Nature

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
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THURSDAY, MARCH 2, 1916.

THE NEW ZEALAND FLORA.

Illustrations of the New Zealand Flora. Edited by T. F. Cheeseman, assisted by Dr. W. B. Hemsley. Plates drawn by Miss M. Smith. Vol. i., pp. 8+121 plates. Vol. ii., pp. 34+ plates 122–250. (Wellington, N.Z.: John Mackay, Government Printer, 1914.)

PERHAPS no country of equal extent possesses a vegetation more interesting than does New Zealand, the 1600 indigenous vascular plants of which include some three-fourths that are endemic. Few floras have received more attention from a long succession of distinguished workers. The history of botanical discovery in the Dominion from the time of Captain Cook's first visit (1769–70) to the middle of last century is fascinatingly told in Hooker's introductory essay to the second portion of his "Botany of the Antarctic Voyages of the *Erebus* and *Terror*," retold and continued with more detail half a century later in Cheeseman's "Manual of the New Zealand Flora." Space forbids the recapitulation here of this instructive story; it is, however, worth while recalling the chief attempts that have been made to publish the results achieved. The first of these was an "Essai d'une flore de la Nouvelle Zélande," by A. Richard, issued in 1833 as part of the account of Dumont d'Urville's voyage in the *Astrolabe*. This was followed by Allan Cunningham's less satisfactory "Floræ Novæ Zelandiæ Præcursor," issued in instalments about 1839, and by the fine "Choix de Plantes de la Nouvelle-Zélande," published by Raoul in 1846. Next came the "Flora Novæ-Zelandiæ" of Hooker, which forms part ii. of the results of the voyages of Ross (1839–43), issued under Admiralty authority during 1852–55.

A decade later (1864–67) Hooker published at the request and under the authority of the New Zealand Government his "Handbook of the New Zealand Flora," a work which for thirty years remained the standard authority on the subject and stimulated the activities and the critical acumen of a generation of collectors and students. One of the most active and accomplished of these, the late Mr. T. Kirk, devoted much time to the accumulation of material for a new flora incorporating descriptions of the many novelties discovered and characterised since Hooker's "Handbook" was issued. The services of a competent local botanist being now available, Kirk was asked by the New Zealand Government in 1894 to write a "Students' Flora of New Zealand." Three years later, when less than half his task had been overtaken, Kirk died. The portion of this work actually completed was officially printed, and its quality was such as to increase the regret caused by the author's death and to strengthen the Government resolution to provide the new flora so urgently required.

The preparation of the much-desired work was entrusted to Mr. T. F. Cheeseman, curator of the Auckland Museum. His "Manual," eagerly looked for, when published at Wellington in 1906, received a warm welcome from all who were interested in the vegetation of the Dominion. Except perhaps in England, it was already generally appreciated that botanists are indebted to New Zealand for some of the most weighty additions to natural knowledge in the ecological field. The appearance of Cheeseman's "Manual" taught systematists that the Dominion had besides at least one taxonomic writer in whom are happily blended those powers of observation, that balanced judgment, and that capacity for taking pains so essential in floristic study.

When Cheeseman was commissioned to prepare

his "Manual" the official scheme included the provision of a volume of plates to illustrate some portion of the species described. Two suggestions occurred to those who had urged the undertaking. One was to reproduce on a reduced scale the unpublished engravings prepared to accompany the descriptions by Solander of plants collected during Captain Cook's first visit to New Zealand; the other was to employ afresh the beautiful illustrations which accompany Hooker's "Flora Novæ-Zelandiæ." Both suggestions possess the merit attaching to pious inspirations, though in reality both owed their origin to the hope they held out of enabling the Dominion Government to solve a serious practical difficulty. This difficulty is due to the circumstance that as yet there is not in New Zealand a demand for work of the kind sufficient to induce resident artists to devote themselves to the very special occupation of preparing and reproducing figures of botanical subjects. Fortunately, we think, the demand for the "Flora" itself was so urgent that it was decided to leave the question of illustrations in abeyance until the text should be completed. That question, however, was in the interval carefully considered in all its bearings. For reasons which seem unanswerable, both suggestions were set aside. It was resolved that the "Illustrations" should be new ones, educational in character, expressly drawn for the work, and so designed and executed as to be of use in the study and identification of the plants portrayed. The practical difficulty was frankly recognised, and was overcome by the employment of an artist, a lithographer, and a printer in England, while arrangements were made for the supervision of their work, at every stage, by an English botanist.

The two handsome volumes of "Illustrations of the New Zealand Flora" now before us show how satisfactory these arrangements have been; the artist, whose name appears on the title-page, the lithographer, Mr. J. N. Fitch, and the printers, Messrs. West, Newman, deserve equal commendation for the excellence of their work. In his choice of a supervising colleague, whose name also appears on the title-page, the author of the text has been especially fortunate; Mr. Hemsley has fulfilled his part with remarkable judgment, and, as the author explains, has often been able to make comparisons of the material actually figured so as to confirm its identity with the type of the species concerned. The subjects of the 250 plates have been so selected by Mr. Cheeseman that they illustrate satisfactorily the main features of the New Zealand flora. No really important genus or group of plants is left unrepresented, nor is any latitude or altitude of the Dominion inadequately dealt with. The descriptive matter which accompanies each plate is clear and concise, singularly free from technical terms, and replete with information of botanical, economic, and historical interest. The work is worthy of the reputation of all those concerned in its production, and while it affords proof, were this needed, that New Zealand can command competent botanical assistance, it also shows that the Dominion enjoys an enlightened administration which is fully aware of this fact.

NEW AMERICAN STEAM TABLES.

Properties of Steam and Ammonia. By Prof. G. A. Goodenough. Pp. vii + 108. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

THESE tables are a great improvement on previous American work in the matter of thermodynamic method and consistency, but the expressions employed for calculating the tables are too complicated to be of practical use for other purposes, though comparing favourably with many empirical formulæ. The author assumes a characteristic equation of the type,

$$V - b = RT/p - (1 + 3ap^{1/2})m/T^n,$$

and deduces consistent expressions for the total heat and the entropy, according to Callendar's method, by the aid of a formula for the specific heat at zero pressure. He objects to Callendar's equation on the ground that it makes the isothermals straight lines on the pv, p diagram, which is well known to be a good approximation at moderate pressures over the experimental range from 0° to 200° C., but begins to fail at higher pressures. Linde introduced the factor $(1 + ap)$ in the last term to give the desired curvature to the isothermals at high pressures. His equation has been widely adopted in America, but is most unsatisfactory, because it would make steam become a "pluperfect" gas (pv increasing with p at constant t) at a temperature of 400° C., a few degrees above the critical point, which is impossible. The form assumed by Prof. Goodenough escapes this objection, and gives "reasonably good agreement" with throttling experiments, but appears to lead to excessive curvature of the isothermals at low pressures, where they should be very nearly straight, and also gives deficient curvature at high pressures near the critical point, besides making no allowance for the well-known fact that the curvature must change sign at a temperature not far above the critical.

There are many ways in which Callendar's equation may be modified to meet these conditions and give good agreement with the saturation

pressures up to the critical point. But since there are no experimental data for the volume, or the total heat, or the specific heat, or the cooling-effect, at pressures above 8 or 10 atmospheres, it is impossible to decide between different equations satisfactorily at high pressures without further experimental work. It is comparatively easy to calculate values on suitable mathematical assumptions with a fair degree of probability, but it may reasonably be questioned whether it is worth while to risk spoiling the approximation for ordinary purposes for the sake of a doubtful advantage beyond the experimental range.

The expression employed for the variation of the specific heat with temperature gives a minimum in the neighbourhood of 140° C., and the values are nearly constant from 80° to 200° C. The value at 100° C. and atmospheric pressure is nearly the same as that recently found by Brinkworth (*Phil. Trans.*, 1915). The variation with pressure agrees closely with that given by Callendar over the experimental range. The agreement is exact at 70 lb. and 300° F., and also at 200 lb. and 500° F. The increase of S_0 at low temperatures cannot be verified experimentally, and is theoretically improbable. The gradual increase above 200° C. is not improbable in order of magnitude, but the experimental evidence is so conflicting, and the importance of the variation so small for steam engine work, that it may be questioned whether it is worth while to attempt to take account of it. These minor variations, besides being somewhat uncertain, render all the expressions so complicated as to be of little use for practical calculations without reference to tables. The adiabatic equation, in place of being the same as that of a perfect gas, becomes quite unmanageable, and there is no simple relation between the volume and the total heat.

The properties of saturated steam are deduced from an empirical formula for the saturation pressure of the general type,

$$\log p = A + B/T + C \log T + DT + ET^2 + FT^3 + GT^4,$$

which represents very closely the observations on which it is founded. Clapeyron's equation is employed for deducing the latent heat and the heat of the liquid, which serve as a rough verification of the method. The general arrangement of the tables follows familiar lines, but it is to be regretted that they are restricted to British thermal units on the Fahrenheit scale, according to the common practice among American engineers, and that no values are tabulated on the Centigrade scale or expressed in metric units. The only diagram given is that of Mollier, with total heat and entropy as co-ordinates, which is useful for adiabatic expansion, but has the disadvantage of not showing the volume and of having a variable scale of pressure.

The properties of ammonia are developed and tabulated in a similar manner to those of steam, but with less elaboration, owing to the scanty experimental data. The results are noteworthy as the first serious attempt at consistent representation in the case of this vapour. The whole work is admirably lucid, and should do much to advance thermodynamic method in the construction of tables.

OUR BOOKSHELF.

Limes and Cements: Their Nature, Manufacture, and Use. An Elementary Treatise. By E. A. Dancaster. Pp. xii+212. (London: Crosby Lockwood and Son, 1916.) Price 5*s.* net.

THIS is especially suited for students who require an elementary text-book on the subject, containing, as the author justly observes in his preface, very little that will have to be unlearned at a later period. It is sufficiently comprehensive to have some value for many who are not beginners, for though the matter is necessarily compressed in view of the limited space, the ample bibliography of modern publications dealing wholly or partly with the materials under consideration will enable fuller details to be found by such as may need them.

The work is admittedly based on Burnell's "Limes, Cements, Mortars, etc.," but the alterations and additions involved in bringing that treatise up to date render the present volume practically a new production. All the important varieties of lime, artificial and natural cement, mortar, concrete, etc., are noticed, however briefly, including the mode of preparation or occurrence, and the approved manner of using.

A chapter on the chemical analysis of limes and cements gives brief directions for the determination of the principal constituents, and another chapter furnishes descriptions of the physical and mechanical tests applied to some of the substances in question, but chiefly to Portland cement.

It is noteworthy that misprints, though not entirely absent, are commendably rare. Illustrations are not very numerous, but will probably be found sufficient except for special details. The style of the descriptions is clear throughout the book. J. A. A.

Hancock's Applied Mechanics for Engineers. Revised and rewritten by Prof. N. C. Riggs. Pp. xiii+441. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 10*s.* 6*d.* net.

THE first edition of this book appeared in 1909, and was reviewed in NATURE for September 16 of that year. Considerable alterations have been made in the present edition, and graphical methods have been used more freely. About two hundred new problems have been added to the

previous large number. Statics occupy the first eight chapters, then follow three chapters on motion, two chapters on work and friction, a chapter on the dynamics of rigid bodies, and another on impacts.

The book differs somewhat from most of the text-books on applied mechanics for engineers produced in this country; had it been published in Great Britain it would probably have been called "Applied Mathematics for Engineers." The treatment of the principles of mechanics is exceptionally good, and we can confidently commend the book to any engineering student who wishes to understand more thoroughly many matters which receive but little attention in most of our own text-books. With the omission of some of the more mathematical sections, which could be read profitably by engineering students later in their course, the book would prove very useful to students who desire to attain the standard of the intermediate examinations of the universities. There is a capital section on moments and products of inertia, containing matter for which the engineering student has generally to search in books containing little else of interest to him; the practical examples given in this section are good.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1916. Edited by G. E. Brown. 55th issue. (London: H. Greenwood and Co., Ltd.) Price 1*s*. net.

ALL those who are practically interested in photography look forward to the appearance of the "B. J. Almanac," and in spite of the stress of circumstances they will not be disappointed. Although there are fewer new things to chronicle for last year, the general features of the volume are much as usual. The editor's special contribution is a long article on printing processes. These "practical notes" will be much appreciated. The "Epitome of Progress" section preserves its usual character, but the section usually devoted to a review of the novelties introduced by the trade during the past year is replaced by a survey of the resources of Great Britain and certain well-known firms of Entente nationality in the production of the requisites for photography. This shows that in several important respects we are rendering ourselves independent of German supplies.

An Introductory Course of Practical Magnetism and Electricity. By Dr. J. R. Ashworth. Third Edition. Pp. xvii+96. (London: Whittaker and Co., 1915.) Price 2*s*. net.

THE laboratory course described in this book is divided into thirty sections, and can be worked through in the course of a winter session. The present edition of the book is substantially the same as the previous issues, though some additions have been made. Sections have been introduced on the measurement of the internal resistance of a cell and the effect of joining cells in series and in parallel, and upon the use of the Wheatstone bridge for the comparison of resistances.

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.*]

Exploration in South-West Africa.

PROF. H. H. W. PEARSON, of Cape Town, has just conducted an exploring expedition through part of the recently conquered "South-West." The expedition, which is expected to yield important economic as well as scientific results, started with the express approval of General Botha, and, like Prof. Pearson's previous journeys through the less explored parts of South Africa, was promoted by the Percy-Sladen Memorial Trust. I have just received the following letter, and I am sure many readers of NATURE will be glad to learn from it that Prof. Pearson has returned safely from his interesting and successful trek.

W. A. HERDMAN.

University of Liverpool, February 18.

CAPE TOWN,
January 28, 1916.

DEAR PROF. HERDMAN,

Just a line to tell you that the journey is accomplished with results which I hope will prove to be quite successful. I learned just what I wanted to learn and a good deal more besides. The route was a particularly interesting one; it showed me more of the transition zone between the littoral desert and the plateau than I had expected, and it gave me a good insight into the relations between the Damaraland and Namaqualand floras. It has connected up the results of my previous journeys, and I can now tackle my general summary much more satisfactorily than I could have done before.

The journey itself was in some respects the most difficult I have ever done. Along the edge of the desert the road disappeared entirely, and we got entangled in the ravines of a peculiarly awkward range of mountains. On December 31 we spent five hours in advancing considerably less than a mile. Both the wagons broke down, one of them twice within half an hour and in a vital part. But for the extraordinary skill of the two Hottentot drivers we should never have got them both through. Darkness found us in a dangerous river-bed, in which, in defiance of all the laws of good trekking, we had to spend the night—and a sleepless one so far as I was concerned. However, the new year was kinder, and although we broke down again in later stages of the journey, I had the satisfaction of taking everything safely into Windhook except two of my thirty donkeys. One of these died on the road; the other I left in a weak condition with one of our military outposts, and it eventually recovered. Our troubles were due primarily to a bad mistake in the *German* maps, and to the fact that for 120 miles the country was absolutely without inhabitants, white or black. . . .

I passed through the semi-independent territory of the Bastard Hottentots. No German dare venture into it, but when these people found I was English they could not do enough for me. The chief sent his son with me for thirty miles to make sure that I regained the trunk road lost through the mistake mentioned above. They and all the natives throughout the country are profoundly thankful that the German *régime* is over—and they have good reason to be.

H. H. W. PEARSON.

Science and the State.

IN reference to the recent memorandum signed by thirty-six eminent men of science on the neglect of science in our national organisation, it may be of some interest to your readers to be reminded of the paragraph on a similar topic written by Thomson in his "History of Chemistry," which appeared in 1831, or more than three-quarters of a century ago:—

"What Minister in Great Britain ever attempted to cherish the sciences, or to reward those who cultivate them with success? If we except Mr. Montague, who procured the place of master of the Mint for Sir Isaac Newton, I know of no one. While in every other nation in Europe science is directly promoted, and considerable sums are appropriated for its cultivation and for the support of a certain number of individuals who have shown themselves capable of extending its boundaries, not a single farthing has been devoted to any such purpose in Great Britain. Science has been left entirely to itself; and whatever has been done by way of promoting it has been performed by the unaided exertions of private individuals."

The above statement is not literally true of the present day; but the same spirit of indifference still exists.

J. B. COHEN.

The University, Leeds.

Altitudes of Auroræ.

IN NATURE of August 7, 1913 (vol. xci., p. 584), a short account was given of my auroral expedition of 1913. I think, therefore, that the accompanying preliminary result of the determination of altitude (Fig. 1) will interest your readers. More details will soon be published in the *Comptes rendus* of the Paris Academy of Sciences, in the *Astrophysical Journal*, and especially in *Terrestrial Magnetism and Atmospheric Electricity*, where a series of reports are in the press.

Kristiania, February 15. CARL STÖRMER.

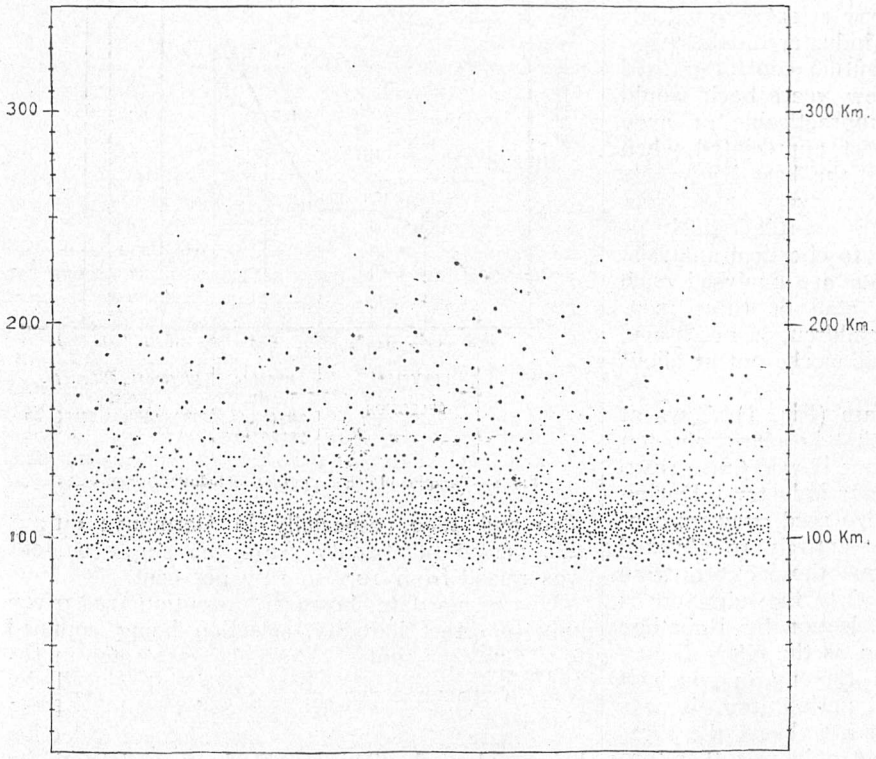
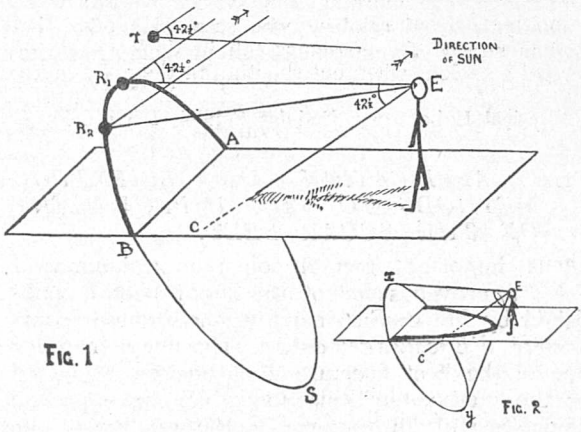


FIG. 1.—The altitude of aurora borealis seen from Bossekop during the spring of 1913. Each calculated altitude is marked by a dot and the several hundred simultaneous photographs of aurora from the stations—Bossekop and Store Korsnes—(mutual distance 27½ kilometres) gave about 2500 determinations of height, which are seen above.

Ground Rainbows.

MY observations of ground rainbows are here described in the hope of learning whether the phenomenon is well known. I can find no reference to it, and no information as to how the gossamer, which causes the rainbow, and seems to be a kind of spider-web, comes to be spread over so large an area.



The ground rainbow observed occurred about 11.0 a.m. on October 14, 1915. A cricket field of about two acres was covered with a thick layer of gossamer which the early morning mist had loaded with millions of glittering beads of water. As one walked over the ground a rainbow of about the brilliancy of a good secondary bow moved over the grass—stretching from one's feet in the direction away from the sun in a sweeping curve with two arms. The explanation is obvious on the ordinary theory of primary rainbows.

Those rays will enter the eye which fall on the drops in the direction of the thick circle, $A R_1 R_2 B S A$ (Fig. 1). But the raindrops were all on the ground, and so what the eye saw was the underneath part, A S B, of the rainbow circle—that is, the rays which lie on the under surface of the cone, $E x y$ (Fig. 2). The rainbow is therefore the trace of the cone, $E x y$, on the ground plane. It follows at once that the form of this trace will depend on the angle of elevation of the sun; when the sun is in the zenith the curve is a circle, when the angle of elevation is between 90° and 42° it is an ellipse, when 42° a parabola, and when below 42° a hyperbola. Some of my pupils measured the elevation, by finding the height and length of

Beets and beet sugar

shadow of an observer, and found it to be 23°. They also pegged out the curve and proved it a hyperbola, and showed that half the angle of the cone was approximately 42°. The gossamer was spread quite evenly over the field, and at the brightest part of the morning—which was still and cloudless—a slight secondary bow could be distinguished.

Mr. N. T. Porter has sent me some photographs of gossamer taken on the lawn of Downing College, Cambridge, one morning some weeks before; when a similar ground rainbow was seen. He adds that he has noticed the gossamer fall in thick clouds on several occasions when out shooting in the early morning.

A. E. HEATH.

Physical Laboratory, Bedales School, Petersfield.

THE APPLICATION OF SCIENTIFIC METHODS TO THE IMPROVEMENT OF THE SUGAR BEET.

AN important memoir on the production of improved seeds of the sugar beet is published by M. E. Schribaux in the *Bulletin de la Société d'Encouragement.*[1] The memoir gives one of the best accounts that has yet appeared of the methods of selection which have proved so successful in improving the quality of the sugar beet during the past fifty years. It is to these improvements that the remarkable growth of the beet sugar industry is largely due. They provide an admirable illustration of what can be effected by applying rigorous scientific methods to agricultural practice and industry on the large scale, and demonstrate scientific control pushed to a limit which only a few years back would have been regarded as impracticable or even impossible. This can be best appreciated when it is stated that in selecting the best beet roots to be used as seed-producers, every single root which appears suitable on morphological or other grounds is subjected to chemical analysis. Often more than 3000 roots are analysed each day; for this purpose a staff of three men, assisted by ten women or children, is necessary, and the price of each analysis works out at about four centimes.

The accompanying diagram (Fig. 1) shows at a glance the improvement that has been effected in the quality of the beet since it was first grown as a raw material of the sugar industry. During the interval from 1838 to 1870 seed growers confined their attention almost entirely to physical characteristics, such as form; these efforts were not without success, and led to the adoption of the type which, after its selection by Rabethge and Giesecke, became known as the *Klein Wanzleben,* from the district in Saxony in which it was grown. During this period, too, it was noticed that the largest roots are always the poorest, and a medium-sized root only was therefore aimed at. From 1838 to 1870, the increase in the percentage of sugar was but small, namely, from 8·8 to 10·1 per cent.

The second period of selection opened with the discovery by Louis de Vilmorin of the fact that, although the saccharine quality of the beet is a hereditary character, in order to maintain the improvement of the stock it is necessary to repeat the selection of the seed-bearing plants (*porte-graines*) at frequent intervals. He created the celebrated race *Vilmorin améliorée* associated with his name, by adopting a strictly scientific control in place of the empirical one which had previously determined selection. To ascertain the richness in sugar of the mother plants Vilmorin at first floated the roots in baths of salt or sugar solutions of known specific gravity. This method was soon replaced by a process of ascertaining the density of the juice expressed from small sectors of the roots, and this, in turn, gave way to the polarimetric process which is now universally in use. The methods introduced by Vilmorin were adopted with great success between

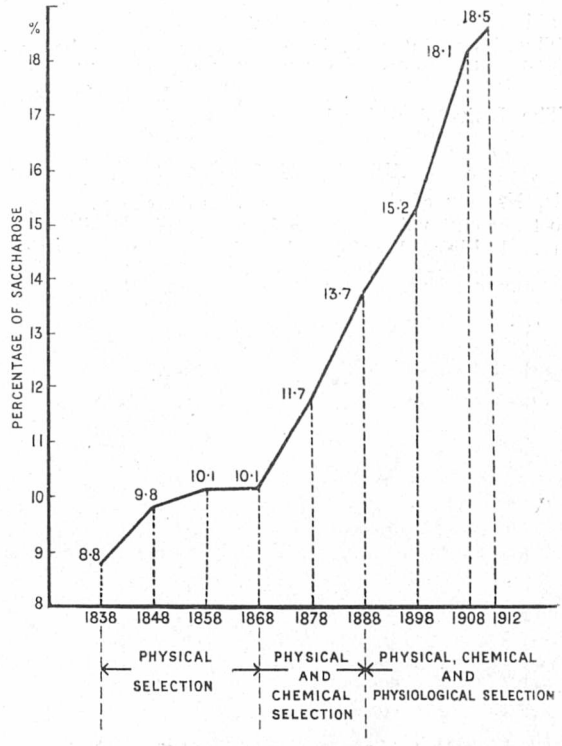


FIG. 1.—Variation of richness in sugar of industrial sugar beets.

1870 and 1890, especially in Germany; during this period of twenty years the sugar content was raised from 10·1 to 13·7 per cent.

Up to this date, however, attention was given only to direct heredity, selection being confined to the mother roots. The next great step in the improvement of the beet was introduced by taking into account the ancestral heredity of the seed-bearers, *pedigree* or *genealogical* selection being adopted. This method was defined by Vilmorin as follows: "It consists in valuing the different reproducing plants separately and individually, keeping the seeds produced by each apart, and determining by direct experiment the faculty of transmission which each plant enjoys." From 1898 to 1912, by this *individual* method of selection, aided and controlled by chemical ana-

[1] "La production des graines de betterave industrielles assurée par l'agriculture francaise." By E. Schribaux. (*Bull. Soc. d'Encouragement,* vol. cxxiv., No. 4, pp. 178–251)

lysis, the sugar content has been increased from an average of 15·2 to one of 18·5 per cent. Individual roots have contained from 26 to 27 per cent. of sugar, and there is every reason to believe that the improvement of the beet is far from having reached its limit.

It is impossible here to do more than glance at the latest methods of working adopted by the seed-selecter. Each single root grown has its sugar content determined by a process which leaves it practically uninjured and suitable for planting after its character has been ascertained. The small sample of pulp is taken for analysis by means of a small rasp-drill which pierces the root about 2 cm. below the base of the neck at an angle of about 45°. Experience has shown that although the sugar content is very different in different zones, the particular section taken in this way corresponds with the *average* over the whole root. 4·065 grams of the pulp so obtained (one-quarter the "normal" weight) are transferred to a 50 c.c. measuring flask, and water, containing basic lead acetate, added, so as to make the volume about 40–45 c.c. After adjusting exactly to 50 c.c. and filtering, the solution is examined in a 400 mm. continuous-flow saccharimeter tube. In this way the percentage of sugar in the root is read off directly on the instrument.

As a result of the analysis the roots are divided after lifting into three classes: "mothers," "grandmothers," and "élites." Thus, in the case of the 1915 crop, mothers and grandmothers would be used to furnish commercial seed, the "mothers" in 1916, the "grandmothers" in 1918. The "élites" would, in 1916, give seed which, in 1917, would yield the supply of roots to be again subjected to selection.

From time to time the selecter comes across roots the characteristics of which stand out as abnormally desirable. Such plants are subjected to careful genealogical selection in order to ascertain whether their descendants show these qualities on even a greater scale. If so, these roots are made "heads of families" and are the starting-points of new and improved races. Progress in the future largely depends on discovering remarkable "heads of families." For such a result it is necessary, not merely for the operator to be skilled in selection, but he must work on enormous numbers of roots—several hundreds of thousands each year.

A field of future work, which as yet has scarcely been touched, lies in an attempt to avoid the injurious effect of cross-fertilisation, which tends to retrogression of the race. Another rich opportunity for work is to be found in the adaptation of beet seed to local soils and climatic conditions. For this purpose it would be necessary to carry out the experiments with the seed plants in the localities where the main crops are subsequently raised for the sugar manufacturer.

One of the most promising directions for future work in improving the sugar beet is to be found in the asexual method of propagation suggested by Nowoczek and adopted with success by M. Gorain at Offenkerke and M. Hélot at Noyelles-sur-Escaut. In this system multiplication is effected by grafts and buds in the individuals used to give the seed of the first generation of "heads of families" and "élites." Full details are given in M. Schribaux's paper of this system, which has the great advantage of rapidly increasing the number of the specially desirable individuals to be subjected to further selection.

Many other problems face the seed-selecter in France which are dealt with in considerable detail, more particularly that of the improvement of the germinative power of the seed and the best means of rapidly producing in France at the present time the necessary supply of high-grade seeds, which in the past were largely imported from abroad. W. A. D.

THE RECENT MORTALITY AMONG BEES.

HOME industries and home sources of food supply are to the fore under the present conditions of war. Wastage of native food sources seems to arise from two main factors, namely, ignorance and carelessness. The serious loss of home-produced honey owing to bee diseases, more especially "Isle of Wight" disease and foul brood, is largely to be ascribed to the two human failings just mentioned.

When epidemics of known origin occur in man or vertebrates, such as cattle, there are well-known rules the prompt application of which stops the outbreak. Two prominent preventive measures are destruction of the source of the infection and segregation of the infected individuals and of contacts with them. It is safe to say that had such measures been rigorously enforced when "Isle of Wight" bee disease was first observed in England about 1904, the great mortality recently occurring among bees at Peterborough, as well as in other parts of Great Britain, would not have arisen.

While several diseases are prevalent among bees at the present time, the so-called "Isle of Wight" disease is responsible for much of the damage. The disease is parasitic in character, and a minute, one-celled animal organism, *Nosema apis*, has been shown to be the causal agent. The life-history of the parasite and the mode of infection were elucidated by Drs. Fantham and Porter in 1911, and they have also engaged in researches on the prevention and cure of the malady.

The life cycle of *Nosema apis* may be commenced conveniently with the resistant, infective spore form of the parasite. When some of the contents of the food canal, or the excrement of a bee suffering from the more chronic form of the disease, is examined microscopically, small, rice-grain-like, shining bodies are seen, mingled with pollen grains in various stages of digestion. These small bodies are the spores, which are about one-thousandth the size of an actual rice grain. They have a tough, resistant coat, and, when set free from the body of the bee, can live for a long time. If they are carried by the wind into water at which bees drink, or if they contaminate honey eaten by

bees, the spores pass into the digestive stomach of the bee before undergoing any further change. Under the influence of the digestive fluids of the host, the spore coat or sporocyst softens, and from a pore in it a thin, anchoring thread or polar filament is shot out, which attaches the spore temporarily to the wall of the bee's gut. Once anchored, a minute amœboid germ or amœbula—also termed a planont, because of its power of wandering—emerges from the spore. It creeps about over the surface of the epithelial lining, and finally penetrates in or between cells. There it becomes rounded, loses its power of movement, and grows passively for a time at the expense of the protoplasm of its host. Next, it commences to multiply, and is termed a meront. The nucleus divides into two, and protoplasm collects around each part. The resulting daughter forms separate usually as soon as they are produced, and each repeats the division, a cluster of potential spores, known as sporoblasts, being thus formed. Multiple fission may also occur. Each sporoblast soon secretes a sporocyst and becomes a single spore. During the time that the sporocyst is hardening and becoming opaque, five nuclei are produced within. Two of the nuclei control the formation of the coat, one regulates the action of the polar filament, and the other two are the nuclei of the amœbula. These nuclei are not easily seen all at one time, for when their function is fulfilled, all except the two nuclei of the amœbula disappear.

The most destructive period of the life-history of *Nosema apis* is the meront stage. By the formation of the meront colonies, the digestive cells of the bee are rendered useless and the digestive fluids are not properly secreted. The cells normally are cast off and then burst in order to liberate the digestive fluid. But when they are diseased, food, such as pollen, merely serves as an irritant, and the infected bee succumbs the more easily.

Infection of bees takes place by the ingestion of spores. When a bee is parasitised, its abdomen is often somewhat distended and the slightest touch is sufficient to produce discharge of bowel contents. The result is that honey, comb, and other bees are spattered with excrement that may contain the spores of *Nosema apis*. Cleansing operations are immediately commenced by other bees, which by their very cleanliness may contract the disease that results in their death. The queen, too, may be infected by her attendants, while the larvæ that are fed on infected food may die from the effects of the parasite. Sometimes the larvæ may give rise to a race of young bees, perhaps already infected, but usually with impaired vitality, and thus less capable of resisting infection by way of their food or drink. Water at which bees drink also can be infected with spores.

Other bees may acquire a tolerance for the parasite and be relatively unharmed thereby. Such infected bees act as parasite carriers, and void Nosema spores constantly in their fæces. Showing no external symptoms, they may remain undetected in a hive for some time and ultimately cause great destruction among their fellows. Infected drones also serve to spread the disease by their roving habits, several hives in succession being visited and polluted by them.

Humble bees, wasps, ants, and wax-moths that invade hives can also act as disseminators of spores. Human agency is a further aid. The sending away of unhealthy stocks, union of weak ones, and the use of old comb, foundation and equipment from "dead" hives have all contributed to the spread of disease.

Preventive measures should be vigorously adopted. All hives from which the bees have died out should be closed immediately to prevent robbing and thereby the further dissemination of disease by the robbers. As soon as possible all dead bees, quilts, frames, comb, and foundation in the hives should be burned. If the honey present is extracted from the comb it should be used for cooking purposes only, and not be re-fed to bees. Similarly, if the comb is melted for beeswax the latter should be used for domestic purposes only, and not for making foundation. The interior and exterior of the hive should be scorched or charred over with a painter's lamp in order to destroy the spores of *Nosema apis*. The soil around and under the hives should also be purified by fire. This is easily done by sprinkling petrol or paraffin on the soil and setting light to it. The ground should be well limed. Care should be taken to exclude wasps from hives. These pests were very troublesome in the summer of 1915, and many weakened colonies, some being convalescent, were robbed out and succumbed in the battle with wasps.

Finally, with regard to curative measures, it is known that there are certain drugs that will cure the bees, but their application is inadvisable, since they may poison the honey. Other drugs that are not injurious are known. These are very effective if rightly applied, and if the beekeepers will only help by strict attention to the hygienic and sanitary methods necessary for the prevention of the disease. Without a due regard to such elementary and essential, but often neglected, sanitary procedures, treatment is useless. A further point is that, as with human disease, there is a point when the malady is too far developed to be capable of cure. The disease needs to be treated in its very early stage, when often in the owner's opinion the colony is healthy. Microscopic examination is necessary to detect the parasite, and such examination should be obtained. Treatment based on observations of external symptoms only is not satisfactory, as the range of expression on the part of the bee is very limited, and is apt to be misleading so far as differentiation of disease is concerned. However, prevention is better than cure, and there is little doubt that if concerted action were taken for the quick destruction by fire of all infected materials the losses among bees would be enormously reduced, to the great advantage both of the beekeeper, of the general public, and of the hospitals where honey is much appreciated and used. F.

ANTHROPOLOGY AND FAUNA OF THE CHAD BASIN.[1]

THE volume before us, which is published by the Ministry of the Colonies at Paris, represents—we assume—the outcome of the scientific researches in the very heart of Africa—the basin of Lake Chad—made by the exploring expeditions of the late (?) Commandant Tilho, who between 1906 and 1909 did so much to place correctly on the map of Africa this variable reservoir of the waters streaming northwards from the Congo watershed (it would seem as though this gallant and indefatigable explorer had recently died, from the rather obscure wording of the preface).

Lake Chad was first definitely discovered by the British expedition under Oudney, Denham, and Clapperton, which crossed the Sahara from Tripoli in 1822–23. Its existence had been rumoured in the heart of Africa from Roman times onwards. The twentieth-century investigations of British and French explorers, combined with some previous work done by Germans, indicate Lake Chad and some of the brackish lakes and lakelets to the south-east as the last remains of a vast sheet of shallow water anciently connected with the inner basin of the Niger. Farther back still in earth history, in Cretaceous and probably Eocene times, this huge lake must have stretched from the limits of Senegambia to the Nile and Congo watersheds, and have communicated probably with the Atlantic Ocean to the north of the Senegal River. Even at the present day there is an intermittent water connection between the Chad system and the Upper Benue, and there may well have been a similar connection in earlier times with the south-western basin of the Nile. The altitudes that separate the Congo basin from the Chad and the Benue basins are not considerable, though more marked in height than the line of water-parting at its lowest between the Nile system and that eastern backwater of Lake Chad known as the Bahr-al-Ghazal (this confusing name, which is also applied to the huge south-western area of the Nile basin, simply means "River of Antelopes"). The way in which these great river and lake systems of Central Africa either communicate with one another, or very nearly communicate, reminds one of the water connection between the systems of the Orinoco and the Amazon in analogous Equatorial South America.

The fish fauna collected by Commandant Tilho and his companions comes as an additional proof to the luminous theories of Dr. G. A. Boulenger, of the British Museum, who, by means of his studies of the fresh-water fish of tropical Africa, has shown us that at one period there must have been water communication between the systems of the Senegal, Upper Niger, Benue, Lake Chad, and even the south-western affluents of the Nile. The fish fauna of the Congo basin is far more specialised, and though the two systems of drainage at one time must have been less separated than they are now and have approached one another so near that aerial methods of transporting fish over from one to the other must have been possible, there remains nevertheless a far closer connection between the basins of the Nile, Lake Chad, and the Niger than there is between all these and the Congo and Congolese lakes.

The volume contains chapters on the anthropology of the islands and eastern coastlands of Lake Chad and the western Bahr-al-Ghazal; on the reptiles and the batrachians; on the fish, the gastropods, and the bivalves or fresh-water oysters; on the diptera; and lastly on the botany of the region. The anthropological notes deal chiefly with the Buduma and Kuri of the Chad archipelago, and secondarily with the Kanem-bu and Mangawa, the Teda or Tubu, and the Uladsliman Arabs. These last, also known as Wasili, Washila, etc., seem to have migrated to this region from the south of Tripoli some 500 or 600 years ago. The Buduma are an exceedingly interesting people of puzzling characteristics, their language (not illustrated in the work under review) suggesting affinities with the Nilotic group far to the east. Their physique seems to indicate that they are the result of crossing between Nile negroes and the Ful who invaded this Chad region several centuries ago. The physiognomy of the Mangawa, on the other hand, recalls the Bantu type of the northern Congo and south-east Niger basins. The Tubu or Teda are another ethnological puzzle. They speak a negro type of language of no discoverable affinities (virtually identical with the language of Bornu), but in their physical appearance they resemble very strongly the hybrids between Nilotic Negro and Gala of Equatorial East Africa.

Much information is given in regard to the tsetse- and gad-flies of the Chad region.

H. H. JOHNSTON.

[1] "Republique Française. Ministère des Colonies. Documents Scientifiques de la Mission Tilho (1906–09)." Tome troisième. Pp. vii+484. (Paris: E. Larose, 1914.)

PROF. IVAN PETROVITCH PAVLOV.

IN the death of Ivan Petrovitch Pavlov, which was announced in the *Times* of February 12, a physiologist has passed away who made the world of medical science his debtor for all time. Pavlov, the son of a secular clergyman, was born in 1849, and thus at his death had not reached the allotted span of human life. When he last mingled with his *confrères* at the International Congress of Physiology in Groningen—little more than two years ago—he appeared to be in the full vigour of life, and no one would have supposed that the summons to his long home would so soon be issued.

Pavlov is chiefly known to the present generation of physiologists by his work on the digestive glands; but this only represents the middle period, though perhaps the chief period, of his activities. His earliest published work (1877) was on the "Accommodation Mechanism of Blood Vessels." This was carried out in the laboratory of Ustimo-

vitsch, in Petrograd, and in it he showed that a reflex constriction of the blood vessels of the ear of the rabbit occurs on opening the abdominal cavity. This was extended in 1879 to reflex effects on blood pressure due to variations in the distension of the stomach before and after section of the vagus nerve. His work, in fact, at this time and for more than fifteen years later was all concerned with innervation mechanisms.

In 1878 he studied the nervous mechanism of pancreatic secretion. This, though vitiated by overlooking certain factors which have since come to light, largely through the investigations of his own pupils, was of a most painstaking character and appeared to bring the secretory mechanism of the gland into line with that of other similar organs. As an outcome of it, he introduced an important improvement in the making of pancreatic fistulæ for the study of the outflow of the juice, the principle of which he extended (1883) to the collection of urine from the urinary bladder.

Up to this time Pavlov remained in Petrograd, but in 1884 he went to Breslau, and there under Heidenhain carried out work—also in the domain of the nervous system—namely, an investigation into the neuro-muscular mechanism of the opening and closure of the valves of the mussel. In 1886 he went to Leipzig to study under Ludwig, and from there published an article on the nervous control of the left ventricle of the heart.

This was followed in 1887 by an elaborate piece of work from Botkin's laboratory, Petrograd, which showed great thoroughness and insight, namely, on the centrifugal nerves of the heart. His conclusions were that there are four classes of such nerves—inhibiting of frequency, inhibiting of force, augmenting of frequency, and augmenting of force of the heart's contractions. This work may be said to mark the close of the first period of his activities. The succeeding fourteen years were devoted to his main life-work—a study of the activities of the digestive glands. In 1888 a further contribution to the secretion and innervation of the pancreas appeared, followed in 1889 and 1890 by articles, in conjunction with Madame Schumova-Simonovskaja, on the innervation of the glands of the stomach. These indubitably established the fact that the secretion of gastric juice is directly controlled by the vagus nerve. The difficulties met and surmounted in this investigation can only be adequately gauged when it is remembered that six years earlier, Heidenhain had written in Hermann's great text-book of physiology as follows:—"The results of the numerous observations quoted proclaim, without doubt, that the extrinsic nerves of the stomach possess no demonstrable influence, of a direct kind, on its secretion" (Hermann, "Handbuch," Bd. v., 1, S. 121, 1883). Numerous colleagues and pupils from this time began to associate themselves with Pavlov, amongst them being M. Nencki, an able biological chemist. To this co-operation is to be attributed work on the ammonia content of the portal and other veins in its relation to the formation of urea by the liver. Pavlov's technical skill was here shown in the success with which he performed the difficult operation of establishing the communication between the portal vein and the inferior vena cava, known as Eck's fistula.

About this time an occurrence took place which greatly influenced the master's later career. In 1885, a short time after Pasteur had discovered his method of treating hydrophobia, an officer of the regiment of the Guards lost his life through the bite of a rabid dog. Prince Alexander Petrovitch, of Oldenburg, who commanded the corps of the Guards at that time, was so affected by the sad event that he established at his own expense a laboratory for the treatment of the disease in the infirmary of the regiment. The work of this laboratory grew; investigations were undertaken, as well as treatment applied, and in 1888 the Prince obtained permission from the Emperor to found an institution for the experimental study of medicine. A site was chosen in the outskirts of Petrograd in a beautiful park adjoining the Neva, and in April, 1891, the Imperial Institute of Experimental Medicine was opened by order of the Czar, with Prince Alexander of Oldenburg as curator. Regular work began in the following October. The institute comprised numerous buildings and laboratories, and embraced six sections, namely, physiology, pathological anatomy, biological chemistry, bacteriology, epizootology, and syphilidology. Pavlov was chosen to be chief of the section of physiology, and Nencki that of biological chemistry.

Here under ideal conditions, with numerous colleagues and a large staff of assistants, Pavlov continued his investigations for the remainder of his life. The earlier work of the institute was published in Russian and French in the *Archives des Science Biologique de St. Pétersbourg,* and a summary of it was given in 1897 by Pavlov in a series of lectures to Russian medical men, which was published in Russian. A German translation appeared in 1898, followed by French and English translations in the next few years. It was mainly through these that European and other physiologists outside Russia, came fully to recognise the importance of the work carried on in Petrograd. It is not too much to say that all were profoundly impressed. Pavlov had for the first time devised methods of obtaining all the important digestive secretions, in pure condition, in exactly measurable quantities, and from animals in perfect health.

In his studies on the secretion of gastric juice Pavlov became impressed with the importance of the psychic stimulus, produced by the taste, sight, and smell of food. This was further shown in the secretion of saliva, where not only the flow, but the composition of the saliva was influenced in this way. Thus *dry* food caused a copious flow of thin, watery saliva; *moist* food a scanty flow of viscid saliva. The former was needed for the chewing of food, the latter only to facilitate swallowing. In these results he recognised the great effect of external, possibly un-

perceived, influences on all the functions of the body. These influences were exercised not alone through visual, but also through auditory and olfactory channels, likewise through cutaneous sensory nerves. Nor was it actually necessary that the food should be presented to produce the psychic effects. A musical note or a bright colour, or a pronounced odour, or a skin stimulus, if associated with the presentation of food, would after a short time become effective alone. Nothing could be more impressive than to see, as the writer has witnessed, a flow of saliva start on the sound of a musical note, except it be the failure to do so on sounding a note not more than a quarter of a tone different from the effective one.

To these phenomena Pavlov gave the name of "conditioned reflexes," and the greater part of his activity from 1901 onwards consisted in making use of them for the objective study of the psychical faculties in higher animals. He claimed that he was thereby restoring to physiology what properly belonged to it, and what had been divorced from it under the name of psychology or psycho-physics. On one point he was very emphatic, namely, that it is only by an active interchange of opinion between the physiologist (using the term in its widest sense) and the physician that the common goal of medical science and medical art can best be reached. In his own work he lived up to this maxim.

Pavlov's fame now drew recognition from many quarters and from various learned societies all over the world. To mention a few of these: in 1904 he was awarded the Nobel prize, in 1907 he was elected a foreign member of the Royal Society, and the same year he was elected an ordinary member of the Imperial Academy of Science, Petrograd. In 1912 he was awarded the honorary degree of D.Sc. by Cambridge University, Cambridge being the only one of the older universities of Great Britain upon the rolls of which Pavlov's name appears. It is true a grace was passed by the Senate of Dublin University to confer upon him the honorary degree of D.Sc., but illness at the time prevented him from attending to have it conferred. In 1913 he was promoted to be director of the Imperial Institute of Experimental Medicine. The last honour bestowed upon him in this country was by the Royal Society in 1915 in the form of the Copley Medal for his investigations in biological science.

Pavlov had a charming personality, and was never happier than in the company of his colleagues and pupils. He was impatient of anything he conceived not to be strictly scientific. In his later years he travelled a good deal, and was present at several of the international congresses of physiology. He visited this country twice, in 1906, when he delivered the Huxley lecture at Charing Cross Hospital, his subject being "The Scientific Investigation of the Psychical Faculties or Processes in Higher Animals," and in 1912, when he came as a delegate to the celebration of the 250th anniversary of the founding of the Royal Society.

W. H. T.

SIR LAURENCE GOMME.

BY the death of Sir Laurence Gomme on February 23, at sixty-two years of age, London has lost a most devoted son who loved her with an affection that was not merely filial, but was based upon an exhaustive knowledge of her history and a profound faith in her destiny; more than that, he spent all his life in her service. In early life Sir Laurence Gomme entered first the service of the Fulham District Board of Works, and then that of the Metropolitan Board of Works; when the London County Council was established he joined the Comptroller's Department, then he was made head of the Statistical Department, and in 1900 was appointed Clerk to the Council, which high office he held until last March. He always worked very hard, often up to the very limit of his powers, and about two years ago he had a serious breakdown in health, from which he never fully recovered. Only those conversant with the scope of the London County Council can have any idea of what London owes to him. His annual "Statistical Abstract" of the L.C.C. has served as a model for other municipal bodies. His first book, "Index of Municipal Offices," was published in 1879; it was followed by several others, among which may be mentioned, "The London County Council" (1888), "Lectures on the Principles of Local Government" (1898), "London Statutes" (1907), "The Governance of London" (1907), "London, 1837–1897" (1898), "The Making of London" (1912), "London" (1914).

Ethnology and folklore have lost a keen student in Sir Laurence Gomme, who did more than anyone else to found and direct the early career of the Folklore Society, of which he was first secretary and later president. He was president-elect of Section H (Anthropology) of the meeting of the British Association for the current year. The following list of books will give some idea of his activities in the direction of folklore: "Primitive Folkmoots" (1880), "Folklore Relics of Early Village Life" (1883), "The Village Community" (1890), "Ethnology in Folklore" (1892), "Folklore as an Historical Science" (1904). In addition to a remarkable output of books, he published numerous papers on folklore and allied subjects, all of which are marked by that breadth of view and suggestiveness which was so characteristic of him. He always recognised the great importance of method in ethnological research, and he did his best to raise folklore to a scientific status.

Those who knew Sir Laurence well have lost an inspiring and real friend, a genial personality, and a comrade of wide interests and full of sympathy for various cognate branches of study. He was constantly helping others alike in science and in the everyday walks of life.

Sir Laurence married in 1875 Alice Bertha Merck, author of "The Traditional Games of England, Scotland, and Ireland" (1894–98), who ably assisted her husband in numerous ways, and has been a constant stimulus to him in his work.

A. C. HADDON.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Prof. E. H. Barton, Mr. W. R. Bousfield, Mr. S. G. Brown, Prof. E. G. Coker, Prof. G. G. Henderson, Mr. J. E. Littlewood, Prof. A. McKenzie, Prof. J. A. MacWilliam, Mr. J. H. Maiden, Prof. H. H. W. Pearson, Prof. J. A. Pollock, Sir L. Rogers, Dr. C. Shearer, Prof. D'Arcy W. Thompson, Mr. H. Woods.

SIR RAY LANKESTER writes:—"The serious illness of Prof. Metchnikoff, of the Institut Pasteur, has been briefly noticed by some of the daily papers. Your readers include many friends and admirers of my friend, who will be glad to have accurate information on the subject. It commenced some time before Christmas with distressing symptoms, which were described as 'une crise du cœur.' In order to avoid the daily journey from Sèvres, where he usually resides, and the climbing of the stairs leading to his laboratory, Prof. Metchnikoff, accompanied by Madame Metchnikoff, took up his residence in rooms in the Institut Pasteur which were placed at his disposal, and so he was able to continue his work with the least possible fatigue. But trouble in the lungs now appeared, and developed into an attack of pleurisy and pneumonia, which necessitated his removal to the hospital of the Institut. There he has been for some weeks in a very serious condition. To-day, however (February 26), I hear from Madame Metchnikoff that there is better news. For the third time the pleural cavity has been tapped and a litre of liquid removed, which has given great relief. His medical attendants believe that the pleurisy will now soon disappear. The pulmonary congestion has already disappeared. I will let you know when I hear again from Paris."

MR. DOUGLAS W. FRESHFIELD, president of the Royal Geographical Society, M. Henri Curdier, the French Orientalist, and General Schokalski, the Russian oceanographer, have been elected honorary members of the Italian Royal Geographical Society.

WE learn from *Science* that the Bruce gold medal of the Astronomical Society of the Pacific has been awarded to Dr. G. E. Hale, director of the Mount Wilson Solar Observatory.

THE King's prize of 400*l.* for human physiology has been awarded by the Accademia dei Lincei of Rome to Dr. Filippo Bottazzi, who holds the chair of physiology in the University of Naples.

DR. C. W. HAYES, who was chief geologist to the U.S. Geological Survey from 1902 to 1911, has died at Washington in his fifty-seventh year. He was geologist to the Nicaraguan Canal Commission in 1898–9, and had written largely on theoretical and economic geology.

DR. J. D. FALCONER, lecturer in geography in Glasgow University and Swiney lecturer in geology at the British Museum, has been selected by the Secretary of State for the Colonies for the post of temporary assistant district officer in the northern provinces of Nigeria. Dr. Falconer has been granted leave of absence from the University from the end of the present term.

MR. HAROLD COX will give an address on "Industrial Development," before the Institution of Civil Engineers on March 7. In inviting Mr. Cox to address the institution on this subject, the council has considered that the present time calls for some earnest attention on the part of engineers to the economic issues which, after the war, must influence profoundly the future of engineering, as well as the industrial and commercial enterprises which are vital to its progress both in this country and abroad.

SOME of the bones of the gigantic fossil elephant (*Elephas antiquus*) obtained last summer from Chatham have just been placed on exhibition in the Geological Department of the British Museum (Natural History). With the humerus and scapula have been arranged the corresponding bones of the mammoth from Ilford to show the comparatively small size of the latter. The massive fore foot of the Chatham specimen is especially impressive. The relative smallness of the molar teeth is also noteworthy.

THE death is announced, at Streatham, on February 18, of Prof. R. H. Smith. Accounts of his career appear in *Engineering* and the *Engineer* for February 25. He was born in 1852 in Edinburgh, where he completed his scientific training at the University. His practical training was obtained during an apprenticeship with Messrs. Tennant and Co., of Leith; he had further experience in the Whitworth works, and in the drawing office of Messrs. Wohlers, Berlin. He was appointed professor of civil and mechanical engineering at the Imperial University, Tokio, and afterwards held the professorship in civil, mechanical, and electrical engineering at the Mason College, Birmingham. Prof. Smith contributed many articles on engineering subjects to the technical Press, and was the author of numerous books on commercial economy in steam, heat, and power plants, electric traction, etc.

WE regret to announce the death of Richard Dedekind, which occurred on February 11, at Brunswick, his birthplace (1831) and residence for the greater part of his life. Dedekind is best known by his two arithmetical tracts, "Was sind u. was sollen die Zahlen?" and "Ueber Stetigkeit u. irrationale Zahlen," and by his supplements to successive editions of Dirichlet's "Zahlentheorie." In the latter he developed the theory of ideal primes, invented by Kummer, so as to make it applicable to any field of algebraic numbers whatever. In his two tracts he applies the notion of a *cut* (Schnitt) so as to give an exact definition of an irrational number, and a precise explanation of the continuity of the ordered set of real arithmetical quantities. Each of these achievements is enough to place him in the first rank of pure mathematicians for all time. Not a voluminous writer, his briefest note invariably bears the stamp of his profound and original genius; and, like Dirichlet and Hermite, with whom he may be aptly compared, he wrote with a combination of clearness and elegance difficult to equal, and impossible to surpass.

WE regret to learn, from an obituary notice in the *Victorian Naturalist* for January, of the death of Dr. T. S. Hall, for more than twenty years lecturer in biology in the University of Melbourne, and before that director of the School of Mines at Castlemaine. Dr. Hall's original investigations dealt chiefly with the palæontological aspect of his subject, and he was recognised as a leading authority on the graptolites of Victoria. In 1901 the Geological Society of London awarded him the balance of the proceeds of the Murchison fund in recognition of his researches. He took a very active part in the organisation of scientific work in Australia, and had been president both of the Royal Society of Victoria, and of the Field Naturalists' Club; he also did a great deal of useful work in connection with the Australasian Association for the Advancement of Science. He became personally known to many British men of science on the occasion of the recent visit of the British Association to Australia, when he not only acted as local secretary of the Zoological Section in Melbourne, but rendered valuable services in other directions also. Dr. Hall's charming personality, his sound common sense, and his extraordinarily keen sense of humour endeared him to a large circle of friends, by whom his loss will be very deeply felt. He was fifty-eight years of age at the time of his death.

AT the meeting of the Buteshire Natural History Society, held on February 8, in the society's library at the Bute Museum and Laboratory, the curator, Mr. L. P. W. Renouf, explained at some length the aims and objects of the laboratory and museum under its new *régime*. Briefly, these are to get together a complete collection of the fauna and flora of Bute and its more or less immediate waters, to supplement the actual collection with a card index of occurrences over an extended period so as to have a complete local history of the species, and to provide accommodation for anyone desirous of working at any of the problems of natural history. Emphasis was laid on the exceptional advantages offered by Bute for such an undertaking, its size, position, and industries combining to make it an ideal site for the work. The laboratory offers all the necessary facilities for research work, and possesses equipment for the carrying on of both marine and fresh-water investigations, and the museum already contains the nucleus of a very fine collection. Intending workers should apply to Mr. Renouf, who will be glad to supply any particulars.

THE subordination of science forms the subject of the leading article in *Engineering* for February 25. Our national neglect of science has long been manifest, but there are also some reasons for believing that the fault lies in part with the scientific man himself. British scientific men, including engineers, have formed a habit of rendering the nation gratuitous services of the greatest intrinsic value. There have been many instances of this since the commencement of the war, and, unfortunately, the general attitude towards such services is to value them at cost price. It is probable that the public would take a much higher view of the worth of these services had the scientific experts concerned, like the lawyers, politicians, and certain trade-unionists, made demand for adequate remuneration. There is no doubt also that our unfortunate educational tradition has much to do with the public attitude towards the scientific and engineering expert. There is not a little reason for believing that the country would derive great benefit from an Act making it illegal for any schoolboy under sixteen years of age to devote more than one hour a week to Latin and another hour to Greek. Our public schools in the past have failed to provide a general education, but have been devoted largely to the attempt to convert most of the pupils into classical specialists.

PROF. MOHN has published, through the Fridtjof Nansen Fund, a discussion of the meteorological observations made by the Norwegian Antarctic Expedition of 1911–12, under Capt. Roald Amundsen. The memoir is a pamphlet of seventy-eight pages, and is written in English. The observations at Framheim, the base of the edge of the Barrier near King Edward Land, are discussed in detail, and a full account is given of the less complete observations made on the sledge journey to the south pole and back, including a discussion of the heights deduced from the aneroid and boiling point observations. Great prominence is given to wind, and the relation of the Antarctic winds to other conditions is worked out in a remarkable series of wind roses. The climate of Framheim is dealt with by calculating normals based on the five-years' observations available at McMurdo Sound, taking account of the relation between Amundsen's figures and the synchronous observations of the Scott Expedition. Prof. Mohn states that the climate of Framheim, which was the southernmost meteorological station in the world, may be characterised as having rather low atmospheric pressure, and very low temperature, both lower than at McMurdo Sound (maximum observed, −0·2° C. minimum, −59° C.), the yearly mean being −24° C., as compared with −17·4° C. for the same latitude in the northern hemisphere. The vapour tension was small, and the relative humidity and cloudiness were moderate; no rain was observed, and snow fell one day out of five. The prevailing wind direction was easterly, and the force moderate, averaging 20 metres per second, being much less than at McMurdo Sound, and gales were very infrequent.

AT the Manchester meeting of the British Association last year it was strongly represented that the association, with its great breadth of interest, might afford an effective mechanism for the investigation of many of the problems of national and Imperial importance which will arise after the close of the war, and already call, or will call later, for scientific investigation and advice. Before the meeting the Section of Economics had made investigation into the questions of outlets for labour after the war, of the effect of the war on credit, currency, and finance, and of industrial harmony. The Engineering Section set on foot at the Manchester meeting an inquiry into problems affecting the national welfare; and at the same time, at the instance of the Chemical Section, a research committee was appointed to inquire into the question of economy in fuel and allied problems. The wider suggestion, as affecting the work of the

sections generally, has been taken up since the meeting by the council, which appointed a committee to deal with the matter, and, on its recommendation, called upon the organising committees of the sections to submit questions, in their various departments of science, which might profitably be investigated. We are informed that a number of important subjects for investigation have already been suggested, and no doubt some of these will find a place in the programme of the next annual meeting, but others are being dealt with in the meantime. There is good reason to hope that this extension of the work of the association will have valuable and far-reaching results.

IN *Ancient Egypt*, part i. for 1916, Miss Alice Grenfell publishes a catalogue of the fine collection of scarabs formed by Field-Marshal Lord Grenfell while commanding in Egypt. These are illustrated by a long series of photographs and drawings. It is suggested that the symbols of the double and single spiral signify "life," and that the fish, which originally symbolised Isis and fertility, was utilised by early Christian converts who had no objection to use pagan symbols. Prof. Flinders Petrie adds a note fixing the date of these scarabs. The collection, as a whole, is of the highest value to students of Egyptian religion.

IN the January issue of *Man*, Prof. Ashby and his colleagues, MM. Themistocles Zammit and Giuseppe Despott, describe the excavations made in Malta during 1914. The megalithic building, on a site known as Id-debdieba, "the place of the Echo," has been fully examined. The object of this remarkable structure is still uncertain. Among the more remarkable objects unearthed in the course of the excavations are six pillars of limestone or sandstone, cylindrical in shape, but some tapering at one end, of the type usual in Maltese megalithic ruins. Flint implements were rare, but potsherds were abundant, mostly from vessels of Neolithic times, that is to say, contemporary with the original building, and fragments of dark red bricks with a very rough texture, some of which were evidently parts of floors or walls of ovens.

THE supplement to the forty-fourth annual report of the Local Government Board, containing the report of the Medical Officer (Dr. Newsholme) for 1914–15, has just been issued. Dr. Newsholme surveys the measures taken on account of the war for co-operation between the civil and military sanitary services, and reviews the incidence of infectious diseases in England and Wales and the development of tuberculosis work over the country. Dr. Bruce Low furnishes a report on the epidemiology of typhus fever in recent years, which deals mainly with the distribution of this disease in the various countries of the globe. Dr. Twort makes a preliminary report on the bacteriology of infantile diarrhœa. Various micro-organisms were isolated by means of a special medium and examined, but so far no evidence has been obtained of the existence of any specific bacterium for this disease. Owing to war conditions, the report is much shorter than usual.

THE report just issued by the Medical Research Committee, under the National Health Insurance Act, on "Cerebro-Spinal Fever during the Epidemic of 1915," brings together, in a clear and concise form, a great mass of very careful and well-planned bacteriological work, done by many observers. The authors of the report are Prof. F. W. Andrewes, Prof. Bullock, and Prof. Hewlett; one could scarcely find three names of higher authority. The work done is, of course, scarcely intelligible to those who are not bacteriologists; but the chief conclusions are important to all. That the "meningococcus" is indeed the specific germ of the disease, remains the sure foundation of the work. It is a true species, "as species go amongst bacteria." There are subspecies of it; but these ought none the less to be called meningococcus, not para- or pseudo-meningococcus. From this "specificity" of meningococcus, it follows that bacteriological examination is the necessary method for a positive diagnosis of the case. The whole subject of the detection and treatment of "carriers" is very carefully considered. It appears that even the most vigorous and varied treatments of the back of the throats of carriers may fail to rid them of the germs; the report is more hopeful of good results from "an open-air life and the provision of as much fresh air as possible." For the treatment of the declared disease, the specific antitoxin did not, in the adverse conditions of last winter, fulfil men's expectations: it did not achieve so much as it achieved in the Belfast epidemic of 1907, and in some American epidemics. It remains the only "rational" treatment; but we cannot put it anywhere near diphtheria antitoxin in the records of the art of healing. That is the fault of the disease, not of the bacteriologists.

MISS MAUD HAVILAND, in *British Birds* for February, makes some welcome additions to our records of the life-history of the Lapland bunting. Her notes are based on observations during her stay on the Yenisei. Though she obtained some beautiful photographs of the nest and of nestlings, she failed to obtain pictures of the adults, which refused even to approach the nest while the tent containing the camera was in the neighbourhood. She succeeded, however, in obtaining some valuable notes on the habits of the adults, and the feeding of the young, as well as on the migratory habits of this species. The many peculiarities of this bunting are skilfully brought out by contrasting it with the snow bunting and other species haunting the same area.

ORNITHOLOGISTS, for some inscrutable reason, have paid but little attention hitherto to the many problems presented by the study of the renewal of plumage by moulting. Yet this is a theme of far wider importance than is commonly supposed. Recently, however, our knowledge of this subject has been materially increased by several important papers, and not the least of these is that which appears in the *Scottish Naturalist* for February by Dr. C. B. Ticehurst. His summary of his work, however, is very inadequate, and it is at times difficult to be sure of the precise value he attaches to his observations, which are further marred by the inexcusable use of the term, "tertials," though he is not the only offender in this matter.

THOSE who are inclined to doubt whether museums play any useful part in war-time should read the account of what is being done in the Leicester Museum, by means of an Infant Welfare Exhibition, to combat the appalling mortality among infants. This account appears in the *Museums Journal* for February, and has been written by Mr. E. E. Lowe, the curator, who is responsible for the scheme and its execution. This mortality, which is largely preventable, is brought out with startling vividness by means of a series of wooden columns, that for infants up to twelve months old standing no fewer than 11 ft. high, while that for the death-rate between the ages from five to twenty is but $2\frac{3}{4}$ of an inch high. The food values of human, cow's, and condensed milk, the injurious effects of "dummies," of "push-carts," and of certain kinds of clothing, are brought out by means of specimens, models, or diagrams. Models also are used to demonstrate the dangers of contamination by flies. The keenest interest has been displayed in this exhibition since its installation, especially by the poorer classes, for whom it was more especially intended. Hence it is devoutly to be hoped that this and similar museums will not be closed by the local authorities from mistaken notions of economy in war-time.

A NEW genus of Ranunculaceæ, Beesia, named in honour of the firm of Bees, Ltd.—to whose enterprise so much botanical exploration in China, Burma, and the Himalayas has been accomplished—has been described by Prof. Bayley Balfour and Mr. W. W. Smith in Notes from the Royal Botanic Garden, Edinburgh, vol. ix., No. xli. The new plant, *Beesia cordata*, which is figured, is allied to the Japanese genus Glaucidium, and to the Japanese and American Hydrastis. It was collected by Mr. F. Kingdon Ward in northern Burma, at 9000 ft. altitude, in the deep shade of the rain forest.

THE annual report of the Agricultural Department, St. Vincent, shows that a good deal of useful work has been done in the past year in connection with efforts to raise new strains of cotton, particularly with reference to disease resistance. The progress of the cotton industry is well shown in the tables covering the period of the last ten years. The area planted in 1905–6 was 790 acres, and in 1914–15 4226 acres, though in 1911–12 it rose to more than 5000 acres. The weight of lint in 1905–6 was 137,460 lb., and in 1910–11 reached as high a figure as 561,526 lb., the average yield of lint per acre for the ten years being 128 lb.

WE notice in *La Geographie* for November, 1915, that the hydrographic department of the French Admiralty have replaced the German names in Kerguelen by names of French origin. It must be very galling to the French to see an abundance of German names scattered over the chart of their Antarctic island, especially as German explorers were never sparing in their naming or very mindful of previous names. At the same time, however, the practice of changing established names is a dangerous one if carried far, and it is to be hoped, in the interests of geographical accuracy, this principle will not be applied indiscriminately, for confusion would certainly be the result. The new names for Kerguelen appear in the *Avis aux Navigateurs* of May 29, 1915.

AN article on the Peru-Bolivia boundary commission, by Sir Thomas Holdich, in the *Geographical Journal* for February (vol. xlvii., No. 2) is another reminder, were any required, of the losses that geographical science has sustained by the war. In January, 1911, the services of four British officers were lent to the Government of Peru to determine the boundary with Bolivia. Two of them, Capt. H. S. Toppin, Northumberland Fusiliers, and Lieut. C. G. Moores, R.E., have already lost their lives in action. Capt. Toppin was to have written the report for the Peruvian Government. When that became impossible the Royal Geographical Society was asked to undertake the work, and it was placed by the society in the hands of Sir Thomas Holdich. Moreover, in certain circumstances in the dispute the Royal Geographical Society was made arbitrator by the Peruvian Government. In the same number of the *Geographical Journal* is a paper by the late Capt. Toppin on the diplomatic history of the Peru-Bolivia boundary.

MR. F. E. WRIGHT, writing in the Journal of the Washington Academy of Sciences, vi., 1, describes a device for solving equations of the form $a=bc$, where a, b, c are functions for which suitable scales of representation have been plotted. The method is apparently based on the geometrical construction for the product of two quantities by treating the latter as the fourth term of a proportion having unity as the first. It is, however, not easy to follow from the description, but it may be useful to overcome the difficulties in cases where some process of the kind has to be frequently used.

DICHROIC fog is one of the troubles of the amateur photographer when plates are developed under difficult conditions as to temperature or otherwise. An investigation of its causes, prevention, and cure is given by M. Ernest Coustet in the *Revue générale des Sciences* (xxvi., 21). Of the causes, the most important is the presence of traces of the fixing salt in the developer or of the developer in the fixing salt. The latter appears to be the most important, and thorough washing before fixing the best preventive. A high temperature and a weak fixing bath are favourable to fogging. Of remedies the author recommends neutral (never acid) permanganate followed by bisulphite of soda.

THE issue of the index numbers of the two sections of *Science Abstracts* completes the volumes for the year 1915. The physics volume has 770 pages and the electrical engineering volume 622, while the number of abstracts are 1789 and 1152 respectively. The volumes are therefore quite equal in size to those issued before the war, though there seems to be a small decrease in the number of articles abstracted, partly no doubt due to the reduction in the amount of scientific work being published. The name indexes include names of authors and those mentioned in abstracts, and cover twenty-nine and fifteen pages re-

spectively. The subject indexes extend to fifty-two and thirty pages respectively, and the method of arrangement adopted in past years is continued. The facility with which a piece of research can be looked up in "Science Abstracts" makes it invaluable to those engaged in scientific work in either physics or electrical engineering.

THE Journal of the Royal Society of Arts for December 31 contains an interesting article by Sir Charles Watson on the origin of English measures of length. The author is of opinion that the measures of length used by the different nations of the world are for the most part derived from a common origin. He regards the longer measures of distance as having been first used by a people who possessed a high degree of astronomical knowledge, who were acquainted with the form of the earth and were able to carry out accurate geodetic measurements. He explains the means by which the ancients determined the unit for terrestrial measurements of distance, now known as a geographical mile, and he then proceeds to consider how the subdivisions of the geographical mile were assimilated with the cubit. Two new cubits appear to have been invented for this purpose; one of these was equivalent to 18·225 English inches, and the other, afterwards known as the Babylonian royal cubit, was equal to 20·25 inches. Sir Charles points out that the English sea mile is exactly the same as the geographical mile of the Babylonian system; that its tenth part, the cable length, is identical with the stadium; and that generally the English measures of length are no haphazard modern invention, but have come down to us from prehistoric times.

A SHORT article on the production of potash in the United States appears in the *Chemical Trade Journal* of February 12. In 1915 steps were taken to produce potash salts on a commercial scale in the United States, and the plant of the Universal Products Corporation began to operate in October last at Marysvale, Utah, producing both potassium sulphate and alumina in high-grade form. The rated capacity of the works is from 25 to 30 tons of 95 per cent. potassium sulphate per day. The present plant handles about 150 tons of alunite daily, and plans are being made to double its capacity. At Searles Lake, California, the American Trona Corporation proceeded with the construction of its works to treat the potassium-bearing brine of that desert basin by the Grimwood process. At Trona (Searles Lake) only mixed salts are produced from the first part of the process, and these are refined at the port of San Pedro, California. The initial plants are expected to produce 100 tons of potash and 30 tons of borax daily. The alunite deposits of the Florence Mining and Milling Company at Marysvale, Utah, is to be exploited by a newly-formed corporation, the Utah Potash Syndicate. Some plants were erected elsewhere to utilise the potash of the felspars, but did not get into operation on a commercial scale.

"THE *Athenaeum* Subject Index" to the periodical literature on the economic, political, and military history of the war is a classified list of the titles of articles that have appeared during 1915. About 150 periodicals are cited, including twenty published in the United States and ten published in France. There is an alphabetical list of authors' names. The titles of the articles are classified under more than 250 headings, arranged in alphabetical order. The primary classification is in great measure topographical, being based upon the names of countries, and such headings as "Eastern Question" and "European War." These main sections are, however, subdivided into subsections, such as "Army," "Colonies," "Commerce," "Economic Condition," "Finance," and "Intellectual Life." In addition to the topographical headings, there are many others, such as "Aliens," "Architecture," "Civilisation," "Compulsory Service," "Eugenics," "Food Supply," "Liquor Problem," "National Characteristics," and "Social Psychology." In drawing up such a list it is obviously very difficult to decide what are the subjects of greatest interest to those who will consult the index. Compensation for any defects in the arrangement will be found in the large number of cross-references, which make it possible without much difficulty to trace the various entries relating to any subject that may not have been confined to one section.

THE letter of Sir Lauder Brunton which we published in our issue of February 10 (vol. xcvi., p. 649), advocating the introduction of Latin as an international language, has inspired several communications on the subject for which we are unable to find space. Mr. L. F. Richardson, of Eskdalemuir Observatory, directs attention to the simplicity of "Ido," which has been suggested as an international language, and points out that the language can be read by anyone. Mr. F. H. Perrycoste, Polperro, Cornwall, emphasises the saving of time which would result from the adoption of Sir Lauder Brunton's suggestion, and urges that most people would really be better off with a good equipment of Latin than they now are "with a more or less efficient or inefficient equipment of French and German and a practically useless semi-equipment of Latin acquired at enormous expense of school time." Mr. P. W. Stuart-Menteath, writing from Ciboure, Basses Pyrénées, maintains that "The revival of Latin as the unique language of science can alone secure the co-operation of the humanist, the intellectual independence of the Latin nations, and the essential unity of both their science and their religion." Mr. C. M. Houghton urges the advantages of Esperanto, the inventor of which was an adherent to the Latin project for many years before he constructed his artificial language for international use. He adds that Mr. W. J. Clark's "International Language" (Dent, 1*s.* net) "contains a *résumé* of the history of the problem and its solution from 1653 up to 1910, together with a large amount of other valuable information."

IN future the journal hitherto known as the *Journal of Economic Biology* will bear the name of the *Journal of Zoological Research*, the subject-matter of which will be confined to original zoological research—systematic and anatomical. The style and price of the periodical will remain unaltered.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—The Astronomer Royal informs us that he has received the following telegram from Prof. O. Baeklund, director of the Pulkova Observatory:—"New comet Neujmin., 11·0 mag., February 24, 9h. 17m. Simeis M.T., R.A. 8h. 58m. 40s., declination 16° 24′ N. Motion slow. Probably south." A further observation telephoned to us as we go to press is as follows:—R.A. 8h. 58m. 29·8s., declination +14° 42′ 58″, February 27, 11h. 33·6m., G.M.T.

COMET 1915*a* (MELLISH).—Additional measures of the condensations in the tail of this comet are given in Lowell Observatory Bulletin, No. 70. Photographs taken with the 40-in. reflector have been measured by Mr. C. O. Lampland. Mr. E. C. Slipher made visual micrometric measures with the 24-in. refractor.

The following positions of the comet are extracted from an ephemeris given in Circular 501 of the *Astronomischen Nachrichten*:—

	12*h.* G.M.T.		
	R.A.	Dec.	Mag.
	h. m. s.	° ′	
March 2 ...	3 37 24 ...	+20 56·6 ...	11·7
6 ...	40 12 ...	21 27·2 ...	
10 ...	43 9 ...	21 56·9 ...	11·9

U.S. NAVAL OBSERVATORY, 1915.—We have received a copy of the report of the superintendent of this extremely active institution. The Gaithersburg Station of the International Latitude Service has been discontinued. Dr. F. E. Ross has been transferred to Washington, together with the photographic zenith tube for continuous determination of the variation of latitude.

A DAYLIGHT METEOR.—An extremely interesting account of a great meteor seen over the Chusan Archipelago during the forenoon of February 13, 1915, has been given by Capt. W. F. Tyler, R.N.R., in a paper communicated to the North China Branch of the Royal Asiatic Society (Journal, vol. xlvi.). Capt Tyler's attention was directed to the matter by the report of the light-keeper at Steep Island that a man-of-war had fired an aerial torpedo which nearly hit the tower. The combined observations from a number of adjacent islands and from Shanghai seem to be best fitted by assuming the meteor followed a strongly curved path, at first travelling a little east of north, and finally moving towards the south-east. The meteor was seen to fall into the sea near Video Island, and a violent explosion was heard over a very wide area. It is notable that exceptional meteoric displays have been recorded about this date in previous years.

A TRANSNEPTUNIAN PLANET.—The first number of the first volume of the Memoirs of the Lowell Observatory deals with this alluring subject. Although the cometary evidence which has been held to indicate the existence of an additional member of the solar system may be open to other interpretation, yet it may be confidently predicted that extended knowledge of the motions of the known outer planets will ultimately settle the matter if, that is, the hypothetical body, or bodies, exist. It is interesting to compare the material Dr. Lowell finds available with that which led to the capture of Neptune. In the first place, the latter has not yet been known long enough to enable its theory to be developed with the accuracy required as a basis of a search for a source of perturbation, hence instead of the planet next in the series, recourse must be made to the antepenultimate Uranus. Then, secondly, the residuals given by Gaillot's theory of Uranus do not exceed 4·5″ at any point of its path (1709–1910), whilst in 1845 Uranus showed an unexplained discrepancy amounting to 133″. A comparison of the present residuals, small though they be, with the probable errors of observations, shows that they are too large to be due to the latter. By a lengthy process of trial by error Dr. Lowell shows that the hypothesis of a single outside perturbing body can reduce the residuals 71 per cent., or, including errors of observation, by 90 to 100 per cent. Two solutions are found to be equally indicated, one with the unknown situated (July 0, 1914) in heliocentric longitude 84·0°, for the other in 262·8°. The distances, masses, and eccentricities are closely alike, being about forty-four times the earth's distance from the sun, 1/50,000 of the sun's mass, and an eccentricity about 0·2, indicating a visibility of 12–13 magnitude, and a disc greater than 1″ in diameter.

ARTIFICIAL IRRIGATION IN THE WESTERN STATES OF NORTH AMERICA.[1]

THE hydrological department of the United States Geological Survey finds nowhere, perhaps, so important and fruitful a field of operations as in the great tract of country which lies west of the 100th meridian of west longitude. The difficulties attending the agricultural development of regions in which the rainfall is so scanty as to be almost negligible are sufficiently obvious, but the lack of adequate supplies of water is no less felt for mining and industrial purposes, to say nothing of ordinary domestic requirements. Hence arises the necessity for a close and searching investigation into all such sources as are actually available, and the conservation of supplies from streams and wells, so that they may be utilised to the best advantage, with the reduction of waste and loss to a minimum.

Such are the conditions prevailing on the south-eastern portion of the State of Nevada. Large areas of fertile soil lie idle for want of moisture to make them productive, and very little vegetation survives, unaided, the long periods of drought. The average annual precipitation of rain at seven gauging stations in different localities ranges from 3·42 to 11·99 in. When a rainfall does occur, it often takes the form of a cloudburst, in which a large quantity of water falls on a small area in a very short space of time. Much consequently is lost. The majority of the upland streams, moreover, disappear in the alluvial slopes at the foot of the mountains, and only flood waters from heavy rains reach the central valleys. Wells and springs, therefore, constitute some of the most important sources of supply, and they are found to give the best yield in the unconsolidated sedimentary deposits which partly fill the structural basins of the district. The lower indurated strata, forming what is called the "bed-rock," are much less productive. These lower formations are usually hard, compact, and impervious layers, representative of various systems, mostly sedimentary, but with some igneous intrusions. They serve the useful purpose of confining the water which enters the "valley-fill," and of preventing its downward escape.

Tularosa Basin, in New Mexico, with an area of 6000 square miles, is another arid region with similar climatic conditions. The sky is generally clear, the atmosphere dry, and the average rainfall in the lower

[1] "Ground Water in South-Eastern Nevada." By Everett Carpenter (Water Supply Paper 365.) Pp. 86, with diagrams and 5 plates.
"Geology and Water Resources of Tularosa Basin, New Mexico." By O. E. Meinzer and R. F. Hare (Water Supply Paper 343.) Pp. 316, with diagrams and 19 plates.
"Springs of California." By Gerald A. Waring (Water Supply Paper 338.) Pp. 410, with diagrams and 13 plates.
"Ground Water for Irrigation in the Sacramento Valley, California." By Kirk Bryan (Water Supply Paper 375 A.) Pp. 49, with diagrams and 2 plates.
"Ground Water Resources of the Niles Cone and Adjacent Areas, California." By W. O. Clark (Water Supply Paper 345 H.) Pp. 43, with diagrams and 9 plates.
(Issued by United States Geological Survey, Washington, 1915.)

parts is only about 10 in. per annum. The valley possesses considerable mineral wealth, including gold, copper, lead, iron, turquoise, coal, and gypsum. The metalliferous deposits, especially gold, have been extensively worked. But, from an agricultural point of view, the district has been practically neglected. Vast tracts of arable land, capable of producing valuable crops, lie uncultivated for lack of treatment. In any system of development, artificial irrigation would, of course, be a necessity, but there are abundant stores of underground water available for exploitation and use. As in south-eastern Nevada, these supplies are more prolific in the "valley-fill" than in the "bed-rock." The most important sources are the sand and gravel deposits, which lie in irregular lenticular masses at different depths in different localities. The Cretaceous rocks, however, underlying the eastern portion of the basin, yield a sufficient supply for domestic and cattle-raising purposes.

Further to the west lies the great State of California, second only to Texas in point of size, and characterised by a remarkable physiographical diversity. Thus it encloses both the highest and the lowest levels in the Union, viz., 14,501 ft. above the sea (Mount Whitney), and 276 ft. below the same datum (Death Valley). There are equally diverse hydrographic features. In the southern deserts is to be found the extreme of aridity: a rainfall which averages less than 3 in. per annum, and, in some years, is merely a trace; whereas, in the north-west, there is very heavy precipitation, amounting to an annual average of close on 100 in. at certain stations. Mr. Waring's paper contains a very full account of the natural springs scattered throughout the State, with an interesting study of their occurrence and yield. The hot springs are perhaps the most remarkable class, and these include all springs having a temperature higher than about 90° F. Other groups of springs include carbonated springs, sulphur springs, saline springs, magnesic springs, and iron springs, each class named after the constituent which marks the flavour and character of the water. One curious spring is the so-called "poison spring" on the western border of Death Valley, which is an arm of the Colorado Desert. It yields a salty water, impregnated probably with sulphates, producing a strong feeling of nausea in anyone imbibing it. Other popularly described "poison" springs are believed to contain arsenic, but of this there is some doubt, as arsenic is a rare constituent of water and seldom present in measurable amount.

The most prominent topographical feature of California is the Great Central Valley, 16,000 square miles in area, flanked on each side by mountain ranges running parallel with the coast. One portion of this is the Sacramento Valley, a broad and fertile plain lying between the Sierra Nevada and the Coast Range. It is a district unmistakably adapted to agricultural pursuits, possessing climatic conditions of the most favourable kind. The winters are moderate, and the rainfall, which averages from 20 to 25 in. annually, is concentrated, in a large measure, within the five months of their duration. The orchard industry has acquired special prominence. All deciduous fruits bear heavy crops, being rarely damaged by frost, while the more delicate varieties, such as apricots, almonds, olives, etc., flourish in suitable localities. Under normal conditions it is quite unnecessary to resort to artificial irrigation, but, as a means to the more extended and intensive cultivation of ground crops and the inclusion under operation of certain lands at present only available for grazing, the study of water storage and distribution is receiving attention. The ground water is principally contained in the uppermost alluvial deposits, and the valley is remarkable for the large area in which the water-level stands near the surface of the ground. The alluvium is of two periods: an older deposition dating from the Pliocene epoch and continuing into the Pleistocene, and a later deposit of more recent formation. This latter is the most productive water-bearing stratum, and consists largely of sands and gravels in an uncemented condition. The total quantity of ground water in the valley is undoubtedly very considerable, and the application of irrigation from this source presents great possibilities of development.

Adjacent to the Sacramento Valley, on the eastern side of San Francisco Bay, is situated a somewhat notable cone of alluvial deposit, built up by a neighbouring creek, and called, from its proximity to a town of the name, Niles Cone. The cone proper is 11,800 acres in extent, but a marsh tract adds 9000 acres to the area forming the ground-water district covered by Mr. Clark's report. The creek from which the cone derives its origin is Alameda Creek, at the outlet of the Santa Clara Valley. This receives the drainage of 640 square miles of mountains and interior valleys. The alluvial deposits have been brought down by streams during periods of irregular flow. The upper layers belong to the Pleistocene and Recent series of the Quaternary system; the lower strata form part of the Orinda formation in the Pliocene series. Below these fresh-water deposits lie shale and sandstone of the Cretaceous, and, possibly, of the Jurassic periods. The development of artificial irrigation is proceeding rapidly, and numerous wells have been sunk during the past few years, but the limit of yield from the ground water has almost been attained, and any further supplies will have to be obtained by conserving the large quantities of flood water which have hitherto been allowed to run to waste. B. C.

SOME RECENT STUDIES ON PROTOZOA AND DISEASE.

DR. J. W. SCOTT MACFIE describes in *Annals of Tropical Medicine and Parasitology* (vol. ix., No. 4) a number of interesting protozoa from Accra, West Africa. He records the occurrence of a piroplasm—*Nuttallia decumani,* n. sp.—in the blood of brown rats, and gives an account of a case of amœbic dysentery in a monkey (Cercopithecus), in which numerous Entamœba were present, together with a vast number of minute spirochætes. He designates as a new variety (var. *equinum*) a strain of *Trypanosoma congoiense,* chiefly on the ground that in many of the trypanosomes the trophonucleus lies near the anterior end. The clinical aspect of the disease produced by this trypanosome in the original host—a mare—was also peculiar in that there appeared on the skin of the body raised disc-like patches or plaques, which, however, disappeared after about three days. Dr. Macfie also records observations on two mules suffering from a form of trypanosomiasis clinically resembling acute dourine, and states that in these cases infection by coitus—the usual method of transmission of this disease—may be excluded with certainty.

An account of researches by Drs. Fantham and Porter on induced herpetomoniasis in birds appears in the same number of the Annals. Water-scorpions and gnats, in the intestine of which the flagellate parasite Herpetomonas was present, were fed to birds—canaries, sparrows, and martins. A fatal infection of the birds ensued, and herpetomonads, flagellate and non-flagellate, were found in the internal organs (liver, spleen, bone-marrow, etc.). The disease ran either an acute or a chronic course. In acute cases the flagellate form of the parasite was more common in the birds at death, while in chronic cases the non-

flagellate forms—often Leishmania-like—were more numerous. The authors recall the fact that a flagellate stage of *Leishmania donovani*—the causal organism of kala azar in man—has recently been found by Dr. Wenyon in a dog subinoculated with a strain derived from a human case, and that flagellate stages of *L. tropica*—the organism of oriental sore—have been found in man. In view of the similarity of the morphological cycles of Leishmania and Herpetomonas, the authors suggest that the species of Leishmania are probably insect herpetomonads introduced long ago into man, and usually perpetuating the non-flagellate and relatively non-resistant forms, though capable of assuming the flagellate form.

THE NEW ZEALAND INSTITUTE.

THE forty-seventh volume of the Transactions and Proceedings of the New Zealand Institute constitutes a record of much valuable and painstaking research, dealing chiefly with the fauna and flora of the Dominion. It is gratifying to find that the war has interfered so little with the activities of New Zealand naturalists, and that so many ardent workers are now engaged in adding to our already very extensive knowledge of this important region. Most of the papers in this volume are of a systematic character, and probably work of this kind is the most important that can be undertaken at the present time in New Zealand. Such papers, however, naturally appeal to a very limited number of readers, especially when they are written in the ultra-technical language which so many systematists seem to prefer. This appears very markedly in Mr. Meyrick's revision of New Zealand Tineina, in which the diagnosis of the very first genus contains the following cryptic sentence—if sentence it can be called:—"Hindwings under 1, termen abruptly emarginate beneath acutely produced apex; 3 and 4 rather approximated, 5 nearly parallel, 6 and 7 rather approximated towards base."

We cannot help thinking that, apart altogether from the question of style, a somewhat more generous expenditure of type would be appreciated by those who might like to take up the study of this group of Lepidoptera in New Zealand, and are not already experts in the subject. Mr. Meyrick is of opinion that there still remain a large number of additional species of Tineina to be discovered in New Zealand, and it seems a pity, therefore, that the generic and family characters given only hold good for the New Zealand species, for apparently they may be upset at any time by further discoveries, and may prove quite inadequate for the determination of new forms.

One of the most interesting discoveries recorded in the volume is that of a new genus of gymnoblastic hydroids, Ascidioclava, found living as a parasite in the peripharyngeal groove of an Ascidian, and described by Prof. H. B. Kirk.

We are glad to see that local botanists are paying attention to the life-history of the Lycopodiaceæ, which form such an important element in the New Zealand flora. Mr. J. E. Holloway contributes a note on the protocorm of *Lycopodium laterale*, and Miss K. V. Edgerley describes the prothallia of three species. Prof. Charles Chilton gives an interesting account of the recently established Mountain Biological Station belonging to the Canterbury College, the existence of which may be expected to do much to promote biological research.

It is impossible in a short notice to do justice to such a mass of valuable material as this volume contains. We can only express our satisfaction at the great activity displayed, and congratulate all concerned on the results of their labours. A. D.

THERAPEUTIC ACTION OF ULTRA-VIOLET RAYS.

ATTENTION has recently been directed again to the therapeutic action of ultra-violet rays by the publication of a paper in the *Lancet* of January 8, in which a source of light invented by Mr. Simpson was referred to. There is nothing novel, of course, in the fact that certain forms of disease may be cured by exposure to light of wave-length ranging from 300 $\mu\mu$ to 90 $\mu\mu$, but the discovery of a new ultra-violet lamp raises many questions of wide interest. Dr. Sidney Russ has now shown, however, that an arc simply produced between two tungsten rods exactly simulates the so-called "Simpson light," and it is evident that the powerful source of ultra-violet rays thus obtained will prove of service in the treatment of all those superficial lesions which Finsen and others have proved to be favourably affected by this type of radiation. Dr. Russ has further pointed out that even one-tenth of a millimetre of human skin readily absorbs a large part of the ultra-violet rays from this arc, and that less than one per cent. passes to a depth of one millimetre.

When its spectrum is compared with that of the mercury arc, the carbon arc, or one between copper and silver, it is seen to consist of numerous lines grading off towards the shortest wave-length, and affording an exceptionally rich source of ultra-violet light over the region, which is of great therapeutic use. In medical work, however, the cleanliness and convenience of the method by which any particular radiation can be produced are naturally of great importance, and in this respect it is evident that the electric discharge between a broken column of mercury enclosed in an exhausted quartz tube has much to recommend it. On the other hand, the new tungsten arc lamp made by Messrs. Edison and Swan (see NATURE of December 23, 1915, p. 467), enclosed in a silica bulb instead of in glass, would no doubt be an ideal means of producing ultra-violet light, and one which could be readily adapted for medical as well as other purposes.

Dr. Russ has contributed a short illustrated article to the *British Medical Journal* for January 22, in which some interesting points are considered respecting the seventeen octaves of radiations which are now available: from visible light to the gamma rays of radium. He deals very clearly with the X-ray spectrum, the dangers of prolonged or frequent exposure to that radiation, ultra-violet light, and some of the chief physical facts with which medical students should become acquainted.

THE UTILISATION OF PEAT.[1]

PEAT AS A SOURCE OF POWER.

THE problem of the utilisation of peat for industrial purposes is one of perpetually recurring interest, and scientific men in many countries have turned their attention to search out a solution. This is not surprising in view of the fact that the amount of combustible matter in the world's peat deposits exceeds that of all the known coal-fields. For Ireland the question is one of vital interest. Her coal deposits are small and relatively unimportant, while nearly one-seventh of the area of the country, *i.e.* more than two and three-quarter million acres, is covered with peat, much of which is of excellent quality. This represents a vast amount of potential energy awaiting only a practical means of utilising it.

[1] Abridged from articles entitled "Peat as a Source of Power," by Mr. George Fletcher, and "Some Chemical Aspects of the Peat Problem," by Prof. G. T. Morgan, F.R.S., published in the Journal of the Department of Agriculture and Technical Instruction for Ireland (vol. xvi., No. 1).

The defects of peat as a fuel are (1) that it contains and retains a large amount of water; (2) it has, compared with other fuels, a low calorific value; and (3) it is extremely bulky, involving a high cost of carriage. Thus it is that most of the schemes for peat utilisation have been concerned with artificially drying and compressing the material. This can be done readily enough, but the energy consumed in the operation, and the low calorific value of peat, render the commercial success of any such scheme extremely problematical. Other schemes have sought to combine the preparation of a fuel from peat with the extraction of by-products. When one recalls the fact that the by-products of the manufacture of coal gas, once regarded as useless, have come to rival the gas itself in value, this aspect of the peat problem appears full of possibilities; further reference will be made to this.

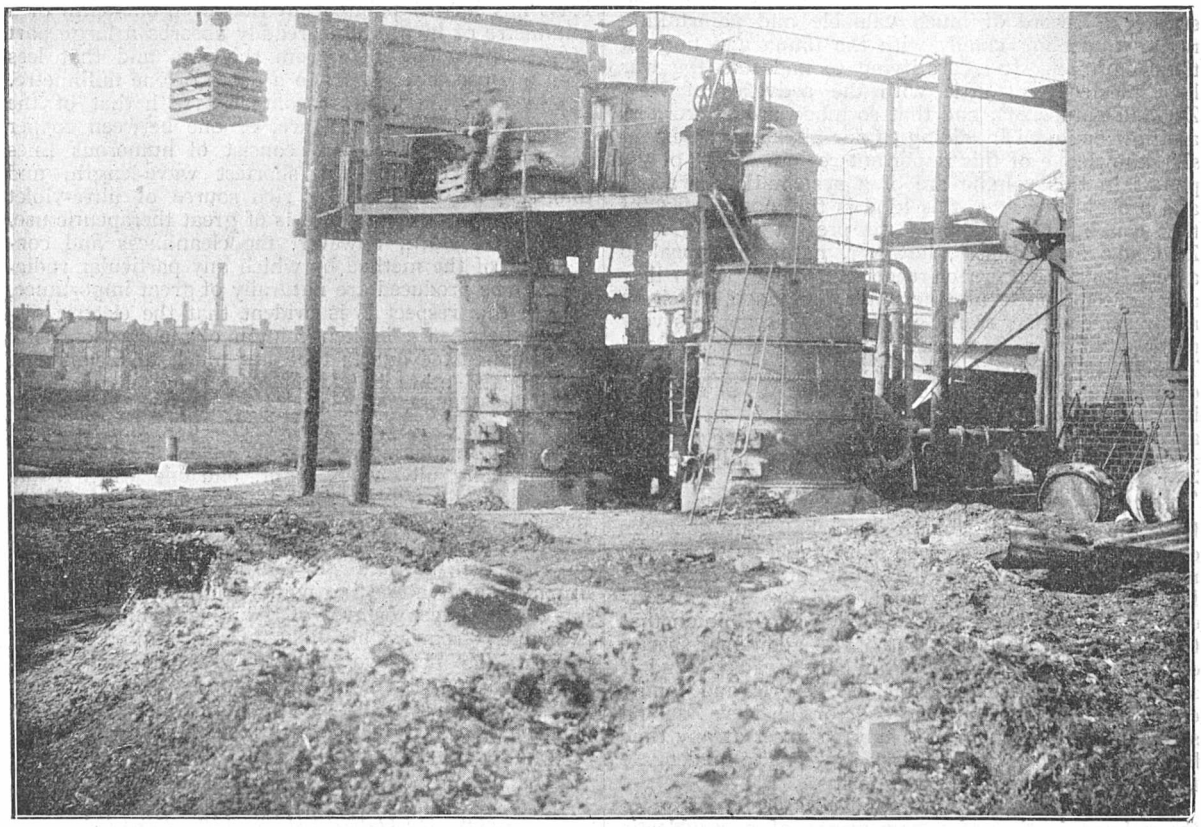


FIG. 1.—Producer gas plant, utilising peat, at Messrs. Hamilton Robb's factory at Portadown.

A new vista of potentialities for peat has opened up in recent years. Just as the nineteenth century will always be associated with the development of the steam engine, culminating in the steam turbine, so will the twentieth century be able to claim the triumph of the internal-combustion engine. The success of the gas engine has led to investigations which resulted in the many forms of producer gas plant, and there are now many thousands of installations of this method of producing power for mechanical purposes.

It is a noteworthy and encouraging fact that an installation at Portadown for utilising peat in gas-producer plant has been found to be entirely satisfactory, and to effect a considerable saving over anthracite. This is the more remarkable, as the by-products are not at present utilised. But these by-products are of considerable value, and it will be of interest to refer to two instances where peat has been used in plant designed to recover the by-products.

The first of these is the power plant of the Societa per L'Utilisazzione du Combustibili Italiani, at Orentano in Italy. This plant, erected by the Power Gas Corporation, Ltd., Stockton-on-Tees, is situated on the edge of a bog a few miles distant from Orentano. The area of the bog is about 1482 acres, of which the company operating the recovery power plant owns about 500 acres. This portion of the bog has an average depth of about 5 ft. of good peat fuel. The bog has to be drained by pumping. The peat, excavated by manual labour, is fed into Dolberg peat machines, and these are provided with belt conveyers to transport the peat to the macerators. Part of it is air-dried, and part mechanically treated and artificially dried. The peat delivered to the producers with an average moisture content of 33½ per cent., has an average nitrogen content of 1·04 per cent. The nitrogen is recovered as ammonium sulphate, and the gas is used to drive two gas engines of 350 metric horse-power each, which drive alternate-current generators—there being a transmission line to Pontedera, ten miles distant.

The second installation referred to is the ammonia recovery power plant of the German Mond Gas Company, situated on the Schweger Moor, about twenty-five miles from the city of Osnabrück. It is constructed according to the system of Frank and Caro, and was designed to utilise peat containing upwards of 60 per cent. moisture—an important point as lengthening the season during which peat manufacturing operations could be carried on. The gas plant is capable of gasifying and recovering the by-products from 210 tons per day of twenty-four hours of air-

dried peat. The total power capacity is more than 3000 h.p., and the gas engines are coupled to alternators running in parallel. The current, transmitted at a tension of 30,000 volts, is distributed over an area of about twenty-five miles' radius.

If more rapid progress has not been made in solving the problem in the United Kingdom, it must be remembered that in the manufacturing parts of England coal is comparatively cheap, and owing to its greater heating power is more suitable for producer gas than is peat. In many parts of Ireland, however, coal is very dear, but (and to some extent because of this fact) in these districts we have not at present in existence industries demanding power. The possibility of securing cheap power would be a stimulus to industrial development.

Happily, a noteworthy step has been taken in the way of solving the problem by the action of Messrs. Hamilton Robb, of Portadown. This firm have in Portadown a weaving industry, and a little more than four years ago decided to try the experiment of establishing a (peat) producer gas plant. They accordingly installed a suction gas plant constructed by Messrs. Crossley Brothers, Ltd., of Manchester, of a capacity of 400 brake-horse-power. The fuel used is peat, and this is cut from a bog some miles distant and dried in the open air by the usual method of stacking. The plant supplies gas to two engines, each of 120 b.h.p., and one of 150 b.h.p. There are two producers, each having a capacity of 200 b.h.p. By means of the conveyer the peat blocks are elevated and carried to the feed hoppers on the top of the producers, from which they pass into the generators, where gasification takes place. It is stated that under working conditions, with peat at 5*s*. a ton, power can be obtained at the rate of one-sixteenth of a penny per horse-power hour.

The gas, before passing to the engine, must be purified, but the substances removed are valuable, although the by-products of a small plant would not justify treatment. There is nitrogen, which can be recovered as ammonium sulphate, and also peat ash and peat tar, containing valuable constituents. It is not unreasonable to assume that with an extension of this method of utilising peat, it would be possible to deal in a profitable manner with the by-products which would thus be produced in a sufficient quantity to allow of their being dealt with in chemical works. We should in this way not only establish an additional industry, but this method of obtaining power from peat would be rendered still more profitable.

It may be said that the conditions at Portadown are favourable, in view of the neighbourhood of the peat bog to the weaving factory, and it is undoubtedly a very great advantage to be able to avail of water carriage from the bog to the factory. There are, nevertheless, without doubt, many other places in Ireland where corresponding advantages could be found. But even in their absence it seems certain that peat could be profitably utilised on the lines indicated, with one modification, though that is an important one. Where a sufficient demand for power exists, it appears certain that instead of carrying the bulky peat either by road or by water, it would be advisable to instal producer plant on the bog itself and to convert the mechanical power into electricity, and transmit the energy at high pressure to the point where it is required. The efficiency of such conversion and transmission is now very high, and the financial results of such a mode of transmission can be ascertained with a considerable degree of accuracy in any case where the conditions can be stated.

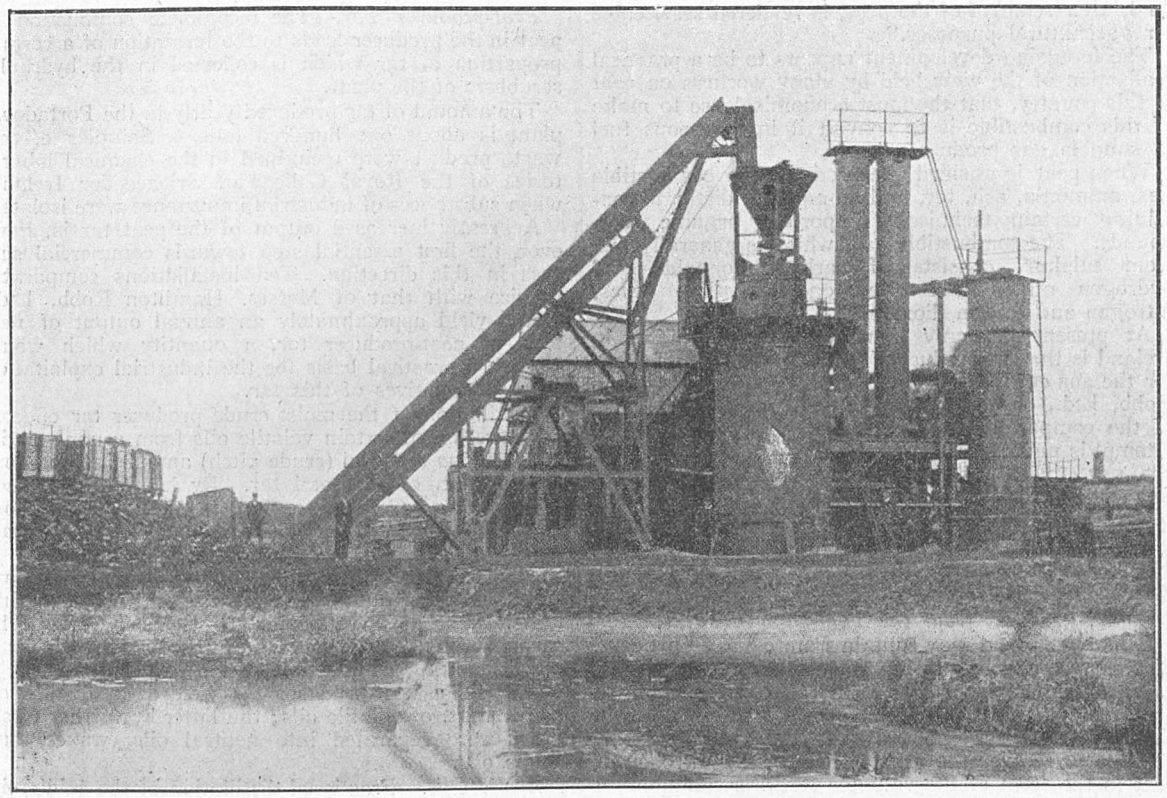


FIG. 2.—The first producer plant in the world making regularly producer gas and ammonium sulphate from wet peat, containing up to 75 per cent. of water.

CHEMICAL ASPECTS OF THE PEAT PROBLEM.

Extensive deposits of peat exist in Great Britain, France, Russia, Italy, Scandinavia, Germany, and Austria. One-seventh of the total area of Ireland is covered by peat, and enormous tracts of this deposit are found in Canada.

Only two years before the outbreak of war a practical solution of the peat problem was claimed for Germany by Dr. Carl Duisberg, of Elberfeld, who at the Congress of Applied Chemistry held in 1912 at New York, stated his case in the following words:—

"The latest and most rational method of utilising the peat or turf beds which are so plentiful in Germany and many other countries is practised in Schweger Moor near Osnabrück, according to a process discovered by Frank and Caro. There peat gas is produced and utilised, and ammonia obtained as a by-product, the required power being generated in a 3000-h.p. central electric power station. The moorland, after removal of the peat, is rendered serviceable for agricultural purposes."

The foregoing development appears to be a practical realisation of the view held by many workers on peat in this country, that the most economical use to make of this combustible is to convert it into gaseous fuel in suitable gas producers.

When peat is gasified the products are combustible gas, ammonia, ash, tar, and an aqueous distillate containing certain technically important organic compounds. The combustible gas, which is generally free from sulphur, consists of carbon monoxide and hydrogen mixed with the non-combustible gases, nitrogen and carbon dioxide.

At present the only plant of this description in Ireland is the gas-producer furnishing the gaseous fuel for the gas engines of the factory of Messrs. Hamilton Robb, Ltd., of Portadown, and although, on account of the comparatively small capacity of the plant, no attempt is made to recover and utilise any by-products, yet, nevertheless, this installation has proved to be a financial success. There can be little doubt that in a scientifically controlled plant, large enough to render practicable the recovery of ammonia and other by-products, the economy effected would be considerably greater.

By-Products from the Peat-Gas Producer.

Ammonia.—Peat may contain from 0·5 to 2·5 per cent. of nitrogen, and by passing steam over peat heated to 350–550° almost the whole of the nitrogen is obtained as ammonia. This improvement has been embodied in the modern types of Mond plant, so that now it is possible to recover the greater part of the nitrogen of peat in the form of the valuable fertiliser, ammonium sulphate. The importance of increasing the output of ammonium sulphate from peat lies in the circumstance that this salt can displace sodium nitrate as a nitrogenous manure, thus rendering the nitrate available for the manufacture of explosives and other chemical products.

The Power-Gas Corporation, Limited, of Stockton-on-Tees, who in 1905 first turned their attention to this method of utilising peat, have obtained the following extremely favourable results:—

Fuel used	German peat per cent.	Italian peat per cent.	English peat per cent.
Moisture content of fuel	40 to 60	15	57·5
Nitrogen content of fuel	1·0	1·58	2·3
Quantity of gas produced per ton of theoretically dry peat.	cubic ft. 85,000 B.T.U. per c.f.	cubic ft. 60,000 B.T.U. per c.f.	cubic ft. 90,000 B.T.U. per c.f.
Heat value of gas produced ...	150	166	134
Sulphate of ammonia produced per ton of theoretically dry peat	70 lb.	115 lb	215 lb.

The Simon-Carves Bye-product Coke-Oven Construction and Working Company, Limited, have made large-scale experiments on the gasification of peat in Moore gas-producers. Peat, containing 63 per cent. of moisture and with a nitrogen content of 2·235 per cent., yielded per ton 94,850 cubic ft. of gas (100 B.T.U. per cubic ft.) and 168 lb. of ammonium sulphate.

Peat Ash.—Peat differs from wood in yielding on combustion a comparatively large proportion of mineral ash (5 to 15 per cent.). The ash of peat contains the oxides of aluminium, iron, and calcium existing to a considerable extent in the form of carbonate, sulphate, silicate, and phosphate, a very appreciable amount of alkalis, with a preponderance of potash. By using the peat ash as a dressing for the recovered land the potash locked up in peat would be rendered available for agriculture at a time when the shortage of this alkali is felt very acutely.

Peat-producer Tar.—The incomplete combustion of peat in the producer leads to the formation of a certain proportion of tar which is collected in the hydraulic scrubbers of the plant.

The amount of tar produced yearly in the Portadown plant is about one hundred tons. Samples of this waste product were examined in the chemical laboratories of the Royal College of Science for Ireland, when substances of industrial importance were isolated.

A greatly increased output of the peat tar is, however, the first essential step towards commercial success in this direction. Ten installations comparable in size with that of Messrs. Hamilton Robb, Ltd., would yield approximately an annual output of 1000 tons of peat-producer tar, a quantity which would furnish a practical basis for the industrial exploitation of the derivatives of this tar.

Distillation of the moist crude producer tar effected a separation of certain volatile oils from a non-volatile bituminous material (crude pitch) amounting to about 17 per cent. of the total tar. By heating the crude pitch to 122° C. and pouring off the liquid portion, about 6 per cent. of a refined soft pitch could be separated from a solid friable carbonaceous residue.

This pitch, either alone or mixed with the carbonaceous matter, could be used as asphalt, as a caulking material, or as an insulator in electrical work. The carbonaceous matter could be utilised separately as a self-briquetting combustible of high calorific value.

The moist peat-producer tar yielded on distillation 50 per cent. of volatile oils; the latter by further treatment were separated into neutral oils, waxes, and acidic oils.

Acidic Oils.—Fractional distillation of the acidic oils showed that these substances consisted principally of complex phenolic compounds. Attention was specially directed to these substances as they seemed likely to afford material for the manufacture of useful disinfectants comparable in efficacy with lysol, creolin, cyllin, and other coal-tar disinfectants.

The well-known Rideal-Walker test for disinfectants and the modified procedure devised by Martin and Chick afford methods for controlling quantitatively the separation of the germicidally active acidic oils from peat tar, and for ascertaining the bactericidal value of these acidic oils. Phenol and the cresols are segregated in the fraction boiling below 200° C., which is about seven times as toxic as phenol itself towards *Bacillus typhosus*. The fraction of acidic peat oil boiling at 200–250° is seventeen times as active as phenol (carbolic acid) on the same pathogenic organism.

The most intense germicidal activity is possessed by the fraction of acidic peat oil boiling at 253–360°, for this product has a phenol (carbolic acid) coefficient of 31.

These results show that by distillation and simple

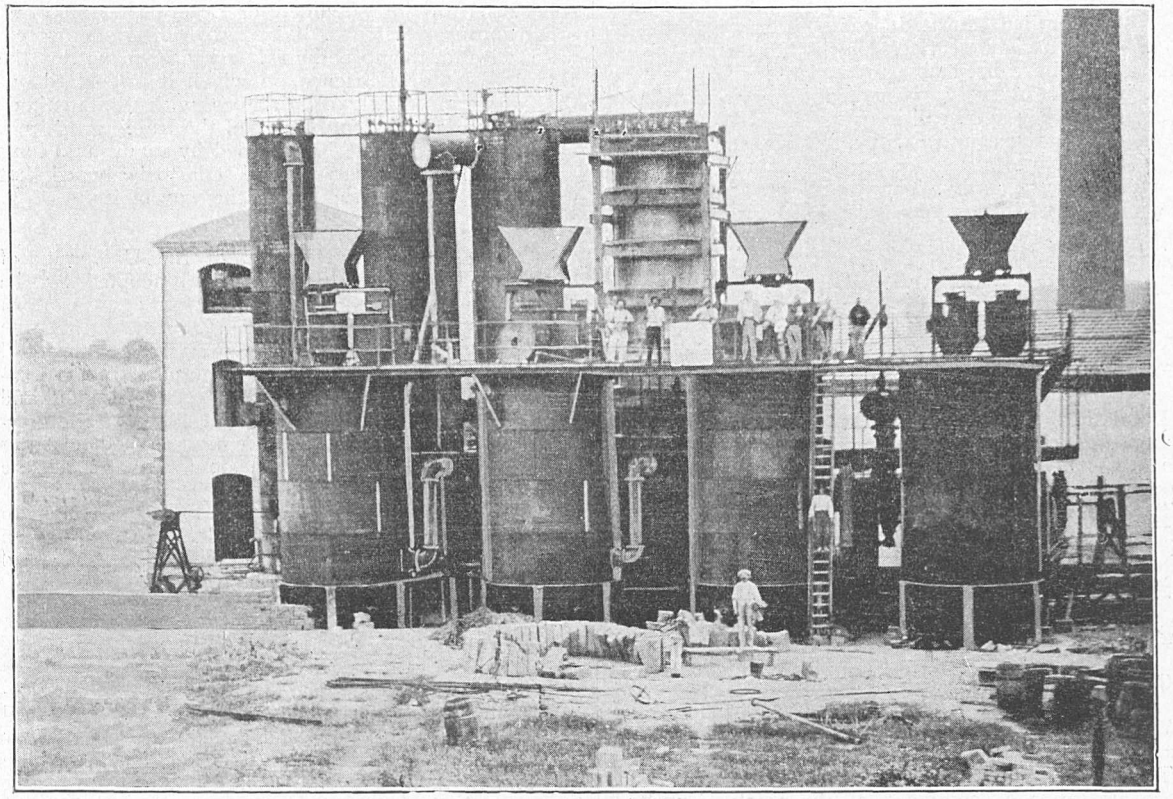
chemical treatment of the oils obtainable from peat-producer tar one can, under appropriate bacteriological control, isolate oils of intense bactericidal activity suitable for the manufacture of antiseptics, disinfectants, and germicides. When it is remembered that phenol (carbolic acid), the standard disinfectant of this type, is greatly required in the manufacture of explosives (lyddite), drugs (salicylic acid, aspirin, etc.), as well as for many other synthetic products, it will be readily realised that these peat disinfectants would be welcomed as efficacious substitutes for carbolic acid, if they were forthcoming in sufficient amount, especially at the present time, when antiseptics are so urgently needed.

The neutral oils left after extracting the germicidal acidic oils with alkali could be used as lubricants, as pyridine bases are pungent liquids useful both as solvents and as disinfectants. The recovery of these compounds could be rendered practicable by suitably modifying the peat-producer plant.

SUMMARY.

1. The industrialisation of peat could be most efficiently brought about by gasifying it in gas producers, as this procedure would render feasible the recovery of several valuable by-products.

2. The combined nitrogen of the peat can be economically recovered in the form of ammonium sulphate. This valuable fertiliser, together with the peat ash containing potash and phosphoric acid, could be restored to the land from which the peat has been taken.



The Power Gas Corporation, Ltd., Stockton-on-Tees.

FIG. 3.—Mond peat power gas plant, with ammonia recovery, designed to gasify about 100 tons peat per day. In operation at a Central Electric Station, Pontedera, Italy.

liquid fuel, for example, in Diesel engines, and when mixed with the pitch from peat tar would furnish a refined tar.

The higher fractions of the neutral oils boiling above 250° C. deposit on cooling considerable quantities of almost colourless wax, which would serve as a promising starting point for the manufacture of candles.

The aqueous distillate from the producer contains, in addition to ammonia, certain organic substances soluble in water, among which have been recognised methyl alcohol, acetone, acetic acid and its immediate homologues, and pyridine bases. Methyl alcohol is an important solvent and the starting point for formaldehyde. Acetic acid and its homologues are required for the manufacture of acetone and other ketones. Acetone is an important solvent used in considerable quantities in the manufacture of the explosive, cordite. The

3. Peat tar, another by-product, can be fractionated into the following useful materials:—Refined pitch and tar, candle wax, lubricating and burning oils, and very powerful disinfectants, greatly exceeding carbolic acid in germicidal strength.

4. The aqueous distillate from the producer contains methyl alcohol, acetone, pyridine bases, and crude acetic acid, all of which are capable of recovery and utilisation.

The economical utilisation of peat in the generation of gaseous fuel, even without recovery of by-products, is to-day an accomplished fact. It can scarcely be doubted that, with efficient chemical control, a larger plant of sufficient capacity to deal rationally with the ammonia, tar, and other products of the destructive distillation of peat would lead to still greater economies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the annual meeting of the Court of Governors, held on February 24, the Vice-Chancellor referred to the services rendered by the University to the country in the prosecution of the war. Not only was the staff able to render valuable help in undertaking scientific work and serving on public bodies, but in addition something like 500 present and past students had joined the Services, and of these nearly 10 per cent. had already lost their lives.

The principal, Sir Oliver Lodge, referring to the unwisdom of false economy in education and scientific training and investigation, said:—"It has certainly been one of our dangers that the country as a whole has not been wide awake in this direction, and has been contented with a singular kind of ignorance on the part of otherwise educated people—even of people in high position. The services which the universities of the country have been able to render during the war have been already very marked, and might have been greater had they had facilities from the first. It seems unlikely that the country will allow these institutions to drop back into a position continuously handicapped by inadequate resources. They are not only educational; they are repositories of learning and of a special kind of ability not elsewhere cultivated. Knowledge is not a thing to be merely passed on to a coming generation, it is a thing to be utilised and increased and applied by every generation; and if the occupants of university posts—especially the younger members—are prevented from doing their duty and realising their privilege in this respect, the country cannot keep its place in the van of civilisation."

In view of the increased intercourse between this country and Russia which may be anticipated after the war, it is hoped that the teaching of Russian may be undertaken by the University, but shortage of funds will not allow this step at present.

The treasurer reported that the income was reduced by 920*l.* owing to the war, and of this amount 770*l.* was due to loss of fees.

The following were elected members of the council:—The Bishop of Birmingham, Mr. Richard Threlfall, Miss S. M. Fry, and Dr. F. D. Chattaway.

CAMBRIDGE.—The Raymond Horton-Smith prize has been awarded to Dr. E. Mellanby for a thesis entitled "An Experimental Investigation into the Cause and Treatment of Diarrhœa and Vomiting in Children."

The Degree Committee of the Special Board for Mathematics is of opinion that the work submitted by Mr. S. Ramanujan, of Trinity College, entitled "Highly Composite Numbers," together with six other papers, is of merit as a record of original research; this gentleman was sent to the University by the Indian Government on account of his remarkable mathematical powers.

The Vice-Chancellor has given notice that the subject for the Sedgwick prize essay for the year 1919 is "The Lower Palæozoic Rocks of Some British District."

OXFORD.—The subject of Prof. Mark Baldwin's Romanes lecture is "The Super-State and the 'Eternal Values.'" The lecture will be delivered in the University Museum on Wednesday, March 15, at 2.30.

Like other departments of the University, the school of forestry has been seriously affected by the war. Eight students, however, have received the diploma in the course of 1915, and the professor has conducted visits to the Forest of Dean, the Tintern Crown Forests, and other areas, in addition to the usual excursions for instruction to Bagley Wood. Planting and thinning has continued in the experimental plots, and Mr. W. E. Hiley has continued his research on fungal diseases of trees. The publication of his work on the diseases of the larch may suffer some delay from the fact that Mr. Hiley has accepted a commission as scientific worker at Woolwich Arsenal.

It has often been thought by many of those who are interested in the progress of science at Oxford that the examinations for honours in natural science were framed too much on the model of those belonging to the older academic subjects. A statute which will come before Congregation on March 7 marks a new departure in this respect, so far as concerns the honour school of chemistry. The object of the statute is to ensure that every candidate for honours in chemistry shall not only be examined in paper and practical work as at present, but must also produce records of experimental investigations carried out under the supervision of the Waynflete or Lee's professor, or of other approved persons. This provision is in accordance with a memorandum lately drawn up by the Board of Natural Science, in which it is pointed out that some practical acquaintance with the methods of research is an essential part of the training of every chemist. The statute is regarded by many as a long step in the right direction, and it is to be hoped that no obstacles will be thrown in the way of its passing.

A PLAN for the development of the University of California Medical School has been adopted by the regents of the University of California. We learn from the issue of *Science* for February 4 that the University of California has now increased to a total of 32,400*l.* per annum its expenditure on medical instruction, over and above the hospital receipts, and within the next few months it will complete the erection, at a cost of 123,000*l.*, of a new 216-bed teaching hospital. The regents have now outlined as the immediate future needs of the medical school a new laboratory building for anatomy and pathology, to cost 30,000*l.*; an "out-patient" building in conjunction with the new teaching hospital, to cost 20,000*l.*; and a nurses' home for 100 nurses, to cost 20,000*l.*

THE second annual report, for the year ending December 31, 1915, of the executive committee to the trustees of the Carnegie United Kingdom Trust has now been circulated. The trust deed expressly prohibits "any part of the trust funds from being used in any way which could lend countenance to war or to warlike preparations." This fact prevents the trustees, in their corporate capacity, taking any part in the activities in which the country is chiefly involved at present. Prior to the date of the last annual report a total sum of 550,000*l.* had been expended or promised for the provision of church organs; when to this sum is added the grant promises made during the year, a total sum of about 600,000*l.* will have been expended in this way and about 3800 organs will have been procured. No further applications for organs are to be entertained. The executive committee has decided that the library movement which is being carried out can best be dealt with under the heads: rural library grants, grants for special libraries of a national character, loan charge grants to public libraries, and grants for public library buildings. In the case of rural libraries, a number of experimental schemes have been set on foot of which particulars are given in the report. During the year the committee has assisted in the establishment of a central lending library for students, has rendered assistance to the agricultural library attached to the Rothamsted Experimental Station, and has promised assistance towards the more commodious housing of the British Library of Political Science attached to the London

School of Economics. Among miscellaneous grants made during the year may be mentioned a sum of 1500*l.* to the United Irish Women, and 4000*l.* to the Women's Industrial Council towards the cost of building a nursery training school; and to provide an aquarium for the gardens of the Zoological Society of Scotland 10,000*l.* is to be given.

How unwise it would be if the present demand for national retrenchment led to any reduction of State aid to our modern universities can be gathered from an inspiring article by a special correspondent in the issue of the *Times* for February 9. The impressive array of facts as to the value of the application of research to the purposes of the war which the article provides shows that those nations will take the first rank in peace and war alike which utilise most completely the resources which science has placed at the disposal of mankind. The article deals more especially with the four universities of the North of England, and we select the following instances from the numerous examples cited:—Distillations from coal tar, testing of steel and explosives, calibrating of aeroplane recording instruments, and the production of pharmaceutical drugs are included among the special war enterprises of Manchester University. Liverpool University has given expert advice in the manufacture of explosives, and has undertaken the analysis of explosives in a district extending from Ruabon to Fleetwood. The equipment and *personnel* of the tinctorial chemistry and dyeing department of Leeds University were put at the disposal of the Government in 1914, and the department has done valuable research work in relation to dye-stuffs and raw materials not hitherto made in England. Another department of this University is conducting the recovery of toluene from coal gas in Lincolnshire and Yorkshire, and is inspecting the production of high explosives in Yorkshire. The chemists of the University have furnished a large supply of the anæsthetic novocaine, which we formerly imported from Germany, and have prepared about a hundred antiseptic compounds for the military hospitals. In regard to the University of Sheffield, valuable and confidential work has been done there in relation to the science of steel, and the Scientific Advisory Committee of the University has given local manufacturers expert guidance in their efforts to replace exports from Germany. Thus, advice has been given on the processes of hardening steel, on materials for polishing razors, on the contact process of procuring sulphuric acid, and so forth. Steps have been taken also to encourage the revival of the old glass industry of South Yorkshire.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, February 10.—Sir Joseph Larmor, president, in the chair.—J. H. **Grace**: (i) Theorems on straight lines intersecting at right angles. (ii) The classification of rational approximations.—Mrs. G. C. **Young**: Infinite derivates.—E. H. **Neville**: The bilinear curvature and other functions of independent directions on a surface.—Dr. S. **Brodetsky**: The attraction of equiangular spirals.—J. **Proudman**: Additions and corrections to a former paper, "Limiting forms of long-period tides."—R. E. **Powers**: Certain composite Mersenne's numbers.—Prof. H. F. **Baker**: Note on a formula connected with the theory of spherical harmonics.—Dr. T. J. I'A. **Bromwich**: Note on Dr. Baker's formula.—J. **Hammond**: Notes on the arithmetic of prime numbers.

Royal Meteorological Society, February 16.—Major H. G. Lyons, president, in the chair.—C. E. P. **Brooks**: The rainfall of Nigeria and the Gold Coast. The paper dealt with the rainfall on the Guinea Coast and its hinterland for the ten years 1904–13. The driest month is January, with scarcely any rain, the wettest is June, and the monthly maps show how the rainy belt travels inland as the wet season comes on. In August it reaches its northernmost position, and the coast is drier during that month than in July and September. The coast is very rainy, the annual fall averaging 160 in., and reaching 200 in. in wet years at some stations in the Niger delta. The interior merges into the desert, with a rainfall of less than 10 in. annually. The variation of the rainfall from year to year is governed by the development and movements of the equatorial belt of low pressure and the subtropical "highs," while it is the alternation of dry and wet seasons which governs the temperature and humidity, rather than the position of the sun, and the dominant factor in Nigerian climatology is not temperature, but rain.—Dr. J. R. **Sutton**: South African coast temperatures. This paper dealt with the normal monthly mean temperatures at selected stations on the coast of South Africa, a few miles inland, and on the tableland, and the author endeavoured to connect the retarding of the maximum and minimum temperatures at certain stations with the moderating effect of the temperature of the sea and of the direction and force of the wind.

Linnean Society, February 17.—Prof. E. B. Poulton, president, in the chair.—Miss C. **Herring-Browne**: John Bartram, the pioneer American botanist. Bartram was born on March 23, 1699, near Darby, in County Delaware, Pennsylvania. In 1731 his friend, James Logan, procured a copy of Parkinson's "Theatrum" from England as a present for Bartram, and this decided him to make excursions after plants into Maryland and Delaware. To receive and grow his discoveries he began before the end of the year to lay out the garden, the charm of which was felt by Washington, Jefferson, and Franklin. Many of the American trees were first sent to Europe by Bartram, amongst them being the *Taxodium distichum*, still extant at Mill Hill, in Collinson's old garden. An even finer specimen, which died a few years ago, was 150 ft. high, and 27 ft. in girth; the trunk still stands in the Bartram Garden Park, Philadelphia. Bartram died on September 22, 1777. His life was shortened by the apprehension that his cherished garden might be laid waste by British troops, but his fears were not realised. This garden is now the property of the city of Philadelphia, and is supported as a public park.—E. P. **Stebbing**: The infestation of bamboos in tidal waters by *Balanus amphitrite* and *Teredo navalis* in Tenasserim. The rapid destruction of bamboo piles is a serious loss, and investigation shows that up to now no species of bamboo is immune; research is to be continued.

Institution of Mining and Metallurgy, February 24.—Sir T. K. Rose, president, in the chair.—E. T. **Mellor**: The conglomerates of the Witwatersrand. Of the various theories which have been from time to time advanced to account for the association of the gold with the conglomerates of the Rand, two now hold the field: the infiltration theory and the theory which regards the conglomerates as placer deposits modified by subsequent recrystallisation of many of the constituents. In view of recent extensive developments in prospecting by boreholes and mining, and the evidence accumulated as the result of a survey of the Witwatersrand system during the past five

years, the author submits certain geological aspects of the question which he thinks may assist in forming a conclusion as to the precise nature of the conglomerates and the origin of the gold associated with them. After reviewing the position in the light of these recent investigations, which have, he claims, seriously disturbed the even balance of previously adduced evidence favouring opposing theories, the author considers that the evidence in favour of regarding the conglomerates as "fossil placers" is convincing and is increasing continually with the extension of opportunities for collecting information. The importance of establishing such a theory as fact can scarcely be over-estimated from its bearing upon the future of the Rand goldfields, which have now for some years had a yearly output to the value of approximately 40,000,000*l.* sterling.—H. E. **Nicholls**: A pioneer bucket dredge in northern Nigeria. The chief interest in this account of the installation of the first bucket dredge in northern Nigeria relates to the fact that the dredge in question was, to the author's knowledge, the first to be operated by internal-combustion engines of the semi-Diesel type. The choice of this type of motor was enforced by the local absence of firewood and the then existing prohibitive cost of coal, which seemed to render the use of steam power quite out of the question. The paper gives a full description of the dredge and its engine, and there are also details of the costs of operating and other particulars which should be useful to engineers confronted with similar problems.—A. S. **Wheler**: Antimony production in Hunan Province, South China. In view of the importance of this metal at the present juncture, and the fact that China is the world's largest producer—Hunan being, moreover, the chief source of the Chinese supply, this paper makes a timely appearance. It would seem that, as in most Chinese mining, the processes adopted are of a crude and sometimes even primitive nature, but despite this the production is of great economic value, and of the output it is computed that at least 90 per cent. (about 25,000 tons in the year 1914) is exported to other countries.

MANCHESTER.

Literary and Philosophical Society, February 8.—Prof. S. J. Hickson, president, in the chair.—Prof. G. Elliot **Smith**: New phases of the controversies concerning the Piltdown skull. Prof. Elliot Smith considered the different views that had been recently expressed; (1) that the canine belonged to the upper and not the lower jaw; (2) that the mandible was not human, but that of a hitherto unknown species of chimpanzee, which by some unexplained means made its way into England in the Pleistocene period; (3) that the features differentiating this mandible from that of modern man had been unduly exaggerated; (4) that the canine tooth could not have belonged to the same individual as the skull and the jaw because it differed from them in age, according to one authority being definitely *older,* and to another distinctly *younger,* than the other fragments. These widely divergent views tend to neutralise one another. In considering the possibility that more than one hitherto unknown ape-like man or man-like ape expired in Britain side by side in the Pleistocene period, and left complementary parts, the one of the other, the element of improbability is so enormous as not to be set aside except for the most definite and positive anatomical reasons. The evidence submitted in support of each item of the arguments for the dissociation of the fragments was examined, and it was maintained that none of it was sufficiently strong to bear the enormous weight of improbability which these hypotheses imposed upon it. The author directed special attention to the implied inference that the cranium itself was not sufficiently simian to be associated with the jaw; and emphasised the fact that the skull itself revealed certain features of a more primitive nature than any other known representative of the human family.—W. J. **Perry**: The geographical distribution of terraced cultivation and irrigation. Attention was directed to the stupendous efforts made by various populations in the past, whereby whole mountain-sides were laboriously built up into series of great steps, which in many cases were watered by gigantic irrigation works, so that thousands of acres of what otherwise would have been sterile land were made to produce crops and maintain large populations. Such methods were (and in some instances still are) used in Great Britain and Ireland, Spain, Italy, Switzerland, and South Germany, many of the Mediterranean islands, Phœnicia, Mauretania, Canary Islands and Nigeria, Darfur, East Africa, British Central Africa, Rhodesia, Madagascar, Southern and Central Arabia, India, Ceylon, Burma, Assam, Western China, Sumatra, Nias, Java, Madura, Bali, Lombok, Sumbawa, Luzon, Formosa and Japan, New Guinea, Melanesia, Pelew and Caroline Islands, Marquesas Islands, Hawaii, Lesser Paumotus, Easter Island, Peru, Mexico, Honduras, New Mexico, Western Texas, Arizona, East California, and Haiti. These methods, applied in the same way in this peculiar geographical distribution, and irrespective of whether such highly laborious measures were necessary or not, afford the most positive tokens of the migration of primitive culture along the same routes and probably at the same time as the stone-using, mine-working peoples first intruded into the same localised spots on the surface of the globe.—J. W. **Jackson**: The geographical distribution of the shell-purple industry. One of the most curious uses of shellfish is that of their employment for the production of a purple dye, known to the ancients as "Tyrian purple." The invention of this dye has usually been accredited to the Phœnicians, but Bosanquet has recently shown that it was known to the Minoans of Crete in 1600 B.C. The Phœnicians, however, appear to have been instrumental in spreading the knowledge of the art far and wide; the search for purple-shells was probably one of the motives which led these people to explore areas further afield than their own immediate surroundings. Throughout the Mediterranean, stations for the manufacture of purple were established by these ancient mariners, and evidence is also available of the early practice of the art on the coast of N.W. Africa and in the British Isles (Cornwall and west of Ireland). Eastward of the Mediterranean the knowledge of the art seems to have spread through the Malay region, China, and Japan, as far as Mexico and Central America. In the latter region it was certainly practised in pre-Columbian times, and still survives among the Indians.—J. W. **Jackson**: Shell-trumpets and their distribution in the Old and New World. The employment of shells as horns and trumpets is of very ancient origin. The sites of the past and present uses of these trumpets form a continuous chain from the Mediterranean region, through India and the Pacific Islands to the American continent. As in the case of shell-purple, Crete figures very prominently in the early use of the conch-shell trumpet, it having been associated with Minoan religious worship. From Crete the cult spread, doubtless through Phœnician influence, to numerous places in the Mediterranean, to India, Tibet, China, and Japan, through Indonesia and the Pacific Islands, to the central parts of America. In the Mediterranean, Triton trumpets have been found in Ligurian caves, said to be of Neolithic age. In India the chank-trumpet is used in connection with Hindu temple worship and special sanctity is associated with

the chank itself. The shell-trumpet enters into ceremonies in Malabar, Siam, etc.; and signal-horn shells are used in Japan. In certain of the Pacific Isles their uses are many. In the New World the shell-trumpet was known in pre-Columbian times, and entered into the religious ceremonial of the Aztecs. Ancient Mexican manuscripts provide evidence of its use in temple worship in precisely the same way as in India. The shell-trumpet was also employed by the Incas and other ancient peoples, and survives to-day in several places.

DUBLIN.

Royal Irish Academy, February 14.—Rev. J. P. Mahaffy, president, in the chair.—J. G. **Leathem**: Periodic conformal curve-factors and corner-factors. The paper deals with the repeated conformal representation of the doubly connected region which is bounded internally by a closed curve or polygon and is externally unbounded, upon successive semi-infinite strips of a half-plane. Smooth curves are dealt with by means of periodic conformal curve-factors; and the properties of such curve-factors and some comprehensive formulæ for them are discussed. Periodic corner-factors are defined, and it is shown how they give the required transformation in the case in which the internal boundary is polygonal. The periodic curve-factor is exhibited as the limit of a product of periodic corner-factors, and special types are deduced. The results are interpretable in terms of two-dimensional fields of liquid or electric flow, or electric induction. Fields with logarithmic singularities (sources, vortices, electrodes, etc.) are then discussed, and it is shown how, by a double transformation, such fields can be specified for any region the conformal representation of which has been formulated. Thus the field due to a line-charge in presence of a charged conductor in the form of an elliptic cylinder or a polygonal prism is readily determined, and the method is equally applicable to many other problems of similar type.—G. H. **Carpenter**: The Apterygota of the Seychelles. The collection described was made by members of the Percy Sladen Trust Expedition, and comprises thirteen species of Thysanura and eighteen of Collembola. As only three Apterygota were hitherto recorded from the Seychelles, most of the species now enumerated are regarded as new, and three remarkable Machilids are referred to a new genus. Structural details of the jaws of Isolepisma, Lepidospora, Lepidocampa, Heteromuricus, and Cremastocephalus are given, together with an account of the genital appendages in Lepidospora and Lepidocampa. The presence of the latter genus in the Seychelles is of considerable geographical interest; together with some of the Collembolan genera it indicates Malayan and Indian affinities for the fauna of the granitic islands of the Seychelles proper, while the species from the coral islands of the Farquhar and Aldabra groups have on the whole Malagasy and African relationships.

PARIS.

Academy of Sciences, February 14.—M. Camille Jordan in the chair.—G. **Bigourdan**: A work of F. Viété, supposed to be lost, "l'Harmonicon cœleste."—B. **Baillaud**: Remarks concerning the determination of the difference of longitude between the Observatories of Paris and Washington. An account of the work of the French-American Committee commencing October, 1913, in which wireless signals between Arlington and the Eiffel Tower were utilised. The final result adopted is 5h. 17m. 36·67s.—Henry **Le Chatelier**: The law of solubility. A reply to M. Colson.—T. H. **Gronwall**: Deformation in conformable representation.—Œchsner de **Coninck** and M. **Gérard**: The atomic weight of bismuth. By the reduction of bismuth chloride in hydrogen the value 208·50 was obtained for the atomic weight of bismuth.—L. Fernandez **Navarro**: The discovery of a basalt outcrop in the Sierra de Guadarrama (Spain). This is the only known volcanic outcrop in the centre of the *massif*.—M. **Deprat**: The stratigraphic series in North Tonkin.—Ph. **Glangeaud**: The volcanic Pliocene of the Saut de la Pucelle (Puy-de-Dôme).—V. **Vincent**: The circulation of manganese in natural waters. Manganese is probably present in natural waters as the bicarbonate. The oxides of manganese, in presence of carbon dioxide, do not dissolve to the same extent as the carbonate.—G. **Bourguignon**: The stimulation of nerves by discharges from condensers.—E. **Colardeau** and J. **Richard**: A stereoscopic arrangement for the examination of radiographic proofs, either with normal or pseudoscopic relief.—Ch. J. **Gravier**: The madrepores collected by S.A.S. the Prince of Monaco in the great depths of the North Atlantic.—A. **Vayssière**: A Notochiton and some Gasteropods from the second expedition of Dr. Charcot.—J. **Bounhiol** and L. **Pron**: A case of complete hermaphroditism in *Chrysophrys aurata*.

BOOKS RECEIVED.

The Mathematical Theory of Probabilities and its Application to Frequency Curves and Statistical Methods. By A. Fisher. Translated and edited with the assistance of W. Bonynge. Vol i., Mathematical Probabilities and Homograde Statistics. Pp. xx+171. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Macmillan's Geographical Exercise Books. iv., The Americas. With Questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 6*d*.

Thomas Alva Edison. By F. Rolt-Wheeler. Pp. ix+201. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 2*s*. net.

Board of Agriculture and Fisheries. Fishery Investigations. Series ii., Sea Fisheries. Vol. iii., No. 2. Report on Sexual Differentiation in the Biology and Distribution of Plaice in the North Sea. By A. E. Hefford. Pp. 73. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*.

National Health Insurance. Medical Research Committee. Report of the Special Advisory Committee upon Bacteriological Studies of Cerebro-spinal Fever during the Epidemic of 1915. Pp. 64. (London: H.M.S.O.; Wyman and Sons, Ltd.) 6*d*.

Napier Tercentenary Memorial Volume. Edited by Dr. C. G. Knott. Pp. xi+441. (London: Published for the Royal Society of Edinburgh by Longmans and Co.) 21*s*. net.

Wireless Transmission of Photographs. By M. J. Martin. Pp. xi+117. (London: Wireless Press, Ltd.) 2*s*. 6*d*. net.

Harvey's Views on the Use of the Circulation of the Blood. By Prof. J. G. Curtis. Pp. xi+194. (New York: Columbia University Press; London: Oxford University Press.) 6*s*. 6*d*. net.

The Athenæum Subject Index to Periodicals, 1915. Science and Technology, with Special Reference to the War in its Technological Aspects. Pp. 79. (London: Athenæum Office.) 2*s*. 6*d*. net.

Woburn Experimental Fruit Farm. Fifteenth Report of the Woburn Experimental Fruit Farm. Pp. 83. (London: Amalgamated Press, Ltd.) 2*s*. 3*d*.

British Fungi and How to Identify Them. By J. H. Crabtree. Pp. 62. (London: C. H. Kelly.) 1*s*. net.

Instincts of the Herd in Peace and War. By W. Trotter. Pp. 213. (London: T. Fisher Unwin, Ltd.) 3*s*. 6*d*. net.

Examples in Magnetism for Students of Physics and Engineering. By Prof. F. E. Austin. Second edition. Pp. 90. (Hanover, N.H.: Prof. F. E. Austin; London: E. and F. N. Spon, Ltd.) 1 dollar 10 cents.

A New Table of Seven-Place Logarithms of all Numbers from 20 000 to 200 000. By E. Sang. Pp. xviii+365. (London: C. and E. Layton.) 21*s.* net.

Department of Commerce. U.S. Coast and Geodetic Survey. Geodesy. Application of the Theory of Least Squares to the Adjustment of Triangulation. By O. S. Adams. Pp. 220. (Washington: Government Printing Office.)

State of Connecticut. Public Document No. 24. Thirty-eighth Annual Report of the Connecticut Agricultural Experiment Station, 1914. Pp. xiv+448. (Hartford, Conn.)

The Endocrine Organs: an Introduction to the Study of Internal Secretion. By Sir E. A. Schäfer. (London: Longmans and Co.) 10*s.* 6*d.* net.

Scientific Papers. By Sir G. H. Darwin. Vol. v., Supplementary Volume containing Biographical Memoirs. By Sir Francis Darwin and Prof. E. W. Brown. Lectures on Hill's Lunar Theory, etc. Edited by F. J. M. Stratton and J. Jackson. Pp. lv+81. (Cambridge: At the University Press.) 6*s.* net.

Elements of Mineralogy. By F. Rutley. Revised by H. H. Read. Nineteenth edition. Pp. xxii+394. (London: T. Murby and Co.) 3*s.* 6*d.* net.

The Tribes and Castes of the Central Provinces of India. By C. V. Russell, assisted by Rai Bahadur Hīra Lāl. Four vols. Vol. i., pp. xxv+426. Vol. ii., pp. xi+540. Vol. iii., pp. xi+589. Vol. iv., pp. xi+608. (London: Macmillan and Co., Ltd.) 42*s.* net.

The Homeland Handbooks. Penzance and the Land's End District. Edited by J. B. Cornish and J. A. D. Bridger. Pp. 123. (London: Homeland Association, Ltd.) 6*d.* net.

Manuals of Chemical Technology. vi., The Salt and Alkali Industry, including Potassium Salts and the Stassfurt Industry. By Dr. G. Martin, S. Smith, and F. Milsom. Pp. viii+100. (London: Crosby Lockwood and Son.) 7*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 2.

ROYAL SOCIETY, at 4.30.—The Antiseptic Action of Substances of the Chloramine Group: J. B. Cohen, H. D. Dakin, M. Daufresne and J. Kenyon.—The Structure of the Dicynodont Skull: I. J. B. Sollas and Prof. W. J. Sollas.—Analyses of Agricultural Yield. Part III. The Influence of Natural Environmental Factors upon the yield of Egyptian Cotton: W. L. Balls.—The Function of Chlorophyll, Carotin and Xanthophyll: A. J. Ewart.

ROYAL INSTITUTION, at 3.—Recent Excavations in Mesopotamia—The Northern Capitals, Nineveh and Asshur: Prof. L. W. King.

CHILD STUDY SOCIETY, at 6.—The Danish Child at School: A. E. Hayes.

LINNEAN SOCIETY at 5.—Exhibit of *Giardia* (*Lamblia*) *intestinalis* from cases of Diarrhœa in Soldiers, the Infections being contracted in Flanders: Dr Annie Porter.—Larval and Post-Larval Stages of *Jasus lalandii*: Dr. J. D. F. Gilchrist.—The August Heleoplankton of some North Worcester-hire Pools: B. Millard Griffiths.—The Distribution of the Box-tree, *Buxus sempervirens*: Dr. Otto Stapf.

FRIDAY, MARCH 3.

ROYAL INSTITUTION, at 5.30.—Corona and other Forms of Electric Discharge: Prof. S. P. Thompson.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Oil-fields of Trinidad: V. C. Illing.

MONDAY, MARCH 6.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some little-known Polynesian Settlements near the Solomon Islands: Charles M. Woodford.

ARISTOTELIAN SOCIETY, at 8.—Sense-Data and the Physical Object: Prof. T. Percy Nunn.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

SOCIETY OF ENGINEERS, at 5.30.—Sewage and its Precipitation: R. Brown.

TUESDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—The Plant and the Soil—Man's Control: Dr. E. J. Russell.

ZOOLOGICAL SOCIETY, at 5.30.—Kinematographs of African Animals: H. K. Eustace.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Industrial Development: Harold Cox.

RÖNTGEN SOCIETY, at 8.15.—*Adjourned Discussion:* The Injurious Effects produced by X-rays.—The Use of Inverse Current: A. C. Gunstone.

WEDNESDAY, MARCH 8.

GEOLOGICAL SOCIETY, at 5.30.—Fossil Insects from the British Coal Measures: H. Bolton.

ROYAL SOCIETY OF ARTS, at 4.30.—Optical Appliances in Warfare: C. R. Darling.

THURSDAY, MARCH 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Distribution of Intensity in Broadened Spectrum Lines: Prof. J. W. Nicholson and T. R. Merton.—Prof. Joly's Method of avoiding Collision at Sea: Prof. H. C. Plummer.

ROYAL INSTITUTION, at 3.—Recent Excavations in Mesopotamia—The Southern Capital, Babylon: Prof. L. W. King.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Continuous-current Railway Motors: E. V. Pannell.

OPTICAL SOCIETY, at 8.—A Simple Focometer for the Determination of Short Focal Lengths both Negative and Positive: T. F. Connolly.—The Manufacture and Testing of Prismatic and other Compasses: F. E. Smith.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 5.30.—Illusions of the Upper Air: Sir Napier Shaw.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

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