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THE EVOLUTION OF THE VASCULAR SYSTEM IN FERNS.

Lectures on the Evolution of the Filicinean Vascular System. By A. G. Tansley. Pp. viii+143. *New Phytologist* Reprint, No. 2. (Cambridge: Botany School, 1908.) Price 3s. 6d.

THIS is the second "*New Phytologist* Reprint" of special courses of lectures in botany, delivered under the auspices of the University of London. The publication of these advanced lectures serves a very useful purpose, and it is to be hoped will be continued.

The present reprint differs, as regards the introductory lecture, from the original report in the *New Phytologist,* of which Mr. Tansley is editor. This lecture has been re-written, in the light of some friendly criticisms published since its first appearance, so that it is necessary to consult the reprint in order to learn the author's mature views. The first lecture is of wide interest, for it deals with the question of the origin of the Pteridophyta, involving that of the vascular plants generally. As the author says (p. 4), there is much reason to believe that the true vascular plants had a common origin—in other words, that the Pteridophyta are a monophyletic group. We have, however, no direct knowledge of any plants which suggest "Pro-Pteridophyta," and are forced to take refuge in speculation. The author first notices the well-known "antithetic theory," which traces the origin of the spore-bearing plant from a sporogonium or fruit like that of the Bryophyta (*see* NATURE, November 5, 1908, pp. 1-4). The author points out that this theory involves some tremendous morphological assumptions in the way of the origin of new organs, particularly leaves. The position has changed considerably since this book was published, and the theory is no longer maintained by its chief advocate, Prof. Bower, in its original form;[1] we have, probably, in the future to look rather for some explanation such as is here suggested by Mr. Tansley. He starts from a form like the seaweed Dictyota, "in which two morphologically identical generations, the one bearing sexual organs and the other bearing tetrasporangia, follow one another in regular alternation."

"If we imagine such a form to become subterrestrial, its spores becoming adapted to aërial distribution, its thallus-branches becoming specialised into stem and leaf, while its sexual generation is reduced in vegetative development, we have a practicable ancestor of the Pteridophyta" (p. 7).

It is probably on such lines as these that the problem of the origin of the plant in the Vasculares will be solved, if a solution is ever attainable.

The author, however, accepts the antithetic theory for the moss phylum, and therefore concludes that the alternation of generations in the two groups had a distinct origin, and that the sporogonium of a bryophyte is not homologous with the spore-bearing plant of a fern. The author suggests an ingenious view of the relation between the two forms of alternation, but the reviewer inclines rather to the belief that the sporogonium of the mosses and liverworts represents a reduction from some more plant-like type of sporophyte.

Lectures ii.-ix. treat of the main subject of the course, the evolution of the vascular system in the fern series. Lecture ii. is on the important Palæozoic group Botryopterideæ, the most ancient family of ferns of which the structure is known. In some of these plants the leaf branched in more than one plane, four series of pinnæ, instead of two, springing from the main rachis. In the opinion of the author,

"This tendency to radial organisation of the frond may perhaps be regarded as a relic of the time when, according to our basal hypothesis, the structure of the fronds of ferns was but little differentiated from the structure of their stems" (p. 23).

The radial branching of the frond, however, appears to be characteristic of the more complex members of the family, and may more probably be regarded as a specialisation (perhaps peculiar to the fertile frond) than as a vestige of primitive organisation. The known Palæozoic plants were, after all, a long way removed from primeval simplicity.

In lecture iii., the simple structure of the filmy ferns, so similar in many respects to that of the extinct Botryopterids, is considered. Lecture iv. is concerned with the Gleicheniaceæ and Lindsayeæ, families in which the solid vascular cylinder is beginning to give rise to the tubular structure which forms the transition to the more complex vascular systems. The Lindsaya type, in particular, with an internal strand of phloëm running through an otherwise solid woody axis, is of great evolutionary interest, because the same structure recurs in the early stages of development of more advanced ferns.

Lecture v. treats of the evolution of the tubular stele as shown in the Schizæaceæ, a family of small extent which presents a remarkable range of anatomical structure.

Lecture vi. is devoted to the evolution of "dictyostely" (the typical polystely of Van Tieghem), in which the vascular system opens out into an elaborate network of strands, each having in some degree the structure of the entire vascular cylinder of the lower forms. The author, however, in his glossary at the end of the book, tells us that the use of the term polystely and its variants should be discontinued altogether, at least in the fern series. As a counsel of perfection this judgment may be received with submission, but the terminology of the great French anatomist still has a descriptive value, and its use will probably not be wholly abandoned at present.

The specially complex anatomical organisation described as "polycycly," where the vascular system is built up of two or more concentric cylinders, is considered in lectures vi. and vii. In the more extreme forms of polycycly (Marattiaceæ and tree-ferns), the highest elaboration met with, either in the fern series or elsewhere, is attained.

In the next lecture (viii.) simpler types (those of the Osmundaceæ and Ophioglossales), which lie apart from the main lines of descent, are taken up. The

[1] See Discussion on "Alternation of Generations" at the Linnean Society, *New Phytologist*, March, 1909, pp. 104-16.

Osmundaceæ have recently acquired a remarkable interest from the researches of Kidston and Gwynne-Vaughan, who have succeeded in tracing back this family, on anatomical evidence, to a common origin with the Palæozoic Botryopterideæ. The adder's tongues, on the other hand, have been separated from the ferns by some authorities. The author lays stress on the relations of this family to the Sphenophyllum-Psilotum type, as well as to the ferns and Cycadofilices.

Lecture ix. is occupied partly with the filicinean leaf-trace, partly with the development of the vascular system in the individual plant (ontogeny). In introducing the latter subject an interesting comparison is drawn between animal and vegetable embryology (p. 121).

In the final lecture the vascular system of the ferns is compared with that of other phyla of vascular plants. A valuable criticism of Prof. Jeffrey's proposed division of the higher plants into Lycopsida and Pteropsida is given in this connection. Sections on the morphological construction of Selaginella compared with that of the ferns (with which a remarkable analogy is ingeniously traced), and on the relations of ferns and seed-plants, conclude the course.

The book is an admirable example of the evolutionary treatment of the anatomical structure of plants, a line of research in which English-speaking botanists have for some time past taken the lead, the author himself being one of its best exponents.

We have only one verbal criticism to add; it is a pity that the author lends his sanction to the misuse of the word *hypothecate*, now becoming frequent among certain of the younger writers of scientific papers. He speaks of "such an ancestor as we have hypothecated" (p. 6). We have learnt from Sir W. S. Gilbert that ancestors may be bought, but it was reserved for the modern botanical author to discover that they may be *mortgaged*!

A glossary, bibliography, and index complete the volume. D. H. S.

ELECTRICAL ENGINEERING.

Heavy Electrical Engineering. By H. M. Hobart. Pp. xxiv+338. (London: A. Constable and Co., Ltd., 1908.) Price 16*s*. net.

With so prolific an author as Mr. Hobart, the expectation of finding in any new book a good deal of old matter in a new guise is but natural, but in the present case such an expectation would be quite erroneous. This book is original from beginning to end; moreover, it is a perfect store of useful practical data and is clearly written, so that the reader always remains in touch with the author and knows what point he wishes to make. These points are not matters of little detail, but the features in a design which really count. It is this ability of Mr. Hobart to take a broad and comprehensive view of his subject which makes this book so eminently readable. But in parts it is also highly controversial, and although also these parts are interesting reading, one cannot help feeling a little anxious for the author lest he should prove a false prophet. Thus he calls the London, Brighton and South Coast electrification "this single-phase monstrosity," and devotes several pages to prove that the work could have been done for two-thirds the money on the direct-current system and in much less time. It may be that he is right, but if one remembers that the Swiss railway committee, which has been deliberating for three years, has not yet taken heart to condemn the single-phase system root and branch as Mr. Hobart does, a saying about a region where angels fear to tread comes to one's mind. Another point on which the author is equally dictatorial in his judgment concerns the transmission of power by high-pressure continuous current on the series system.

The general scope of the work is excellent. The author takes in succession all the parts of a large electricity supply undertaking, and shows us the determining factors and their relative importance in the right perspective. The metric system is used throughout, and as unit of power the kilowatt. As unit of energy the author uses the kilowatt-hour, whether the energy be mechanical or heat. Thus we find even such quantities as the specific heat and the latent heat of steam expressed, not in calories, but in kilowatt-hours. As the unit mass to which these quantities are referred he takes one metric ton of steam or water. In the first two introductory chapters are given tables on the property of steam in the new measure, evaporative power, cost and calorific value of coal, the over-all efficiency of generating stations, an analysis of the losses, the plant capacity in various stations, the demand for light, power, and traction in various towns, &c., all from actual experience and carefully tabulated. He then shows by way of example how the figures collected may be used to design an electricity works for a town of one million inhabitants, and comes to the conclusion that the immediate demand would be for 77 million kilowatt-hours per annum, and the demand in the course of the next ten years 120 million kilowatt-hours. The works should, therefore, be designed with the view of an extension up to this limit. With chapter iii. and subsequent chapters we enter into the more technical part of the subject, namely, steam-raising plant, engines and turbines, generating machinery, condensing plant, and the generating station considered as a whole. This brings us to chapter viii., which deals with overhead lines and underground cables, whilst the last two chapters are devoted to a criticism of the Thury system and to electric traction.

Most of what the author has to say on steam engines is concerned with turbines, and very little is said about piston engines. Neither does the author discuss the advantage of combining the piston engine with the turbine in the sense that the former utilises the high-pressure steam and exhausts into the latter. His ideas as to the ultimate size of turbine sets are on a grand scale. He thinks that units of 10,000 to 20,000 kw. at pressures up to 20,000 volts will come into use. Curiously enough, he says nothing about the question of how sets of this magnitude are to be kept cool.

is quite obvious that the air required for ventilation would not only have to be supplied in huge quantities by special fans, but also that it would have to be carried away in closed ducts to the outside of the engine-room.

When dealing with gas engines for alternating-current generators the author falls into a strange error. He mentions as one of the drawbacks that power is lost through the damping coils which the irregular motion of a gas engine renders necessary. Now it is well known that damping coils must not be used in such cases. His remarks on slot insulation, on which subject he is an authority, are highly interesting; he believes that eventually it will be possible to reduce this to something like 2 mm. for a 10,000-volt machine, but unfortunately he does not say in what manner this improvement is to be achieved. He is evidently an advocate of severe testing, and the subject of insulation tests gives him the opportunity of a homily on the ethics of the inspecting engineer. His suggestion that the sufficiency of the mechanical support of the winding should be tested by short-circuiting at full excitation the terminals of, say, a 5000-kw. alternator sounds rather heroic, and his anticipation that not more than six times normal current would flow at the instant of closing the switch may be doubted, although he is quite right in saying that, a moment after, the current would only be about three times the normal value.

The chapter on the design of the central station as a whole is particularly interesting and useful. Here we find an enormous mass of information collected from a variety of stations and tabulated in a convenient form. The same may be said of the chapter on transmission plant. The author gives us, not only technical details, but also the cost from actual experience, and one cannot but admire the industry with which he has collected so much really valuable information. As regards electric traction, his sympathies are all for the direct-current system, for which he predicts a rise of working pressure up to something like 1200 volts. The single-phase system he condemns entirely, but as regards the three-phase he admits a slight superiority in the matter of weight over the direct-current system. As the limits of the power of motors at the ordinary one-hour rating he takes 150 h.p. for the single-phase, 300 h.p. for the continuous, and 400 h.p. for the three-phase system. The three-phase system is a little lighter, and the single-phase system more than twice as heavy as the continuous-current system. A new and very simple formula for the tractive resistance in kg. per ton of train is given on p. 231. It is as follows:—

$$R = 2{\cdot}70 + 0{\cdot}09\frac{V^2}{W}$$

for railways in the open, and

$$R = 3 + 0{\cdot}3\frac{V^2}{W}$$

for tube railways. V is the speed in km. per hour, and W is the weight of the train in tons.

GISBERT KAPP.

WHY LEAVES ARE GREEN.

Zur Biologie des Chlorophylls, Laubfarbe und Himmelslicht, Vergilbung und Etiolement. By Ernst *Stahl.* Pp. v+153. (Jena: Gustav Fischer, 1909.) Price 4 marks.

IN this interesting and suggestive book, Prof. Stahl presents us with the results of his observations and speculations upon the ever-interesting problems of the biology of chlorophyll and its related colouring matters. One of the most interesting of these is the cause of the prevailing green colour of our vegetation. How does it arise that the various photosynthetic organs of plants are green, and not some other colour?

Engelmann has already shown that the colours of the algal vegetation of the sea are complementary to the light which falls upon them, and Gaidukov has made experiments to show that the Cyanophyceæ, or blue-green algæ, undergo a change in colour complementary to the light which falls upon them, when grown under different coloured lights. Prof. Stahl thinks that these observations may lead to an explanation of the green colour of land plants. The chlorophyll spectrum may be regarded as a combination of two absorption spectra. The absorption at the blue end of the spectrum agrees very nearly with that of etiolin and the colouring matter of yellow leaves, whilst the absorption in the red corresponds to that of the green colouring matter which is formed when etiolated plants are exposed to light, and disappears in the autumn, when the leaves again turn yellow. The yellow-green colour of the leaf may, therefore, be an adaptation to the prevailing colour of the diffuse light which falls upon it, the yellow being complementary to the blue of the heavens, and the green to the orange and red which mostly prevail when the sun is low.

The region of least absorption in the chlorophyll corresponds with that of maximum energy in the spectrum. The plant does not, therefore, depend for its assimilative work upon the rays of greatest energy. On the other hand, the possibility of using these rays is shown by the red algæ, which absorb the green as well as the blue, the maximum of their assimilative activity lying exactly in the green.

The author tries to show that the non-absorption of the green rays is not only due to the fact that the chlorophyll makes no use of those rays which usually reach it in a weakened form, but also to the fact that the absorption of these rays in direct sunlight would be dangerous to the plant, because of their great heating power. Under normal conditions an intense illumination is unnecessary. The amount of energy used up by the chlorophyll grain in carbohydrate assimilation is only a small part of the total energy it absorbs. In light of lower intensities, however, it is clear that the amount of energy absorbed by the plant becomes more nearly proportional to the amount used for assimilation, and thus a complementary colour adaptation to the light is understandable. In the red and brown seaweeds, the blue-green algæ, &c., the absorption of the green rays may be necessary to supply the plant with the energy required. A too intense illumination of the leaf, by concentration of the sun's rays upon it, destroys the chlorophyll. According to Pringsheim, this is caused by the chemical rays, but Prof. Stahl considers that the effects of the heat rays have been overlooked, and he insists on this as an important factor in the problem. The variation in the colour of foliage leaves, according to whether they are in the sun or in the shade, is partly due, he thinks, to this danger of overheating. In the special case of the red and brown seaweeds, he considers that the colours are not entirely due to an adaptation to the quality of the light, but also to its intensity.

How far the author's conclusions are justified remains to be seen, but he adduces a considerable amount of evidence in favour of them, which he discusses in a most interesting and suggestive way.

Prof. Stahl suggests that the etiolation, and the yellow coloration of leaves in autumn, may be due to the need of economy in food materials. Willstätter has shown that, in its purest form, green chlorophyll contains C, H, O, N, and Mg. The yellow colouring matters contain only C, H, and O, so that, by keeping back the green chlorophyll in the spring and re-absorbing it in the autumn, a saving would be effected in nitrogen and magnesium, which are of great value to the plant.

Some interesting experiments are described to show that this actually does take place. If leaves which are just on the point of turning yellow, but are still green, are removed from the plant and kept in a damp chamber, they retain their green colour, whilst neighbouring leaves, still attached to the plant, become yellow. So, also, if slits are cut in the leaf, so that the principal veins are severed, the portions of leaf thus cut off from the main conducting vessels remain green, whilst the other parts turn yellow. The results of experiments made by various observers, and others recently made at the author's suggestion, in the agricultural laboratory at Jena, are brought forward to show that potassium and nitrogen, phosphoric acid, iron, chlorine, and silica, are more or less reduced in amount in the yellow as compared with the green leaf. The significance of these facts, which no doubt lend considerable support to Prof. Stahl's interesting hypothesis, is fully discussed, but that the etiolation of young leaves and the yellow coloration of old leaves are so definitely associated with the plant's need for economy cannot, from the evidence before us, be said to be so clearly established as Prof. Stahl seems to think.

H. W.

THE FOUNDATIONS OF GEOMETRY.

Grundlagen der Geometrie. By D. Hilbert. Third edition. Pp. vi+280. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 6 marks.

THIS fascinating work has long since attained the rank of a classic, but attention may be directed to this new edition, which has various additions, mainly bibliographical, and seven supplements, which are reprints of papers by the author on topics related to that of his famous essay. Two of these can be enjoyed by readers with no exceptional mathematical knowledge. In the one on the equality of the base angles of an isosceles triangle, Dr. Hilbert proves, *inter alia,* the remarkable fact that, even if we assume Euclid's theory of proportion, we cannot prove his propositions on equalities of area, unless we assume the truth of prop. 4, bk. i., of the "Elements" in the wider sense—that is, when one triangle has to be turned over to make it fit the other. It is also pointed out (p. 68) that two tetrahedra can be constructed with equal heights, and bases of equal area, which cannot be cut up into congruent polyhedra, and to which congruent polyhedra cannot be added in such a way that the solids thus produced can be sliced up into congruent parts. Consequently it is impossible to build up a theory of equality of volumes strictly analogous to Euclid's theory of equality of areas.

Another supplement of general interest, and easily understood, is that on the notion of number. The most noticeable thing here is the remark that the commutative law of addition ($a+b=b+a$) can be deduced from the distributive laws of multiplication, together with the axiom $a.1=1.a=a$; thus

$$(a+b)(1+1)=(a+b).1+(a+b)1=a+b+a+b$$
$$(a+b)(1+1)=a(1+1)+b(1+1)=a+a+b+b;$$

therefore $a+b+a+b=a+a+b+b$, and hence $b+a=a+b$.

The seventh supplement, on the foundations of logic and arithmetic, deserves very careful study, both by mathematicians and by philosophers. The main feature of this is that an aggregate is defined as *any* object of thought, and the notion of "element of an aggregate" is a derived one. Dr. Hilbert objects to Dedekind's method in his well-known tract on number, because it postulates the aggregate of "all objects of thought" as a definite conception. A sort of promise is given that the author will expand the ideas of this essay in greater detail, and it is earnestly to be hoped that this intention will be carried out. In connection with these discussions there is one point that deserves attention; a finite intelligence thinks *in time,* and cannot rid itself of that idea. Now, if we take the statements (1) I am conscious; (2) I am conscious that I am conscious; (3) I am conscious that I am conscious that I am conscious; (1) is the most elementary possible thought from a metaphysical point of view, (2) is the most elementary form of reflection, and if we admit that any thought can be reflected upon, we at once get the natural scale in the form t, tr, tr^2, tr^3, &c. It is not impossible that some such reasoning was in the mind of Rowan Hamilton when he made the statement, which puzzled De Morgan, that "Algebra is the science of Pure Time." Until time is defined in terms of simpler entities, it is open to question whether any generation of the natural scale is really more fundamental than the above. Of course, there may be methods which are preferable in the eyes of a mathematician who wishes to avoid metaphysical discussion; but the fact remains that there is a metaphysical aspect of the question which must be faced before a final answer is reached.

G. B. M.

VALENCY.

The Theory of Valency. By Dr. J. Newton Friend. Pp. xiv+180. (London: Longmans, Green and Co., 1909.) Price 5s. net.

ALTHOUGH one may be inclined to criticise the inclusion of this volume in Sir William Ramsay's well-known series of text-books of physical chemistry, it is to be heartily welcomed on its own account, for there is no English treatise, and no very recent German one, dealing with the important subject of valency. The author's exposition is careful and thorough, dealing at length with the bearing of the periodic law on valency, and with the numerous, and in some cases fantastic, theories which profess to interpret the facts of chemical combination. Dr. Friend is not in a position to expound any one theory of valency which commands general acceptance; in the present state of our knowledge he can only put before the reader some half-dozen theories—Werner's, Abegg's, Ramsay's, his own, and others—to each of which exception may be taken in one respect or another.

The theory of constant valency, which had difficulty with the interpretation of the so-called "molecular" compounds, has, of course, been abandoned, and the authors of the newer theories vie with each other in postulating valencies of all sorts and conditions—"principal," "auxiliary," "normal," "contra-," and "latent." From the examples quoted in the book it will be seen that, according to the theory adopted and the particular compound under consideration, hydrogen may be regarded as mono- or di-valent, nitrogen as tri-, tetra-, or penta-valent, bismuth as di-, tri-, or tetra-valent, and chlorine as mono-, di-, tri-, or tetra-valent. Perhaps, however, the crowning example of departure from the older view of the constancy of valency is found in the suggestion, which has been brought forward in one quarter, that oxygen may have a valency of six or even twelve! The grounds on which a particular number is chosen to represent the valency of a given element are, indeed, frequently unconvincing, and after a perusal of Dr. Friend's volume one feels how much vagueness and arbitrariness there is about the whole subject.

In proportion as it is found necessary to admit the variability of valency, doubts arise as to the practical value of a doctrine of valency. It must be borne in mind that certain chemists have challenged even the contention on which is based the whole structure of modern organic chemistry, the contention, namely, that carbon is never anything else than tetravalent. The author, indeed, maintains that nothing is gained by assigning a variable valency to carbon, and prefers to attribute variability to other elements, such as oxygen, chlorine, and fluorine. But the argument that unless the valencies of carbon and hydrogen are limited to four and unity, respectively, the possibilities of formulation are indefinitely multiplied is not a weighty one. Equally unconvincing is a criticism of the interesting view that different grades of chemical union may exist; this view is characterised, not as unsound, but as "dangerous," a line of argument that generally bespeaks a certain weakness in the defence.

The author is probably right in concluding that the solution of the valency problem is to be sought for on electrical lines, but at the same time he has done well to present to the reader everything which has a bearing on the subject, as, for instance, the new theory of Barlow and Pope, who regard valency from a non-electrical standpoint. It is only by a full and faithful presentation of conflicting facts and theories that the actual state of the problem can be rightly understood.

J. C. P.

ECONOMIC GEOLOGY IN BRITISH GUIANA AND SOUTH AFRICA.

(1) *The Geology of the Goldfields of British Guiana.* By J. B. Harrison. With Historical, Geographical, and other Chapters by F. Fowler and C. W. Anderson. Pp. ix+320. (London: Dulau and Co., 1908.)

(2) *The Ore Deposits of South Africa.* By J. P. Johnson. Part i., Base Metals. Pp. iv+61. (London: Crosby Lockwood and Son, 1908.) Price 5s. net.

(1) THE history of gold mining in British Guiana dates from 1720, when an expedition was dispatched to Berbice in quest of gold. Further unsuccessful attempts were made at intervals, and modern mining in the colony dates from 1863. The first important success was gained in 1886, and mining regulations were enacted. The efforts were again commercially unprofitable, but some alluvial mining has always since been carried on. Quartz mining first attracted much attention in 1890, but none of the attempts was then commercially successful, because, Mr. Harrison tells us, the work was conducted recklessly, mills being erected before the mines had been adequately prospected. At length, in 1903, more judicious management was rewarded by success, and the mines on the Puruni River added British Guiana to the profitable gold-fields of the British Empire. The greatest yield was 138,000 ounces, in 1893–4, since when the yield has been slowly falling, until the output in 1906–7 was 85,000 ounces.

The first important contribution to the geology of British Guiana was the memoir by Brown and Sawkins, published in 1875 by the British Geological Survey. Since then various additions have been made to its mining literature, and an important series of contributions to its pure geology by its Government geologist, Mr. J. B. Harrison. He has now issued a valuable handbook to the geology of the colony, to which chapters on the history and geography are contributed by Messrs. Fowler and Anderson.

Mr. Harrison's monograph includes a detailed account of the geology and petrography of the country, which consists of a foundation of Archæan rocks, with intrusive series of granites and diabases, covered by a series of sandstones apparently of Algonkian age. Intrusive diabase and other basic igneous rocks are widely distributed; they are perhaps the most interesting rocks in the country, and, according to Mr. Harrison, are the source of most of the placer gold. The origin of the gold is discussed in an interesting chapter, and the author concludes that it was derived from the basic igneous rocks themselves. De Launay, Perkins, and other mining authorities share that view, which has, however, been rejected by Prof. Louis, who considers that the gold came from quartz veins in the schists and gneisses, and also by Mr. J. A. Spurr, who thinks it is derived from the acid igneous rocks, and was introduced in solutions connected with the intrusion of dykes of the ultra-acid rock which he has called alaskite. Some of the placer gold has been derived directly from quartz veins formed in the superficial sheets of laterite that cover much of the country, but the gold in these veins is no doubt derived from the primary deposits in the underlying rocks. The gold in the secondary veins in the laterite sometimes occurs in rich pockets. It is therefore not surprising that the placer gold includes small nuggets. Mr. Brown, however, strongly supports the view that gold is present dissolved in the soil waters, and is thus carried into the drifts and there chemically deposited. As a proof of the solubility of the gold in the waters of the soil, he refers to its presence in the vegetation. The occurrence of gold in the trees growing on gold-fields has been repeatedly affirmed and denied. Mr. Harrison accordingly carefully assayed samples of wood from the interior of trees, and proved that the ashes contain gold up to several grains per ton. The establishment of this fact by Mr. Harrison is an important contribution to the problems of gold deposition; nevertheless, the information he gives as to the distribution of the alluvial gold suggests that the bulk of it is of detrital origin.

(2) Mr. Johnson's book contains less original matter. It is a short summary, in sixty-one pages of large type, of the chief facts as to the distribution of base metals in South Africa. It is prefaced by a brief theoretical introduction, and concludes with some pages of practical hints to prospectors. It is a useful guide to recent literature, and to mining work on the base metals in South Africa. The author adopts the American quantitative classification of rocks, and his short theoretical statement gives the arguments fairly for both sides of disputed questions. J. W. G.

OUR BOOK SHELF.

The Method and Scope of Genetics. An Inaugural Lecture delivered on October 23, 1908. By Prof. W. Bateson, F.R.S. Pp. iv+49. (Cambridge: University Press, 1908.) Price 1*s.* 6*d.* net.

THE University of Cambridge is to be congratulated in respect of the professorship of biology, which it founded last year, with the aid of an anonymous benefactor. It is to be congratulated because it has had the wisdom to recognise the import and the promise of a kind of inquiry which is still young (though it justified itself long ago at Down, at Brünn, and elsewhere), and has hitherto had very little academic recognition; for although the professorship bears the comprehensive title "of biology," it was founded with the understanding that the holder should apply himself to a particular class of physiological problems—those of heredity and variation—the study of which is denoted by the new term "genetics." Some years ago, in the University of Edinburgh, thanks, we believe, to the energy of Prof. Cossar Ewart, whose "Penycuik Experiments" have been so important in themselves and in their incentive, there was established a lectureship on the physiology of reproduction, which has been filled by Dr. A. H. H. Marshal with conspicuous success.

But Cambridge has gone one better—we hope the equivalent Scottish step will soon follow—in instituting this professorship of biology, ear-marked to mean genetics. The University of Cambridge is not less to be congratulated on being able to secure for this new professorship an investigator like Mr. Bateson—on whom Darwin's mantle has fallen—whose critical insight, patience, ingenuity of experiment and infectious enthusiasm have won him the respect and admiration of all the biologists of to-day.

In his inaugural lecture Prof. Bateson shows that the claims put forward in the name of genetics are high, and that they are not high without reason. "Mendel's clue has shown the way into a realm of nature which for surprising novelty and adventure is hardly to be excelled." "It is no hyperbolical figure that I use when I speak of Mendelian discovery leading us into a new world, the very existence of which was unsuspected before." Let us notice some of the progressive results which warrant these enthusiastic statements. A great law of inheritance has been discovered, and a simple hypothetical *rationale* of the law has been suggested. The duality of inheritance which the cytologist had demonstrated in his own way has been likewise proved—one may almost say played with—experimentally. Curiously puzzling phenomena have been made plain. Fresh light has been thrown on reversion and on variation. A new *point d'appui* has been found for physiological chemistry, and from cases so different as cinnamon-canaries and sweet peas, currant-moths and colour-blindness, it seems as if we were on the eve of discovering something of the mystery of sex. And, besides all this, "if we want to raise mangels that will not run to seed, or to breed a cow that will give more milk in less time, or milk with more butter and less water, we can turn to genetics with every hope that something can be done in these laudable directions." Even in regard to human kind it does not seem any longer an idle dream to see an art of eugenics rising on the foundations of genetics. J. A. T.

Hydraulic Générale. By A. Boulanger. 2 Vols. Tome i., Principes et Problèmes Fondamenteaux. Pp. xvi+382. Tome ii., Problèmes à Singularités et Applications. Pp. vii+299. (Paris: Octave Doin et Fils.) Price 10 francs.

THE science of hydraulics in France has long been served by distinguished and devoted adherents—to instance only a few, Bazin, St. Venant, Du Buat, Prony, and Boussinesq. The numerous contributions of this last-named exponent, during a period of nearly forty years, to the Academy of Sciences and other scientific bodies, are familiar enough to students of the subject, but, owing to their detached and voluminous character (the total publications of the eminent man of science amount to 1800 quarto pages), they have not hitherto been conveniently adapted to the requirements of systematic study, and it has long been felt that a *résumé* of their more important conclusions would be of great service. At the instance, therefore, of the director of the Bibliothèque de Mécanique, and with the concurrence of M. Boussinesq himself, the present work was undertaken with this end in view.

There are two volumes, the first being devoted to a demonstration of fundamental principles and to the statement of general phenomena, appertaining as much to the province of the physicist as to that of the engineer. Thus, after an introduction on the laws governing the pressure and deformation of a confined material element, and on the movements of fluids in general, there are three sections dealing with phenomena in which the influence of friction is negligible or sensible, and covering the motion of waves and the flow of water in pipes and channels.

The second volume is occupied with the elucidation of problems which appeal more particularly to the practical engineer, who, apart from his interest in the purely scientific aspect of an investigation, demands for his use some definite, even if empirical, quantitative solution. To arrive at such results, postulates of a more or less contestable character have oftentimes to be assumed, and the processes cannot be as rigorous as a mere theorist would desire. The questions treated in this way include the flow of water through orifices and over weirs, and in pipes possessing abrupt changes of direction and sudden restrictions of area. The influence of friction on undular movement is also expounded, and a final chapter deals with water-hammer.

The work is based on mathematical processes of a very advanced nature, and from considerations of space the calculations, many of them intricate enough, have been set forth as succinctly as possible. For further information on particular points the reader is referred to various sections of M. Boussinesq's writings which deal specially with them. There is a serviceable bibliographical index at the end of each volume.

The author manifests his keen appreciation of the *travaux pénétrants* of M. Boussinesq, and concludes his preface by stating :—" Qu'il n'est pas de question d'hydrodynamique appliquée qui ne doive à ce Maître des progrès considérables." The tribute is just, and will be heartily endorsed by British men of science.

The Chadwick Lectures, University of London, Session 1907–8. By W. D. Scott-Moncrieff. Pp. 79. (London: St. Bride's Press, Ltd., 1909.) Price 2s. net.

THE Chadwick lectures in the University of London were established in 1907 for a period of five years, the endowment being derived from the funds of the trust created by the will of a great sanitarian, Sir Edwin Chadwick, K.C.B. The trustees have provided that two short courses of lectures shall be delivered each year, at the University, upon subjects relating to sanitary science, with special reference to recent advances in hygiene and municipal engineering. In the lectures under review, Mr. W. D. Scott-Moncrieff deals with the subject of sewerage and sewage disposal in four lectures. At the outset he deals with facts which are mainly historical, tracing the evolution of our present methods, and summarising the Acts of Parliament and the reports of Royal and other Commissions relating to sewage disposal. He then proceeds to a critical survey of the various provisions which have been made, from time to time and in different places, for purifying sewage.

The lectures will serve exceedingly well to indicate the lines upon which we are now advancing towards the solution of the sewage problem, and the lecturer is to be congratulated upon having made an interesting, instructive, and suggestive contribution to the subject of sewage disposal. He strongly emphasises the waste of manurial values involved in modern methods and the economy of ascertaining by direct experiment the conditions necessary to success, in every specific instance, before spending money in ignorance of what these conditions really are. As one of the pioneers among British workers upon the biological purification of sewage, he remains a strong advocate of that method.

After reviewing the enormous amount of study and experiment which chemists, biologists, and engineers have for many years devoted to the subject of sewage purification, the reader will find food for contemplation in the circumstance that the trend of modern scientific opinion is in favour of the methods of "mother earth." Biological agencies, "the scavengers of nature," are now generally considered to afford at once the most economical and effectual means of sewage purification. The natural disposal of fæces upon earth had always proved satisfactory so long as the soil was suitable in nature and amount, but with the growth of our towns and the introduction of the water-carriage system a new set of circumstances had to be faced. Large volumes of water polluted with fæcal matter had to be dealt with; and the disposal of this, without causing a nuisance or contaminating drinking-water supplies, became the problem which is even now but partly solved. Mr. Scott-Moncrieff shares the very general view that it is by methods in which "nature's scavengers" are placed under the best conditions for their work that we are likely to obtain the best all-round results.

LETTERS TO THE EDITOR.

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

The Temperature of the Upper Atmosphere.

SINCE my last letter on the above subject the columns of NATURE have contained some interesting data from Mr. E. Gold, and an account of the meeting at Monaco on April 1 of the International Commission for Scientific Aëronautics. The proceedings of the commission seem to have included the enunciation of a creed in which the members expressed their individual belief in the existence of an "isothermal layer" (*aliter* "stratosphere"). This promulgation was apparently intended mainly for the benefit of heretics in England. As is not unusual with creeds, an exact definition of the essential term *stratosphere* does not seem to have been supplied, and I am thus in doubt whether I am or am not one of the elect. The term "stratosphere" can hardly have been employed in its very strictest sense, which would seem to imply that at any given instant of time temperature is a function only of the distance above the ground. This obviously could not be true at altitudes where either a diurnal or an annual variation was sensible, and I doubt whether members of the commission are yet prepared to deny the existence of these variations at the heights with which they are concerned. In the recent German balloon ascents in Central Africa temperatures were recorded which differ somewhat notably from those met with at corresponding heights in Europe, while in the polar regions temperatures are sometimes recorded at ground-levels which are lower than those usually encountered in balloon ascents here.

The term *stratosphere* is thus presumably intended merely to indicate in a general way that at high levels the rate of change of temperature in any horizontal direction is normally very small. In this sense I too am rather disposed to be a stratospherist. What has been objected to by myself, and I believe I speak for others in this country, is the application of the term "isothermal layer" to the whole of the upper atmosphere—so far as yet explored by kites and balloons—which exists above the level where fall of temperature with increase of height ceases (*cf.* Mr. W. H. Dines, NATURE, February 27, 1908, p. 390). I see no objection to the application of the term to a layer of finite thickness, if such exists, throughout which rate of change of temperature with height is vanishingly small. If t and h denote temperature and height, then, according to most Continental balloon records, dt/dh during an ascent is normally first negative and later positive. As a mathematician, I recognise, of course, that this implies either an absolute discontinuity—a rare event in nature—or else the existence of at least one surface where dt/dh is zero. In the latter event one would naturally expect dt/dh to be small for an appreciable distance on either side of the surface where it vanishes.

Coming now to Mr. Gold, if he will refer to my original letter (NATURE, March 12, 1908, p. 437) he will see that errors of $\pm 10°$ F. were not *asserted* to exist as a normal thing, but were suggested as a *possible* explanation of the following results, which had been quoted by Mr. W. H. Dines as recorded on one and the same occasion (November 11, 1907):—

Station	Height of "isothermal layer"	Temperature of "layer"
Ditcham Park ...	36,000 feet ...	−42° F.
Oxfordshire ...	38,500 ,, ...	−58° F.
Manchester ...	37,000 ,, ...	−74° F.

If Mr. Gold can suggest any other explanation likely to carry conviction to those who are sound in the stratospheric faith, I should be much interested to know what it is.

The figures quoted by Mr. Gold in his letter show that the examples which I had given of the differences between the temperatures recorded by two thermometers of different patterns sent up in the same balloon were not exceptional. Unless I misunderstand his figures, they signify that, taking two thermometers of different types, A and B, the reading from A is the higher when temperature rises and the lower when it falls. Taking both rising and falling readings, the *average* value of $(A \sim B)$ max. in Mr. Gold's sixteen cases is 3·2° F. In one case it is 6·3° F. It must also be remembered, as explained in my last letter, that if $A-B$ represents lag, it is likely to be an underestimate of the true error in the more sluggish thermometer. If we take the range of the *algebraic* difference $A-B$ during the ascent and fall, Mr. Gold's figures give a mean of 4·6° F., the extreme value being 8·3° F.

The fact that on the average of *all* the readings, both rising and falling, $A-B$ (or is it $A \sim B$?) is small—on the mean of the sixteen cases almost exactly 1° F.—seems to be regarded by Mr. Gold as a great tribute to the accuracy of the instrument makers. This, however, does not necessarily follow, if—as I should naturally assume—the observers followed the procedure customary with meteorologists of applying to their readings before publication the corrections obtained by comparing the thermometers with some recognised standard. This, however, is perhaps hardly germane to the present discussion.

May 23. C. CHREE.

An Optical Phenomenon.

I HAVE a greenhouse facing nearly due south. In a vertical pane of glass there is an imperfection. When the sun shines on this pane no light is transmitted through the imperfection. The result is that on a board or piece of paper held at right angles to the sun's rays there is produced an intense black disc about 1 inch in diameter, the board being held about 8 inches from the glass. This black disc is margined all round by a very narrow, brilliantly white line.

I can form no explanation of the phenomenon, for, so far as I can see, interference has no chance of acting. The glass is quite transparent, and the flaw so small that I could not find the cause of the black spot for some time. The disc is not hot.

So far as I can see, the glass is in tension round a central minute imperfection. By "sighting" the pane at various angles it is possible to detect certain lines. It is difficult, however, to get at them with any accuracy. There is no perceptible difference in thickness.

I cannot find any reference in any text-book to a pane of clear glass which absolutely intercepts the sun's rays in this way.

Can anyone give me an explanation of what appears to be a very unusual phenomenon? V. P.

Crohill, Pendennis Road, Streatham, May 22.

THE OLDEST REMAINS OF MAN.[1]

THE oldest remains of Man with which, until now, we were acquainted date back to the middle Pleistocene, to the Moustier period. They are represented by the cave relics from Neanderthal, Spy, Krapina, Naulette, Malarnaud, and possibly Mentone, by the drift relics from Galley Hill and Bury St. Edmunds. In the memoir under notice, however, we have the description of the two halves of a lower jaw for which a much higher antiquity is claimed.

FIG. 1.—Mandible seen from the side.

They are attributed to the earliest Pleistocene or even to the late Pliocene.

The jaw, which, fortunately, contains its complement of teeth, was found 24·10 metres below the surface in a deposit of sand at Mauer, 10 kilometres south-east of Heidelberg. The date of the discovery was October 21, 1907.

When found, the two parts were thickly coated by the deposit in which they lay; the left half had a piece of limestone firmly cemented to it, both jaw and stone being similarly marked by dendritic deposits of iron and manganese. The sand in which the jaw

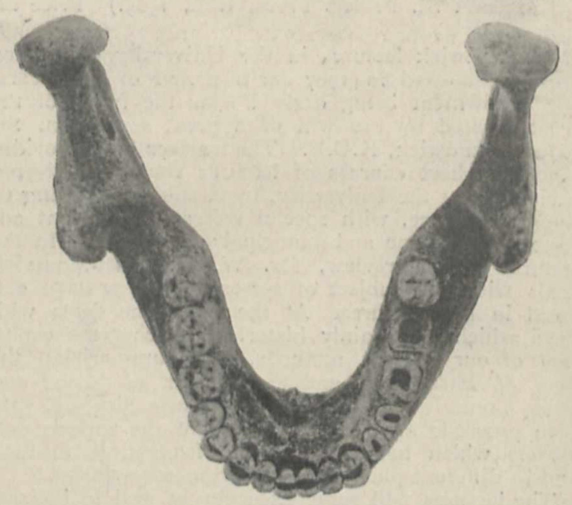

FIG. 2.—Mandible seen from above.

was found is of the same age and nature as the sand of Mosbach, and is attributed to the earliest Pleistocene, although the remains of the fauna found within it justify us to some extent in ascribing it to an epoch even more remote—the period of the Cromer Forest Bed in England, the late Pliocene of South Europe. The fauna includes, among many species distinctly diluvial, *Rhinoceros etruscus*, Falc., a horse

[1] "Der Unterkiefer des Homo Heidelbergensis aus den Sanden von Mauer bei Heidelberg." Ein beitrag zur Paläontologie des Menschen von Otto Schoetensack. Pp. iv+67; 13 plates. (Leipzig: W. Engelmann, 1908.) Price 14 marks.

intermediate between *Equus stenonis*, Cocchi, and the Taubach form, and *Elephas antiquus*.

A full description of the site and of the manner in which the discovery was made, with a careful compilation of the animals the remains of which have been found in the deposit, constitute the first portion of the book. Two other parts are concerned with the remains themselves, viz. with the jaw and with the teeth. The latter are typically human, and permit of no doubt as to the mandible being that of a man. The canines are not unduly prominent, while the dimensions of the teeth are within the variation limits of living man. The most striking features of the jaw, which, it may be said, was divided into two parts by the spade of a workman, are the absence of a chin, the thickness of the body, the width of the ascending ramus, and the low level of the coronoid process. Correlated with the absence of a chin is a well-marked incisura submentalis, the lower border of the symphysis being 50 mm. above that of the lateral portion of the body. The sulcus supramarginalis, interdigastric spine, trigonum postmolare, and præcoronoid fossa recognised by Klaatsch in Australian mandibles are also apparent in the specimen. A small tubercle lies immediately below the mental foramen; a similar excrescence has been noted by Gorjanović-Kramberger in the jaw fragment Krapina H and by Klaatsch in recent Australians. The geniohyoglossus muscle arose from a groove, the genio-hyoid from a rounded prominence.

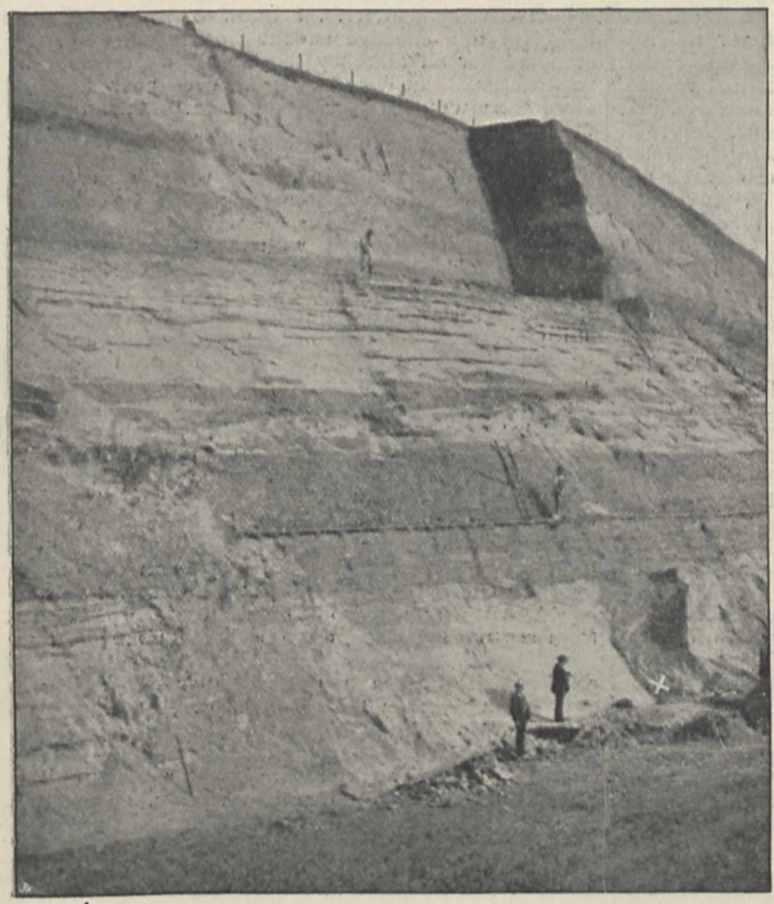

FIG. 3.—Position in which the mandible was found, Mauer, near Heidelberg.

The width of the ascending ramus is 60 mm. The coronoid process is blunt and rounded. The condyloid process is chiefly remarkable for the large size of its articular facet.

The lower border of the mandible passes backwards and only slightly outwards from the symphysis to the junction of body and ramus, where it suddenly takes a more outward curve. The border thus has a contour not unlike that of a trefoil window.

Comparisons are made between the Heidelberg jaw, those of Spy and Krapina, and, in addition, those of recent Australians and Negroes. The author concludes that the Heidelberg specimen surpasses all in its combination of primitive characters, that it is a generalised type from which all jaws, ancient and recent, can be readily derived, that the Spy mandibles resemble it most, the Krapina examples exhibiting marked but mere individual variations.

As to the teeth, all the molars are quinquicuspid; the second molars are the largest; the first and third molars are of equal size. Certain teeth were fractured by the spade, the pulp cavity being laid open. It was possible to measure the diameters of the pulp cavity and the thickness of the wall in the case of the premolars and first two molars of the left side; these measurements were considerably in excess of those which obtain in recent Europeans. The jaw was, further, Röntgen-rayed, little additional information being, however, supplied.

The figures, which are mainly photographs, number forty-eight, and are disposed on thirteen plates. They leave nothing to be desired.

The whole volume reflects the greatest credit on Dr. Otto Schoetensack. Anthropologists are to be congratulated that the work of describing what there is every reason for thinking are the oldest remains of man fell into such capable hands.

WILLIAM WRIGHT.

A GREAT ENDOWMENT AND ITS INFLUENCE.[1]

IT was in April, 1905, that Mr. Carnegie added to his many benefactions in the interest of education by handing over to a board of trustees of his own selection a sum of 2,000,000*l.*, the revenue of which was to provide pensions for the teachers of universities, colleges, and technical schools in the United States, Canada, and Newfoundland. The trustees were nearly all presidents of universities or colleges—the few others being men of conspicuous eminence in business and finance. In 1906 the trust was incorporated by charter under the title of the Carnegie Foundation for the Advancement of Teaching. In his deed of gift the donor stated that the fund was to be applied without regard to race, sex, creed, or colour. He did not "presume to include," among the institutions which were to benefit, State-supported universities or colleges on the ground that "they might prefer that their relations should remain exclusively with the State." In response, however, to the desire of the professors in State universities, expressed through their National Association, Mr. Carnegie in March, 1908, increased his original gift by 1,000,000*l.* in

[1] The Carnegie Foundation for the Advancement of Teaching. Third Annual Report of the President and Treasurer, October, 1908.

order that State institutions of the requisite academic grade which "apply through their governing boards, with the sanction of the legislature," might also participate in the benefits of the foundation.

The annual reports of this foundation show how far-reaching may be the effects of a wisely administered, wealthy trust, even though it has been established for what may seem a narrow and special purpose. These effects will be all the more important now that the State institutions may be admitted to share in the grants. In Scotland, the Carnegie Trust, which devotes part of its income to the payment of fees at the universities, has exercised a considerable influence in raising the standard of university, professional, and technical education by granting its favours only to those who reach a high preliminary standard of attainment, and who show fair ability and sufficient industry in their university studies. So there are already clear proofs that the Foundation for the Advancement of Teaching is quickening the movement in America for improved secondary education, raising the standard of entrance to college and university, and thereby uplifting the whole of higher education to a worthier plane. The foundation is making good the claim of its president that it should be considered not "as a charity, but an educational agency," which is making for "educational coherence and educational unity," and is taking into account "the interests not alone of a community or of a section, but of a continent." The trustees came to the conclusion that their true task is to consider the merits, not of individuals, but of colleges; to decide upon fair and wise standards, and then to admit to the system of retiring allowances such institutions as comply with the standards, and come within the provisions of the charter. To accomplish this, it was necessary to collect facts concerning the various institutions, such as "their method of government, their denominational relations, their value as centres of moral and intellectual influence, their financial resources, and, most important of all, their academic standards of work."

It was found that there are more than 950 institutions in the United States and Canada calling themselves colleges and universities. Of these some 850 are in the United States. An examination of the curricula, the income, and the work of these institutions showed that these names had in a large majority of cases been assumed with little regard to the meaning of the names, and little consideration of the difference between the work of a high school, a college, and a university. The trustees had to recognise that the pioneer stage of education had passed, and that it was necessary to standardise the higher institutions of learning.

They saw clearly that the nature of the requirements for admission to a college or university affects fundamentally the character of that institution. It was essential to enforce a reasonable standard—a standard which could be articulated with the work of the high schools, and enforced with care and judgment. The Carnegie Foundation, recognising that entrance requirements form the sole feasible means of securing a fair degree of unity in an educational system, had to reduce to a common method of expression the various systems in these 950 institutions, and to "define the amount of preparation which a college ought to demand of its matriculants." This definition had to rest upon the actual practice, and had to be formulated after a study of the curricula of the standard high schools. These schools require at least four subjects to be studied daily five times a week. Counting as a unit a study pursued in this way for a year, the ordinary high-school course would furnish sixteen such units in four years. The Carnegie Foundation, making allowance for certain possibilities, considers fourteen such units a fair measure of preparatory work, and fixes that number as the standard entrance requirement for any college which desires recognition. This standard demands not only four years of high-school training following upon good preliminary work in the grammar school, but involves a fair distribution of the time among different subjects. Some of the letters published in this report make it evident that this is a standard at present somewhat beyond the reach of many southern colleges in view of the undeveloped condition of secondary education. But the following extract from the president of a Kentucky university proves the wisdom of the trustees in setting up a standard which is really satisfactory:—"There is a positive advantage in a standard which will make it necessary for every college president and professor in the South to become an active missionary for public school development. . . . I know of no stimulus so powerful and effective as the maintenance of the standard for all alike by the Carnegie Foundation." Another president writes:—"We need your standard more than we need your recognition." It is evident, therefore, that one of the results of the working of this trust will be a great forward movement in secondary and university education in districts where until recently all higher education was in a very backward condition.

Another result of the conditions laid down by the Foundation in accordance with Mr. Carnegie's wishes will be the gradual liberation of many colleges from obsolete sectarian limitations. For not only is an educational standard required, but those institutions alone are recognised in which no denominational or sectarian test is applied in the choice of trustees, officers, or teachers, or in the admission of students. The trustees of an institution applying for recognition must further testify that "no distinctly denominational tenets or doctrines are taught to the students." Several of the institutions recently admitted to the accepted list have obtained release from conditions which constituted a sectarian barrier. Bowdoin College had to surrender to a theological seminary a sum of fully 10,000*l*., which it had accepted as an endowment with denominational conditions. The Central University of Kentucky, with some difficulty, obtained freedom from sectarian patronage so as to qualify itself for acceptance by this foundation. Doubtless many other colleges will struggle to get rid of their bonds, in order to obtain a place on the coveted list.

Another desirable result at which the policy of the trustees aims is the raising of the standard of professional education in America. The "schools of law and of medicine had, up to recent years, no common standards and no relation to the general system of education." The tendency has been to make these schools of law and of medicine a department of the university. The desire of the trustees is to foster this tendency, and so aid in removing commercialism, raising standards, and giving unity to professional training. The public interest will thus be safeguarded by the provision of a regular supply of educated men thoroughly trained as physicians or lawyers. Low standards are dangerous to the nation and demoralising to the profession.

The report before us contains a hint that the trustees hope to promote in the colleges and universities increased security of position by obtaining freedom from political as well as sectarian restrictions.

It is not long since political and denominational influence was rampant in university matters. Even during the last year two State universities suffered severely through political interference with their organisation. If the Carnegie Foundation can help to bring about a complete divorce of educational administration from politics it will have added a bright jewel to its crown.

According to the third report there are now sixty-two institutions which satisfy the requirements of the foundation, and are recognised as accepted institutions. To their professors the benefits of the foundation are extended through the institutions themselves. That is, if the professor has reached the age agreed upon, or has been in the teaching profession for a certain period of years, he will receive his retiring allowance as soon as his institution applies for it. The trustees have given special consideration to the professors whose active salary is low. They have adopted a scale under which such a teacher is granted a much higher percentage of his salary than is granted to one receiving a high salary. Any person sixty-five years of age, who has been a professor for at least fifteen years, shall receive a retiring allowance on the following scales:—

A. *Salary not more than* 1200 *dollars.*—An allowance of 1000 dollars, or not more than 90 per cent. of his salary.

B. *Salary above* 1200 *dollars.*—An allowance of 1000 dollars, increased by 50 dollars for each 100 dollars of salary above 1200 dollars.

No retiring allowance shall exceed 4000 dollars. This is 1000 dollars more than the limit originally fixed.

In these sixty-two accepted institutions there are already in force 116 retiring allowances, the average amount of which is 1600 dollars per annum.

The trustees have also from the beginning granted retiring allowances to certain professors not on the "accepted list." These grants have in all cases been made on the ground of distinguished and unusual service. When applications from individual professors are received each case is minutely considered by the trustees and judged upon its own merits. At present sixty-six such retiring allowances are in force, the average amount of which is fully 1400 dollars.

The foundation has also incorporated in its rules a recommendation of the executive committee that a pension be granted to the widow of a professor in an accepted institution who has been for ten years married to the professor. This widow's pension is to be one-half of what the husband would have been entitled to receive.

According to the report, pensions are at present granted to nine widows of professors in accepted institutions, and to six widows of professors not in accepted institutions. The average allowance in the former case is 963 dollars, in the latter case 680 dollars.

The trustees are to be congratulated on the wisdom and firmness of their administration of the foundation, and on the influence which they have already exercised upon the progress of higher education. The full effect of that influence is just beginning to be foreshadowed.

JOHN EDGAR.

GERMANY AND THE PATENTS AND DESIGNS ACT, 1907.

WE have received a report to the Secretary of the Department of Agriculture and Technical Instruction for Ireland on a visit to Germany made by a deputation in connection with the operations of the Patents and Designs Act, 1907. Section 27 of the Act provides that any person may apply to the Comptroller for the revocation of a patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom, and also provides that unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent within the United Kingdom, or gives satisfactory reasons why this is not the case, the Comptroller may revoke the patent either forthwith or after a reasonable interval.

The wording of this section clearly suggests that a patentee who manufactures an article or carries on a process exclusively or mainly abroad runs a grave risk of having his patent revoked under the sanctioned procedure, and considerable alarm has been manifested by foreign patentees in consequence. They have hoped against hope that the section does not mean what it says, or at least that it will be interpreted to mean something quite different, and now that it is being borne in upon them that the section will be construed to mean exactly what it says, they are making very sincere attempts, in some cases, to comply with the plain requirements of the section.

One way of complying with the requirements and of thus avoiding the risk of revocation is obviously to work the patent in the United Kingdom, and there have been many inquiries from foreign patentees as to the feasibility of taking this course. There have been, on the other hand, numerous attempts to bring to the notice of such foreign patentees the advantages of particular places in the United Kingdom for the establishment of industries, and the chief object of this visit to Germany was to interest foreign manufacturers who might be affected by the Act in the opportunities for industrial enterprise now being offered in Ireland. When it is remembered that in the year 1906 more than 6000 patents were granted to foreigners, it is clear that the object of the visit might easily have been defeated by attempting too much, and, in order that this might not occur, the members of the deputation wisely decided to devote their energies particularly to industries specially suitable for introduction into Ireland. In seeking for such industries, they were of opinion that it was undesirable to concern themselves with industries already established in Ireland and capable of further development from within, and they were finally led to limit the object of the visit to an attempt to convince the directors of certain chemical industries, such as those concerned with the manufacture of anilin dyes, and certain electrical industries, that the conditions which exist in Ireland are specially suited to the requirements of these industries.

Most of the important centres of these industries in Germany were visited, and the report contains an account of the wonderful development which Germany has made in these industries during the last quarter of a century. Of their visit to Berlin they state that

> We seized the opportunity of visiting the largest of the electrical firms—the Allgemeine Electricitäts Gesellschaft (known familiarly and shortly as the A.E.G.), which last year celebrated the twenty-fifth anniversary of its inauguration. The development of this company has been phenomenal. Founded in 1883, with a capital of 250,000*l.*, it has to-day a capital of 5,000,000*l.*—including debentures and reserves, 9,200,000*l.* From the manufacture of dynamos, motors, and lamps it developed and erected in 1885 an Electric Power Station in Berlin, which developed into the Berlin Electrical Works, where they manufacture a great variety of electrical plant, and, keeping pace with every new discovery, are now manufacturing the metal-filament lamps which threaten to displace the carbon-filament lamps. Since 1885 it has erected power stations in nearly 700 German and foreign towns. It then took up electric traction, and has constructed a large number of electric railways. It has a vast number of agencies in Germany and other countries.

At Ludwigshafen,

> We were fortunate in being able to see a portion, at least, of the well-known works of the Badische Anilin- und Soda-Fabrik at Ludwigshafen. By the kindness of the head of their Patents Department, Dr. Ehrhardt, and Dr. Lloyd, his assistant (both from Birmingham), we were

shown through part of the huge works, to see the whole of which several days would be required. These works were founded in 1865 for the manufacture of colouring matters and other derivatives extracted from coal tar. In that year there were only thirty workpeople. In 1870 there were 835; in 1885, 2377; in 1895, 4450. Now there are 8000. They employ, moreover, some 200 trained chemists, 100 engineers, and more than 700 mercantile clerks. The area of the site of the factory is about that of the City of London. On one side of it is the Rhine, so that there is easy transport for the coal (they use 1000 tons a day) to drive their 370 steam engines, and for the pyrites (of which they use 100,000 tons a year), and other raw materials required.

This is not the place for a full account of the progress of discovery in this branch of chemistry, but each discovery in turn has been utilised and turned into gold. Their staff of trained chemists are continually adding to their store of knowledge, and are provided with well-equipped laboratories. To the benches are distributed hot and cold water, compressed air, vacuum and electrical power. The commercial value of their discoveries is safeguarded by a patent department having some seventeen assistants. They hold more than 1200 patents, and take out on an average about two a week.

The Badische Anilin- und Soda-Fabrik has already decided on a site at Birkenhead, but as it is only one out of a dozen German chemical companies which have during the past five years paid dividends of from 10 per cent. to 35 per cent. per annum, there appears to be good reason for bringing to the notice of the directors of these companies places in the United Kingdom which are specially suited to these industries.

There can be no doubt that before the directors of successful foreign companies attempt to establish industries in the United Kingdom, they will make exhaustive investigations as to the general industrial conditions in this country and as to the special considerations relating to their particular industries. The deputation discusses at some length the industrial conditions in Germany, and, in order to compare the industrial conditions there and here, reference is made to the recently published Board of Trade report (Cd. 4032, 1908) on the condition of the working classes in Germany. This question is so directly before the public to-day that there is no necessity to discuss the matter here, but it is of interest to know that Dr. Walther Rathenau, one of the leading industrial authorities in Germany, in his "Reflexionem," remarks that, speaking of the chemical industry,

the reason the Germans have so far surpassed us is because English science is not strong enough to direct the numerous ramifications of the source of the "black art" into the technical stream, and because English industry has not the army of trained workers which is annually recruited from the German high schools. The same difficulties, he remarks, are encountered by the electrical industries in England.

The other conditions which are considered of importance in deciding the question of the establishment of a chemical industry are stated to be :—

(1) The cost of motive power.
(2) The price of coal, alkali, and acids.
(3) The availability of salt or brine.
(4) The price of land and the amount of taxes.
(5) The supply of water and provision for discharge of effluent.

The deputation appears to have considered fairly fully the various conditions necessary to the successful establishment in Ireland of industries such as the electrical and chemical industries, and it is of opinion that there is no reason why such industries should not be profitably carried out there.

When the deputation made its report, the Comptroller's first decision under Section 27 (in the case of an application for the revocation of Hatschek's patents No. 6455 of 1900 and No. 22,139 of 1900) was under appeal, and it was doubtful what interpretation of the section would finally prevail. Since then, however, Mr. Justice Parker has delivered judgment in the appeal, and there can be no further doubt that a patentee who manufactures exclusively or mainly abroad runs a very grave risk of having his patent revoked. Patentees will therefore be more inclined than they have been to manufacture here, and in order to direct those who may benefit by this inclination, we give the general conclusions arrived at by the deputation, viz. :—

(1) The first is that, if reasonable facilities are offered, there is a strong probability that manufacturers in certain industries will find it to their interests to set up branches of their works within the United Kingdom.

(2) In the next place, in order to attract such manufacturers to any particular part of the United Kingdom, it will be necessary for those interested in the industrial development of any given city or locality to themselves make special and persistent attempts to bring before particular firms the facilities and advantages which the localities in question have to offer. In other words, it will not be enough to send circulars—even those translated into good German—to our Consular representatives abroad. We saw a large pile of these from various municipalities on the table of one of the large Consulates "in case of inquiry." There had been no inquiries. It needs to be recognised that the matter is one into which the keenest competition enters, and in regard to which only persistent efforts on the part of the competing localities themselves will produce results.

(3) There is a third general conclusion which we believe to be of considerable importance. It seems clear that the effects of the working of the Patents and Designs Act will not be immediate, but gradual and continuous. It is already evident that a number of foreign manufacturers will establish branches of their business in the United Kingdom, and will so maintain their patent rights. But many manufacturers will doubtless prefer to sacrifice their patents rather than take this course. The inventions contained in patents which will be revoked as a consequence become public property, and may be utilised by any enterprising person. Given the necessary enterprise, it will be possible to build up new industries, whilst existing industries may derive benefit from the freedom to utilise inventions in cases where the covering patents are not being worked to such an extent in the United Kingdom as to comply with the Act.

DR. VON NEUMAYER, For.Mem.R.S.

THE news of the death, on May 24, at Neustadt, in the Bavarian Palatinate, of Excellency Georg Balthasar von Neumayer was received with genuine regret by a world-wide circle of scientific men, to a very large number of whom he was personally known for his sterling qualities, the warmth of his friendship, his genial urbanity, and his kindly disposition, more especially towards young men entering upon a scientific career. To these he was the fatherly counsellor who gave them every encouragement to prosecute their studies in the broadest possible manner, for he had long ago realised that science had entered upon a new era of marvellous progress. The foreign visitor to German scientific gatherings has always been struck by the universal reverence for the name of Neumayer, for there have been very few of the savants of the fatherland during the past half-century who have not been influenced, more or less, by the great personality who is now no more.

Dr. von Neumayer was born at Kirchheimbolanden, in the Palatinate, on June 21, 1826, so that at the time of his death he was within a few weeks of completing his eighty-third year. From his early youth he developed a decided predilection for scientific investigation, and during his career at the Munich University he became intensely interested in the Polar expeditions which were being conducted by Sir James Ross and Sir John Franklin. The German navy and the German overseas trade are subjects which are widely discussed to-day, but few recognise that the vast changes which have taken place originated in the brain of the youthful Neumayer. At a time when divided Germany had neither navy nor mercantile marine worthy of mention, Neumayer was the first to entertain the idea as to the direction in which a united Germany should advance, which was long afterwards crystallised by the present Emperor, when he declared that "Unsere Zukunft liegt auf dem Wasser." So early as 1849 the university student had visions on the subject, and in 1850 we find him departing from Munich to take a subordinate post before the mast on a sailing ship bound for South American ports. This afforded him the opportunity for studying the theory as well as the practice of navigation and nautical astronomy.

On returning from the southern seas in the following year Neumayer went for a time to Trieste as a teacher of navigation, proceeding thence to Hamburg, where in after life he was destined to become a distinguished citizen. But he could not rest long ashore, the sea had its attractions for him, and in 1852 he again took ship for the southern oceans, where he spent a couple of years. In 1856 he went out to Tasmania, and there devoted his time to magnetic work at the observatory which Sir John Ross started at Hobart Town. The following year found him at Melbourne, and here, with the assistance of Maximilian, King of Bavaria, and Alexander von Humboldt, he founded the Flagstaff Magnetical and Meteorological Observatory, which was subsequently taken over by the Victorian Government authorities. A great deal of his time in Victoria was given to a magnetic survey of the country, which was carried on right up to the foot of Mount Kosciusko, in New South Wales. Having accumulated a mass of magnetical and meteorological information, he left Melbourne in 1864 by the then celebrated clipper ship *Sovereign of the Seas,* and returned to Europe. His reception in London on this occasion made a lasting impression upon him, and to the end he never failed to acknowledge the encouragement which he obtained from prominent members of the Royal Society—Sir Roger Murchison, Sir Edward Sabine, and many others, with whom a life-long friendship was entered upon. Settling down quietly in his native land, the Palatinate, he devoted about six years to the careful discussion of the voluminous records which he had gathered in Australia.

Placing a high appreciation on the value of the work thus far done by Neumayer, the recently formed Imperial Government of Germany in 1872 offered him the appointment of hydrographer to the Imperial Navy, a post which he occupied until 1876, when he was promoted to the directorship of the Deutsche Seewarte, at Hamburg, an institution the establishment of which in 1868, under Wilhelm von Freeden, as the Norddeutsche Seewarte, he had strenuously advocated. In his new post Neumayer was retained as adviser to the Admiralty at Berlin. The efficiency of the German navy of to-day is largely due to his unbounded admiration for the methods of the English navy. Whether in matters of discipline, surveying, magnetic observations, or any other subject, his aim was to train his countrymen to attain at least the English standard of excellence. During his directorship of the Seewarte he was indefatigable in his exertions to introduce the best scientific methods into all work performed in the German naval and mercantile services, and to-day, thanks to his guidance, both may be said to be second to none in the correctness and trustworthiness of their contributions to scientific progress.

While Neumayer was recognised as an authority on meteorological problems, the subject which he made specially his own was magnetism, and to this field of research he devoted the greater part of his life, down to within the past few months. With the object of furthering our knowledge of this subject he exercised his influence in promoting investigations in all parts of the world—in the international circumpolar expeditions of 1882–3; in the fitting out of the German Antarctic expedition on the *Gauss*; and in many other ways. Recognising the great international importance of the question, he, in February, 1898, made a special visit to London to join in the appeal which was then being made by the Royal Society for the equipment of an English scientific expedition into the Antarctic Ocean. The special points which he advocated on that occasion were gravity and magnetism. "A gravity survey," he said, "is, in connection with a thorough geographical survey of the Antarctic, one of the most urgent requirements of the science of our earth. There are no measurements of the gravity constant within the Antarctic region; indeed, they are very scarce in the southern hemisphere south of the thirtieth parallel, and they are so closely connected with the theory of the figure of our earth that it is hardly possible to arrive at any conclusive results in this all-important matter without observations within the Antarctic region."

Magnetic investigations always entered into his advocacy of Arctic and Antarctic expeditions in addressing meetings of the German Association, the Geographentag, and other scientific bodies. In Germany the rules regulating the retirement of public servants into private life are not so rigidly enforced as they are in England, and this was particularly noticeable in the case of Dr. Neumayer. With advancing years, and when he felt entitled to withdraw from the service, he several times sought permission to give up active work as director of the Seewarte, but such were the high opinions of him entertained by the ruling authorities at Berlin, as well as by his fellow-countrymen generally, that deaf ears were turned to his appeals. It was not until 1903, when he was approaching the close of his seventy-seventh year, that the Emperor paid a personal visit to the Seewarte, and at last the aged director was permitted to retire into private life with a pension and the honour of the ennobling title "von."

During the last six years Neumayer resided at Neustadt, a short distance from his birthplace, his rooms decorated with numerous mementos of his long career in both hemispheres, and to the last maintaining his interest in his favourite subject. He was a Privy Councillor of the Empire, and both at home and abroad he was awarded many distinctions. When the German Meteorological Society was founded at Hamburg, in November, 1883, he was unanimously chosen as its first president; in 1899 he was president of the German Association; while his services to the great port of Hamburg were recognised in many ways, the city perpetuating his memory by naming one of the new streets near the Seewarte and the Bismarck monument after him. In London he was elected an honorary member of the Royal Meteorological Society so long ago as 1874, and he became a Foreign Member of the Royal Society in 1899. "The world is certainly the poorer for his loss" is the expression of one of his English admirers. He was the author of numerous books and scientific papers, some in English, the results of the Victorian investigations being published in two English volumes. His papers and addresses are to be found in the publications of many scientific societies, and he was also the author of various magnetic and other charts and atlases.

Hy. Harries.

T. MELLARD READE.

By the death of Mr. Thomas Mellard Reade, F.G.S., geological science has lost an amiable, painstaking, and enthusiastic geological worker. Educated as a civil engineer, he was at one time chief draughtsman in the civil engineering department (northern division) of the London and North-Western Railway. Later on he became engaged in independent engineering and architectural work, and was elected an Associate Member of the Institution of Civil Engineers and a Fellow of the Royal Institute of British Architects. In the course of his professional work, the strata exposed in foundations and trenches aroused his interest, and, recognising the practical advantages of a knowledge of geology, he began, when about thirty-five years of age, to pursue the study with great earnestness. The list of his scientific papers and works, numbering about 200, commenced in 1870 and continued until the present year. Residing in the neighbourhood of Liverpool, his attention was in earlier years given especially to the Glacial and post-Glacial deposits of Lancashire and Cheshire, and he was ever an advocate of the glacio-marine origin of much of the Boulder-drift.

Mr. Reade became a Fellow of the Geological Society of London in 1872, and was also an active member of the Liverpool Geological Society, of which he was three times president. His more important papers were communicated to these societies, and to the *Geological* and *Philosophical Magazines*, while many short contributions (dating from 1870) were published in Nature. He extended his researches on Glacial geology into North Wales, Norfolk, Scotland, and Ireland. Tidal action as a geological cause, chemical denudation in relation to geological time, and the physiography of the Trias are among the subjects with which he dealt. In 1886 he published his great work on "The Origin of Mountain Ranges considered Experimentally, Structurally, Dynamically, and in Relation to their Geological History." The results of much original and experimental research were given in this volume, and the existence of a level-of-no-strain in a cooling solid globe was for the first time pointed out. It was recognised that his experiments on the rates of expansion of different kinds of rock were of great interest and value, although they did not explain some of the more complicated phenomena of mountain structure. In recognition of this work and other researches, the Geological Society in 1896 awarded him the Murchison medal.

Pursuing the subject of dynamic geology, and making further experimental investigations, he published in 1903 a volume entitled "The Evolution of Earth Structure, with a Theory of Geomorphic Changes." In this work he embodied much material which he had previously published, including researches on slaty cleavage, carried out in conjunction with Mr. Philip Holland, as well as essays on denudation and on the permanence of oceans and continents; and the volume may be said to summarise his main contributions to geological science. He expressed his conclusion that while the relative proportions of land and water have been fairly constant throughout the ages, regional changes of level are due to alterations in the bulk of certain portions of the lithosphere caused by expansion and contraction, without other movements in mass. Among his later investigations, those on "Sands and Sediments," in which he had the cooperation of Mr. P. Holland, are of great interest and importance, especially in connection with the micro-sediments, such as quartz-dust, and fine particles of carbonate of lime of detrital origin. In the latter case the suggestion is made that some deep sea-limestones may be due in part to mechanical causes.

Mr. Reade died on May 27, aged seventy-seven, at his residence, Park Corner, Blundellsands, Liverpool.

H. B. W.

NOTES.

The Croonian lecture of the Royal Society will be delivered on Thursday, June 10, by Prof. E. A. Schäfer, F.R.S., on "The Functions of the Pituitary Body."

The statue of Lamarck, erected by international subscription, is to be unveiled in the Jardin des Plantes, Paris, on Sunday, June 13, at 3 p.m. M. Fallières will preside at the meeting.

The death is announced of M. Eugène Grenet, well known as an electrical engineer and the inventor of the potassium bichromate cell.

Prof. Ira Remsen, president of the Johns Hopkins University, Baltimore, U.S.A., has been elected president of the Society of Chemical Industry for the ensuing year. The next annual meeting of the society will be held in Glasgow.

It is announced that the principal trustees of the British Museum have appointed Mr. Lazarus Fletcher, F.R.S., keeper of the department of mineralogy, to the post of director of the natural history departments of the British Museum.

The New York correspondent of the *Times* announces that the American delegates to the Darwin centenary celebration at Cambridge will bring with them a bronze bust of the great naturalist, 40 inches in height, which they will present to Christ's College.

It is announced in *Science* that the American Academy of Arts and Sciences has awarded the Rumford premium to Prof. R. W. Wood, of the Johns Hopkins University, for his discoveries in light, and particularly for his researches on the optical properties of sodium and other metallic vapours.

Mr. Horace Darwin, F.R.S., has been elected a corresponding member of the Vienna Academy of Sciences.

The annual meeting of the Cape Chemical Society was held on April 30, when the following officers for 1909 were elected:—*president*, Dr. R. Marloth; *vice-president*, Dr. C. F. Juritz; *hon. secretary and treasurer*, Mr. St. Clair O. Sinclair; *additional members of council*, Mr. G. N. Blackshaw and Prof. P. D. Hahn. Dr. R. Marloth delivered his presidential address, on "The Chemistry of some Vegetable Products of South Africa."

At the last meeting of the International Physiological Congress, which was held at Heidelberg in 1907, it was decided to hold the next congress at Vienna in 1910, at Whitsuntide. It has been found, however, that at this time of year it would be impossible for a large number of physiologists to attend the congress, and the local committee of the congress at Vienna has therefore, after consulting the local secretaries in the various countries, determined to change the date. In accordance with the general wish, the congress will now be held on September 26–30, 1910.

On July 1 the price of the *Astrophysical Journal* is to be increased. In a letter upon this change, Prof. E. B. Frost, the managing editor, points out that a periodical of a strictly scientific character like the *Astrophysical Journal*, even though conducted without expense for contributions or for editorial or clerical assistance, cannot be self-supporting. The annual deficit of the journal has been met by a subsidy from the University of Chicago, which in the last two years has been 400*l*., but no increase in this subsidy can be expected. With the advance in subscription price it is expected that the size of the journal and the number of illustrations will be maintained as during recent years.

THE fifth congress of the International Association for Testing Materials is to be held, under the patronage of King Frederick VIIIth of Denmark, on September 7–11 in Copenhagen. After the ceremonial opening of the congress on September 7, in the presence of the King of Denmark, and an address by the Prime Minister, Mr. Paul Larsen will read a paper on the development of the cement industry in Denmark. The three following days will be devoted to meetings of the sections, and on September 11 a paper will be read by Mr. J. E. Stead, of Middlesbrough, on the practical use of the microscope in testing metals and alloys. The latest date at which applications to take part in the congress can be received is June 15, and application should be made to the secretary of the Iron and Steel Institute at 28 Victoria Street, London, S.W.

WE regret to see the announcement of the sudden death of Dr. J. D. E. Schmeltz, director of the Royal Ethnographical Museum at Leyden, at seventy years of age. From the *Times* we learn that Dr. Schmeltz was a native of Hamburg, where he made the acquaintance of a wealthy merchant, Herr Godeffroy, an enthusiast in geographical and ethnological studies. Godeffroy founded an ethnographical museum in 1863, and made Schmeltz director. When in 1882 the Godeffroy Museum was sold, Schmeltz had a name sufficient to secure immediate nomination as conservator of the Leyden Museum of Ethnography, of which establishment he was appointed director in 1897.

DISTURBANCES, said by daily papers to be due to earthquakes, were reported from Tiverton, and the surrounding district on May 25. They began at 12.54 p.m., and continued for twenty minutes, causing windows to rattle and houses to shake. They were preceded by a noise like thunder. The long interval throughout which the shocks were noticed, the apparent transmission of the waves through the air, and the fact that some observers remarked on the likeness between the disturbances and those caused by distant gun-firing, pointed to this as their cause. Inquiries have now shown that the supposed earthquakes were of artificial origin. They were caused by the firing of heavy guns in the Channel off Weymouth, about fifty miles from Tiverton. The disturbances at places nearer the centre, such as Dorchester and Yeovil, were, of course, assigned at once to their true cause.

IN connection with the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease, Mr. Burns, the President of the Local Government Board, has authorised the following special researches:—(1) a continuation of the investigation into protracted and recurrent infection in enteric fever, by Dr. T. Thomson, in conjunction with Dr. Hedingham; (2) a continuation of the investigation into protracted and recurrent infection in diphtheria, by Dr. T. Thomson and Dr. C. J. Thomas; (3) a continuation of the investigation into flies as carriers of infection, by Dr. Monckton Copeman and Prof. Nuttall; (4) a continuation of Dr. Andrewes's investigation on the presence of sewage bacteria in sewer air, with the view of ascertaining their number and the distance they can be carried by air currents; also a continuation of Dr. Andrewes's investigation into the part played by changes in bone marrow in the defensive mechanism of the body against infection; (5) a continuation of Dr. Savage's investigations on the bacterial measurement of milk pollution, and on the presence of the Gaertner group of bacilli in prepared meats and allied foods; (6) an investigation into the chemical and physical changes undergone by milk as the result of infection by bacteria, and into the relation of the pancreas to epidemic diarrhœa, by Dr. Schölberg and Mr. Wallis; (7) an investigation of the records of charitable lying-in hospitals as to the nutrition of the mother and other factors influencing the vitality of infants and their progress in the first fourteen days of life, by Dr. Darwall Smith; (8) an investigation into the occurrence and importance, in relation to treatment, of mixed infections in pulmonary tuberculosis, by Dr. Inman; (9) an investigation on the relative importance of certain types of body-cells in defence against the tubercle bacillus, and the effect of tuberculin and other remedial agents on their activities, by Dr. J. Miller.

COUNT ZEPPELIN is reported to have beaten every existing record in the navigation of steerable balloons. On the evening of May 29, at 9.45, the ascent of the airship *Zeppelin II.* took place from Friedrichshafen, and the descent at Göppingen was made, in order to obtain a fresh supply of petrol, during the afternoon of May 31, when the cruise had lasted 37h. 40m. The *Times* of June 2 gives the following bee-line analysis of the voyage:—

Outward Journey (against wind).

	Distance Miles	Time Hours	Average Speed. Miles per hour
Friedrichshafen to Ulm ...	60 ...	5 ...	12
Ulm to Nuremberg ...	86 ...	6 ...	14
Nuremberg to Plauen ...	85 ...	5 ...	17
Plauen to Leipzig ...	60 ...	$3\frac{1}{2}$ ...	17
Leipzig to Bitterfeld ...	20 ...	$2\frac{1}{2}$ ...	

Return Journey.

Bitterfeld to Halle ...	18 ...	$\frac{1}{2}$ ...	36
Halle to Weimar ...	45 ...	$1\frac{1}{2}$ ...	30
Weimar to Würzburg ...	105 ...	$7\frac{3}{4}$ ...	13
Würzburg to Stuttgart ...	80 ...	5 ...	16
Stuttgart to Göppingen ...	25 ...	1 ...	25

The bee-line distance for the whole journey is 584 miles, and the total distance travelled was probably nearly 900 miles. Taking the running time as thirty-eight hours, and the distance 870 miles, the average speed works out at 23 miles an hour.

THE sixteenth International Medical Congress is to be held in Budapest from August 29 to September 4 next, under the patronage of the Emperor Francis Joseph, who will be represented by Prince Joseph. The formal opening will be held in the morning of Sunday, August 29. The business of the congress will consist largely of sectional meetings, the sections being as follows:—(1) anatomy and embryology; (2) physiology; (3) general and experimental pathology; (4) microbiology (bacteriology) and pathological anatomy; (5) therapeutics (pharmacology, physical therapeutics, and balneology); (6) internal medicine; (7) surgery; (8) obstetrics and gynæcology; (9) ophthalmology; (10) diseases of children; (11) diseases of the nervous system; (12) psychiatrics; (13) dermatology and venereal diseases; (14) diseases of the urinary tract; (15) rhinology and laryngology; (16) otology (this section forming also the eighth International Otological Congress); (17) stomatology; (18) hygiene and immunity; (19) juridical medicine; (20) military and naval sanitary services; and (21) maritime medicine and tropical diseases. There will be six general meetings of the congress, when the following subjects will be dealt with. Dr. G. Baccelli, of Rome, will discourse on heroic medicine; Dr. E. F. Bashford, of London, on cancer; Dr. M. Gruber, of Munich, on inheritance, selection, and hygiene; Dr. R. Kutner, of Berlin, on the post-graduate instruction of medical men, his address being given at the request of the central committee of Prussian post-graduate instruction; Dr. A. Laveran, of Paris, on tropical medicine; and Dr. J. Loeb, of Berkeley, on artificial parthenogenesis and its bearing upon the physiology and the pathology of the cell. The first issue of the Journal of the congress will give particulars as to the place, the day, and the time of each of these meetings. The executive committee of the congress has also arranged general meetings for the discussion of the reports and communications dealing with the subjects of appendicitis and immunity. It is interesting to note that 408 addresses and 781 communications, covering every branch of medical science, had been received at the time of the publication of the circular we have received from Budapest. The office of the congress is viii., Esterházy-utcza 7, Budapest, Hungary.

To Messrs. John Wheldon and Co., of Great Queen Street, we are indebted for a copy of a catalogue of works and papers on vertebrates, exclusive of birds, marine biology, &c., including selections from several libraries.

IN the thirty-seventh annual report of the board of directors of the Zoological Society of Philadelphia reference is made to the good results which have attended the testing with tuberculin of each monkey received at the gardens before its entrance to the quarantine-room. There has been no death from tuberculosis among the monkeys exhibited since October, 1907, and the results of the experiment justify the belief that, apart from an occasional sporadic instance, the disease can be held in check, and the heavy mortality due to this cause finally stopped.

To the May number of the *Zoologist* Captain S. S. Flower contributes a list of the known zoological gardens of the world; the total number recorded is 154, of which, however, a few appear to have been closed, while information is required concerning a few others. Of existing establishments of this nature, the oldest appears to be the Imperial Menagerie at Schönbrunn, Vienna, which was founded in 1752, the next in point of seniority being the menagerie at Madrid, dating from 1774, and the third that of Paris, founded in 1793.

FROM the report of the director of the Field Museum of Natural History, Chicago, for 1908, we gather the great progress that has been made in that museum (in common with other institutions of a like nature in the United States) in the mounting of groups of animals for public exhibition. During the year groups of woodchucks (marmots), musk-rats, and six of fishes have been added to the exhibition series in the Field Museum. The larger fish-groups are set up in cases 6 feet long by 20 inches in height and width, the specimens being mounted to give the effect, so far as possible, of live fishes under natural conditions.

A REVISION of the mice of the American genus Peromyscus, by Mr. W. H. Osgood, forming No. 28 of the "North American Fauna," now in course of issue by the U.S. Biological Survey, affords an instructive example of the elaborate and detailed manner in which that survey is being carried out. In this respect it is safe to say that it has no rival in any part of the world. We have only to look at the coloured map serving as a frontispiece, and illustrating the distribution of the races of *Peromyscus maniculatus* and its relatives, to realise the detailed nature of the survey's operations, and the enormous amount of collecting and technical work involved. Whether the game is really worth the candle need not now be discussed, and we may be content with congratulating Mr. Osgood and his co-labourers on the manner in which they have carried out their task, which is even now declared to be not finally completed. The members of the genus Peromyscus, commonly known as vesper-mice and white-food mice, include a vast number of species ranging over almost the whole of North America, and wonderfully numerous in individuals, and the group is therefore specially fitted for the study of the numerous problems connected with distribution, variation, and the limitations and intergradations of species and races.

Two articles have lately appeared in the *Fortnightly Review* under the title of "Suggestions for a Physical Theory of Evolution." The arguments of the writer are vitiated throughout by his implied assumption that the importance of the environment in evolution lies in its supposed power of directly inducing variation. The selective function of surrounding circumstances is passed over, and no serious attempt is made to deal with the essential differences that exist between somatic modification and variation properly so-called. The author commits himself to a "photographic" theory of the phenomena of mimicry and protective resemblance, ignoring the formidable difficulties that stand in the way of such an explanation. His treatment of this subject does not argue an adequate knowledge of the facts which he is endeavouring to explain.

AMERICA is by no means behindhand in celebrating the centenary of Darwin's birth. The April issue of the *Popular Science Monthly* is entirely devoted to a series of articles and addresses inspired by this occasion. Dr. H. F. Osborn leads the way with an excellent and appreciative lecture on the life and works of Darwin, in which, however, he avows opinions as to "directed variation" which would not have been acceptable to the object of his eulogy. Estimates of the influence of Darwin's work in the fields of zoology, botany, and geology are contributed by Dr. H. C. Bumpus, Dr. N. L. Britton, and Prof. J. J. Stevenson. Prof. T. H. Morgan's essay, "For Darwin," bases Darwin's claim to the gratitude of posterity chiefly on his method of investigation. This is inadequate; Darwin's preeminence consists in the revolution he has been the means of effecting in every department of thought; his method alone would not have singled him out from other great men. The substitution of the dynamic for the static conception of nature, of which Darwinism is at once a cause and a symptom, is well brought out by Prof. W. M. Wheeler, while the strength and nobility of Darwin's character and the distinctive features of his career and its results find a fitting interpreter in Prof. R. M. Wenley. The intensely interesting addresses given by Dr. A. R. Wallace and Sir Joseph Hooker at the Linnean Society's celebration, held last July, are added; and the record is completed by the insertion of a facsimile reproduction of part of the original manuscript of the "Origin of Species," together with portraits of Darwin himself, of Lyell, Hooker, Wallace, and Malthus.

THE Egyptian Gazette of April 21 supplies a report of a lecture delivered at the annual meeting of the Cairo Scientific Society by Dr. Elliot Smith, on the origin of the people of Egypt. He explained that the theories of the earlier anthropologists have now been in a large measure superseded by recent investigations of prehistoric interments, which have now rendered it possible to arrange archaic burials in systematic order. The earliest inhabitants of Egypt with whom we are acquainted were a people slightly below the average height of mankind and of poor muscular development. While they conform to the south European and Arab type, they are more closely allied to the Berbers of the southern shores of the Mediterranean. No remains of any population of like age having been as yet discovered in any neighbouring country, it seems clear that their culture was evolved in the Nile Valley, which they must have occupied at a period long antecedent to the earliest remains so far discovered. With the rise of the first dynasty a definite change sets in, the head becoming broader and more filled out, the nose narrower, and the physique improved. Little is known of the origin of this new race, but it seems probable that the original purely Egyptian population of Lower Egypt was modified by the immigration of alien elements entering the delta from the islands or northern shores of the Mediterranean, or wandering along the southern shores of that sea from Libya on the west or from Palestine on the east. The original type was, however, only slightly modified during the Ancient Empire, and at all times large numbers of persons of the pre-dynastic type are found. The modification really set in with the rise of the New Empire. In Nubia the case was different. Here the original type survived in early dynastic times unaffected by the immigration which made its mark in Lower Egypt; but instead of this influence the race here became subject to another—that of the negro. The Nubian is thus the descendant of pre-dynastic Egyptians slightly mixed with the negro, while the Egyptian of the delta represents the same primitive stock somewhat modified by intermixture with some Mediterranean people.

THE most important paper in the current issue of the Journal of the Royal Anthropological Institute is that by the president, Prof. Ridgeway, on the origin of the Turkish crescent. So far from being an ancient Mohammedan symbol, it was not employed by the Arabs or by any of the original nations who embraced the faith of the Prophet, nor was it borne by the Saracens who fought in the Crusades. It was not identified with Islam until after the appearance of the Osmanli Turks, and there is ample evidence that in the time of the Crusades, and long before, the crescent and the star were a regular badge of Byzantium and of its emperors. Comparing the crescent with similar forms of ornament used by other races, Prof. Ridgeway comes to the conclusion that the Turks derived it from two sources, the old amulet made of one or two boars' tusks, and the crescent and star which they found everywhere in their new empire. Without denying that representations of the moon may have been made and venerated by the inhabitants of the Swiss lake-villages, and that, in some regions and in some periods, the crescent of boars' tusks was likened to the new moon, still, with the evidence of Spartan and Danubian metal imitations of boars'-tusk amulets before us, we may conclude with some safety that the use of crescents of boars' tusks and of imitations of these was far older in the regions ruled by the emperors of Byzantium than the badge of crescent moon or star. It may well be that the latter was adopted by the emperors of the East from the Star of Bethlehem. The Turks probably became acquainted with the boar, and used its tusks as an amulet after their settlement in Asia Minor. In their standard, consisting of the crescent and horse-tail, we may perhaps recognise only another form of the amulet of badger's hair and teeth of wild beasts used now in Italy to protect horses from the Evil Eye.

THE annual statement, in this case for two years, of the collated series of phenochrons, *i.e.* the earliest observed dates of opening flowers and other natural phenomena, compiled from data supplied by a large number of schools in Nova Scotia and Canada, is published as a report of the Botanical Club of Canada by Dr. A. H. Mackay. The report would be more generally useful if the observations were summarised and a general comparison made with the data of preceding years.

THE mode of formation of balls of weed made by the rolling action of water, both in lakes and in the sea, is discussed by Dr. A. H. Mackay in vol. xi., part iv., of the Proceedings and Transactions of the Nova Scotian Institute of Science. It is suggested that the deposition of a mass of molluscan or other eggs on a basis of seaweed might, by furnishing agglutinate matter, start the formation of such a weed-ball; but in other instances roots of algas serve as a nucleus, while in some cases the whole structure consists of the finer kinds of brown algas.

A CONTRIBUTION, by Dr. S. Yamanouchi, to the cytology of Fucus, dealing chiefly with the first and second nuclear divisions in the oogonium and with the antheridium of *Fucus vesiculosus*, appears in the *Botanical Gazette* (March). The details of the mitoses, with numerous excellent figures, are given, but a full discussion of the fertilisation process is reserved. Regarding the number of chromosomes, it is found that sixty-four chromosomes are present in the Fucus plant, and that the reduction to half that number occurs at the end of the first two nuclear divisions in the oogonium and antheridium initials. Each of the four nuclei then produced contains thirty-two univalent chromosomes, and this persists to the sperm and egg.

AN account of the vegetation in and around the Redrock Lake, Colorado, published in the University of Colorado Studies (vol. vi., No. 2) by Dr. F. Ramaley, is interesting since the lake is situated at an altitude of about 10,000 feet, and the growing period is limited to a few months. Four zones are demarcated; *Nymphaea polysepala* provides the most abundant aquatic type, while *Carex utriculata*, with other species of Carex and *Caltha leptosepala*, are conspicuous in the sedge zone. The willows and *Betula glandulosa* are dominant in the shrub zone, beyond which the forest area lies, where *Picea Engelmanni* forms almost pure stands in wetter localities and *Pinus flexilis*, with *Pinus murrayana*, dominate the drier situations; *Vaccinium oreophilum* is the most characteristic undershrub in the woods.

MAY usually has a large amount of bright sunshine, but this year it has beaten all previous records, not only for the corresponding month, but for any month since the sunshine records for London were started in 1880. The duration of bright sunshine was 297 hours at the reporting station of the Meteorological Office in Westminster, and the previous highest record for May is 237 hours, in 1906, whilst the previous highest record for any month in the year is 261 hours, in July, 1900. At Greenwich the duration of bright sunshine for May was 326 hours, which is 140 hours more than the average, and in April there was an excess of 103 hours, making a total excess of 243 hours for the two months. In May there were seven days with more than fourteen hours of bright sunshine, and there have only been two days without sunshine during the last two months. At some places in the south of England the sun was shining in May for 350 hours. The aggregate duration of sunshine since the commencement of the year is largely in excess of the average over the whole of England, the excess for the twenty-one weeks amounting to more than 200 hours in the south-east of England.

AN important contribution to the study of the upper air, by Dr. W. Köppen, is published in *Aus dem Archiv der deutschen Seewarte*, vol. xxxi., part i., entitled "Three Years' Simultaneous Meteorological Kite Ascents near Hamburg, Berlin, and St. Petersburg." In order to throw light on the lateral extension of the warm and extremely dry strata met with in kite ascents, on the conditions of their occurrence and disappearance, and on their effect on weather changes, the author has collated, side by side, the results for each day during the period December, 1903, to November, 1906, on 108 diagrams, each containing ten days, and showing temperature, wind direction and velocity, and low conditions of humidity. The general discussion of this very useful synoptic material is left for future work; the author nevertheless directs attention to several interesting points. The inversions of temperature are specially noticeable, particularly those which occur suddenly, where the warm stratum borders almost immediately on the cold layer beneath; the temperature gradients in these remarkable inversions are often very large, and mostly occur in late autumn and in winter. The increase of wind velocity with height naturally differs with the direction and with season; all the curves show a rapid increase up to 500 metres, after which it becomes more gradual. The diagrams only include altitudes up to 4000 metres; between the ground and 3000 metres, at Hamburg, the general mean of the velocity (irrespective of direction) in metres per second is 16·7 in the summer half-year and 17 in the winter half-year, while at Berlin the velocities are 9·1 and 12·8 respectively. These special points are discussed by the author in considerable detail.

IN a pamphlet of twenty-seven pages published by Gauthier-Villars, of Paris, M. Jacques Boyer has recently given an admirable sketch of the work done of late years, especially in France, in the artificial production of precious stones. With respect to the formation of true rubies, some of which are quite undistinguishable from the natural stones, new and interesting information is given concerning the work accomplished by the successors of Fremy—Feil, Verneuil, Diener Wyse, Maiche, Michaud, and Marc Paquier—with photographs of the actual apparatus employed in the latest manufactures. While the reproduction of the ruby, of perfectly natural colour, has been so successful, much greater difficulty has been experienced in trying to imitate the sapphire, the actual source of the colour in this gem being more doubtful. M. Boyer, however, claims that excellent results have now been obtained by M. Disclyn and M. Louis Paris. In the reproduction of the varieties of quartz used as gems, it is interesting to learn that the different tints of the amethyst have been produced by the action of radium on the uncoloured mineral; and with regard to the opal and emerald information is given, though no results of commercial value have as yet been obtained. The work concludes with an account of what has been effected in the way of producing the diamond by artificial means, photographs of Moissan's electric furnace and other apparatus being given. A bibliography at the end of the paper is useful, but the work, though it contains much valuable and interesting information—sometimes on points upon which there has been much concealment—cannot be regarded as in any sense exhaustive.

PROF. J. TRAUBE, of Charlottenburg, has always been one of the most pronounced opponents of the dissociation theory of solution, and in the April number of *Ion* he shows how the idea of cohesion pressure, that is, the attraction exerted by the molecules of the dissolved substance on the molecules of the solvent, may be used to explain the properties of solutions, whether these are met with in physical, chemical, or physiological fields. Prof. Traube's paper should pave the way to a thorough discussion of the question of solutions. In the same number Dr. V. Kurbatov, of St. Petersburg, shows the inadequacy of the electronic theories of the conduction of electricity in metals, as stated in various forms by Profs. Drude, Lorentz, and Sir J. J. Thomson, to explain the facts observed. He gives an outline of his own theory which is based on the electronic constitution of matter, but he does not justify the assumptions on which he founds it. The translation of this paper is far from perfect.

SINCE flame spectra were first discovered two explanations have been offered as to their nature. According to one, they are the direct result of chemical reactions going on in the flame—the reduction of the metallic salt, in the opinion of Pringsheim—while the other regards them as the effect of the normal oscillations of the atoms at the high temperature of the flame. In the latter case the speeds of the atoms are distributed according to the law of Maxwell, in the former there will be regions of chemical action in which the speeds will be in excess of the normal. The experiments of Pringsheim, and more recently those of Fredenhagen, seem to support the chemical luminescence theory, while the work of M. E. Bauer, described in the April number of *Le Radium*, lends strong support to the pure temperature explanation. M. Bauer has measured the radiation and absorption of a large Mëker flame for sodium light and for the long rays produced by repeated reflections from fluorite ("reststrahlen"), and finds that Kirchhoff's law is followed, while the temperatures of the flame calculated from the two sets of observations agree very closely. The conclusion seems forced on us that temperature is the essential factor in the production of flame spectra, and if chemical action accounts for any of the radiation it does so only indirectly.

THE new 300-ton universal testing machine recently installed by Messrs. W. and T. Avery, Ltd., in the civil engineering laboratory of the University of Birmingham is described and illustrated in the *Engineer* for May 21. The machine is of the horizontal type, and can take exceptionally long specimens—under tension to a maximum stretched length of 33 feet 6 inches, and under compression up to a maximum length of 30 feet. An hydraulic pressure of 1000 lb. per square inch is supplied from an accumulator charged by a motor-driven pump, and advantage is taken of the city main pressure of 85 lb. per square inch for returning the straining cylinder ram and for low load tests. The weighing arrangement consists of a bell-crank lever connected to a second lever which in turn is connected to the steelyard. There are no loose weights; seven poises travel on the steelyard, each representing, when in extreme position, a load of 100,000 lb. on the specimen. These poises are traversed by means of a screw, and can be instantly engaged or disengaged. The machine, in the capable hands of Prof. Dixon, should turn out some useful and interesting results on the strength of built-up structures, for which it seems to be well adapted.

BULLETIN No. 362 of the United States Geological Survey, by Mr. J. S. Burrows, deals with the mine sampling and chemical analyses of coals tested at the United States Fuel-testing Plant in 1907. This is one of a series of papers dealing with work done at the fuel-testing station, work valuable to the coal owner, coal user, and to all interested in the scientific study of coal. The results of the examination of seventeen samples of Jamestown coals are given in this bulletin, including proximate and ultimate analyses and the experimentally determined calorific values. A list is given at the end of the previous survey publications on fuel testing.

BULLETIN No. 365 issued by the United States Geological Survey contains an interesting account of the fractionation of crude petroleum by capillary diffusion, by Messrs. J. E. Gilpin and M. P. Cram. When oil is allowed to rise by capillary attraction in a tube packed with Fuller's earth, there is a decided fractionation of the oil, the fraction at the top of the tube being of lower specific gravity than that at the bottom. There is a tendency for the paraffin hydrocarbons under these conditions to collect in the lightest fractions at the top of the tube, and the unsaturated hydrocarbons at the bottom. If the oil is mixed with Fuller's earth and then displaced with water, about one-third of the oil remains in the earth.

BRIQUETTE-MAKING formed the subject of a paper recently read before the South Wales Institute of Engineers by Prof. W. Galloway. Small coal cannot be burnt so economically in the furnaces of boilers in its original state as when in the form of briquettes, partly on account of so much of it falling through the fire-bars, and partly because the particles lie so closely together as to prevent the free access of the air required for combustion. Briquettes made exclusively with anthracite coal burn too slowly, and it is advisable to mix a certain proportion of bituminous coal to overcome this objection. Up to the present, no kind of agglomerating material other than pitch or resin, or a mixture of these, has given satisfactory results. Briquettes made with resin alone become soft and lose their shape in the fire; those having a mixture of 4 per cent. of pitch and 1½ per cent. of resin give better results. It is of interest to note that the total output in the United Kingdom in 1906 amounted to 1,513,220 tons, while Germany produced 14,500,851 tons of this fuel in the same year. The paper contains full descriptions and drawings of the mixing and drying machinery and presses required for briquette-making, together with estimates of labour required and costs. For example, at an English works making 102½ tons of briquettes per day of ten hours, the total cost, including labour, materials, fuel and stores, interest and depreciation, works out to 9*s*. 7·45*d*. per ton.

A RECENT paper by G. Jaffé in the *Annalen der Physik*, on the electrical conductivity of pure hexane, will possess considerable interest to those who are concerned with the *rôle* of the solvent in electrolysis, as well as to those who are working on the electrical conductivity of gases. The impure material owes much of its conductivity to electrolytic impurities, but these can be removed by electrolysis and by repeated distillation, when samples are obtained with a very minute but practically constant conductivity, about twelve times greater than that of air under similar conditions. The pure hydrocarbon, indeed, shows almost all the electrical properties of a gas of high density. How widely its properties differ from those of purified water or other feeble electrolytes may be seen from the fact that two-thirds of the conductivity vanishes when the measuring vessel is sheathed with lead in such a way as to cut off external radiations, and that the remainder of the conductivity is greatly influenced by the nature of the containing vessel, aluminium giving exceptionally low values. Two other remarkable points of contrast are (1) the constancy of the current at different temperatures, and (2) the fact that an increase of potential from 200 to 2000 volts produces no increase in the current, which reaches a "saturation" value analogous to those of gases, although at a much lower voltage.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JUNE:—

June 3. 11h. 43m. to 15h. 14m. Eclipse of the Moon, visible at Greenwich.
9. 20h. Mars in conjunction with Moon (Mars 2° 33′ N.).
12. 18h. Saturn in conjunction with Moon (Saturn 2° 13′ N.).
17. 12h. Sun eclipsed, invisible at Greenwich.
21. 8h. 22m. Transit (ingress) of Jupiter's Satellite IV. (Callisto).
,, 11h. 41m. Minimum of Algol (β Persei).
,, 14h. Sun enters Cancer, summer begins.
22. 18h. Venus in conjunction with Neptune.
,, Saturn. Major axis outer ring = 39·78″, Minor axis = 8·85″.
23. 1h. Jupiter in conjunction with Moon (Jupiter 4° 21′ S.).
24. 9h. 15m. to 9h. 59m. Moon occults ν Virginis (4·2).

THE DISPERSION OF LIGHT IN INTERSTELLAR SPACE.—In the *Revue générale des Sciences* (No. 8, p. 350), Dr. Ch. Nordmann reviews the work recently performed by MM. Tikhoff and Belopolsky and himself on the dispersion of light in interstellar space. The results obtained in the first experiments have been questioned by a number of astronomers, and, in re-stating the case clearly, Dr. Nordmann disposes of many of the objections.

As has already been recorded in these columns, Dr. Nordmann's method consists in observing the difference, in time, of the minima of variable stars when screens of different colours are employed, whilst in the Tikhoff-Belopolsky method the dispersion is shown by the various displacements of lines in the different parts of the spectra of spectroscopic binaries.

It has been suggested that the observed differences may be due to physical changes in the binary system itself, but Dr. Nordmann argues that if this were the case the displacement of the curves for different parts of the spectrum would vary at different parts of the orbit, whereas if the displacement is due to dispersion in space it would be the same in all parts of the orbit. At present he is content that a matter of so great an importance to astronomers and physicists is re-opened, and would attach no rigorous significance to the quantitative results so far obtained; qualitatively they are in the right direction, and are in accordance with the results of ordinary refractive media. Should the validity of these results be established their importance in any cosmological discussion can scarcely be overestimated; for example, the determination of the distances of binary systems would become greatly simplified.

A REMARKABLE TRANSIT OF JUPITER'S THIRD SATELLITE.—No. 4324 of the *Astronomische Nachrichten* contains an account, by Mr Innes, of a remarkable transit of Jupiter's third satellite observed at the Johannesburg Observatory on April 3.

Before and after the transit both the north polar cap and the dark marking along the north torrid zone of the satellite were noticed. When the satellite was about three-quarters of its journey across the planet a double dark spot was seen in its position, and re-focussing failed to alter the apparition. Approaching the limb of the planet the n.p. part of the double spot was replaced by a bright spot, smaller than the satellite, but s.p. the remaining grey mark. A few minutes before internal contact took place the dark grey spot disappeared, whilst the bright spot increased in size.

Immediately after last contact J III. was seen against the sky nearly round, but perhaps shaded off a little towards Jupiter, and with a small north polar bright spot with a darkish band below it. When the dark double spot was visible it looked like a close double star, dark instead of bright, having a separation of 0·9″ and an angle estimated at 300°.

THE SPECTRUM OF MAGNESIUM IN HYDROGEN.—The significance of the "magnesium hydride" bands in the spectrum of sun-spots lends great importance to any investigation of their nature, and a paper, by Mr. E. E. Brooks, which appears in the April number of the *Astrophysical Journal* (vol. xxix., No. 3, p. 177), is therefore of astronomical interest.

Experimenting at the Leicester Technical School with magnesium in hydrogen, Mr. Brooks employed a unidirectional, but pulsating, current, which is intermediate between arc and spark, and arrived at the following conclusions regarding its spectrum:—(1) The spectrum represents some transitional unstable state; (2) although hydrogen is essential, the production of the "hydride" spectrum appears to depend far more upon the nature of the discharge than upon the quantity of the gas present; (3) a trace of water vapour appears to be more effective than hydrogen, yet its presence cannot be regarded as essential; (4) if due to a hydride the substance is probably decomposed as fast as it is formed.

THE PERTURBATIONS OF BROOKS'S COMET (1889 V) BY JUPITER IN 1886.—From his investigations of the perturbations, and the resulting path, of Brooks's comet, Prof. Poor concluded that this object could not be identified with the lost comet of Lexell.

In this regard an interesting paper, by Herr G. Deutschland, appears in No. 4321 of the *Astronomische Nachrichten*, giving the results of a re-investigation of the planetary perturbations, taking into account the oblateness of Jupiter. These results exhibit variations from those previously obtained by Prof. Poor, especially in the time of the comet's nearest approach to the planet.

RECENT OBSERVATION OF DANIEL'S COMET, 1907 *d*.—Among the photographic observations recorded by Prof. Wolf in No. 4321 of the *Astronomische Nachrichten* is one of an object which is, possibly, Daniel's comet of 1907. Owing to the faintness of the object and the poor sky, the identification is not quite certain, although the image appears on two plates. The middle of the exposure was at 13h. 25·4m. (Königstuhl M.T.) on April 19, and the position of the object was $\alpha = 15h.\ 18{\cdot}7m.$, $\delta = -7° \ 37'$; magnitude 16·5.

THE VARIABLE STAR 6.1909 URSÆ MAJORIS.—In a note appearing in No. 4324 of the *Astronomische Nachrichten*, Prof. Wolf announces that the variable star near the spiral nebula M101 had decreased in brightness more than half a magnitude by May 9.

POLAR MAGNETIC STORMS.[1]

THE last ten or twenty years have been marked by great activity in Arctic and Antarctic expeditions. The results obtained in the department of terrestrial magnetism form a great contribution to knowledge, and prove that continued effort in this direction will do much to remove the difficulties that enshroud the problem.

The present expedition was the development of preliminary expeditions carried out in the preceding six years by Dr. Birkeland, the object being the study of the connection between and origin of auroræ and magnetic storms. The funds were provided by the Norwegian Government, by learned societies in Norway, and by Dr. Birkeland himself.

The preliminary expeditions had indicated the frequent occurrence of magnetic storms having a probable origin vertically above the vicinity of the North Cape, and the plan of the 1902–3 expedition was to make simultaneous observations at four stations in that region. The four stations were on Iceland, Spitsbergen, Nova Zembla, and in Finmark. Each of the stations was provided with a similar set of recording magnetographs of the pattern due to Eschenhagen. These are admirably suited for expeditions on account of their portability and simplicity of adjustment. They can be given a high sensibility, although some may doubt whether the high value used by Dr. Birkeland was altogether a blessing for the purpose of studying magnetic storms. It was, of course, a distinct advantage in studying the minute and extremely regular periodic movements that were frequently observed. In addition, each station was provided with auxiliary meteorological and electrical apparatus, and one of the stations had an instrument for recording earth currents.

The present volume begins with a description of the equipment and installation of the various stations, and those of us who live in temperate regions may well reflect on the advantage of making physical observations without having to interrupt work for the purpose of suppressing the scientific ardour of a polar bear.

In analysing the magnetic storms, Dr. Birkeland was able to obtain simultaneous records from twenty-three observatories in various parts of the world, in addition to those from the four special stations. Dr. Birkeland at the outset indicates that the results have been analysed and presented with the view of supporting the theory he holds, viz. that these storms are due to the incidence of (negatively) charged corpuscles projected from the sun. The desirability of such a method of procedure may be open to question, but we think that the author has gained immensely by so doing, and the results are put in such a form that their value is not in the least prejudiced by whether we accept his ultimate conclusions or not.

The method is in outline as follows. Any disturbance of the magnetic needle may be represented as the effect of a certain electric current. The course of a storm may thus, so far as the horizontal components are concerned, be represented by an arrow of certain length in a certain direction. For each particular storm discussed the records from the various observatories are shown in a plate reduced to a uniform time scale. In the text a general description of the storm is given, followed by charts showing with arrows the direction and magnitude of the assumed disturbing current at different stages and at different places. These are followed by a discussion as to the general character of the horizontal current required to produce the storm.

The current charts are remarkably simple, and give an extremely clear presentation of the results free from any theory. In this way the existence of certain well-defined types of storm is established.

The supposition that these arrows represent true electric currents of corpuscles is almost a natural consequence. Arguments are given to show that they cannot be earth currents, but that they are probably due to streams in the upper regions of the air, the general height being some 400 kilometres.

It is remarkable that the stream so frequently sets between the four stations, and thus confirmatory evidence is obtained from the different signs of the vertical-force variations on opposite sides of the stream.

It is found that the horizontal stream is not always sufficient to account for the facts, but that the horizontal portion must be regarded as a bend in a stream descending vertically, and then with greater or less rapidity returned into space.

Dr. Birkeland supports, and we think very ably, his arguments by reference to experiments on a highly magnetised sphere (a terrella) placed in the path of kathode

[1] The Norwegian Aurora Polaris Expedition, 1902–3. Vol. i., "On the Cause of Magnetic Storms and the Origin of Terrestrial Magnetism." By Kr. Birkeland. Pp. viii+315; 21 plates. (Christiania: H. Aschehoug and Co.; London: Longmans, Green and Co., n.d.) Price 22s. net.

rays, the arrangements being made to imitate the earth with the sun as kathode. The experiments, of which numerous photographs are given, are exceedingly beautiful, and present distinct analogies with the deductions from the magnetic storms. At the same time, the analogies are by no means conclusive, and may in some cases be very misleading.

The work of analysing each storm independently must have been tremendous, but the results amply justify the work.

It is impossible to enter into details in such a brief review, but we think no serious student of terrestrial magnetism will read this book without feeling that a very distinct step has been made towards the solution of the refractory problem of terrestrial magnetism.

G. W. W.

ROCK-ENGRAVINGS IN SOUTH AFRICA.

MR. L. PÉRINGUEY, in the eighteenth volume of the Transactions of the South African Philosophical Society, continues his report on rock-engravings of animals and the human figure. The examples now described are superior in finish and artistic merit to those hitherto known. We have no longer mere lines or outlines produced by rough pointing or punching; the technique is more elaborate, and the figures are drawn in relief. Thus, in the illustration (Fig. 1) of an elephant fleeing before a hunter armed with a bow and arrow, the lines in relief represent the skin corrugation; and the position of the ears, the hanging lower lip, the curves of the back and legs, are all strikingly artistic, and suggest keen observation on the part of the sculptor. Equally artistic is the representation of the buffalo (Fig. 2), the figure of which is fully hollowed out, the attitude of the animal and the twitching of its tail being full of life.

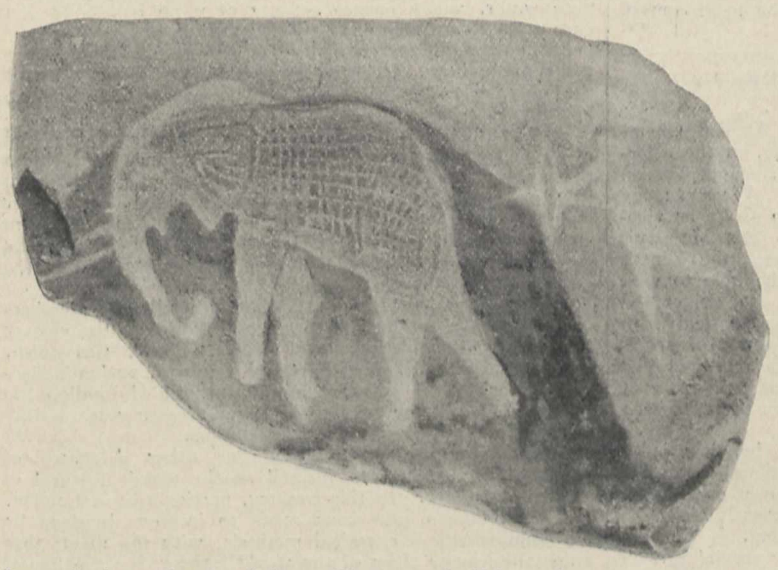

FIG. 1.—Rock-engraving of an elephant and hunter armed with bow and arrow. Size 60×39 cm.

FIG. 2.—Rock-engraving of a buffalo. Size 60×40 cm.

The age of these sculptures is still uncertain. Mr. Péringuey, comparing them with similar rock-engravings in Algeria and the Sudan, and remarking the patination of the rock surfaces, the presence of Palæolithic implements in the neighbourhood, and the absence of scenes representing domesticated animals, believes them to be anterior to the Hottentot immigration. As in Mauretania, the most highly finished sculptures, as well as paintings, are the most ancient, and a decadence of artistic skill seems to have set in with the arrival of the newer immigrants. There is no evidence that these engravings were the work of the Bushmen, and it is equally difficult to attribute them to the Strand Looper Hottentots, whom Dr. Shrubsall has recently identified on the southern seaboard. On the whole, they suggest intercourse between North and South Africa, a view corroborated by the analogies between the engravings in Mauretania and those of South Africa, the identity of type in the stone implements in both these regions, and other considerations generally accepted by modern ethnologists.

CENTENARY OF THE PHYSICO-MEDICAL SOCIETY OF ERLANGEN.[1]

THE Physico-medical Society of Erlangen, founded by Joh. Christian Friedrich Harles in 1808, reached its one hundredth birthday on March 20, 1908, and celebrated the occasion on June 27 by an anniversary meeting and a dinner. The first of the two publications cited below contains (*a*) a history of the society, by Prof. M. Noelther, of the University of Erlangen, covering eighty-three pages, and illustrated by portraits of Harles, Henke, Leupoldt, Korn, Wagner, Canstatt, Gerlach, Gorup, Zenker, and Beetz; (*b*) an address, by J. Rosenthal, "Ueber die Beziehungen der Physik und Chemie zu den medizinischen Wissenschaften"; and (*c*) a report of the anniversary celebrations, by Oskar Schulz.

Honorary doctorships in medicine were conferred on Prof. Becquerel, Prof. Curtius, and Prof. Nernst; doctorships in philosophy were conferred on Sir Victor Horsley, Prof. von Leube, and Prof. von Kries. Honorary membership of the society was conferred, on general grounds, on Queen Margherita, Count Zeppelin, and Dr. Oskar von Miller; of the special sciences, chemistry was honoured by including in the list the names of Bechmann and Buchner; physics was represented by Blaserna, zoology by Dohrn, mineralogy by Zirkel, botany by de Vries, mathematics by Poincaré, geography by Günther, physiology by Pflüger, anatomy by Roux, and the medical sciences by Erb, Ehrlich, Kocher, and Kraepelin. Amongst the new corresponding members we notice the names of Prof. Rutherford, of Manchester, and Prof. Sherrington, of Liverpool.

The *Sitzungsberichte* for 1907, sent out with the report of the centenary, is a bulky volume containing seventeen scientific communications. Nearly half the volume is devoted to a memorial notice of Henri Moissan, written by Gutbier, and extending over 260 pages; a complete list of Moissan's papers is given, and his work on fluorine, boron, silicon, ammonium, calcium, diamond, the

[1] (1) Festschrift der Physikalisch-medizinischen Societät zu Erlangen, zur Feier ihres 100 jährigen Bestehens am 27 Juni, 1908. Pp. ix+124. (Erlangen: Kommissionsverlag von Max Mencke, 1908.)
(2) Sitzungsberichte der Physikalisch-medizinischen Societät in Erlangen. Redigiert von Oskar Schulz, 39 Band, 1907. Pp. xxiv+562. (Erlangen: Kommissionsverlag von Max Menche, 1908.)

metallic carbides and hydrides, and the electric furnace is fully described. Three *Beiträge zur Geschichte der Naturwissenschaften*, numbered xi., xii., and xiii., are contributed by Prof. Eilhard Wiedermann, and a paper on the emission-spectra of cadmium and zinc vapours jointly with A. Pospielow. Papers on the atomic weights of rhodium and of palladium are contributed by A. Hüttlinger and by P. Haas, and papers on electrolysis by Gutbier and by Herzog; papers dealing with medical subjects are contributed by de la Camp, by Grünbaum, and by Jamin, and a mathematical paper appears under the name of Noether.

At the end of 1907 the society included fifty-one ordinary, fifty-four honorary, and seventy-eight corresponding members; nine meetings had been held, and sixteen papers had been read and discussed. The "yield" of scientific work will bear comparison with that of many societies claiming a wider range of membership, but in view of the large variety of topics discussed and the small number of papers dealing with any one branch of science, it is at least doubtful whether the publicity attained can be sufficient to compensate for the heavy cost of setting up and printing; as a general rule, the disadvantages of local publication are so serious as to outweigh the advantages which arise from stimulating the local centres of research.

THE INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

THE seventh International Congress of Applied Chemistry was opened on Thursday, May 27, in the afternoon, at the Royal Albert Hall by the Prince of Wales, who was accompanied by the Princess. A very large gathering was present, and the Prince, who spoke as vice-patron, the King being patron, offered in His Majesty's name a most hearty welcome, and expressed the King's pleasure that the foreign delegates would be able to visit Windsor Castle. It is only recently that the Prince, as president of the Board of Trade Committee to deal with exhibitions, directed attention to the importance of scientific progress, and at the opening of the congress he accentuated the value of scientific progress in words of such importance that we reproduce a portion of his speech verbatim.

"The main object which you all have in view is, I assume, to discuss in your numerous sections the many topics of interest and importance that are continually arising owing to the marvellous discoveries which the science of chemistry, both pure and applied, is making from day to day. Those interested in some special branch meet in the different sections their *confrères* from other lands to their mutual benefit. . . . These conferences, whether of a scientific or of a more intimate character, between men living in distant lands, all working for the same object, although under different conditions, cannot but be favourable to the progress of science and of the industries to which many of you have devoted your lives, as well as to the general peace of the world. I fully appreciate the important part which chemistry plays in almost every branch of our modern industry. We all recognise that without a scientific foundation no permanent superstructure can be raised. Does not experience warn us that the rule of thumb is dead, and that the rule of science has taken its place—that to-day we cannot be satisfied with the crude methods which were sufficient for our forefathers, and that those great industries which do not keep abreast of the advance of science must surely and rapidly decline? On behalf of the Princess of Wales and for myself, I offer our cordial greetings to the members of the congress, and I earnestly trust that great results may accrue from your deliberations. I now have much pleasure in declaring the seventh International Congress of Applied Chemistry open."

Sir William Ramsay, in the course of his opening address, said it is impossible to draw a hard-and-fast line between scientific and technical chemistry. Above all, chemistry is a practical science, although in recent years it has more and more tended to become a branch of applied mathematics. The chief difference between pure and applied science consists in a satisfactory answer to the question—all-important to the technical chemist—"Will it pay?" This, however, is irrelevant to the man of science. On the answer to this question the success of a process depends; but in its essence applied and industrial chemistry are one. This has hardly been realised in a practical way on this side of the Channel or even on the other side of the Atlantic. Our Continental friends have realised it and acted upon it under the conviction that the industrial prosperity of a nation can best be advanced by an alliance between the technical and practical workers, that is to say, between the university and the factory. Such congresses as the present can teach much, and if this lesson be learnt, then a valuable national asset will have been gained. It is often said that science knows no country, and the existence of this congress accentuates the proof of the saying. All the nations of the civilised world are represented, and have met together to discuss how best to develop the special branches of chemistry to which the members have devoted their lives.

Prof. Wiley, of America, said there is no more apt illustration of the utility of chemistry than to say that if its principles were unknown and unapplied, teeming millions of the globe would be at this moment unclad and unfed. Sanitation is a chemical problem; pure food, pure air, pure water, which ensure activity of mind and body and cure disease, are also problems for the chemist.

Prof. Armand Gautier, of France, said that in the development of industrial science England and France are not the only, but the great leading nations—never enemies, but always rivals.

Prof. O. N. Witt, replying for Germany, said the field of applied chemistry extends in two directions. It includes the analysis scientifically and the control of commercial raw products, and also of finished products. It further includes the advance of the chemical industries which are concerned with them. The congresses promote friendly feeling and noble rivalry, and as a consequence obtain the patronage of the rulers of nations.

Prof. Paternò, of Italy, said that naturally the members responded with enthusiasm to an invitation from the country which was the birthplace of Boyle, Black, Cavendish, Priestley, Dalton, Davy, Faraday, Graham, and Woollaston. Even in the noisy rush and turmoil of London life scientific men know how to find the necessary tranquility to carry out their scientific investigations.

Prof. Arrhenius, in replying for other delegates of foreign lands, spoke of England as the classical world of applied chemistry. In this country, particularly in London, successful efforts have been made to improve hygiene by the employment of chemical methods, with the result that among the large cities of the world London has the lowest death-rate.

Later in the afternoon sectional meetings were held to arrange the work for the succeeding days of the congress. The organisation of the sectional work was a matter of considerable difficulty owing to the large number of papers sent in. This was notably the case in the sections for organic chemistry, analytical chemistry, and electro-chemistry, in each case the number considerably exceeding one hundred, while the actual time available for work only amounted to 18½ hours.

In several cases, where the subject was of interest to more than one section, joint meetings were held. A special case of this was a joint meeting of five sections to discuss the fixation of atmospheric nitrogen, when Hofrath Prof. Bernthsen, Prof. Birkeland, and Dr. N. Caro presented the subject from different points of view. This particular discussion attracted great attention, not only because of its enormous importance, but also because Prof. Bernthsen's address was experimentally illustrated.

The process of Birkeland and Eyde, in which the arc is drawn out into a thin disc by the means of powerful magnets, is well known, but that of the Badische Anilin- und Soda-Fabrik had not been previously described in this country. An iron tube contains an insulated electrode at one end and itself acts as second electrode. At its formation the arc springs from the insulated electrode to an adjacent part of the iron tube which is only a few millimetres away. Air is, however, blown tangentially or with a rotary motion through the tube. This carries the end of the arc along the wall of the tube, so that it ends at a considerable distance from the electrode or on a special electrode placed at the further end for this purpose. Commercially, arcs nearly eight yards long have been produced. The air passing up the tube through the arc thus becomes oxidised. Prof. Bernthsen showed such an arc about three-quarters of a metre long. It was struck in a glass tube which had a copper spiral running up its entire internal length, this being shown in a darkened room. The sight of Prof. Armstrong's lecture theatre at the Central Technical College crowded to suffocation was very striking. After the arc had been burning for about one minute, two large glass globes connected with the arc tube became filled with brown fumes of oxides of nitrogen.

Prof. Birkeland followed, and accentuated some points in connection with the Birkeland-Eyde process. Then Dr. N. Caro described the cyanamide process, and claimed that it was the cheapest method for the fixation of atmospheric nitrogen. It was easy to obtain ammonia directly from cyanamide, and, furthermore, a host of chemical products could be made by using cyanamide as a starting product.

Mr. E. R. Taylor read a paper of great interest upon national and international conservation of water-power, a subject which is attracting considerable attention in America. It will also be remembered that at the annual meeting of the British Science Guild Sir William Ramsay also brought this matter forward, and a committee was appointed by the Guild to consider the matter.

The pollution of sea-water was discussed in the hygiene section by Prof. Kenwood and Mr. F. N. Kay-Menzies. Edible sea shell-fish reared or deposited in the neighbourhood of our shores are often exposed to dangerously contaminated sea-water; it is also questionable whether bathing in such water is not dangerous. The bacteria of typhoid can survive for several days in sea-water, and coastal tides and eddies are capable of carrying sewage contamination several miles in the course of twenty-four hours.

Dr. M. Frenkel described a method for rendering motor-car escape gas odourless. The car is fitted with a special box containing platinised asbestos or platinised porous porcelain. The exhaust gases are made to pass through this box, and the contact of the air and malodorous gas with the catalytic platinum causes complete oxidation, and thus deodorisation.

On Friday afternoon, May 28, Prof. Halle, of France, and Prof. Paternò, of Italy, gave addresses to the whole congress. On Monday, May 31, Prof. O. N. Witt, of Germany, and on Tuesday, June 1, Sir Boverton Redwood also gave addresses to the combined sections of the congress.

The congress was attended by more than 4000 members, and the number of papers presented was very large. The attendance at the sectional meetings was quite extraordinary, many members attending their particular section from 10 in the morning to 1.30, and then from 4 to 6 in the evening, and listening to the reading of twenty or thirty papers ranging over the whole scope of the subject. In one section there were at 6 p.m. more than 100 members alert and eager for more.

The hospitality has always been a feature of these congresses, and the countries in which the congresses have been held have vied with each other in the entertainment of their guests. In this respect also the congress in London was not behindhand. The members were entertained by the Lord Mayor and Sheriffs at the Guildhall on Wednesday, May 26, and on May 27 a reception was held at the Foreign Office by Mr. Lewis Harcourt, M.P., on behalf of the Government. About two thousand invitations were sent out; and the company bidden to meet the delegates included the French, Russian, Austro-Hungarian, Spanish, American, and Japanese Ambassadors; the Portuguese, Netherlands, Belgian, Brazilian, Swedish, Chinese, Greek, Norwegian, and Danish Ministers; leading members of the Government and the Opposition; and others of social and political distinction. Though most of the foreign members of the congress were present, apparently no effort was made to bring together British men of science of distinguished eminence in all departments of scientific activity to meet them. The visitors must have been disappointed to find that the chief people present at the reception, other than actual members of the congress, were renowned for their political and diplomatic connections rather than by their position in the scientific world.

There was a great banquet at the Crystal Palace on May 28, which was held in the central transept, and to which nearly 2000 ladies and gentlemen sat down. The dinner was followed by speeches, which some heard, and then by a special display of fireworks, which all saw. On Saturday, May 29, the King received a deputation from the congress, who were accompanied by Sir Henry Roscoe (hon. president), Sir William Ramsay (acting president), and Mr. W. Macnab (hon. general secretary). The following delegates had the honour of being presented to the King by Sir Henry Roscoe:—Dr. W. H. Nichols (America), K.K. Regierungsrat F. Strohmer (Austria), Dr. François Sachs (Belgium), Mr. O. Kouanze (China), Prof. Léon Lindet (France), Prof. Otto N. Witt (Germany), Prof. E. Paternò (Italy), Prof. Kuhara (Japan), Dr. S. Hoogewerff (Netherlands), N. Tavildaroff (Russia), Prof. Pinerùa y Alvarez (Spain), Prof. Arrhenius (Sweden), and M. F. Reverdin (Switzerland). On Saturday there was also a great garden-party at the Botanic Gardens, given by the ladies' committee, and in the evening a reception by the president of the Society of Chemical Industry. On Sunday and Monday there was a host of private parties, which absorbed nearly three thousand of the guests. Finally, on Tuesday, June 1, a reception was given at the Natural History Museum.

Such congresses cannot but help international goodwill and stimulate friendship between the nations. No jarring word was heard; delegates from all the civilised world fraternised, and each taught the other something of the work which is being done in their own country; friendly rivalry has been stimulated, and by means of the social functions they have learnt to know each other as friends. It is often said that international sport is a bond of friendship between the nations, but it often leaves heartburnings. The meeting of a congress such as this leaves behind no unpleasant feeling, but stirs enthusiasm and admiration for the work which our rivals are carrying out, and cements the nations in a manner which no number of Dreadnoughts can accomplish.

EDUCATION AND RESEARCH IN APPLIED CHEMISTRY.[1]

THE question of the training of industrial chemists, after having been dormant for some years, has again been raised, and it has now taken the more definite form of whether our universities should develop schools of applied chemistry. Let us look at the example of the engineering industries. There has been more coherence and solidarity and more personal interest on the part of the leaders of the engineering profession with regard to technical education than has been shown by chemical manufacturers. The practical effect is that the term "technical education" in Great Britain has become almost synonymous with training in engineering, and on the governing bodies of the newer institutions the engineering influence is predominant. The lack of active interest in the educational side of applied chemistry on the part of the manufacturers has acted detrimentally to their own cause. The teachers, if left alone by the manufacturers, are apt to become too purely bookish, and the manufacturers, if they cut themselves adrift from the academic side of chemistry, are likely to become too narrowly practical. The recent discussions upon the desirability of the better training of industrial chemists have centred round the universities, and the technical schools and technical colleges have been passed over.

Definition of Terms.

In many cases where the education of the technical or industrial chemist has been under discussion, the manufacturers on the one hand, and the teachers on the other, have had in view totally different kinds of people. When the training of an industrial chemist is under discussion, do we mean his preparatory general scientific education, or that *plus* something more? If the latter, what is that "something more" to be? The manufacturers who ex-

[1] From the presidential address delivered before the Society of Chemical Industry on May 26, by Prof. Raphael Meldola, F.R.S.

pected the new technical education movement to staff their works with expert technologists underestimated the complexity of their own industries. Those teachers, on the other hand, who are clamouring for the staffing of our factories by scientifically trained chemists, as distinguished from technologists, have damaged their case by leaving out of consideration the expert technologist altogether—the man whose knowledge of *technique* enables him to translate a discovery into pounds, shillings, and pence. The education of the "chemical technologist" is of the same importance for chemical industry as the education of the "pure" chemist. Highly competent scientific chemists are as inseparable from the "technologist" or the "chemical engineer" or the "practical manufacturer" as were the Siamese twins from one another. Severance is death to both; and the manufacturers cannot afford to leave out of account the scientific chemist any more than the teachers can afford to ignore the technologist. In these discussions on education the teachers have had in mind the research chemist and the manufacturers the chemical engineer. The research chemist ought to be producible from the universities and technical colleges. With respect to the chemical technologist, the question is whether he can be produced under any of our existing educational curricula, or whether the factory is the only proper training ground.

The Works Chemist.

So long as we know what kind of student we are talking about there need be no confusion. The research chemist is a man who has received the highest possible training as a scientific chemist, and whose resourcefulness has been developed by prolonged systematic research. It is immaterial whether he receives his training in a university or in an efficient technical college. When we come to the consideration of the chemical technologist there must be more discrimination between the different branches of chemical industry before the conflicting views of teachers and manufacturers can be brought into harmony. The requirements of a chemical factory may be thus classified:—

(1) Research for the discovery of new products, or of new processes for producing known substances, or for the improvement of processes already being carried on.

(2) Supervision of the factory operations with respect both to plant and products; the valuation of the raw materials and finished products; the testing of intermediate products.

(3) A knowledge of the markets with respect to the supply and cost of raw materials and the demand for the finished products.

The "works chemist," or technologist, must be qualified to come under category No. 2, with (possibly) an incursion into the domain of No. 1. By the "works chemist" (excluding the analyst, the mechanic, and the workman) I mean a chemist with more or less knowledge of the general principles of engineering as applied to chemical factory plant. He cannot be too much of a chemist, and the more he is of an engineer the more competent will he be to discharge his duties. Where is this combination of qualifications to be acquired? I consider the question first from the point of view of the technical college.

Theoretical and Practical Instruction.

We have to deal with the student who is entering the technical institution for a systematic three years' course with the view of his becoming a chemical technologist. We much prefer that the student should come to us with no previous school training in science, which is generally too shallow to be of use, and stiffens the mental attitude to the point of conceit, though there is no reason why school science should not be taught in such a way as to make it of preparatory value. In the technical college we have to begin from the beginning. The subjects which, in addition to chemistry, are indispensable for the future chemical technologist are mathematics, physics (including electricity), and mechanics (including drawing-room practice). It takes at least two years to lay an elementary foundation in these subjects; there is left but one year for advanced instruction. This course is not more than a preliminary training; it cannot pretend to add to the scientific training that "something more" which is necessary for the technologist. There is no time for specialisation, and there are few technical schools in this country (exclusive of universities) where specialisation is possible. Can the technical education given in technical colleges be developed into technological training? Can the teaching in technical schools be made to approach the diversified requirements of the different branches of chemical industry so as to make the preparation for technology more effective? I believe it can, if we are prepared to give the necessary time. If I were unable to justify this belief, these newer institutions could not claim to be discharging any function differing from those discharged by educational establishments of all ranks, in which chemistry is taught for purely academic purposes.

Specialisation should follow upon the general training; but it is this specialised training which the manufacturer has in mind when he speaks of "technical" education. The chemical teaching of technical schools can be given a bias in the specialised direction without detracting from its value as an educational discipline and without damage to its theoretical treatment. Chemical manufacture consists in converting certain raw materials into useful products, with maximum yield and minimum expenditure. The systematic treatment of elements and compounds, say in the second- and third-year courses, can be developed in much greater detail in cases where technical products are concerned. There is as much pure scientific doctrine to be deduced from the study of useful products as from the study of useless products. By giving a technical bias to the teaching it is not proposed that technical chemistry, in the sense of chemical technology, which is a specialised subject, should be made a part of that preliminary training which up to this stage I have alone had under consideration. Why should not the "preparations" in the laboratories of the technical schools be made quantitatively? It gives zest to the work if the student is supplied with a known weight of raw material and given to understand that the value of his results will be estimated by the yield and purity of his product. A series of "preparations" might be arranged in which, not only the weight of the raw materials and of the final product were taken into consideration, but also the quantities of the various reagents used, and from these data, making sufficient allowance for the usual—*not* the laboratory—"working expenses," the actual cost of the product ascertained. I advocate the introduction of the large-scale practical exercise into the advanced stage of the preparatory training. The first difficulty the college-trained student has to face in the factory is his want of familiarity with large-scale operations.

With advanced students in the technical colleges the preparation work should be increased in scale so as to introduce an element of training in chemical handicraft. I am not now advocating the introduction of working models of special plant used in particular industries. The plea is for the handling of apparatus illustrating such general operations as are carried on in all factories—heating and cooling, evaporating, distilling, mechanical mixing, grinding, solution, filtration, &c., on something more than the ordinary laboratory scale. This plea does not mean that the colleges should be expected to teach chemical technology in the strict sense—that is a distinct question; nor that *all* preparation work should be done on this increased scale.

Chemical Technology.

The stage of technical chemistry should lead to that of chemical technology. Manufacturers ought not to be satisfied with the youth who has spent his three years at a technical school. The chemical technologist is a chemist *plus* a great deal more. The factory is not the proper place for beginning the technological training. During the supplementary period following the preparatory training in the technical school there should be opportunity for research work. The supplementary advanced or technological training should do for industrial chemistry what the post-graduate training does for academic chemistry—it should enable us to sort out the different orders of faculty. A few students would be found capable of development as research chemists, a larger number as chemical technologists. The omission of research from our educational curricula means a loss to our industry of a class of chemical technologist of which we are in need—the man who has been trained in scientific habit of thought by the most effective of all known methods. In advocating the introduction of research into the advanced curriculum it must be most clearly understood that we are not contemplating the "research chemist" as defined in this address. He comes under another category. We are now considering only the higher education of the works chemist and the importance of research in relation to his advanced training. If it is admitted that some advanced training supplementary to the preparatory course is essential, and that science is to form part of that advanced training, the advanced laboratory work from the fourth year onwards could be made to include experimental investigation either in pure or applied chemistry.

The Sphere of the Chemical Technologist.

There appears to be a general opinion in favour of technological training. The proposals come chiefly from the university side, but that is immaterial. All attempts to move in this direction hitherto have been more or less paralysed by the teachers declaring for pure science and by the manufacturers proclaiming that it is impossible to teach chemical technology in the educational institutions. It is beginning to be perceived that when the technical education of the works chemist is under consideration it is really technological training that is meant. Chemical technology means generalised chemical engineering—a knowledge of the chemical, physical, and mechanical principles underlying the construction and working of the machinery and plant in general use in chemical industry. It is a composite subject, part of which is pure engineering, such as power production and distribution, and part of which is specialised engineering, such as the nature, source, and properties of the materials used in the construction of chemical plant.

There is practically no technical school in this country which provides a complete and coordinated course of training such as I have advocated. For the chemical industries, the technical education movement has been arrested just at that stage where the true technical training should begin. The technical institutions are not wholly, nor for the greater part, to blame; the manufacturers have not sufficiently encouraged them. The greater part of the chemical instruction in the technical institutions is carried on in evening classes. This kind of training is practically useless for industrial chemists. It would take the evening student nine years to complete the three years' preparatory course of the day student. At the same time, evening classes are of real value for men already engaged in the factory work—say foremen and managers who have had no training in scientific theory. After thirty years' technical education applied chemistry is lagging behind all other branches of technology.

The Universities as Schools of Applied Science.

While large numbers of institutions originally intended for instruction in applied science are carrying on purely scholastic courses, the universities, originally academic institutions, are now developing schools of applied science. Ought the universities to create departments of applied chemistry? If the ordinary graduate courses were not suitable for the chemical technologist they could be adapted without much difficulty. The university need only make provision for that kind of advanced work which I have advocated. It does not matter what kind of institution does the work so long as it is done efficiently; the need for it is great.

The Conclusion.

But if the higher work is to be taken over by the universities, the *raison d'être* of the technical school for chemical industry will become a thing of the past. It will be deplorable and wasteful if we find the university and the technical institution in the same town rivals instead of colleagues. The rational solution is that the technical institution should become a school of the university, as is the case at Manchester. Such a solution carries with it the implication that the technical institution will raise its technological teaching to the university standard. That is precisely what we want. In framing any educational policy of practical value for our subject the Society of Chemical Industry can play an important part. We are both imperial and international; we have the means of bringing together a body of expert knowledge and experience, both educational and technological, such as is possessed by no other organisation. An advisory or consultative education committee or board formed by our council from the ranks of our members, and comprising teachers and manufacturers, ought to be of such power that no departure in the technical training of chemists in any educational establishment, of whatever rank, could afford to neglect its counsels.

THE CAMPAIGN AGAINST MALARIA.[1]

MORE than nine years ago I had the privilege of addressing the Royal Institution (March 2, 1900) on the subject of my researches on the mode of infection in malarial fever, and I am now called upon to describe what has been done, or not done, in various countries to utilise for the alleviation of the disease the information then obtained.

The ancients appear to have recognised, not only the principal symptoms of malarial fever, but the fact that it is often connected with marshes; and more recently many authors ascribed this fact to the existence of poisonous vapours, which they supposed are given off by stagnant waters, or even by the soil. Still later, a series of pathological studies led to the discovery by Laveran in 1880 that the malady is produced by vast numbers of minute protozoal parasites of the red blood-corpuscles, and students of the subject now conjectured that these organisms originally inhabited the marshes, and infect man through air or drinking-water. My own studies, however, commenced eighteen years ago, and, confirmed and extended by many workers, showed that the parasites are carried from man to man by certain species of Culicidæ (gnats or mosquitoes), and that it is these carrying agents, and not the parasites themselves, which live in the marshes. Thus malarial fever was now proved to be merely a parasitic disease, the infection of which is carried from man to man by the agency of certain water-breeding insects.

As described in my previous lecture, the broad principles of this theorem were really fully established by the end of the year 1898. Although numerous minor details still required study—such as the precise species of mosquitoes which carry the infection in various countries, the exact habits of each species, and so on—yet I held that these questions could now be elucidated without difficulty in the ordinary course of work, and that we were already in a position to apply the discovery at once to the saving of human health and life. I propose, therefore, to take up the story again from this point.

First let me emphasise the great importance of this practical side of the subject. Malarial fever is spread over nearly the whole of the tropics, abounds in many temperate climates, and has been known to extend so far north as Sweden. In vast tracts of tropical Africa, Asia, America, and southern Europe almost every town and village is infested by it; millions of children suffer from it from birth to puberty; and native adults, though they tend to become partially immune, still remain subject to attacks of it. Although it is not often directly fatal, yet it is so extremely prevalent, so endemic in locality, so persistent in the individual, that the total bulk of misery caused by it is quite incalculable. More than this, its special predilection for the most fertile areas renders it economically a most disastrous enemy to mankind. Throughout tropical life it thwarts the traveller, the missionary, the planter, the soldier, and the administrator. From one-quarter to one-half the total admissions into military hospitals are returned as being due to it, and it is often the most formidable foe which military expeditions have to encounter. There are reasons for thinking that it indirectly increases the general death-rate of malarious countries by something like 50 per cent., and I venture to say that it has pro-

[1] Discourse delivered at the Royal Institution on Friday, May 7, by Prof. Ronald Ross, F.R.S.

foundly modified the history of mankind by doing more than anything else to hamper the work of civilisation in the tropics. Only those who have studied the disease from house to house, from village to village, can form any true notion of the total effect which it must produce throughout the world.

Next let us recall briefly the various methods which we possess for preventing and reducing the disease. The oldest of these—known to us since the time of the Romans—is *drainage of the soil*. The reason why it succeeds became quite obvious after 1898—because it tends to remove the terrestrial pools and marshes in which the Anophelines, that is, the family of mosquito which carry malaria, breed; but the new discoveries not only explained the old method, but also rendered it more simple, cheap, and yet precise, by showing us exactly what waters, namely, those in which the larvæ of the Anophelines actually occur, are to be drained away, or filled up, or otherwise treated. But science has given us other methods as well. Thus we have known for a long time that *quinine* is a preventive as well as a cure—that if, for example, a body of men are given quinine with regularity they will suffer less from fever in consequence. Still further, the old saying that the use of *mosquito-nets* at night will keep off malaria was now fully justified, not because the nets exclude any aërial poison, but simply because they exclude the infecting insects. This simple precaution can, moreover, be extended by protecting all the windows of a house by *wire-gauze*, as already frequently done in the southern States of America. *Punkas* and *electric fans* also serve to keep away the insects; and, lastly, *segregation* of Europeans from native quarters, as used so largely in India, will help to keep them from mosquitoes infected by native children (who suffer so frequently from the disease). It was thus apparent that if the inhabitants of malarious countries could be persuaded to protect themselves by mosquito nets or quinine, or if the Governments of such countries could be persuaded to undertake suitable drainage and other measures against mosquitoes, much improvement in the public health was likely to accrue.

But how precisely was such persuasion to be undertaken? Of course, I do not allude to utterly barbarous peoples, to areas far beyond the influence of civilisation, which are happily shrinking in magnitude every day. I allude to independent or dependent States professing themselves civilised, and to the numerous colonies of the great civilised nations. Here we already possess the requisite machinery. Such States or colonies are administered by governors and councils, and for the most part possess medical and sanitary departments controlled by well-paid officials, whose special duty it is to attend to such affairs. Many dependencies, moreover, such as some of these of Britain, are placed under the central Government of the nation concerned, and can be influenced by it. It might be supposed, then, that at the period referred to all such administrations would have gladly interested themselves in the prevention of a disease which produces so much mischief, and of which the cause had been so clearly elucidated; that they would at once have set about collecting preliminary information, and commencing at least some experimental trials. So far as I can see, there is no real reason why this was not done everywhere nearly ten years ago.

Unfortunately, though science may provide us with facts, humanity is slow to credit them, and still more slow to take advantage of them. History is full of examples of this. For instance, years elapsed before the discovery of Jenner was fully utilised—it is not fully utilised even yet. Another instance, closely connected with malaria, is that of filariasis, a parasitic disease of which elephantiasis is one manifestation. More than thirty years ago very good evidence was given to show that it is carried by mosquitoes, and, considering the horrible and widespread deformities which it produces, one would have thought that strong efforts would have quickly been made to control it by reducing the carrying agents. So far as I can ascertain, however, scarcely anything has yet been even attempted against it. No one has interested himself seriously in the matter, and consequently nothing has been done.

It was therefore early apparent to me that, though the machinery for extensive anti-malarial work existed in many countries, yet it would not easily be got to work unless someone could be found who would devote himself to the task—neither a pleasant nor a profitable one—of urging it forward, and I felt that the duty devolved on myself, in the absence of others, as regards British territory. Happily, Angelo Celli and Robert Koch occupied themselves similarly as regards Italy and Germany, and the creation of the Schools of Tropical Medicine in Liverpool and London in 1899 did much to popularise the recent discoveries. At my inaugural lecture the same year, at the former institution, I described my proposals for the prevention of malaria by mosquito reduction, and a few months later, accompanied by Dr. H. E. Annett and Mr. E. E. Austen, I left England for Sierra Leone in order to perfect the details.

Sierra Leone is a small British colony long notorious for its extreme unhealthiness. We determined rapidly the malaria-bearing species of Anophelines there, and their breeding places and habits, and drew up a series of proposals for their reduction. These have since become the basis of similar work elsewhere; but, simple as they were, we could not get the local authorities to understand them or act upon them. Two years later I again—twice—visited the colony, and, assisted by Dr. Logan Taylor and a sum of money presented to me for the purpose by a private gentleman, attempted to give an object-lesson on the subject. Though the result was successful at the time, we again failed in inducing the authorities to take up the work properly; and I can obtain no adequate information as to what has been done there during the last seven years, and may perhaps be excused for not wishing to inquire.

In the meantime, the Liverpool School of Tropical Medicine and the Royal Society had sent a series of expeditions to West Africa, which did much good work there. As a consequence, Sir William MacGregor, Governor of Lagos, and one of the most enlightened of British administrators, took up the task in that colony with great intelligence and energy, but, unfortunately, was shortly forced to leave by ill-health—a serious blow to anti-malarial work throughout the world. From that time, though much appears to have been done by energetic individuals in West Africa, and though, to judge from popular statements, public health has been decidedly improved there, yet the official reports and returns are too inadequate to enable us to form any trustworthy opinion of the results. The recent statements of Prof. Simpson on the subject are not encouraging; and to my mind, judging from many facts known to me, the sanitary administration of the West African colonies has been generally wanting in leadership and organisation, and the campaign against malaria has been constantly thwarted by administrative indifference and professional jealousy.

Turning elsewhere, I must now mention with great pleasure the early and successful campaign of Koch at Stephensort, in New Guinea. The method of Koch does not depend on mosquito reduction, but on the detection and treatment of cases of malaria by quinine, until they cease to spread the disease among their healthy neighbours. It is allied to the similar method used in other diseases, has been successfully followed in the German colonies and in Italy, and will always be a valuable weapon in the anti-malarial armoury. The great work of Celli and the Italian Anti-malaria Society, commenced early in 1899, has been based on the same, but also on a wider, principle of distribution of quinine, together with mechanical protection from mosquito bites. Working onward step by step against political and local indifference, they have gradually made, during the last ten years, a great reduction in the amount of the disease throughout Italy. An independent witness—Prof. Osler—has recently written as follows to the *Times*:—"In Prof. Celli's lecture-room hangs the mortality chart of Italy for the past twenty years. In 1887 malaria ranked with tuberculosis, pneumonia, and the intestinal disorders of children as one of the great infections, killing in that year 21,033 persons. The chart shows a gradual reduction in the death-rate, and in 1906 only 4871 persons died of the disease, and in 1907, 4160." I should be unable to hang a similar chart for British possessions in my lecture-room.

In 1900–1 a great discovery, closely connected with our subject, was made by the Americans in Havana—I mean the discovery that yellow fever, the scourge of tropical America, is also carried by mosquitoes of the kind called Stegomyia. With the Americans, however, there was no delay in turning this fact to practical account, and under General Wood and Colonel Gorgas they got rid of the disease from that large city in a few months. Since then Colonel Gorgas has been conducting the magnificent sanitary work of the Americans in the Panama Canal zone—work the success of which is too well known to require illustration by figures, but which has enabled the Americans to do what the French, before the date of these discoveries, failed in doing, namely, to continue the construction of the canal. It is not too much to say that the canal is being made with the microscope. Colonel Gorgas has repeatedly stated that the measure upon which he principally relies, against both yellow fever and malaria, is the general reduction of mosquitoes.

For three years my original proposals to remove malaria by this means had not been thoroughly and formally applied by any Government, but I have now to record the first classical successes obtained by it in Ismailia and in the Federated Malay States. The former is a town founded by Ferdinand de Lesseps on the Suez Canal. For many years it had suffered extremely from malaria, the cases amounting ultimately to about 2000 a year among a small population. In 1902 I was asked by Prince Auguste d'Arenberg to advise on the matter, and my advice was acted upon loyally and intelligently by his officers in the town. The result was that the cases fell to 214 next year and to ninety in 1904, and that since then there has been no endemic malaria in the town at all, while mosquitoes of all kinds have been practically banished from it. The work in the two small towns of Klang and Port Swettenham, in the Federated Malay States, was begun about the same time, chiefly by Dr. Malcolm Watson under the orders of the Government and of Dr. E. A. O. Travers, and has been equally successful. No one who has studied the facts published with regard to both these campaigns can for a moment deny the success obtained.

Since then excellent campaigns on similar lines have been conducted at Durban, Hong Kong, Khartoum, Candia, and St. Lucia. Most striking has been the anti-mosquito work conducted at Port Said under the orders of Sir Horace Pinching, recently head of the Egyptian Sanitary Service, by my brother, Mr. E. H. Ross. The town has been so completely cleared of mosquitoes that, as at Ismailia, the ladies no longer use mosquito nets for their children. I may add that I have just recently visited both localities, and was able to verify this statement by conversations with a number of people. Fuller accounts of some of these campaigns will be found in a paper by me published in the *Lancet* of September 28, 1907. Excellent and extensive work has been done for many years in Algeria by Drs. Edmond and Étienne Sergent (*Annales de l'Institut Pasteur*, 1909) by all methods, and by Drs. Savas and Kardamatis and the Greek Anti-malaria League (Annals of Tropical Medicine and Parasitology, Liverpool, June, 1908). The Italian work is published in the *Atti della Società per gli studi della Malaria*, and Dr. Laveran gives much information on the subject in his last book on malaria, "Du Paludisme," 1907.

Two years ago I was asked by the Government of Mauritius to advise regarding malaria in that ancient island colony. The War Office associated Major C. E. P. Fowler, R.A.M.C., with me, and after three months' studies, warmly assisted by the Governor, the officials, the planters, and everyone, we drew up our scheme for a general campaign against the disease. There is no doubt that this scheme will be followed when the present financial situation is rectified, but in the meantime I hope and trust that our reports, which were written with great care, and have been published by the Colonial Office and the War Office respectively, will prove of value in other parts of the tropics.

When I left India in 1899 I hoped that that great dependency of the British Crown, with its powerful Government and well-appointed medical and sanitary services, would lead the way against malaria, a disease which causes untold sickness, and possibly some millions of deaths, annually in the country; but though many local campaigns have been started by individual medical men, and though there has been a steady fall in the malaria rate of the army, I can find no evidence of a generalised effort against the disease. Less than three months ago I attended the Medical Congress at Bombay, largely for the purpose of inquiring into the reason for this, and concluded that though many capable officers, both of the Indian Medical Service and of the Royal Army Medical Corps, had done their best, yet the necessary leadership and organisation were wanting in India as in West Africa. An ill-judged and ill-conducted experiment at Mian Mir has done much to paralyse all efforts in this direction, and I gathered that anti-malarial campaigns were not popular among certain officials. Neither the Indian Government nor the medical services can be congratulated on the result.

Some years ago the Secretary of State for the Colonies issued a circular to the Governors of Crown Colonies asking for information as to what had been done in each against malaria and other mosquito-borne diseases, and statements on the matter from twenty-one colonies were published in the Report of the Advisory Committee of the Tropical Diseases Research Fund for 1907. I have criticised these statements in detail elsewhere. Only those furnished by seven colonies, namely, Southern Rhodesia, Papua, Mauritius, British Central Africa, Gambia, Ceylon, and Southern Nigeria, showed evidence of any real interest in the matter. Those from Bahamas, Barbadoes, Jamaica, and St. Kitts-Nevis showed, to my mind, nothing but neglect of public duty, while those from Northern Nigeria, St. Lucia, British Honduras, Grenada, Somaliland, Straits Settlements, and Sierra Leone gave no decisive evidence of the reverse.

For a number of years I have had very good opportunities of learning the truth as to what is really being done in many of these and other dependencies. It may generally be summed up in two words—very little. Festering pools which might have been cleared years ago for a few shillings or pounds are left in the heart of important towns to poison all around them; quinine prophylaxis is neglected, and house-screening forgotten. No efforts are made even to estimate the local distribution of the disease, much less to organise any serious efforts against it, although it may be causing, perhaps, half the sickness in the place.

Want of funds is always an excuse which is urged—and is always a false excuse. Much can be done at almost no expense; and the men who have actually carried out the work successfully in Panama, Ismailia, the Federated Malay States, and Italy have expressly declared the cheapness of it. Many a town could be kept clear of malaria for the amount, say, of the salary of a single European official. I estimate that a sixth of the medical and sanitary budget should generally suffice to reduce a disease which often causes half the sickness; but instead of doing really useful work which would benefit everyone, the authorities too often fritter away their funds on trifling schemes. I maintain that the health of the people has the first claim on the public purse.

Another excuse is that the possibility of preventing malaria has not been proved, but when one questions the sceptics one generally finds that they have not troubled to study the literature.

The fact is that the neglect of which I complain is due to quite other causes. I do not think that, as a rule, the blame is to be attached to the rank and file of the medical profession in the tropics. Men on the clinical side generally have enough to do with their hospitals and medical practice, while those on the sanitary side frequently complain that their recommendations are not seriously attended to. The immediate responsibility lies with the heads of the sanitary services of the colonies—men who are specially paid to organise such work. Now, though many capable individuals are to be found in such medical services, there is always a percentage of men, in them as in other services, who, to be frank, are not at all capable—men who from the date of receiving their medical qualifications take no further real interest in their work, read no literature, undergo no further courses of instruction, undertake no scientific researches, and make no additions to our knowledge either of medicine or of sanitation, and yet who manage to obtain the highest medical or sanitary appointments, either by seniority or by the well-known arts of self-service and wire-pulling. I am sorry to have to express such an opinion, but I think that this type of person is much too common in all branches of British administration. Worse heads of departments cannot be found. They scoff at the knowledge and efforts of others in order to cover their own ignorance and apathy. To them all new discoveries are frauds, and all new proposals are charlatanism. They repress every kind of honest endeavour among their juniors; they fill the best appointments with their own friends; and they truckle to their official superiors in the hope of obtaining further preferment. At last, decorated and pensioned, they leave the field to others of their own stamp—men without an idea or an ideal, except such as refer to their own advancement. These are the persons who are really responsible for the state of things which I have described.

As a rule, colonial Governments are far too careless in the selection of the men to whom they entrust the health of the public. It is openly said that they often choose either mediocrities or men who they know will be too subservient to them to assert the demands of sanitation—which is never a popular theme. At home, no one may be the medical officer of health, even of an English village, without possessing a proper diploma entitling him to practise as such; but it appears that anyone is good enough to be the chief sanitary officer of a whole country. The most amazing appointments are often made. Men of known and approved ability are passed over in favour of others who are supposed to possess special administrative qualifications, which frequently means nothing but a capacity for self-advancement, and both senior and junior sanitary officers complain that their representations regarding anti-malaria work often receive no intelligent attention either from the civil or the military authorities.

Root-and-branch reforms are required in all these respects. The failure of most of our tropical dependencies during ten long years to understand and act upon modern discoveries in connection with malaria, and, indeed, with other diseases, demonstrates that their sanitary services no longer fulfil the purpose for which they are paid and appointed. Reconstruction, similar to that which has revivified the Royal Army Medical Corps, is urgently demanded. It is not too much to ask that no man shall be appointed to an administrative post without previous examination as to his fitness—that no man shall be entrusted with the post of chief sanitary officer unless he can show evidence of having really worked at the subject, of having mastered scientific details, and of having obtained the qualifying diplomas of public health and tropical medicine. He should be placed on the Executive Council, which is now so frequently managed by the heads of less important departments. Proper arrangements should be made for expert inspection and supervision, and much more science, work, and discipline should be demanded, not only in the services, but in those who control them.

I have now outlined the general course of events. The immediate success which we had hoped for ten years ago has not been attained. The battle still rages along the whole line; but it is no longer a battle against malaria. Malaria we know, we understand fully, we can beat down when we please. The battle which we are now fighting is against human stupidity. Those of us who have taken part in it—not too numerous—know what it has been. We have written and lectured *ad nauseam*; we have interviewed ministers, members of Parliament, and governors; we have appealed to learned societies; we have sought the support of distinguished people; and we have received—sympathy. We have reasoned, and been ridiculed; we have given the most stringent experimental proofs, and been disbelieved; we have protested, and been called charlatans. I think that not one of those young men who have pioneered this important work in the field has ever received thanks for his labours. On the other hand, I know of several who have been actually punished for it. I know that all new movements have to face opposition of this kind; but surely the world is becoming too old for it. We talk much of science, and collect funds for research and teaching, and hold conferences and congresses, and blow trumpets over our doings; but when a useful discovery really is made, when the cause and methods of prevention of the most important of human diseases have been discovered, taught, and tried for ten years, this is the way we employ it for the good of humanity! Of what use is it to make discoveries if, when they are made, they are neglected? Remember that all this time, while we are questioning facts that are proved and methods that are established, hundreds of thousands, nay millions, of poor people are suffering from our dullness. I conclude with an appeal. The matter must be taken up in Parliament and in the Press as vigorously as possible. If some of the officials at fault could be persuaded to accept their pensions and decorations before the usual time, room might be made for more capable men. The few persons who have fought the fight and failed are scarcely able to continue it. If no stronger influences can be exerted, the future of malaria prevention in British dominions will certainly be as barren as the past has been.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed, in connection with the Darwin centenary, to confer the degree of Doctor of Science, *honoris causa*, upon the following:—Otto Bütschli, professor of zoology in the University of Heidelberg; Richard Hertwig, professor of zoology in the University of Munich; Hermann Graf zu Solms-Laubach, professor of botany in the University of Strassburg; F. Vejdovský, professor of zoology in the Bohemian University of Prague; and Max Verworn, professor of physiology in the University of Göttingen.

During the long vacation the science courses will include the following:—the curator of the herbarium, Mr. C. E. Moss, will give a series of demonstrations and lectures on systematic botany (flowering plants) in the botany school, beginning Tuesday, July 6. Weekly excursions will be arranged in connection with the lectures and demonstrations. Mr. K. J. J. Mackenzie will conduct classes on the University farm for a month, beginning on July 6. The classes are specially designed for students who have passed the natural sciences tripos, part i., and propose to take the diploma in agriculture. Dr. Fenton will give a course of fifteen lectures on the outlines of general chemistry on Tuesdays, Thursdays, and Saturdays. These lectures will begin on July 6.

THE directorship of the Harvard Botanical Garden, which recently became vacant through the resignation of Prof. Goodale, as reported in our issue of May 13, has been filled by the appointment of Mr. Oakes Ames, assistant professor of botany.

COMMEMORATION DAY was celebrated at Livingstone College, Leyton, on May 26. The college provides a medical training for missionaries, since the medical part of a missionary's work is now considered of prime importance. During the course of an address, Prof. Alexander Macalister said he had confidence in the course of training given at the college, and from his experience in Syria and China he believed it was essential that a missionary should be able to render simple medical aid to natives, and he hoped before long some such training would be regarded as an absolute necessity for every missionary. Dr. M. A. Stein, in the course of a short speech, referred to the valuable surgical aid he had received from an old student of Livingstone College during his explorations in Central Asia.

FROM July 6 to July 28 short courses of instruction for science teachers will be given at the Imperial College of Science and Technology, South Kensington, London, S.W., in chemistry, light, mechanics, plant physiology, and practical mathematics. Any teacher who wishes to attend one or other of the courses should apply at once for a form of application (Form 501 T) to the Secretary, Board of Education, Whitehall, S.W. The courses are limited to the teachers of classes in science, and in considering applications for admission the Board will have regard to (1) the character of the work done in the class or classes taught by the applicant and the probability of extension of this work; (2) the qualifications of the applicant as showing the extent to which his previous training will enable him to profit by the instruction given.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, May 12.—Prof. W. J. Sollas, F.R.S., president, and afterwards Dr. J. J. H. Teall, F.R.S., vice-president, in the chair.—The Hartfell-Valentian succession around Plynlimon and Pont Erwyd (North Cardiganshire): O. T. **Jones**. The stratigraphical succession and the geological structure of an area lying in the hilly district east of Aberystwyth are dealt with. The rocks within the district are divided into three stages, which are further subdivided into groups and zones. The Plynlimon stage is developed in the northern part of the district, the Pont Erwyd stage along the two valleys of the Rheidol and the Castell, while the Ystwyth stage is developed on the plateau-like tract extending from the Castell Valley to the Ystwyth Valley. The palæontological evidence is in entire accord with the stratigraphical evidence. Three types of structure are dealt with, (1) folding, (2) strike-faulting, and (3) normal faulting, but the first is predominant. Evidence is given for assigning to the "Aberystwyth Grits" of earlier observers a position much higher in the geological sequence than has hitherto been attributed to them. The paper concludes with a tabular list of fossils, correlation tables, and a description of two species of graptolites of zonal importance.—The geology of the neighbourhood of Seaford (Sussex): J. V. **Elsden**. This paper deals with a portion of the South Downs lying between Eastbourne and Newhaven. The inland outcrops of the uppermost zones of the Chalk are mapped. On the east of the Cuckmere River, the beds examined are found to be nearly horizontal. On the west side they are bent into a sharp uniclinal fold, striking east and west. Seaford Head represents a remnant of this fold. The low ground between Seaford and Chyngton occupies the trough of the fold. The complete disappearance of the fold on crossing the Cuckmere cannot be satisfactorily explained by the normal process of dying-out. It is suggested that a transverse fault may exist beneath the alluvium of that river. The fault, if it exists, seems to die away northwards, since no trace of it has been detected higher up the valley. The relation of the Seaford fold to the main flexures of the south coast is considered. Certain existing physiographical features are ascribed to the influence of this flexure, which facilitated the retention of the Eocene cover in the synclinal hollow thus formed. A brief comparison is made between the fossils of the inland exposures and those of the cliff-section, the most notable difference being the evidence in the former of a Conulus band at the top of the zone of *Micraster cor-anguinum*.

Physical Society, May 14.—Dr. C. Chree, F.R.S., president, in the chair.—A bifilar vibration galvanometer: W. **Duddell**. The paper describes a new type of vibration galvanometer and a series of tests made upon it. Vibration galvanometers may be divided into two types:—(1) those in which the moving part consists of a piece of iron or steel, and the current to be measured flows round fixed coils, as in the case of the Thomson galvanometer; (2) those in which the current to be measured flows round a moving coil placed in a fixed magnetic field, on the syphon recorder principle. The vibration galvanometers of Max Wien and Rubens belong to the first class, while Mr. Campbell's vibration galvanometer and the one described in the paper belong to the second. In the instrument described the mass of the moving parts is reduced to a minimum, the moving coil being reduced to the two wires forming its two sides, similar to a bifilar oscillograph, but with this difference: whereas the bifilar oscillograph is designed so as to make the damping aperiodic, the vibration galvanometer is designed so as to keep the damping as small as possible. A series of tests made upon the instrument showed that the total range of frequency was very large, namely, from about 90 ~ per second up to 1900 ~ per second. The damping is very small, so that the resonance is very sharp.—Effect of temperature on the hysteresis loss in iron in a rotating field: W. P. **Fuller** and H. **Grace**. The rotating field was produced by means of two phase currents. One phase was connected to a coil of long rectangular section and of sufficient length to produce a uniform field within a radius of 2 cm. from the centre. The second phase was connected to a similar coil enclosing this one, and causing a flux at right angles to it. The resultant field at the centre was uniformly rotating. The results of the experiment show that the effect of increasing the temperature of iron is to reduce the hysteresis loss at a given induction and to cause the maximum loss to occur at a lower value of the induction. In one specimen the maximum value of the loss at 220° C. was 12,300 ergs per cu. cm. per cycle at an induction of 16,000 C.G.S. units. At 580° C. the maximum loss was 2600 ergs at an induction of 10,700. The frequency of the experiments was 42 cycles per sec.—A method of testing photographic shutters: A. **Campbell** and T. **Smith**. The authors described a simple and rapid method of testing the speeds and efficiencies of photographic shutters, with a maximum error of 0·0001 second at the highest speeds. A vibrating beam of light falling through a narrow slit on to a moving plate serves to measure the time. This beam is obtained by reflecting the light of a Nernst lamp from the mirror (area 50 sq. mm.) of a vibration galvanometer actuated by a current of fixed frequency (say 100 or 500 ~ per sec.) obtained from a microphone hummer. The use of the vibration galvanometer, in which the amplitude is enormously increased by resonance, greatly facilitates the measurements. When the total duration of exposure only is required, the vibrating beam of light is passed through the shutter, tracing a sine curve on the moving plate. The duration of exposure is immediately found by counting the number of ripples recorded on the plate. Ten records of the various speeds of a shutter can be taken side by side on one 5×4 in. plate in one minute. When the efficiency in addition to the duration of exposure is required, the method adopted is essentially that of Sir Wm. Abney, but the time measurements are made with the vibrating beam of light instead of a screen.

Zoological Society, May 25.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—The anatomy of the olfactory organ of teleostean fishes: R. H. **Burne**. The chief structural variations were described in some fifty genera, mostly of common British species, the anatomical facts being illustrated by a series of coloured diagrams.—Description of a new species of the decapod crustacean genus Alpheus, Fabr., from the Bay of Batavia: Dr. J. G. **de Man**.

CAMBRIDGE.

Philosophical Society, May 3.—Mr. H. F. Newall in the chair.—A specimen of the cone *Calamostachys binneyana*, Carruthers: H. H. **Thomas**.—Note on two new leeches from Ceylon: W. A. **Harding**. The leeches described in this paper were collected in Ceylon by Miss Muriel Robertson. The material comprised examples of two species hitherto unrecorded, of which a brief description is given.—Note on an abnormal pair of appendages in Lithobius: L. **Doncaster**.—A property of summable functions: Dr. A. C. **Dixon**.

May 17.—Sir J. J. Thomson, vice-president, in the chair.—Phenomena of X-ray transmission: C. G. **Barkla**. By the use of homogeneous beams of X-rays the author investigated the variations in the relative ionisations in different gases due to changes in the penetrating power of the primary beams used. It was found that as the primary radiation passing through a gas was made more penetrating, within well-defined limits, the ionisation in that gas was approximately proportional to the ionisation produced by the same beam in air. When, however, the primary beam became just more penetrating than the secondary homogeneous radiation characteristic of one of the elements in the gas, the ionisation in that gas increased rapidly. The connection between ionisation in the gas, intensity of secondary radiation from the elements in the gas, and the absorption of the primary rays in those elements was exhibited. It was shown that the apparent irregularities recorded by many investigators in the various phenomena of X-ray transmission—absorption, secondary radiation, ionisation—may be explained in terms of a few simple laws.—Phenomena of the kathode discharge: J. A. **Orange**. The paper deals with the phenomena of the Crookes's dark space, kathode rays, and canal rays associated with double kathodes (as devised by Goldstein), and pairs of simple kathodes. The conclusions of Goldstein and Kunz with respect to the form of beams of canal rays are controverted. Remarkably well-defined beams of kathode rays were obtained with some arrangements. Schuster's relation between thickness of dark space and strength of current was confirmed. The records are photographic throughout.—Some fatigue effects of the kathode in a discharge tube: R. **Whiddington.** The kathode phenomena vary with time of running in such a way as to suggest that the emitted kathode rays become more homogeneous in velocity and more slowly moving. Restoration of the kathode cannot be effected by causing the absorption of hydrogen, oxygen, nitrogen, carbon dioxide, carbon monoxide, or helium, even at the temperature of liquid air. A transient recovery occurs on momentarily running the fatigued kathode as anode. Kathodes of carbon, platinum, and aluminium were tried. The kathode fall of potential shows a falling off with the time.—The influence of dilution on the colour and the absorption spectra of various permanganates: J. E. **Purvis.** Dilute solutions of the permanganates of barium, zinc, and potassium were compared in tubes of different lengths, and so that each tube contained the same amount of dissolved salt. The highly diluted solutions gradually changed from the well-known permanganate colour to reddish-brown and to yellow colours. At the same time several of the absorption bands became narrower, and others wider, until, when the colour had become quite yellow, the bands disappeared and only marked general absorption remained. These changes took place, not only when the solutions were subjected to the influence of light, but the phenomena were observed after the solutions had remained in the dark, although light appeared to accelerate the changes. The changes also occurred when the solutions were kept out of contact with the atmosphere and light. The explanation was that the MnO_4 ion broke down with the production of MnO_2 and O_2, and the MnO_2 was dissolved in the colloidal condition.—Note on the histology of the "giant" and ordinary forms of *Primula sinensis*: R. P. **Gregory.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part i. for 1909, contains the following memoirs communicated to the society:—

January 9.—The representation of unsaturated cyclic acids and carbohydrates with semi-cyclic connection: O. **Wallach.**

February 6.—*In memoriam* Hermann Minkowski. A proof that integers may be represented by a fixed number of *n*th powers (Waring's problem): David **Hilbert.**—Ordinary linear differential equations with singular regions and their particular functions: H. **Weyl.**—The concept of deformation-work in the theory of elastic solids: J. **Weingarten.**

February 20.—The uniformisation of algebraic curves by means of automorphous functions with imaginary substitution-groups: P. **Koebe.**

March 6.—The decomposition of matrices: J. **Wellstein.**

March 20.—Molecular free vibrations: E. **Madelung.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—A Modern Railway Problem: Steam *v.* Electricity: Prof. W. E. Dalby.

LINNEAN SOCIETY, at 8.—On the Alcyonaria of the *Sealark* Expedition: Prof. J. A. Thomson.—On the Cephalochorda of the *Sealark* Expedition: H. A. S. Gibson.—Report on the Porifera collected by Mr. C. Crossland in the Red Sea: R. W. Harold Row.

RÖNTGEN SOCIETY, at 8.15.—Annual General Meeting.

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

FRIDAY, JUNE 4.

ROYAL INSTITUTION, at 9.—Researches in Radiotelegraphy: Prof. J. A. Fleming, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Fossiliferous Lower Keuper Rocks of Worcestershire: L. J. Wills.

SATURDAY, JUNE 5.

ROYAL INSTITUTION, at 3.—The Vitality of Seeds and Plants: (1) A Vindication of the Vitality of Plants: Dr. F. F. Blackman, F.R.S.

TUESDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—Biological Chemistry: Dr. F. Gowland Hopkins, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prehistoric Human Remains from Various Parts of England: Dr. A. Keith.

WEDNESDAY, JUNE 9.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Iron by Permanganate in Presence of Hydrochloric Acid: G. C. Jones and John H. Jeffery.—On Jaffé's Colorimetric Method for the Estimation of Creatinine: A. C. Chapman.—The Estimation of the Alkalinity of Bleaching Powder Solutions: Dr. K. J. P. Orton and W. J. Jones.—(1) The Sabatier-Senderens Test for Distinguishing between Primary, Secondary and Tertiary Alcohols: (2) Note on a New Test for the Halogens: Dr. G. B. Neave.

THURSDAY, JUNE 10.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Functions of the Pituitary Body: Prof. E. A. Schäfer, F.R.S.

ROYAL INSTITUTION, at 3.—A Modern Railway Problem—Steam *v.* Electricity: Prof. W. E. Dalby.

MATHEMATICAL SOCIETY, at 5.30.—On the Behaviour at the Poles of a Series of Legendre's Functions representing a Function with Infinite Discontinuities: F. J. W. Whipple.—An Analogue of Pascal's Theorem in Three Dimensions: W. H. Salmon.

FRIDAY, JUNE 11.

ROYAL INSTITUTION, at 9.—Problems of Helium and Radium: Sir James Dewar, F.R.S.

PHYSICAL SOCIETY, at 8.—The Arthur Wright Electrical Device for evaluating Formulæ and solving Equations: Dr. A. Russell and Arthur Wright.—The Echelon Spectroscope, its Secondary Action and the Structure of the Green Hg line: H. Stansfield.—The Proposed International Unit of Candle Power: C. C. Paterson.—Inductance and Resistance in Telephone and other Circuits: Dr. J. W. Nicholson.—Note on Terrestrial Magnetism: G. W. Walker.—On the Form of the Pulses constituting White Light: A. Eagle.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Diagnoses of new Trochoid Shells from North Queensland: H. B. Preston.—Notes on some of the Ampullariidæ in the Paris and Geneva Museums: G. B. Sowerby.—On the Radulæ of British Helicidæ: Rev. E. W. W. Bowell.

SATURDAY, JUNE 12.

ROYAL INSTITUTION, at 3.—The Vitality of Seeds and Plants: (2) The Life and Death of Seeds: Dr. F. F. Blackman, F.R.S.

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