in the Isle of Purbeck at Lulworth and Swanage, where Thomas Webster in early days so admirably depicted the geological structure. The excursion to the Isle of Wight was abandoned, while that proposed for the Edinburgh district was replaced by one to the north-west Highlands, to Assynt, Inchnadamph, and Loch Glen Coul for the purpose of studying the displaced rock-masses brought forward by the Glen Coul and Moine thrusts. This last excursion was the more appropriate considering that the long-looked-for Geological Survey memoir on the North-west Highlands, embodying the researches of Dr. Horne, Dr. Peach, Dr. Teall, Mr. Clough, and other colleagues, has just been published under the editorship of Sir Archibald Geikie.

Some shorter excursions for two days were made to May Hill, Westbury-on-Severn and the Forest of Dean, to Derbyshire, and to the Crag District of Suffolk.

On Saturday, September 28, there was a series of day excursions, all well attended, to the Northampton iron-ore district, to Aylesbury, to Dover, to Box Hill, Leatherhead and Dorking, to Reading, to Erith and Crayford, and to Sudbury. Thus opportunity was given of seeing many important and interesting geological sections.

On Monday, September 30, and following days, the foreign and colonial visitors were entertained at the Universities of Oxford and Cambridge. At Oxford the degree of D.Sc. *honoris causa* was conferred upon Prof. Charles Barrois, of Lille, Prof. Albert Heim, of Zurich, Prof. Alfred Lacroix, of Paris, Dr. Albrecht Penck, of Berlin, Dr. Hans Reusch, of Christiania, and Prof. (Geheimrath) Ferdinand Zirkel, of Leipzig. At Cambridge the degree of Sc.D. *honoris causa* was conferred upon Prof. Waldemar Christofer Brögger, of Christiania, Prof. (Geheimrath) Hermann Credner, of Leipzig, Prof. Louis Dollo, of Brussels, Prof. Albert de Lapparent, of Paris, and Prof. Alfred Gabriel Nathorst, of Stockholm. Prof. (Geheimrath) Heinrich Rosenbusch was unfortunately prevented from attending.

All the recipients of the degrees are foreign members of the Geological Society. Thus was honour done to the society and to many of its distinguished representatives abroad. H. B. W.

THE FOURTEENTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.

THE fourteenth International Congress of Hygiene and Demography, which meets every four years, was held this year in Berlin from September 23 to September 29, under the presidency of Prince Heinrich zu Schönaich-Carolath, the vice-presidents being Profs. Rubner and von Mayr. It was organised in nine sections, comprising every branch of hygiene and demography—bacteriology, parasitology and preventive medicine; general, industrial and school hygiene; port-sanitary and military and naval hygiene; dietetics, life-saving and statistics. Some 4000 members of all nationalities attended the sittings, and were received everywhere with the utmost courtesy and kindness. The meetings were held in the Reichstag buildings, which are central and admirably adapted for the purpose. The question naturally suggests itself, would the British Government pursue the enlightened policy of placing the Houses of Parliament or similar buildings at the disposal of such a congress meeting in England?

The weather throughout was delightful, and many social functions, including excursions, receptions

by Prince Heinrich and the British Ambassador, a banquet, a gala performance at the Opera, concerts, &c., served to make the time pass pleasantly. In addition, visits were organised to all the principal scientific institutions, and were much appreciated. These included the laboratories of the Imperial Board of Health and of the University, the hospitals, sanatoria, schools, &c. It is impossible to do more than glance at a few of the more important communications; the full papers will be published hereafter in a volume of Transactions.

There was an important debate on tuberculosis, and some difference of opinion existed as to the most usual mode of infection in man. Prof. Arloing, of Lyons, discussed the question of the existence of different types of the tubercle bacillus. He said that he had become convinced that the bacillus of this disease is but one, and that the species or types described by several observers are but temporary races or varieties, the apparent fixity of which does not survive the conditions of their surroundings. He considered that:—

(1) The types are rarely defined in a perfect manner; (2) they are blended together in an almost indefinite series of individuals which in growth, shape, and virulence admit of a gradual passage from one to the other; (3) variability is sufficient to explain the usual characteristics of tuberculosis in Mammalia and in birds; (4) there would be real danger, from the medical as well as the hygienic point of view, in making such unstable differences a basis for laying down principles for the prophylaxis of tuberculosis.

Dr. Ravenel, of Philadelphia, considered that:—

(1) The alimentary tract is a frequent portal of entry for the tubercle bacillus.

(2) The tubercle bacillus is able to pass through the intact mucous membrane of the alimentary tract without producing a lesion. This takes place principally during the digestion of fats.

(3) The bacilli pass with the chyle through the lacteals and thoracic duct into the blood, which conveys them to the lung, where they are retained largely by the filtering action of the tissues.

(4) Infection through the alimentary tract is especially frequent in children.

(5) Milk from tuberculous cows is the source of infection in many cases. Our present knowledge does not enable us to state the exact proportion of cases of tuberculosis due to this cause, but it is probably considerable.

Prof. Flugge, of Breslau, said that he had performed experiments which showed that tuberculosis could be communicated to animals by inhalation, and that the dose of bacilli required to infect by the respiratory tract was very far less ("millions of times") than that required to infect by the alimentary tract. The mode of infection in man doubtless varied, and children may be infected by the digestive tract by tuberculous food, particularly milk, but the most extensive source of infection is the number of droplets of tuberculous expectoration coughed up by consumptives; these float in the air and serve as sources of infection to others. Prof. Ribbert, of Bonn, and Prof. v. Schrötter, of Vienna, also from the evidence of autopsies considered inhalation as the chief mode of infection in man. Prof. Calmette, of Lille, believed that in the young, infection by the digestive tract, particularly by tuberculous milk, is the most frequent, and attached little or no importance to dry dust containing tubercle bacilli as a source of infection.

Another important discussion was on typhoid and paratyphoid infections of man and the campaign against typhoid fever. Prof. Löffler, of Greifswald, discussed the classification of the causative micro-organisms of these diseases, and their isolation and differentiation by means of sugar nutrient media containing a small percentage of the anilin dye malachite green. Dr. Lentz, of Berlin, pointed out that the bacteria of typhoid and paratyphoid fevers pass by the lymphatics from the digestive tract to the spleen, bone-marrow and blood, and are excreted by the kidneys, in some cases for long periods. Of great importance also are mild cases, sometimes amounting merely to slight indisposition; though the individual may be but little, if at all, ill, he at the same time excretes the bacillus, and thus may be a source of infection to others. Some of the paratyphoid fevers of man seem to be caused by organisms which produce diseases in the lower animals. Anti-typhoid inoculation was discussed by Prof. Wright, Col. Leishman, R.A.M.C., and Dr. Muschold. The latter, from Prussian statistics, considered the method very promising.

Plague naturally attracted some attention, and Dr. Giemsa, of Hamburg, discussed the best methods of ridding ships of rats. He preferred to expose the hold to a mixed gas, produced in a generator, consisting of 5 per cent. carbon monoxide, 18 per cent. carbon dioxide, and 77 per cent. nitrogen. Dr. Strong, of Manila, discussed the subject of preventive inoculation in plague. He considered that this was the mode of combating the disease which held out the most likelihood of success, and made out a strong case for the use of living but attenuated cultures of the plague bacillus as the prophylactic material. Prof. Gaffky, of Berlin, considered the spread of plague to be due primarily to rats, vermin transmitting the bacillus from rat to man.

In a paper on insects as carriers of disease, Dr. Dönitz pointed out that the ticks are intermediate hosts of spirochætæ and piroplasmata; the parasites pass through a developmental stage, and it is not until this has occurred that they can again infect man and animals. He referred to the present lack of knowledge concerning the structure and developmental history of the ticks, and to the confused nomenclature of these insects now existing.

Many papers were devoted to a consideration of parasitic protozoa. Dr. Doflein discussed the nature of spirochætes, as to whether they are bacteria or protozoa, and their mode of division. Prof. v. Wasielewski, of Heidelberg, believed that all parasitic protozoa can act occasionally as pathogenic agents. The Leishman-Donovan body of the Indian disease kala-azar seemed to be a flagellated protozoon; the piroplasmata also seemed to be allied to the flagellates. Prof. Hewlett, of London, considered the parasites of the different malarial fevers to be distinct species, and the piroplasmata, or some of them, to be more nearly allied to the hæmoflagellates than to the hæmosporidia.

The campaigns against malaria and yellow fever were fully discussed. Prof. Ross, of Liverpool, gave a history of the institution of anti-malaria measures and of their results in Sierra Leone, Lagos, Federated Malay States, Panama, and Ismailia; Prof. Savas, of Athens, described the malaria campaign in Greece; and Prof. Celli, of Rome, that in Italy. The latter advocated drainage, mechanical means to render the mosquitoes innocuous, *e.g.* by the use of netting, &c., and the regular prophylactic use of quinine. Prof. Agramonte, of Havana, described the epidemiology of yellow fever and the campaign against the disease in Havana. He considered that the results obtained in the control and extinction of recent epidemics of this disease confirm the truth of the doctrine of mosquito transmission in its propagation.

Under the heading of dietetics, the subject of the necessary minimum of proteins for alimentation naturally came up for discussion. Prof. Forster, of Strassburg, gave the following as his conclusions:—

(1) Besides albumen, fat, and carbohydrates, man requires for his nourishment certain substances which are contained in animal and vegetable food in varying quantities. These substances are both in quantity and quality related to the nitrogenous ingredients of food.

(2) Digestive and other ferments, the internal secretions, protective matters, &c., are nitrogenous substances or descendants of such; their production must therefore be dependent to a certain extent on the intake of albumen and the conversion of the same in the body.

(3) Until the relations both of quantity and of quality are better understood, it will be advisable for general biological and hygienic reasons to favour an ample proportion of protein in practical nutrition, and not to limit the amount of protein to the minimum with which nitrogenous equilibrium can apparently be maintained.

The alcohol question also was to the fore, but a somewhat guarded opinion seemed to be expressed regarding its supposed evil effects when used in moderation. Dr. Triboulet, of Paris, considered that alcoholic drinks had an unfavourable action in cases of tuberculosis, and that alcohol diminishes resistance and predisposes to tuberculosis. Dr. Moeli, of Berlin, considered that alcohol is not a food, is not necessary, and in many cases is detrimental, and that its use should be discouraged in every way, not only by teaching the masses the evil effects of its use, but by instituting other interests so that the lack of it should not be felt.

Industrial diseases, particularly lead and mercurial poisoning, and those arising from dust, strain, &c., were the subject of several papers, and many suggestions were made to mitigate these evils. Lighting, ventilation and water supplies were also dealt with, and likewise statistics. According to Prof. Ballod, the recent Prussian mortality tables show that as regards mortality the country has a decided superiority over the towns, but that this superiority is only distinctly noticeable among the male sex, and at ages 40–50 years the towns appear to be slightly more favourable than the country.

At the general meeting telegrams of congratulation were received from the German Emperor and Empress, Lord Lister, and others, and three special lectures by English, French, and German men of science respectively were delivered. Dr. Haldane discussed his researches on the effects of high pressures and temperatures in underground workings on man. No ill effects result with pressures below about three atmospheres, but above these, unless the pressure is increased or decreased step by step, as the case may be, grave effects may be produced. As regards temperature, it is the wet-bulb temperature which determines the suitability of atmospheric conditions in mines. The optimum wet-bulb temperature is below 27° C., the maximum that can be sustained without danger being 31° C. Prof. Chantemesse (Paris) discussed the serum treatment of typhoid fever. By growing the typhoid bacillus in a spleen broth medium for a week, heating to 55° C., and injecting into horses, the serum of the latter acquires properties which usually act favourably on the course of the disease when injected into the patient. Thus, in the Paris hospitals from 1901–7, among 5621 cases the mortality was 17 per cent., but during the same period in 1000 cases treated by Prof. Chantemesse with his serum the mortality was only 4·3 per cent. Prof. Schattenfroh, of Vienna, lectured on the hygienic care of water supplies, and the chemical and bacteriological examinations of drinking water. He urged that an international commission should be formed to devise standard methods for carrying out the latter.

The museum arranged in connection with the congress was of the greatest interest. The exhibits of the Imperial Board of Health and of the Institute for Infectious Diseases were especially noteworthy. They consisted of cultivations of pathogenic micro-organisms and drawings and photographs of the same, pathological specimens of tuberculosis and other diseases, series of specimens demonstrating agglutination and precipitin tests for blood, travelling laboratories, &c. All the principal Continental firms showed chemical and bacteriological apparatus, microscopes, and other instruments, and many of the casts showing pathological conditions were marvels of modelling. The exhibit of the Bacteriological Institute of Rio de Janeiro also was a large and comprehensive one, showing what good work is being done abroad, and it is to be regretted that exhibits from the British Empire seemed to be almost entirely wanting.

Demonstrations on the use of apparatus were given, and one interesting exhibit under the microscope was that of living active spirochætes, minute micro-organisms which occur in relapsing fever, syphilis, and certain animal diseases.

THE HARD AND SOFT STATES IN DUCTILE METALS.

WHEN the early craftsmen first observed that the metals they worked in were made harder by hammering, and that the original softness could be again restored to the hardened metal by heat, it probably did not occur to them that any explanation of these useful properties was called for. At a later period, when an interest in the reasons for things became more general, it is probable that hardening was attributed to the compacting of the substance by the driving of its particles closer together so that the mass as a whole became less open or porous. In the same way heat annealing was probably assumed to act by permanently expanding the metal and opening up its texture. So many analogies to these operations were ready to hand from the most common and everyday experiences that it is not surprising that even on closer inquiry this explanation should continue for a time to be accepted as sufficient, the more so as it was obviously true that in some cases unworked metal had an openness or porosity which could be removed by hammering or working. While the researches of chemists on the density of the metals showed plainly that increase of density does not always result from compacting by pressure, these researches were probably too far removed from the ken of those who were most intimately concerned with the working of metals to arouse them to the insufficiency of the existing explanation of hardening.

In the latter part of the past century the views of physicists and chemists on the influence of molecular structure on the properties of matter began to find application in the field of scientific metallurgy. In particular, much attention was directed to the study of the crystalline constituents of alloys and to the influence of heat treatment on their equilibrium. The study of the iron alloys also led to the development of the view that iron itself can exist in several allotropic forms; thus the idea of allotropy was introduced into practical metallurgy.

Mr. G. T. Beilby's researches,[1] which form the subject of the present article, indicate *that all crystalline substances can also exist in a non-crystalline or amorphous form, and that the properties of these two forms are so distinct that they must be regarded as definite allotropic modifications.* Observations on the stability of these forms, and on the conditions under which the one form can pass into the other, confirm this view. As these general principles have been found to apply

[1] "The Hard and Soft States in Ductile Metals." By G. T. Beilby F.R.S. Paper read before the Royal Society on June 27.

without any exception over a wide range of substances, it appears justifiable to conclude that they are universally applicable. The subject is therefore a very extensive one, and the immediate researches which are dealt with here refer to only a small corner of a very wide field.

In the light of present knowledge it would now seem as if the phenomena of the hard and soft states are so striking that they might have been expected to stimulate inquiry into their true meaning at a much earlier date. One of the most obvious of these phenomena has been perfectly familiar ever since metals were first drawn into wire—that is, that the tenacity of the metal is enormously increased by the operation. By the simple operation of wire-drawing, the power of pure soft iron to resist stretching is raised from twenty tons per square inch to more than eighty tons. Recent researches with metals in the highest state of purity have shown that the resistance of gold to stretching may be raised from 4½ tons per square inch to more than 14 tons, while silver and copper are affected to an even greater extent.

Until very recently the adjective "crystalline," when applied to a metal, at once suggested hardness and brittleness, and even yet among practical metallurgists this association of ideas is not easily got rid of. It is no paradox, however, to say that *in the pure ductile metals the crystalline state is actually the soft state.* In what follows it will be shown that a very large part of this softness is directly due to the instability of the crystalline structure. Conversely, the non-crystalline or amorphous state is the more stable mechanically, and is therefore the harder. Not only the softness, but also the malleability and ductility of a metal, largely depend on its crystalline condition. When the metal is mechanically worked, as by hammering or rolling it into sheets or bars, or by drawing it through dies into rods or wires, some of the crystalline is broken down and passes into the non-crystalline form, and as the metal thereby becomes harder it is also reduced to a lower condition of malleability and ductility.

It has been concluded from a long series of experimental observations that in the passage from the crystalline to the non-crystalline state there is an intermediate stage during which the molecules have the freedom and mobility of the liquid state, and that the amorphous state results from the sudden congealing of this mobile phase. It is well known that when a substance passes from the liquid to the solid state, time is required for the molecules to marshal themselves in the orderly formation which is the essential feature of the crystalline state. If a liquid can be congealed with sufficient suddenness, the solid which results is non-crystalline or amorphous, *e.g.* glass, sugar-candy, &c. If we were able to see the actual molecules we may imagine that the amorphous solid would present the appearance of an instantaneous photograph of a liquid in which the molecules would appear as if transfixed in the midst of their rapid movements. It follows from the above that if it were possible in a mass of metal simultaneously to break down all the crystalline units of structure with sufficient suddenness, the whole mass would for an instant be in the liquid condition, and on re-solidification would appear in the non-crystalline state. A little consideration, however, will make it plain that these conditions cannot be fulfilled in the ordinary mechanical operations on metals in the solid state. In a mass of metal, any stresses which are applied mechanically must be applied from the outside, and can only reach an internal point or surface after passing through all the intervening layers. It follows that the breaking down and "flow" of the crystalline elements must take place step by step, so that the mobile condition occurs at successive surfaces within the mass. A wave of mobility can in certain cases be seen as it passes along a stressed rod, but it is instantly followed by a wave of congelation which leaves the metal behind it in a harder and more resistant condition. In some cases a second wave of mobility may be started by the application of a greater stress, but as a rule each successive application of a uniformly increasing stress produces less and less effect. The portions of metal which have yielded and flowed and again congealed protect those portions which still retain their crystalline structure. There appear to be good grounds for believing that even in a gold leaf, in which the metal has been beaten to a thickness of only 1/280,000 of an inch, there are still minute units in the crystalline state which have escaped destruction owing to the protective action of the harder, non-crystalline metal in which they are embedded. Gold wires which have been drawn through a wire plate until they are fifteen times their original length show a microstructure in which deformed and broken down crystals are embedded in non-crystalline substance. *The hardened metal is a complex structure built up of crystalline and non-crystalline substance;* in studying its properties, therefore, it is necessary to remember that no specimen, however drastic may have been its mechanical treatment, can be entirely in the non-crystalline condition.

Though an increase of hardness and tenacity is a very conspicuous feature of the change from the one state to the other, it is only one among a number of equally definite indications of change. A comparison of the heat of solution of a metal in the two states shows that the molecular energy stored in the non-crystalline form is greater than in the crystalline. In this case the difference in solubility which results from this greater energy is further accentuated as the two phases of the metal act towards the solvent as a galvanic couple. A thermoelectric couple made by twisting together the ends of wires in the hard and soft condition is affected by changes of temperature in the same way as a couple made of two different metals would be. In the case of silver a thermocouple of this description can develop an e.m.f. of 27 microvolts for a temperature difference of 83°. *In all these cases the single chemically-pure metal behaves like two distinct metals.*

When hardened metal is heated to a certain temperature, its softness is completely restored. The microscope shows that when this occurs complete crystalline rearrangement has also taken place. The micrographs, Figs. 1 and 2, from the paper by Mr. Beilby read before the Royal Society on June 27, show the two types of structure, the hard and the soft. In Fig. 1 the original crystalline grains have been completely broken down and destroyed by wire-drawing, giving place to masses of deformed and shattered crystal units cemented or concreted together by that part of the metal which has flowed and congealed. In Fig. 2 a new crystalline structure has been developed by heat, and all traces of the other structure have disappeared. This re-crystallisation in hardened metal occurs at a temperature far below the melting point of the metal. In gold the re-crystallisation temperature is about 280°, while its melting point is 1080°; this profound change of structure, therefore, occurs 800° below the melting point.

In the crystalline state the molecules are disposed in sheets or lamellæ of uniform orientation, like soldiers in a battalion. In the liquid state the molecules are in free movement; they do not maintain fixed positions with respect to each other. The effect of sudden con-

gealing probably is to bind the molecules into a rigid mass quite irrespective of any special polar attractions which they may have for each other. They are bound together by the general cohesive force, and their freedom of movement is much curtailed. This is evident not only because they cannot move sufficiently freely to take up the regularly oriented arrangement, but

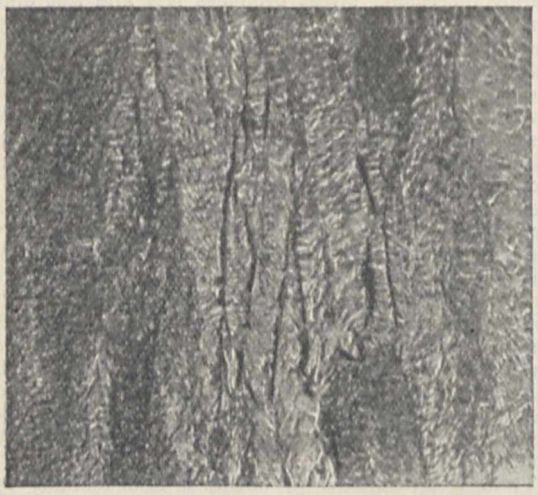


FIG. 1.—Hard-drawn gold wire. Magnification ×700.

also because their elasticity in this state is much less perfect than it is in the crystallised state; the molecules cannot vibrate freely in the amorphous state.

The effect of raising the temperature to the crystallising point is to raise the kinetic energy of the molecules, and therefore to neutralise a part of the cohesive force, thus weakening it and enabling the

FIG. 2.—Hard-drawn gold wire after crystallisation at 280°. Magnification ×700.

molecules to spring into their uniformly oriented position; the crystalline state is thus restored and the internal energy of the mass is reduced. The present observations show that crystallisation occurs over a short and definite range of temperature—short, that is to say, compared with the ranges above and below the crystallisation range. Below the crystallisation range the amorphous or non-crystalline form of the metal is known by direct observations to be perfectly stable down to −180°, while above that range the crystalline form is stable up to the temperature of liquefaction.

The changes in the electrical, mechanical, and other properties, which occur when the crystallisation range is reached, amply confirm the microscopic observations, and all point to the occurrence of an important change in the molecular structure.

By means of an acoustical method it has been found possible to detect the minute changes in elasticity which occur as the temperature is gradually raised to the crystallising range. In this way it has been made evident that there are two distinct stages in the relief of the molecular strains which are caused by hardening. In the first stage no important alteration in the other properties of the hardened metal occurs, while in the second and more important stage the complete restoration of elasticity exactly corresponds with the other changes which occur at the crystallisation temperature.

OCTOBER METEORS.

OCTOBER is a month when meteors are decidedly numerous. They are particularly abundant from October 15 to October 25, and this period includes the well-known shower of Orionids, but the conditions will be unfavourable this year owing to the full moon of October 21.

Early in the month there is occasionally a rich shower near the northern boundary of Boötes at 230°+52°, and on October 8 there are many meteors from Aries about 42°+20°, from Auriga, 77°+32°, and from about this date to October 20 there is a well pronounced morning shower of long-pathed meteors from 154°+39°.

Before sunrise the observer will also trace radiants at 101°+1°, 100°+13°, 108°+13°, 121°+0°, 133°+68°, 133°+48°.

Thirty years ago, viz. in 1877, during the first week in October there were very well pronounced showers at 133°+79° and 313°+77°; the former gave swift streak-leaving meteors, the latter slow faint meteors.

October furnishes several radiants of Perseids, and one of the most notable of these agrees precisely in its apparent position with the centre of the great display of August Perseids on the date of maximum. Between October 8 and 14 I have recorded a number of slow meteors from a well defined radiant at 45°+58°.

The principal shower in the last half of October is one of Arietids from near ε. On 1877 October 28–November 1, I saw thirty-one meteors from 43°+22°, and on 1887 October 11–24, forty-five meteors were registered from 40°+20°. The members of this system are white, rather slow, and occasionally brilliant, with trains of yellow sparks. As they were very active in 1877 and 1887, they may periodically recur at intervals of a decade, and be numerously manifested again in 1907. W. F. DENNING.

MR. HALDANE ON SCIENCE IN COMMERCE.

A VERBATIM report of the speech on scientific commercial education in relation to the successful pursuit of trade, delivered by Mr. Haldane at Liverpool on September 19, and briefly mentioned in last week's NATURE, appeared in the *Liverpool Daily Post* of September 20. The two main points developed by Mr. Haldane in the course of his remarks were the domination of mind over matter and the value of

organisation. Expressed briefly, brain-power was described as the chief factor upon which commercial progress must depend. Subjoined is a summary of the parts of the speech concerned with this subject :—

We live in a time when we shall fall behind in the race if we do not possess as a nation the gift of organisation. Capital has become the instrument in the hands of the directing brain; and the directing brain for huge concerns of to-day is only big enough if it can embrace in its survey the whole of the competing civilisation. Germany, France, the United States, and other countries are pressing us hard, and it is only by the possession of ideas, by the willingness to work as our forefathers never worked, with the same concentration, we can hope to hold our own in the race. At the bottom of great ideas comes great capacity to organise if they are to succeed; and with great capacity to organise great capacity to think. It is the thinker, the man of ideas, who can translate thought into action, that wins the race of to-day—a race far stiffer, far harder, far nobler, than the easy race of our forefathers. Our universities are growing; our tropical schools are starting; our organisation of commerce is going to be on a larger scale; and yet it is none too soon, because other nations are doing the very same thing. So it comes that the great lesson which this nation has to learn appears to be this—to recognise that mind dominates matter, that brains lie at the root of things, and that upon their working out and the results which brains have provided no progress can be made without that secondary but emphatically valuable faculty is added—the faculty of organisation.

The creation of the Committee of Imperial Defence carried scientific principles into the sphere of government, and was the first step toward getting military and naval notions into order. We now have a general staff which is a body, not to exercise command, but to give advice in a thoroughly practical fashion and in a fashion which can be enforced. The speculation may be indulged in whether one of the great reforms of government to which we are coming—because we have been driven to it—will not be the creation in an organised fashion of just such a general staff for departments of government, and not merely for the Army. A concrete instance may be given of the value of scientific advice. In two parts of the dominions of the Crown there are diseases of a terrible character raging at this moment. One is understood, because it has been dealt with by the scientific experts of the Government, but the other is not, because there are no scientific experts to deal with it. The first case is in India, where research work is carried out by experts whom the Indian Government has organised, and who are out working in the subordinate departments of the Government, exercising no authority, but giving advice and reporting to headquarters. These investigators and advisers have brought the plague in India within compass. Then, to give a second case, in one of the West Indian islands, possibly in more, there flourishes what is called tropical anæmia, which, although not fatal to life in the ordinary sense, reduces the working power of its victims by 30 per cent. or 40 per cent. This is a sheer loss to the State, and yet the disease can be and has been combated in other parts of the world. This disease, which also exists in our mines, where it is known as ankylostomiasis, was recently very familiar in Westphalia, and the German Government, working on general staff principles, dealt with the scourge on scientific principles from the beginning. The disease exists in our Cornish mines, but we have not extirpated it as thoroughly as the Germans have.

If people were but aware what can be accomplished and what can be saved to the State, and the extent to which our community can be made more efficient by dealing with these things on a scientific footing, the nation would be wiser and better. This may seem to be the bureaucratic point of view, but when it is founded on science it is the right point of view; and the governments of the future will find more and more work of this kind forced upon them.

THE REV. DR. JOHN KERR, F.R.S.

JOHN KERR, the discoverer of the Kerr effect in magneto-optics, was born at Ardrossan, Ayrshire, December 17, 1824, and received part of his early education at a parish school in Syke. He graduated M.A. with honours in 1849 at Glasgow University, where he greatly distinguished himself, especially in mathematics and natural philosophy. He completed the usual course in theology at the Free Church College in Glasgow, but, instead of entering on a clerical career, became in 1857 mathematical lecturer in the Free Church Normal Training College for Teachers in Glasgow, an institution which has recently passed under the direct control of the Scottish Education Department. Here for forty-four years he trained in mathematics and physics thousands of our youth who afterwards filled important scholastic positions. On his retirement in 1901 his old pupils entertained him at a banquet, when Prof. Magnus Maclean in their name presented him with a tea and coffee service, and made a graceful reference to his great work.

In 1867 Kerr brought out an "Elementary Treatise on Rational Mechanics" (Hamilton, Glasgow), which deserves more than a passing notice. While adhering to the usual mode of treatment at that time, namely, first statics and then dynamics, he introduced what was then a novelty in English books, a separate chapter on kinematics as a preliminary to the chapters on kinetics. Numerous examples are appended to the various chapters, and it is doubtful if among the many more modern treatises of similar standard a better working book for the student exists. Every here and there the physical mind of the author is in evidence, especially in an appendix or "Note," the object of which "is to give a sketch of some of the simpler facts connected with the manifestations of force in nature." Elasticity, cohesion, capillarity, electricity, magnetism, physical optics, and sound are briefly commented on; and the conservation of energy is discussed under that name. The book was written before the formal appearance of Thomson and Tait's "Natural Philosophy," but no doubt under its influence. It is interesting to note that Kerr returns to Newton for the true foundation of dynamics.

In 1875 Kerr published his first paper "On a New Relation between Electricity and Light: Dielectric Media Birefringent" (*Phil. Mag.*, vol. 1., pp. 337–348 and 446–458). Accepting the Faraday theory of electric strain, he constructed a remarkably simple form of apparatus in which the ends of two terminals in connection with the open secondary circuit of an induction coil were brought to within a quarter of an inch of each other in the heart of a plate of glass. Nicol prisms were arranged for extinction with their principal axes at angles of 45° with the line of terminals. When the induction coil was set in operation light was restored by the birefringent action of the electrified glass. The investigation was soon extended to liquids, such as bisulphide of carbon, benzol, paraffin, &c. By an extremely neat and simple use of a compensator of mechanically strained glass inserted in the path of the polarised ray, he proved that electrified glass acted upon transmitted light like a negative uniaxal crystal with its axis parallel to the lines of electric force. Quartz acted like glass, but resin acted like a positive uniaxal, as if it were extended along the lines of force. In later papers, published at intervals in the *Philosophical Magazine* between 1879 and 1882, he continued this research with more elaborate apparatus, and extended it to a great many substances, establishing, among other

things, the law that the optical effect varies as the square of the resultant electric force.

At the meeting of the British Association in Glasgow in 1876, the president, Prof. Andrews, made a pointed reference to these early experiments of Dr. Kerr, but little dreamed that in a few days the whole scientific world would be positively "electrified" by the announcement of the great discovery known as the Kerr effect. Not only did Kerr announce the discovery, but he demonstrated it with the simplest of apparatus before the meeting of Section A. The paper containing a full account of these experiments was published in 1877 (*Phil. Mag.*, vol. iii., pp. 321–343). The great fact established was that the plane of polarisation of a ray of plane polarised light reflected from the end of the iron core of an electromagnet is rotated under influence of the magnetising current, in a direction contrary to the conventional direction of the current. In a later paper (*Phil Mag.*, vol. v., pp. 161–177) the like phenomenon was established for light reflected from the sides of the magnetised iron. These remarkable experiments form the starting point for a prolonged series of delicate measurements in magneto-optics by several experimenters, of whom we may mention specially Righi, Kundt, Du Bois, Sissingh, Zeeman, and Drude.

On the theoretical side Fitzgerald (*Phil. Trans.*, 1880) was the first to attempt a discussion of the Kerr effect. In this effort he broke "new ground," as Maxwell expressed it; and although the theory was not comprehensive enough, nevertheless (to quote from Larmor, who has himself greatly developed the whole electromagnetic theory) "Fitzgerald's analytical work still remains applicable. The extension to metallic media is now formally made, as Ohm's law indicates, by taking the refractive index to be a complex quantity; with this generalisation the analysis has been extended by various writers, including Lorentz, Goldhammer, and Drude, but most completely by Leathem and Wind, and shown to embrace satisfactorily all the mass of detail that has been brought out in recent years in experimental magneto-optic investigations."

Dr. Kerr's latest paper on this subject (*Proceedings of the Royal Society*, 1894) described experiments on a fundamental question in electro-optics: "Reduction of Relative Retardations to Absolute." In 1888 (*Phil. Mag.*, xxvi., pp. 321–341) he published a well-planned and carefully-executed series of experiments on the birefringent action of strained glass. His last contribution to scientific literature was a note read before the British Association in 1901 on the "Brush Grating and its Optical Action."

Before the great scientific events of his life the University of Glasgow showed their appreciation of Dr. Kerr as an educationist by conferring on him in 1868 the honorary degree of Doctor of Laws. He was elected F.R.S. in 1890, and was awarded a Royal medal in 1898. He died August 18, 1907, after enjoying six years' retirement from official duties in the Normal College. Here, in limited accommodation, with still more limited apparatus, and only by devoting evening hours and precious holidays to research, John Kerr made the discoveries which have linked his name for all time with that of the immortal Faraday.

C. G. K.

NOTES.

PROF. M. H. E. TSCHERNING, director of the ophthalmological laboratory of the Sorbonne, Paris, has accepted the invitation of the council of the Optical Society to deliver the first Thomas Young oration on Thursday, October 17, and has chosen for its title "The Development of the Science of Physiological Optics during the Nineteenth Century." The oration has been established for the purpose of providing an annual lecture on some subject connected with physical, geometrical, or physiological optics, and thus to further the development of those branches of science with which the name of Thomas Young is intimately associated. The orator is elected annually by the council of the Optical Society from persons eminent in these branches of science or technology.

A VERY interesting and instructive exhibit has just been added to the public galleries of the geological department of the British Museum (Natural History) in the form of an enlarged wax model of the Silurian arachnid *Eurypterus fischeri*. Remains of these creatures are found in such a wonderful state of preservation in the Upper Silurian strata of Oesel, in the Baltic, that Prof. G. Holm has succeeded in freeing from the matrix considerable portions and mounting them on glass slides in Canada balsam. The original chitin is preserved in an almost unaltered condition, and even the most minute details of the external surface are retained. From these materials it has been possible, under the superintendence of Dr. Calman, to construct the model now exhibited, which is double the natural size, and appears to be between 7 inches and 8 inches in length. The model is temporarily placed in the central hall.

WE learn from the *British Medical Journal* that a movement for the foundation of an institution which is to bear the name of Prof. Robert Koch is on foot in Germany, and a committee has been formed with the object of collecting money for the purpose. The chairman is Dr. von Studt, Prussian State Minister; the vice-president, Privy Councillor Althoff; the secretary, Prof. Schwalbe, editor of the *Deutsche medizinische Wochenschrift*; the treasurer, Dr. Paul von Schwabach, General Consul, Berlin. The institution, which is to be applied to the furtherance of research in all directions for the discovery of means of checking the diffusion of tuberculosis, is intended to be a permanent memorial of the discovery of the tubercle bacillus by Prof. Koch twenty-five years ago. Appeal is made for contributions sufficient to make the institution a tribute of gratitude to Koch, similar to those with which the name of Pasteur has been honoured in France and that of Lister in England.

IT is announced in the *Times* that the Government has completed negotiations for the purchase of the estate of Inverliver, Argyllshire, with a view to its conversion into a State forest. The estate, which has an area of about 12,530 acres, extends for about nine miles along the western side of Loch Awe, stretching across to Loch Avich. It will be of much value as a centre of education in forestry, and arboriculturists in Scotland are gratified that their desires for the establishment of a demonstration area are about to be realised. The afforestation of Inverliver will at once be proceeded with according to a general scheme, which provides for a certain number of acres being planted each year. The estate will be under the management of the Office of Woods and Forests, and, though it will yield no immediate return, it is expected

that it will ultimately cease to be any financial burden to the State.

MAINLY at the instigation of the Hon. John Ferguson, C.M.G., the Government of Ceylon has granted to Dr. A. Willey, director of the Colombo Museum, a sum of 3000 rupees (200*l.*) to secure the services of a British anthropologist for the study of the Veddahs during 1908. Dr. C. G. Seligmann, who has made most admirable investigations in British New Guinea, has been invited to undertake this research, and we have the pleasure of stating that he has accepted the commission. The Cousins Sarasin have published a fine monograph on the physical anthropology of these interesting people, in which they have also given valuable information concerning their habits and customs; but the cultural life of these hunter folk has never been thoroughly investigated. Dr. Seligmann will mainly study the sociology and religion of the Veddahs, but he will also make his researches as complete as possible in other directions, and will pay especial attention to the old stone implements of the Veddahs, the recent discovery of which was duly announced in NATURE. He will receive cordial assistance from Dr. Willey, who has a practical knowledge of the Veddah country, and with this, and other help and information which will be offered to him, there is every reason to hope for a successful expedition. Dr. Seligmann, who will be accompanied by his wife, expects to sail at the end of November.

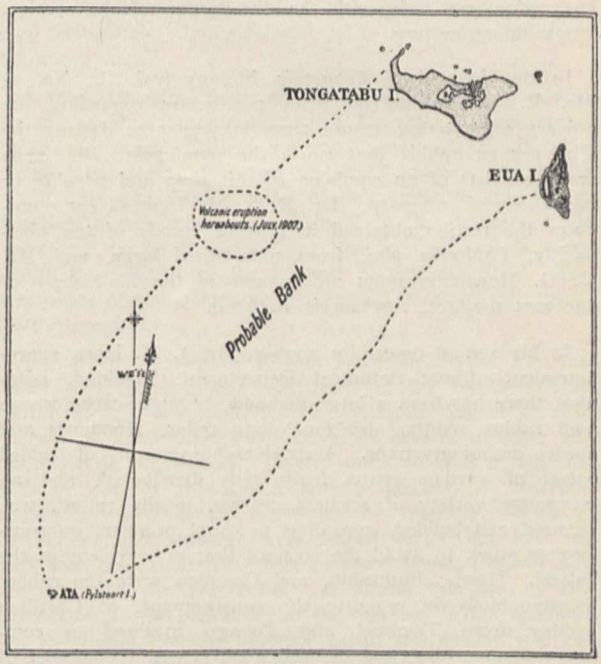
THE first exhibition of the Society of Colour Photographers, open free to the public, is being held at the offices of the *British Journal of Photography*, 24, Wellington Street, Strand, W.C. In organising the exhibition the society is appearing before the public for the first time since its formation a year ago, but its first year of active existence opportunely coincides with the appearance of simplified methods of colour photography, already described in these columns.

DR. W. S. BRUCE, Mr. Stewart Ross, and Mr. Gilbert Kerr returned to Edinburgh on Monday on the conclusion of the Scottish expedition to Prince Charles Foreland. Dr. Bruce told a Reuter representative that they have been able to make a detailed survey of the whole of the west coast of Prince Charles Foreland, of the interior with its mountains, and of a considerable portion of the east coast. Good zoological collections have been obtained, including a specially fine set of bird skins, a few seal skins, and the skeleton of a whale. Valuable geological and botanical collections have also been secured. A Reuter representative has also obtained details of the Arctic expedition undertaken by the Duc d'Orléans, who, together with Dr. Recamier, the surgeon and naturalist of the expedition, arrived in England on Monday. The expedition, which was on board the duke's Polar yacht *Belgica*, under the command of Captain de Gerlache, returned to Hammerfest on September 15. The scientific work accomplished will, it is said, prove of great interest.

WE have to acknowledge the receipt of a copy of the report of the museums of the Brooklyn Institute of Arts and Sciences for 1906, in which it is stated that the most important additions to the natural history department comprise a collection of sponges and corals made by the late Prof. H. A. Ward in Japan and Australia, and another of shells, late the property of Phebe L. Mumford. Considerable progress has been made in the mounting of realistic groups of mammals and birds, of several of which illustrations are given.

BULLETIN No. 5 of the entomological division of the experiment station of the Hawaiian Sugar Planters' Association (published at Honolulu, August 2) is devoted to the sugar-cane leaf-roller, the caterpillar of the moth *Omiodes accepta*. The moths of this genus are regarded by Sir George Hampson as inseparable from Phryganodes, but this is not accepted by Mr. O. H. Swezey, the author of the report, who states that they agree more nearly with the diagnosis of Nacoleia. The caterpillars are very destructive to grass crops, rolling up and glueing together the edges of the blades, and then devouring the softer tissues.

CAPTAIN T. H. TIZARD, F.R.S., assistant hydrographer of the Admiralty, sends us a copy of a notice to mariners, issued on September 14, relating to a volcanic eruption near the Tonga or Friendly Islands, South Pacific Ocean. The notice states:—"Information, dated July 29, 1907, has been received through the Government of the State of Victoria, that the Government of the Tonga Islands has given notice that a volcanic eruption is in progress about



Volcanic eruption near the Friendly Islands.

thirty miles south-west of the western point of Tongatábu (Niuanofo)." The approximate position of the disturbance is lat. 21° 25′ S., long. 175° 45′ W. All the information received has been given in the notice, but probably fuller details will be eventually published. The accompanying illustration from Admiralty chart No. 3421 shows the approximate position of the eruption, and also that it appears likely that a bank runs south-west from Tongatábu towards Pylstaart Island, and that the eruption is situated near the edge of this bank.

ACCORDING to the report of the Government Museum and Connemara Library, Madras, for the year 1906–7, issued by the Educational Department of Madras, July 19, the erection of a new room for the prehistoric collection made by Mr. R. B. Foote is in contemplation. Considerable progress has been made in the anthropological and ethnological section, both in the matter of collections and publications. Unfortunately, the superintendent, Mr. E.

Thurston, has to deplore the loss, by theft, of a number of valuable gold and silver coins, mostly consisting of Roman Imperial solidi and denarii.

IN the third part of vol. ii. of the *Agricultural Journal of India* Mr. H. M. Lefroy gives coloured illustrations, with descriptive letterpress, of the various developmental stages of the two species of Indian locusts. Of these, the north-west locust (*Acridium peregrinum*) is normally a migratory species, inhabiting dry districts, and giving rise to annual swarms. The Bombay locust (*A. succinctum*), on the other hand, is typically a native of the moist Western Ghats, and only occasionally assumes migratory swarms, the members of such flights assuming an abnormal red colouring. In the description of these different phases, on p. 241, the references to the figures are unfortunately incorrect. As to the black-spotted grasshopper (of which figures are also given), there is no evidence of its ever assuming migratory habits. The proper identification of migratory locusts from different parts of the country is a matter of some importance in connection, not only with the distribution of the species, but with agriculture.

IN the *Journal of Economic Biology* (vol. ii., No. 2) Mr. E. R. Burdon publishes particulars regarding the efficacy of spraying spruce trees in winter to destroy the Chermes or aphids that cause the pine-apple galls. The wash consists of an emulsion of soft soap and paraffin or a solution of soft soap. Dr. R. S. MacDougall communicates the results obtained in rearing broods of the pine-sawfly, *Lophyrus pini*, from unfertilised eggs, and Mr. C. G. Hewitt presents an account of the life-history of the root maggot, *Anthomyia radicum*.

IN his annual report for 1906–7, Mr. J. H. Hart, superintendent of the Botanical Department, Trinidad, notes that there has been a large demand for sugar-canes, cacao and rubber plants, also for young cedar, Honduras and native mahogany trees. A considerable quantity of budded stock of various citrus fruits was distributed, and an attractive variety of seedless orange, locally raised, was secured and budded, according to usual practice, on sour-orange stock to avoid the root-rot that is prevalent in the island. Hevea, Funtumia, and Castilloa were the rubber plants chiefly in request; the consignments of Castilloa rubber from Trinidad and Tobago attained to commercial quantities, and realised good prices. A number of camphor seedlings were successfully raised from imported seed, and date palms have received attention. A list is given of more than twenty palms that flowered in the gardens at St. Clair during the year.

THE scientific papers in the *Kew Bulletin*, No. 8, consist of a decade of diagnoses of new plants from the herbarium, an article by Mr. G. Massee on degeneration in potatoes, another on the cricket-bat willow by Mr. W. J. Bean, and a note by Mr. N. E. Brown defining the genus Pergularia. Mr. Massee refers to the experience of growers that "seed" potatoes often fail to form sprouts, and attributes the sterility to two causes, *i.e.* to arrest of development of the vascular system in the tuber, and to a want of sufficient diastase. The information regarding the willows is based on the collaboration of the cricketer, Mr. John Shaw, with the Rev. E. R. Linton, a leading exponent of varieties of willows. On this authority Mr. Bean states that *Salix alba*, var. *caerulea*, bearing pistillate flowers, yields the best timber, and that *Salix viridis* is suitable, although inferior to the former. Since, under favourable conditions, trees grow to a merchantable size in twelve years, the cultivation affords a prospect of profitable remuneration.

THE "Flora of the Presidency of Bombay," prepared by Mr. T. Cooke, makes good progress, as the fourth part of the second volume, issued in July, deals with the concluding orders of the dicotyledons from Urticaceæ to Ceratophyllaceæ, the gymnosperms and the monocotyledons from Hydrocharitaceæ to Typhaceæ. Under the Urticaceæ the genus Ficus is prominent with eighteen species, one, *Ficus Talboti*, being endemic. Only two gymnosperms, *i.e. Ephedra foliata* and *Gnetum scandens*, are regarded as indigenous; the conifers, ten in number, and the two cycads noted are exotic, although *Cupressus glauca* receives the name of the Goa cypress. The Orchidaceæ, with thirty-one genera, include a number of species confined to the western peninsula, and several are endemic. The Scitamineæ and Palmæ contain numerous economic plants, many of them introduced, that are briefly described. Mr. Cooke has also given a key to Drummond and Prain's identifications of species of Agave and Furcræa.

THE writer of the article on "Archæological Discoveries in Egypt," which appeared in NATURE of September 12, desires to add that when the article was written nothing was yet known of the results of Prof. Petrie's excavations, which were therefore not mentioned. Since the proofs were corrected, the annual exhibition at University College has been held, and has shown that Prof. Petrie's discoveries of this year, though by no means very exciting, have been interesting enough. The best things found are some splendid interments of the Twelfth Dynasty, with fine coffins and models of ships, &c., in perfect condition, from a tomb at Rîfa, near Asyût. From other tombs in this neighbourhood Prof. Petrie recovered an interesting series of what he calls "soul-houses," which are the small clay models of dwellings often found in tombs of the VIth–XIIth Dynasty period. They are well represented in our museums, but Prof. Petrie has obtained some new and fine types. Prof. Petrie also excavated at Giza.

WE have received a long letter from the Rev. J. W. Hayes, West Thurrock Vicarage, Grays, Essex, with regard to the so-called "twin-chamber denehole" at Gravesend, recently described in the *Times*, and referred to in our notes on September 19 (p. 522). According to Mr. Hayes, the two chambers were originally two distinct deneholes, each with its own shaft, and being in close proximity were brought into communication by a breach in the dividing wall, made after the excavation of the chalk. There is no true platform in either cavern, but a great quantity of sandy loam occupies the floor. In Mr. Hayes's opinion, the pick-marks on the roughly hewn walls could have been made only by an implement of metal, not by one of horn, bone, or flint; whilst he believes that the caves were certainly not used either as a dwelling or as a storehouse for grain.

IN a communication to the *Ceylon Observer* of August 10 Mr. J. Pole records the discovery of numerous Palæolithic stone weapons on hillocks at Imboolpittia, Ceylon. Similar discoveries have been made by the brothers Sarrasin, who have hitherto monopolised the study of that interesting forest race, the Veddahs. Mr. Pole, on rather shadowy grounds, attempts to connect the implements which he has discovered with the same tribe.

AN interesting report on the borax deposit of Lake Salinas, Peru, has been published by Mr. A. Jochamowitz (*Boletin del Cuerpo de Ingenieros de Minas del Peru*, No. 49). The so-called lake is dry for the greater part of the year, and the borax deposit is about 3 feet in thickness. It consists of ulexite, containing 30 per cent. of boric acid. The bed is impermeable, so that water cannot reach the lake at places where borate occurs. The borate is extracted by means of shallow pits, which become filled with water when the borate is removed. Reports have also been issued by Mr. W. Turner and Mr. J. J. Bravo on the geology of the River Chillon (*Boletin* No. 48), and by Mr. H. C. Hurd on the water supply of the valley of Lambayeque (*Boletin* No. 47).

THE current issue of the Proceedings of the American Philosophical Society (vol. xlvi., No. 185) covers two hundred pages, and contains seventeen papers of very varied interest. The most important memoir is a detailed account of the geology of the San Francisco peninsula, by Mr. Roderic Crandall. It describes the Montara granite, the Franciscan series, the Merced series (Pliocene), the Pleistocene beds, the serpentines, the igneous intrusive rocks, and the schists represented on the peninsula. The age and origin of the rocks are discussed, and an excellent coloured geological map is appended. Another paper of great interest is that by Mr. E. B. Titchener and Mr. W. H. Pyle on the effect of imperceptible shadows on the judgment of distance. Careful experiments show that such shadows, raised almost to the limit of perceptibility, exert no influence upon the judgments of distance by five observers. Mr. M. D. Ewell gives the results of a preliminary study of some modern micrometers. He collected a number of stage micrometers, and measured five to ten spaces on each with great care. The results show that no advance in precision has been made during the last twenty-five years. Indeed, the results do not seem to equal those of the former period. The papers of chemical interest deal with the measurement of the action of water on metals, the production of synthetic alcohol, and the association theory of solutions.

THE September number of *Symons's Meteorological Magazine* contains a useful paper by Mr. R. H. Curtis on the distribution of bright sunshine over the British Isles. Two forms of recorder have been in general use, the photographic and burning instruments; their records frequently differ considerably, and not always in the same direction. For the sake of uniformity, the Meteorological Office now only publishes records from the burning instrument, and these alone have been used in Mr. Curtis's discussion. Latitude being an important factor, we naturally find that the sunniest parts of the United Kingdom are the most southern, the annual total of hours' duration decreasing from 1900 hours in the Channel Islands to 1200 over the north of Scotland. A very clear map shows, however, that the lines of equal duration have a strong tendency to follow the coast lines both in east and west, and that a large portion of the central area of England and of the south-west of Scotland is adversely influenced by smoke and dust; in winter the largest totals of sunshine are obtained in the south-west. A great part of Ireland, central Wales, and the Highlands of Scotland are still very inadequately represented by sunshine recorders.

SEPTEMBER has proved an exceptionally fine and dry month over the entire kingdom, and in England the period without rain continued for about three weeks. Of the stations reporting to the Meteorological Office, the least measurement of rain for the month was 0·28 inch at Yarmouth, which is only 12 per cent. of the average, whilst at Bath the percentage was 18, and at Liverpool 19. At many places in different parts of the kingdom there was less than 50 per cent. of the average. In London the aggregate measurement was 0·58 inch, which is 28 per cent. of the normal. The total measurement of rain since the commencement of the year is deficient, except in the extreme north and west. In London the deficiency amounts to 4·88 inches, and, so far, April is the only month with an excess of rain; the greatest deficiency in any month is 1·48 inches, in September. The duration of sunshine so far this year is, in London, fourteen hours more than the average, the excess occurring in January, February, March, and September. There were in all during the six summer months from April to September sixty-one days at Greenwich with the temperature 70° and above, and only two days with a temperature of 80°. The only years since 1841 with fewer days of 80° and above are 1860, when the thermometer did not once touch 80°, and 1862 and 1879, when there was only one instance of so high a temperature. The type of weather which prevailed with such persistence throughout September has now completely changed, and with October rains have become general.

A SUMMARY of the paper on the effects of heavy pressures on arc spectra, communicated by Mr. W. J. Humphreys to the American Physical Society, appears in the *Physical Review* for June. Pressure seems to increase the width of all lines and displace most of them towards the red by amounts approximately proportional to the pressure. The extent of the shift varies from line to line, and is practically independent of the amount of material used. The intensities of some lines are increased, of others decreased, by the pressure.

MR. E. F. NORTHRUP directs attention in the *Physical Review* for June to the magnitude of the forces exerted by the parts of a non-electrolytic liquid carrying an electric current on each other, and describes several striking experiments in illustration. One of these consists in sending a large current through a narrow channel of mercury connecting two small reservoirs of mercury. With a current of 800 amperes a V-shaped depression half an inch deep formed at the centre of the channel, the mercury flowing into the reservoirs. A slight increase of the current broke the continuity of the mercury in the channel. On the liquid flowing together again the circuit was remade, the arrangement thus constituting a slow and irregular interrupter.

IN the *Physikalische Zeitschrift* for September 15 Dr. K. E. F. Schmidt has an article on the "barretter," *i.e.* the bolometer when used to detect and measure rapid electrical oscillations. He shows that by enclosing the instrument in an oil bath the necessity for using two similar instruments is obviated. The "barretter" in series with a galvanometer of low resistance forms one arm of a resistance bridge, the other arms of which are wound so as to have considerable inductance, and thus confine the oscillating current to the "barretter," the terminals of which are connected to the circuit in which the oscillations are to be measured. The oscillating current heats the fine wire of the instrument, and thus disturbs the balance of the bridge by a measurable amount. The conditions for maximum sensitiveness are considered by Dr. Schmidt, and the results expressed in the form of curves.

UNDER the title "Grandeur et Décadence des Rayons-N: Histoire d'une Croyance," M. Henri Piéron gives in the

Année psychologique (vol. xiii., p. 143) a review of the history of the mysterious *n*-rays from the time when their discovery was first announced by M. Blondlot in 1903. A complete bibliography of the subject is appended which comprises in all 176 original papers, very unequally distributed as regards date, nineteen being published in 1903, 139 in 1904 (103 in the first half of the year), seven in 1905, and fifteen in 1906. After the surprising statement had been made that it was possible to chloroform metals, and thus, by a process of anæsthesia, destroy their power of emitting the rays, and largely in consequence of Prof. R. W. Wood's letter in NATURE (vol. lxx., p. 530) throwing doubt on the existence of the rays, the *Revue scientifique* instituted an inquiry to ascertain whether other physicists who had worked on the subject had succeeded in verifying the remarkable statements made by MM. Blondlot, Charpentier, and Jean Becquerel. This inquiry, which has been briefly referred to in NATURE (vol. lxxi., pp. 113, 132, 157), showed that practically all those who had attempted to establish even the existence of the *n*-rays had entirely failed. A simple method of settling the question once and for all was then proposed by the *Revue scientifique*. A number of wooden boxes of exactly the same size and appearance were to be sealed up after enclosing in some of them small pieces of lead, in others rods of tempered steel, the latter being one of the recognised sources of the rays. It was to be left to M. Blondlot or his assistants to ascertain by experiments, made in presence of a committee of witnesses, which of the boxes contained the active material. This crucial test was, however, declined by M. Blondlot, who stated that "the phenomena were far too delicate for such a trial," and left "everyone to form his own opinion on the *n*-rays either from his own experiments or from his confidence in those of others." The subject was thus withdrawn from the region of fact and transferred to that of opinion. It is significant that from this time forward publication of further experiments practically ceased. A few attempts were made to obtain photographically objective evidence of the existence of the rays, but these did not withstand the test of criticism. It appears now established that the *n*-rays and their wonderful effects had no real existence, but that the results published in so long a series of papers were due to illusion caused by a species of auto-suggestion based on preconceived ideas. The matter forms, indeed, one of the most curious chapters, not only in the history of physical science, but also in that of psychology.

PAGES 1–78 of vol. ix. of the Proceedings of the Washington Academy of Sciences contain a very useful compilation, by Mr. James W. McBain, of all the experimental data referring to the quantitative measurement of electrolytic migration. Abstracts are given of all papers bearing on the subject between the years 1814 and 1905, the numerical results being summarised in the form of tables. In the introduction a brief discussion is given of the probable degree of accuracy of the determinations, of the errors introduced by the use of diaphragms and by the methods of calculation adopted; the interpretation of the results is also dealt with, a number of anomalous cases which are not in accord with the prevalent theory of solutions being considered separately, as well as the questions of hydrated and complex ions. The matter is arranged chronologically, but for convenience of reference indexes of substances and authors are appended. The compilation appears to be very complete, and its value is enhanced by the fact that a very large number of the papers bearing on the subject have titles which give no indication that they contain experiments on electrolytic migration.

MESSRS. J. GRIFFIN AND SONS, LTD., have sent us a specimen of their new Bunsen burner, which they call an "Improved Teclu Burner." The Bunsen, as a matter of fact, is a slightly modified Marshall burner, the chief feature of which was that the air passes up from beneath the burner instead of being drawn in at the sides of the tube. The gas, on the other hand, passes in at the side, and not up the centre. The novelty in the burner is the arrangement for regulating the air supply, which is cone-shaped. We have tested the burner, and find it gives a good non-luminous flame, and can be turned extremely low without striking back. Even when at its lowest the flame is quite non-luminous.

THE new session of the Institution of Mechanical Engineers will be opened on Friday evening, October 18, when a paper on the indicated power and mechanical efficiency of the gas-engine, by Prof. B. Hopkinson, will be read.

OUR ASTRONOMICAL COLUMN.

NEW ELEMENTS AND EPHEMERIS FOR COMET 1907*d*.—The following set of elements has been calculated for comet 1907*d* by Herr Kritzinger, from observations made on June 15, July 20, and August 28:—

$$T = 1907 \text{ September } 3{\cdot}9792 \text{ M.T. Berlin.}$$
$$\left.\begin{aligned} \omega &= 294^\circ\ 21'\ 37{\cdot}7'' \\ \Omega &= 143^\circ\ 2'\ 33{\cdot}7'' \\ i &= 8^\circ\ 58'\ 6{\cdot}1'' \end{aligned}\right\} 1907{\cdot}0.$$
$$\log q = 9{\cdot}709663.$$

This appears in No. 4201 of the *Astronomische Nachrichten* (p. 15, September 20), and is followed by a daily ephemeris computed therefrom by Herr Spohn; the following extract gives the calculated positions and magnitude for every eighth day:—

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

1907		α 1907·0 h. m.	δ 1907·0 ° ′	log r	log Δ	Magnitude
Oct. 3	...	11 38·5	... +3 17·9	... 9·9265	.. 0·2458	6·9
11	...	12 6·9	... +1 6·3	... 9·9908	... 0·2776	7·4
19	...	12 31·7	... −0 49·9	... 0·0472	... 0·3051	7·8
27	...	12 53·6	... −2 30·8	.. 0·0967	... 0·3290	8·1
Nov. 4	...	13 13·2	... −3 58·9	... 0·1399	.. 0·3492	8·5

The magnitudes are derived from the magnitude at the time of discovery, which is taken as 8·0.

An ephemeris extending to December 30 is given by Herr J. Franz in No. 4200 of the *Astronomische Nachrichten* (p. 401, September 12).

An excellent reproduction of Mr. Plaskett's photograph, obtained at Ottawa on July 20, appears as the frontispiece to the current issue of the Journal of the Royal Astronomical Society of Canada (vol. i., No. 4).

SEPTEMBER METEORS.—A magnificent bolide was observed at South Kensington by Mr. F. E. Baxandall at 10.40 p.m. on September 19. Its path lay from near Saturn, where it first appeared, to a little south of Cassiopeiæ, where it was seen to explode and divide into two well-defined portions. The object was intensely brilliant, and travelled very slowly along its path of nearly seventy degrees.

THE ELECTRIC ACTION OF THE SUN AND OF THE MOON.—The results of some experiments on the electric action of the sun and moon, carried out by Dr. Nodon on the summit of the Pic du Midi, appear in No. 12 (September 16, p. 521) of the *Comptes rendus*, and are exceedingly interesting. Using an aluminium-leaf electrometer, so insulated that a charge of 1500 volts was retained for a week, Dr. Nodon found that the sun induced a positive charge, which varied considerably from one moment to another between one and six volts per minute. This charge was completely absorbed by clouds passing before the solar disc, but showed itself when a black card coated with paraffin was interposed between the sun and

the instrument. An earth-connected metal screen absorbed the charge.

Dr. Nodon's experiments also indicated that the potential of the soil depends upon the variable electrical state of the upper layers of the atmosphere, for when the indicated potential of the solar charge received remained constant, that of the soil was also constant, but with a varying solar potential the terrestrial potential varied several hundred volts per minute, attaining its maximum when the former ceased to manifest itself. This action is much less marked at sea-level than at the altitude of the summit of the Pic du Midi. It is suggested that the rapid variations of the terrestrial potential may indicate approaching tempests, storms, and even earthquakes, and actual observations by Dr. Nodon tend to confirm this. With this method improved, prognostications of atmospheric and seismic troubles may become possible. On August 21, between 8 p.m. and 10 p.m., Dr. Nodon also detected a positive induction produced by the full moon analogous to the solar charge, and varying from one to five volts per minute.

PERTH CATALOGUE OF STANDARD STARS.—In "A Catalogue of 420 Standard Stars, mostly between 31° and 41° South Declination, for the Equinox 1905·0, from Observations made at the Perth Observatory, Western Australia," Mr. W. Ernest Cooke, the Government astronomer of Western Australia, appears to have done an excellent piece of work, though one might wish that the details had been given somewhat more fully.

When some of the South American observatories failed to fulfil their engagements with reference to the International Photographic Chart of the Heavens, the gap was to some extent bridged by the Perth Observatory undertaking to observe the zone 32°–40° S. The catalogue plates for this zone are now practically complete, but the measurement of the star images and the necessary reductions are delayed by the want of a sufficient number of known stars to furnish the plate constants. For this reason it is proposed to observe some 10,000 stars, appropriately scattered throughout the zone, and for reasons which are not explained the method of absolute determinations has been abandoned in favour of zonal observations. Unfortunately, Auwers's catalogue, which has been accepted as the basis of the system, does not contain a sufficient number of standard stars, and it has been necessary to choose others to act as secondary standards, and to observe these repeatedly. The present catalogue gives the places of 420 stars, which will be adopted as fundamental in the zone reductions.

The number of observations of each star is usually ten, and, judged by the probable error of a single observation, the accuracy of the mean result should be sufficient for the purpose.

VIENNA MEETING OF THE IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute was held in Vienna on September 23 and 24, under the presidency of Sir Hugh Bell, and was largely attended, there being about 450 members present. The proceedings opened with addresses of welcome by the chairman of the reception committee, by the Minister of Agriculture and Mines as representative of the Austrian Government, by the Mayor of Vienna, and by the president of the Austrian Society of Engineers and Architects, in the building of which the meeting was held. The addresses of welcome, which were delivered in German, having been translated by the secretary, Mr. Bennett H. Brough, the president, Sir Hugh Bell, responded in an eloquent German speech, and incidentally announced that the Archduke Frederick of Austria, who had acted as patron of the reception committee, had accepted honorary membership of the institute. The technical business then began.

Mr. W. Kestranek read the first paper. It recorded the progress made in the Austrian iron industry during the twenty-five years that have elapsed since the institute last met in Vienna. In 1882 Austria-Hungary produced 600,000 tons of pig iron, and the annual output has now risen to 1,900,000 tons. The country suffers from a scarcity of coking coal. It has nevertheless been able to maintain its position among the iron-producing countries of the world.

In the second paper read, Prof. H. Bauerman described the Erzberg of Eisenerz, the largest of the series of mineral deposits associated with the Palæozoic rocks of the eastern Alps. The raw ore averages 38·73 per cent. of iron, and the calcined ore 50·68 per cent. The ore is obtained by quarrying, the entire face of the deposit being laid out in a series of steps or terraces, fifty-eight in all, varying in height from 33 feet to 43 feet, giving a total depth of working faces of about 2000 feet. The present annual output is about 1,600,000 tons. The mining of iron ore on the Erzberg has been carried on from very early times. Traditionally, the workings date back to the eighth century, but there are no authentic records older than A.D. 931.

A paper on steel and meteoric iron was read by Prof. F. Berwerth (Vienna). The paper was prepared by way of introduction to the meteorite collection of the Imperial Natural History Museum, where opportunities are afforded for the study of meteoritic iron masses under conditions unequalled elsewhere. Meteoritic falls from 615 different localities are represented in the collection by 2075 specimens, the total weight of which is 3½ tons. Of these, 232 falls are iron meteorites, weighing together more than 2½ tons. The author's descriptions show that meteoritic iron and steelworks' steels are results of essentially similar chemical and physical causes.

Prof. J. von Ehrenwerth (Leoben) read a useful paper on the determination of the total quantity of blast-furnace gas for a given make of pig iron. The method proposed should prove of great value in view of the increasing importance of the waste gases as an economic factor in iron smelting, more particularly since their successful application in driving gas-engines makes it necessary that closer control should be exercised in their disposal.

At the present time there is a constantly increasing number of cases in which industrial practice is profiting by the application of the laws of modern physical chemistry. Some examples of conclusions dealing with the metallurgy of iron which may be arrived at in this way were given in a lengthy paper contributed by Baron H. von Jüptner (Vienna). He dealt more particularly with the laws of chemical equilibrium as applied to metallurgical chemical processes.

In a paper read before the institute last May, Mr. C. E. Stromeyer (Manchester) mentioned several failures of steel plates and structures, which appeared to indicate that certain qualities of mild steel might have the property of changing their nature with age. In a supplementary paper he gave the results of further experiments. They have not revealed a test which will discriminate between trustworthy and treacherous qualities of steel, but they have nevertheless established the fact that mild steel does possess ageing properties, and that certain practices which are still fairly common amongst engineers are not free from dangerous possibilities.

Four papers were read on the subject of hardening steel. Mr. C. O. Bannister (London) and Mr. W. J. Lambert (Woolwich) dealt with the case-hardening of mild steel, giving the results of some observations on the microstructure of cemented bars, on the depth of hardness, and on the carbon contents. The results do not throw much light on the manner in which the carbon penetrates the metal, but the authors consider that the solid solution theory is capable of offering a satisfactory explanation. Mr. G. Shaw Scott (Birmingham) also contributed a paper on case-hardening. He considered that nitrogen in some form is necessary for the practical performance of case-hardening, and suggested that ammonia, whilst being the prime agent in any change, may lead to the formation of cyanogen, which acts as a carrier of carbon to the metal to be carburised. Nitrogen, he concluded, should be added to the list of elements which cause iron to take or retain the γ form; and since γ iron combines more readily with carbon than does α iron, the action of nitrogen on the iron would appear to be sufficient to explain its beneficial effect during the early stages of the process of case-hardening. Throughout the research burnt leather, which is in general use in trade circles in England, was employed as the standard case-hardening material.

The results obtained in practice during the hardening of steel depend upon the conditions under which the transformations of the metal take place, and particularly on the duration and the temperature of the heating, the energy of the quenching bath, and the size of the pieces quenched. The part played by each of these factors was discussed in a lengthy paper contributed by Mr. L. Demozay (Paris). The last paper on hardened steels, contributed by Mr. Percy Longmuir (Sheffield), was somewhat controversial in character. He stated that no metallographical investigation yet published has been of the least service as a guide to the thermal treatment of high-speed steels, and that comparatively little information has been given on the hardening or tempering of carbon steels. The diversity of structure in normal and abnormal products quenched under unsuitable conditions explains to some extent the attitude of practical men towards the microscope, but instead of leading to condemnation it should rather lead to recognition of the value of microscopical examination. Diversity indicates wasters, whilst uniformity denotes correct hardening conditions. The ideal structure, or lack of structure, of commercially hardened carbon steels is produced only in a certain range of quenching temperature, which varies according to the composition of the steel and the contour of the piece to be hardened. Temperatures outside this range result in more or less crystalline patterns, which in the smallest of sections vary from field to field. Although certain of these patterns may give the appearance of special constituents, they are in reality the product of an abnormal quenching temperature, and steels containing them, although hard, are useless for cutting or resisting abrasion.

A paper was then submitted by Mr. B. H. Thwaite (London) on the economic distribution of electric power from blast furnaces. The scheme he proposed is to pool the waste gases from all the furnaces of an iron-making district and to transmit the electrically transformed energy to a central distributing station.

The last paper submitted was by Mr. F. J. R. Carulla (Derby), who described a new blue-black paint as a protective covering for iron. In the preparation of iron and steel rods for wire drawing and galvanising, as also in the preparation of plates for tinning, the iron is kept for a time in a bath of acid to remove the scale. When hydrochloric acid is used, a solution of chloride of iron is obtained, and many methods have been devised to utilise these solutions. It is now suggested that ammonia might be employed for the precipitation of the oxide of iron, seeing that the value of the ammonium chloride is greater than that of the ammonia employed. The blue-black precipitate is a valuable addition to the list of pigments that can be employed with advantage for the protection of structural ironwork.

During and after the meeting the institute was received with lavish hospitality. The members and the ladies accompanying them were entertained at banquets by the Austrian iron trâde and by the Municipality of Vienna; they were taken to luncheon on the top of the Schneeberg, to afternoon tea at the Imperial Palace of Schönbrunn, and to a special performance at the Imperial Opera House. They were honoured with a reception at Court, and the council lunched with the Archduke in his palace. On September 26 and 27 the members were divided into three groups, to visit the iron mines and works in Bohemia, Styria and Moravia, and Silesia respectively. Altogether the meeting was without doubt the most enjoyable and the most instructive recorded in the institute's annals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. ANDREW CARNEGIE has given a donation of 10,000*l.* towards the establishment of a technical college at Aberdeen.

MR. ARTHUR ACLAND is to distribute the medals and prizes of the Royal College of Science in the lecture theatre of the Victoria and Albert Museum this afternoon (October 3) at four o'clock.

AT Oxford on Monday the honorary degree of Doctor of Science was conferred upon Dr. Ludwig Mond, F.R.S., who was nominated for the degree at the last Encænia, but was prevented by ill-health from attending then to receive it.

A COURSE of free lectures to teachers, entitled "The Native Races of the Empire," will be given by Dr. A. C. Haddon, F.R.S., at the Horniman Museum, on Saturday mornings from October, 1907, to May, 1908, beginning on October 12. Admission will be by ticket only, to be obtained from the Clerk of the London County Council, County Hall, Spring Gardens, S.W.

THE mayor of the borough of Bethnal Green appeals for assistance for the Bethnal Green Free Library, which is supported entirely by voluntary subscriptions. The great want of the present time is a new and enlarged building in a more prominent position, to accommodate the increasing number of readers and provide reading-rooms for boys and girls. Mr. G. F. Hilcken, the librarian, will be glad to receive donations or subscriptions.

ANNOUNCEMENTS of the following scholarship awards have reached us:—University of London: University College—Bucknill scholarship of 135 guineas, T. C. Graves; entrance exhibitions of 55 guineas each, P. V. Early and B. Woodhouse. Guy's Hospital Medical School—Senior science scholarships for university students, 50*l.*, J. G. Saner; junior science scholarships, 150*l.*, J. F. Mackenzie; 60*l.*, R. D. Passey. Entrance scholarships, 100*l.*, C. S. L. Roberts; 25*l.*, G. D. Eccles; 25*l.*, G. F. Romer.

THE programme of university extension lectures for the coming session has just been issued by the University Extension Board of the University of London. A three years' course on the evolution of mankind as seen in the development of industries and institutions will be carried on at University College, the first term's work being taken by Prof. Lyde on geographic control of human evolution, while Dr. Slaughter will lecture in the Lent term on forms of primitive society, and Dr. Haddon in the summer term on the distribution of races. The course of work on human evolution as seen in the child and the race, brought to a successful conclusion last session, will be repeated at the Goldsmiths' College, New Cross, Dr. Chalmers Mitchell giving the earlier lectures and Dr. Slaughter and Dr. McDougall taking the later lectures.

AMONG recent developments connected with the Northampton (Polytechnic) Institute, London, E.C., referred to in the calendar for the session 1907–8, particular mention should be made of those in the department of technical optics. The most noteworthy of these developments is a course on the production and measurement of light, which is being given to both day and evening students by the electrical engineering and applied physics department and by the department of technical chemistry jointly. The lectures and laboratory work in the electrical engineering department deal with all the various kinds of electric lamps, glow, arc, and luminescent; with the problems of the production of light, and photometry, and general questions of radiation. In the technical chemistry department the subject is taken up from the chemical side, and the whole subject of incandescent lighting dealt with. The properties of rare metals and rare earths, their production, extraction, and use for all kinds of incandescent lighting, both gas and electric, are fully dealt with, and the production of metallic filaments for electric glow lamps is thoroughly studied. In the technical optics department four new classes especially suitable for artisan students have been started. There are also special classes for the instruction of kinematograph operators, which it is hoped will place this kind of work upon a sound scientific basis.

THE calendar of University College, London, for the session 1907–8, which has just been issued, contains many new features. There is a sketch of the history of University College by Dr. Carey Foster, together with a full

statement of the statutes and regulations under which the college is now governed in its new position as an integral portion of the University of London. It also contains a set of plans that show the uses to which the extension of buildings is being put. It appears that the space now available for university purposes is greater by one-third than it was last session. Among the most striking features of the new developments are the following:—the institution of a new department of geology with geological museum, rock museum, and research room; the enlargement of each of the engineering departments and of the drawing office; the enlargement of the department of applied mathematics, and the provision of special rooms to be known as the Galton research laboratories in connection with the Eugenics Institute founded by Mr. Francis Galton. The calendar also contains a section setting forth in full the arrangements for post-graduate courses of lectures and arrangements for research work. The opportunities for research work are full and ample, and the regulation with regard to admission is such that no one qualified to undertake research work ought to be debarred therefrom. It appears from the summary of students that there were no fewer than 171 post-graduate and research students in the college last session, consisting of 140 men and thirty-one women.

AT the annual meeting of the governors of the Glasgow and West of Scotland Technical College on September 24 Mr. G. T. Beilby, F.R.S., was unanimously elected chairman of the governors in succession to the late Sir William Robertson Copland. As a chemical technologist, Mr. Beilby enjoys a world-wide reputation. In industrial circles his name is more particularly associated with the Young and Beilby retort, and with a process for the manufacture of potassium cyanide. The introduction of the former revolutionised the process of shale distillation, and enabled the industry to emerge successfully from the struggle for existence; by means of the latter invention he has been instrumental in retaining an important industry in this country. As an investigator in the regions of pure science, Mr. Beilby has also established his reputation, his valuable researches on the surface structure of metals having attracted widespread attention. The second section of the new buildings for the college is in course of erection, and is expected to be ready for occupation in the session 1908–9; operations on the third section, which will complete the buildings as originally planned, will be undertaken immediately. The accommodation provided in the new buildings has enabled the college to extend its work in various directions. Recognition has been given to the importance, in a large engineering centre, of the study of fuels and their applications, and a very complete equipment has been provided in the department of technical chemistry for valuing fuels and illustrating the methods of controlling their use. This consists of calorimeters of all the various types for use with solid, liquid, and gaseous fuels, all the commonly used forms of pyrometer, and an experimental gas producer. Another feature of this department is the plant which has been installed for giving instruction in the methods of conducting technical experiments. The equipment includes grinding mills, filter and hydraulic presses, a hydro-extractor, a small refrigerating plant, pumps, an air liquefier, a steam-jacketed pan, and a double-effect vacuum evaporator plant. The laboratory in the department of motive-power engineering has been fully equipped, and in designing the equipment the object has been, not merely to provide for the illustration of principles set forth in the lecture course, but also to promote the industries of the district by obtaining information ahead of current practice. In addition to the ordinary steam, gas, and oil engines, there are several pieces of plant of special interest; with one of these engines experiments are being made from which it is hoped that information will be obtained to settle the much disputed points in the initial condensation *versus* valve leakage controversy. In the equipment of the other laboratories equal care has been shown, and every effort has been made to render them suitable for the needs of a great centre of industry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 20.—"The Fluted Spectrum of Titanium Oxide." By A. **Fowler.**

The author has previously shown that nearly all the dark flutings which are characteristic of the spectra of Antarian or third-type stars correspond with flutings obtained from compounds of titanium.

The first part of the present paper gives an account of experiments which indicate that the flutings in question are produced by a compound of titanium with oxygen, and not by the vapour of the metal itself. The most conclusive evidence on this point was afforded by titanium chloride, which, in the absence of oxygen, did not show the Antarian flutings, although the occurrence of another group of flutings, attributed to the chloride itself, indicated that the conditions were not unfavourable for their production if their existence depended only upon the presence of titanium. Experiments with metallic titanium also showed that the Antarian flutings were only produced in the presence of oxygen.

The result is of some importance as indicating that the source of the fluted absorption in the Antarian stars is at a temperature low enough to permit the formation of a chemical compound, and also as demonstrating the presence of oxygen, of the existence of which in these stars there is otherwise no direct evidence. The investigation has lately gained additional interest in consequence of Prof. Hale's discovery of some of the less refrangible flutings in the spectra of sun-spots.

The second part of the paper contains a revised and extended table of wave-lengths, based upon photographs taken with much greater dispersion than that previously employed. For the first heads of the more prominent groups of flutings the wave-lengths tabulated are 4584·62, 4761·08, 4954·78, 5167·00, 5448·48, 5597·92, 6158·86, and 7054·5. All of these are strongly marked in the stellar spectra, that in the extreme red having lately been photographed by Slipher and Newall. Two of the stellar bands, however, about wave-lengths 5862 and 6493, do not appear to be sufficiently accounted for by titanium oxide. Photographs of the spectrum are reproduced in the paper.

Received July 4.—"The Effect of Pressure upon Arc Spectra. No. 1. Iron." By W. Geoffrey **Duffield.**

The first part of the paper contains a description of the mounting and adjustment of the large Rowland concave grating in the physical laboratory of the Manchester University. The feature of this is the stability of the carriages carrying the grating and camera, and the novel construction and attachment of the cross-beam, which secure the absence of any disturbance which might be caused by bending or sagging.

The second part describes experiments made with a pressure cylinder designed by Mr. J. E. Petavel, F.R.S., in which an arc is formed between metal poles opposite a glass window, through which the light is examined by means of the grating spectroscope. A system of mirrors allows the image of the arc, however unsteady it may be, to be kept almost continuously in focus upon the slit.

Two sets of photographs of the iron arc in air have been taken for pressures ranging from 1 to 101 atmospheres (absolute), and the results are given below for wave-lengths $\lambda=4000$ Å.U. to $\lambda=4500$ Å.U.

I. *Broadening.*

(1) With increase of pressure all lines become broader.

(2) The amount of broadening is different for different lines, some almost becoming bands at high pressures, and others remaining comparatively sharp.

(3) The broadening may be symmetrical or unsymmetrical; in the latter case the broadening is greater on the red side.

II. *Displacement.*

(1) Under pressure the most intense portion of every line is displaced from the position it occupies at a pressure of 1 atmosphere.

(2) Reversed as well as bright lines are displaced.

(3) With increase of pressure the displacement is towards the red side of the spectrum.

(4) The displacement is real, and is not due to unsymmetrical broadening.

(5) The displacements are different for different lines.

(6) The lines of the iron arc can be grouped into series according to the amounts of their displacements.

(7) Three groups can in this way be distinguished from one another; the displacements of Groups I., II., III. bear to one another the approximate ratio 1 : 2 : 4. (The existence of a fourth group is suggested by the behaviour of two lines, but further evidence is needed upon this point; 1 : 2 : 4 : 8 would be the approximate relations existing between the four groups.)

(8) Though all the lines examined, with two possible exceptions, fall into one or other of these groups, the lines belonging to any one group differ to an appreciable extent among themselves in the amounts of their displacements.

(9) The relation between the pressure and the displacement is in general a linear one, but some photographs taken at 15, 20, and 25 atmospheres pressure give readings incompatible with this relation. Other photographs at 15 and 25 atmospheres present values which are compatible with it.

(10) The abnormal readings are approximately twice those required by the displacements at other pressures, if the displacement is to be a continuous and linear function of the pressure throughout.

(11) On the photographs showing abnormal displacements the reversals are more numerous and broader than they are on plates giving normal values, and there is some evidence in favour of a connection between the occurrence of abnormal displacements and the tendency of the lines to reverse.

III. *Reversal.*

(1) As the pressure is increased, reversals at first become more numerous and broader.

(2) The tendency of the lines to reverse reaches a maximum in the neighbourhood of 20 to 25 atmospheres, and a further increase in pressure reduces their number and width.

(3) Two types of reversal appear on the photographs, symmetrical and unsymmetrical.

(4) Within the range of pressure investigated, the reversals show no tendency to change their type.

(5) In the case of unsymmetrically reversed lines in the electric arc, the reversed portion does not in general correspond to the most intense part of the emission line, being usually on its more refrangible side.

(6) The displacements of the reversed parts of the unsymmetrically reversed lines of Group III. are about one-half the displacements of the corresponding emission lines. Indeed, the reversed parts of the lines of Group III. fall approximately in Group II.

(7) No relation between the order of reversal and the frequency of vibration, such as exists in the spark, has been observed in the iron arc for the ranges of wave-length and pressure examined.

IV. *Intensity.*

(1) The intensity of the light emitted by the iron arc is, under high pressure, much greater than at normal atmospheric pressure.

(2) Changes in relative intensity of the lines are produced by pressure. Lists of enhanced and weakened lines are given.

PARIS.

Academy of Sciences, September 23.—M. Henri Becquerel in the chair.—The red disease of the pines in the Upper Jura: E. L. **Bouvier.** This disease attacks *Abies pectinata* and leaves Picea untouched, and during the last year has assumed alarming proportions in the Jura. A fungus would appear to be the cause of the disease, and as this attacks pines only, it is proposed as a remedial measure to plant no more pines, but to replace them with Picea. Trees that are attacked should be cut down, since their vitality is already destroyed.—Parthenogenesis without oxygen. The elevation of the parthenogenetic larvæ of Asteria up to the perfect form: Yves **Delage.** The author has repeated the experiments of Loeb on the influence of the absence of oxygen, but cannot confirm them; oxygen does not appear to have the influence accorded to it by Loeb. The preparation of the solution for the development experiments has been simplified, and now consists of 300 c.c. of sea water, 700 c.c. of a solution containing 388 grams of saccharose per litre, 0·15 gram of tannin dissolved in a little water, and 3 c.c. of a normal solution of ammonia. The eggs, extracted from the ovary, are placed for one hour in 50 c.c. of this solution, then placed in sea water, two or three times renewed by decantation in order to remove all traces of the reagent. After eighteen hours the vessel swarms with living larvæ. Details are given of all the sea-urchins which have reached the fully developed stage, including one abnormal specimen possessing hexameral symmetry.—The series of methylation of ethyl alcohol from the point of view of the aptitude of isomerisation of the haloid esters: Louis **Henry.** The change of an alkyl halide into an isomer usually means the transference of the halogen atom to a carbon atom combined with a smaller number of hydrogen atoms than the original carbon atom.—The Daniel (1907) comet and its spectrum: Henri **Chrétien.**—Special iron castings, and more especially castings containing nickel: Léon **Guillet.** The net result of this, together with the previous work on the same subject, is that elements such as nickel, aluminium, and silicon, which dissolve in the iron, favour the formation of graphite. Elements which form a double carbide with cementite oppose the formation of graphite (manganese, chromium).—Experimental researches on the lesions following compression and crushing of the sensitive ganglia: G. **Marinesco** and J. **Minea.**—Memory in *Convoluta roscoffensis*: Louis **Martin.** Specimens of Convoluta removed from the seashore and placed in a jar in the laboratory oscillate for a certain time in synchronism with the time of the tides. Under certain conditions, which are described in detail, this memory disappears.—Contribution to the study of the lower valley of the river Ain: J. B. **Martin.**

CONTENTS.