THURSDAY, AUGUST 22, 1918.

## SIR JOSEPH HOOKER.

*Life and Letters of Sir Joseph Dalton Hooker, O.M., G.C.S.I., Based on Materials Collected and Arranged by Lady Hooker.* By Leonard Huxley. Vol. i., pp. x+546; vol. ii., pp. vi+569. (London: John Murray, 1918.) 2 vols., price 36*s*. net.

AMONG the books whose claim on our attention is relatively independent of accidental considerations like timeliness or style, none surpass in interest those that deal with revolutions in human thought. Among revolutions of this kind none have been more important than the one which led to the replacement of the dogma of specific immutability by a more satisfying thesis. The doings and sayings of the men whose minds first proved receptive of this vivifying doctrine inspire in scientific circles feelings akin to those induced elsewhere by hagiologic studies.

The story of the life of Sir Joseph Dalton Hooker, whom Prof. Bower happily designates the "protagonist of evolution," is on this account a contribution of great moment to the history of a period and a movement already illustrated by those of the lives of Lyell, Huxley, Wallace, and especially of Darwin. It rounds off in many ways information already available with regard to a notable advance in human thought, and supplements the material required for that ordered review of a great scientific achievement much needed by the present generation. "The imperfect conceptions of some of its favourers" are as noticeable to-day as they were to Hooker a generation ago; they are only less inimical to a true understanding than were the conceptions of many of its opponents a generation earlier still. There is a distinction between the situation then and the position now. Sixty years ago imperfection of conception was often the result of inability to appreciate what was then a novel doctrine; to-day this imperfection is largely due to neglect to consult the writings in which that doctrine was promulgated.

Readers of NATURE have already been supplied (December 21, 1911) with a sketch of the leading features of Hooker's career, and a generation earlier (October 25, 1877) with an appreciation, by a singularly competent judge, of the work already done by Hooker, and of the position he occupied in contemporary opinion at the height of his career. The tale, worthy of recapitulation though it be, it is not necessary to repeat. The story is fully given in two volumes, now published by Mr. Murray, which should be even more interesting to readers already acquainted with the leading facts of Hooker's long and active life than to those as yet unfamiliar with the subject. Among Hooker's many gifts was the possession of a pleasing style, and those to whom his published works are known will find that this style is as effective in the letters now made available and as happy in his correspondence with the young as in his epistles to the mature. All will welcome the informed and penetrating estimate by Prof. Bower of the position of Hooker as a philosophical student. The work under notice is of further value as a human document. It is no mere chronicle of what Hooker did and how he did it. Thanks to the labours of Lady Hooker and the craftsmanship of Mr. Huxley, these volumes permit the general reader to form some conception of what Hooker was as a man.

His innate modesty led Hooker to claim for himself but one natural endowment, "le talent de bien faire." Even to the possession of this spur to sustained effort he did not publicly confess until it fell to him to acknowledge the receipt, in his seventieth year, of the highest honour his scientific fellow-countrymen could bestow. The same simplicity marked his expression of the feeling evoked by what he has termed the crowning honour of his long life, "as inestimable as unexpected," conferred upon him, twenty years later, in circumstances of peculiar dignity, by the Swedish Academy of Sciences.

No enumeration of the honours of which Hooker was the recipient—no recital of what he accomplished to merit them all—can explain the esteem and respect in which he was held. The simple nature which led him to regard praise with repugnance made it impossible for Hooker to become "popular" in the sense in which that term is usually understood. With him, indeed, the intellectual aversion induced a physical reflex. The mere anticipation of the ordeal of appearance in public led in his case to actual illness, the effects of which sometimes persisted when the ordeal was over. But it was the mental dislike, not the bodily inconvenience, that rendered so rare the participation by Hooker in great debates. Where intervention was plainly necessary Hooker never failed his friends or their cause; the "talent" the existence of which he admitted explains why such intervention, when it did occur, proved so effective.

We learn from this work how deeply Hooker was indebted to his distinguished father. If not exactly born in the purple, he certainly was made to that purple he wore so worthily. The development of his natural aptitudes, the early provision of opportunities for their independent exercise, keen solicitude for his welfare, and anxious care for his interests—all were matters of paternal concern. This regard Hooker repaid by a filial piety as warm at the close of his life as it had been in boyhood, and as it was when he served as his father's tried coadjutor. Reverence for his father's memory and regard for his father's fame gave Hooker inward support during official controversy; led him to continue, after his own retirement, publications his father had edited; and prompted him to undertake, at the age of eighty-five, a finished study of his father's achievements.

The capacity for comradeship and the self-effacing consideration for others which marked this relationship between father and son were natural characteristics. The former was seen in that association with T. Thomson, begun at school, which led to the production of that noble fragment, their "Flora Indica." It is illustrated again in that copartnery with Bentham initiated while Hooker was bearing, unaided, the burden of his directorship, which led to the completion before Hooker retired of that masterly work, the "Genera Plantarum." A striking instance of that self-abnegation which induced Hooker to take from the hands of fellow-workers who had fallen by the way tasks left by them unfinished is seen in his compliance, at a time when his hands were full to overflowing with duties of his own, with the dying wish of Harvey that he should arrange the materials that distinguished botanist had prepared for a second edition of the "South African Genera." A generation later, undaunted by the weight of his eighty years, Hooker wrote two volumes needed to complete a "Flora of Ceylon," whereof only three had been published when Trimen died.

Hooker's distaste for popular applause was untinged by any disinclination for intercourse. However busy he might be, no one, young or old, whose errand was serious, ever was turned away. The soul of hospitality, he was also eminently sociable, though he regarded as essential for social intercourse "some place where we never should be disappointed of finding something worth going out for." When he felt that by so doing he could render real service, he was ready, in spite of his natural reluctance, to undertake those public duties that public men, situated as he was, are expected to perform.

Throughout his life Hooker exercised on contemporary work and thought an influence that was wholly good. The diversity of his interests, the extent of his knowledge, the soundness of his judgment, and the singleness of his purpose explain the value of that influence. Generous of praise where praise was due, he was also, much to the advantage of younger workers, unsparing of blame where blame was deserved. The distinction between Hooker's commendation and his censure lay in this, that work well done by others was to him an abiding memory, but that when a delinquent had been "faithfully dealt with" the delinquency was consigned to oblivion. The affectionate regard in which he was held by younger men may be understood. The admiration of those nearer him in age is as readily explicable. Second to none in the accuracy of his observation, and endowed as few have ever been with the inborn faculty of co-ordination, Hooker possessed in addition one of the rarest of capacities: he remained, throughout his life, free from the thrall of that barrier to progress and foe to intellectual development, a craving for formal consistency.

But what is perhaps most remarkable in the life of Hooker is the circumstance that his influence, in a country such as ours, should have been as great as it deserved to be. The reason for this is to be found in his magnetic personality. It has been the lot of few men to possess so many friends as Hooker did; fortune has given no man friends more faithful. These friendships were too numerous for census here. Their origin may be traced in every case to some community of interest, yet the common interest out of which they grew was by no means always botanical—one of the warmest was that between him and Henry Yule, of "Hobson-Jobson" fame. Some of these associations, like those with Paget and T. Thomson, dated from boyhood; others, like those with Charles Darwin and Asa Gray, began after his return from the Antarctic; others, again, like those with Falconer and Hodgson, went back to his days in India. The faculty remained unimpaired by time; Hooker's "troops of friends" enrolled recruits to the last. What such friendships implied we may measure best by reading the letters exchanged by Hooker with Darwin and Huxley; the genesis of one of the closest is disclosed in the home letters written by Gray while on his first visit to Europe. "The Life and Letters of Sir Joseph Dalton Hooker" is "dedicated to the memory of many friendships." No more fitting superscription could well have been devised for Mr. Huxley's volumes than that approved by Lady Hooker.

## TYCHO BRAHE'S STUDIES OF COMETS.

*Tychonis Brahe Opera Omnia. Tomi Quarti, Fasciculus Prior.* Pp. 376. (København: Gyldendalske Boghandel, 1918.)

AS some documents intended to appear in vol. iv. of the collected works of Tycho Brahe are inaccessible owing to the war, the volume has been divided into two portions, of which the first has just been published. It contains the treatise "De Mundi Ætherei Recentioribus Phænomenis," which was printed at Uraniborg in 1588; this deals mainly with the comet of 1577, which was the brightest of the seven comets that appeared during Tycho's career as an observer; his observations of it sufficed definitely to dispel the Aristotelian doctrine, which Tycho had himself held up to that time. Thus in writing of the nova of 1572, and comparing it with Hipparchus's nova, Tycho said: "It would be absurd to fancy that a great astronomer like Hipparchus should not have known the difference between a star of the ethereal region and a fiery meteor of the air, which is called a comet." However, his principles were to take nothing on trust from ancient authorities, but to submit theory to the test of careful observation, excepting the case of the solar parallax, for which he used the received value of $3'$, though his instruments were capable of showing that the true value was much smaller.

When a very bright comet appeared in 1577 Tycho naturally took advantage of it to endeavour to determine the nature and orbits of these bodies. The book describes his first observation of the comet. On the afternoon of November 13 he was engaged in fishing with some of his assistants. Looking up to the western sky, to see the prospects for observation that evening, he saw a bright object, and pointed it out to the assistants, who took it for Venus; but Tycho said that was now a morning star, and that after sunset they would see the difference; in fact, when it became dark a tail, 22° in length, was seen stretching across Capricornus, the head being in Sagittarius. Tycho was not the first to see it; it had been seen on November 1 in Peru, and on November 2 in London. His observations were, however, much the most accurate that were made; he measured its distance from neighbouring stars with a sextant, the arms of which were 4 ft. long, afterwards observing the places of the stars with his fundamental instruments. He followed the comet until January 26, when it was in Pegasus. He examined its diurnal parallax both by his own observations at different hours of the night and by comparing his places with those observed at Prague by Hagecius. He was thus enabled to say definitely that the comet was considerably more distant than the moon, and consequently the Aristotelian doctrine that comets are simply atmospheric meteors was completely overthrown.

Tycho's endeavours to determine the true orbit were not very successful. He was still under the influence of the old prejudice that all the heavenly movements must necessarily be in circles, and the orbit he assigned to the comet was a circular one, with the sun in the centre, and a radius about six-sevenths of the distance from sun to earth, giving an angle of elongation of 60°. Tycho was unable, however, to represent the observations by uniform motion in this circle. He deduced correctly that the heliocentric motion was in the opposite direction to that of the planets, and supposed that comets were short-lived bodies, the movements of which might be subject to greater irregularities than those of the planets. The inclination of the orbit to the ecliptic he gave as $29\frac{1}{4}°$, about one-third of its true value; it is interesting to quote the parabolic orbit (based on Tycho's own observations) for comparison with his: Perihelion passage, October 27; long. of asc. node, 25°; arc from node to perihelion, 256°; inclination, 105°; perihelion distance, 0·177. It is not surprising to read that many of Tycho's contemporaries did not perceive the force of his proof that the comet was much more distant than the moon, and continued to assert the Aristotelian doctrine. Among them was a Scotsman named Craig, with whom Tycho had a long controversy.

The volume also describes Tycho's system of the universe, and his reasons for adopting it. He thought the earth was too heavy and sluggish a body to be capable of rapid motion, and he also thought the absence of a lateral drift in falling bodies disproved the theory of its rotation. He therefore supposed it to be at rest in the centre of the universe, and that the sun and moon revolved round it, while the planets revolved round the sun. The fixed stars were imagined to be attached to a transparent sphere a short distance beyond the orbit of Saturn; at least, this is suggested by his diagram, which pictures them as all lying between two closely adjacent concentric spheres, and by his supposition that they rotate *en bloc* about the earth in twenty-four sidereal hours. He thought the absence of annual parallax in the stars afforded a decisive proof of the earth's immobility, and the idea of the immense void of space between the orbit of Saturn and the stars, which would be required on the hypothesis of the earth's motion, was repugnant to his mind. Also he considered that he had determined the apparent diameters of the brighter stars to be 2′ or 3′, and he saw that such diameters, in view of the absence of annual parallax, implied dimensions for these orbs that he regarded as inconceivably great. It must be admitted that before the invention of the telescope and the discovery of the laws of motion and gravitation there was a good deal to be said for his point of view, and he did not permit his theory to bias his observations, which enabled Kepler to deduce the true planetary system.

These sumptuous volumes, though printed at Copenhagen, are edited by Dr. Dreyer, who now resides at Oxford. They enable us to picture the astronomical conceptions of Tycho's age, and the enormous progress that has been made in the last three centuries. A. C. D. CROMMELIN.

## OUR BOOKSHELF.

*Natural Science and the Classical System in Education. Essays New and Old.* Edited for the Committee on the Neglect of Science by Sir Ray Lankester. Pp. ix+268. (London: William Heinemann, 1918.) Price 2*s*. 6*d*. net.

FOUR of this admirable series of nine essays were written fifty years ago, but they are wonderfully fresh and stimulating even now. These include a masterly history of classical education by Charles Stuart Parker, and essays "On the Education of the Reasoning Faculties," by William Johnson, the brilliant Eton tutor of the later nineteenth century; "On Teaching by Means of Grammar," by E. E. Bowen, of Harrow, of "Forty Years On" renown; and "On the Present Social Results of Classical Education," by Lord Houghton, father of the present Marquess of Crewe.

The views of Mr. H. G. Wells on modern education, as set out in an address to the members of the British Science Guild, are reprinted in this volume; and readers of the *Fortnightly Review* will recognise the same author's "Case against the Classical Languages," written in reply to Mr. Livingstone's "Defence of Classical Education."

The position of science in educational reconstruction is discussed by Mr. Sanderson, of Oundle School, in an essay which will probably meet with criticism from some educationists. The Master of Balliol has treated the same question in its wider aspects. Sir Ray Lankester concludes with a chapter on "The Aim of Education," throughout which runs the spirit of Huxley.

Nowhere is there any suggestion of antagonism towards the study of the classics; indeed, all scientific workers realise to the full the value of classics as a branch of education. The monopoly of the classical system in education, however, is a different matter, and this dominating factor is assailed on all sides.

*Horizons: At Dawn and at Dusk.* Poems by Colin Tolly. Pp. ix+82. (London: Hodder and Stoughton, 1918.) Price 3s. 6d. net.

MR. TOLLY is clearly a scholar who has been thrown, like so many others, into the brutalities of war, and who heartens himself by writing verses that recall the happier years. But, though he has studied the ancient classics, and also zoology, his manner is not that of a poet, or even of a teacher, seeking in the concise forms of verse the expression of cumulative research. Why, for example, and for what mechanical reason, did the dead Adonis sail "to sea, on springs"? Does the sun "shine" a beam? And will the general reader, who has still so much to learn about ancestral forms of life, really gather anything from the condensed text-book terminology of pp. 49–60? We might, indeed, be pleasantly surprised to "hear the tune" that the Permian reptiles "sang at sundown . . . pregnant with speech and nightingales"; but we cannot believe that, by any process of selection, "Death . . . endowed with brains the victors" in the struggle for existence. The crowded stanzas on the development of religions are not more satisfactory. It is unfair to suggest what Swinburne or Flecker might have made of them; but, even between Olympos and Salonika, Mr. Tolly has caught only the spray of the high and rising wave of war-time inspiration.

G. A. J. C.

*Journal of the Institute of Metals.* Vol. xix. Pp. x+316. (London: Published by the Institute, 1918.) Price 21s. net.

THE latest volume of this useful journal contains several papers of interest. Prof. Carpenter, in addition to his presidential address, in which he deals with the relations between scientific investigation and training and technical practice, contributes, with Miss Elam, a paper on the cause of unsoundness in bronze castings. The subject is a difficult one, and the principal conclusion, confirmed by the experience of others who took part in the discussion, is that the most important factor in ensuring soundness is the proper control of the pouring temperature. The equilibrium between a molten alloy and the gases dissolved in it still remains somewhat mysterious. Die-casting, especially of alloys of high melting-point, has received little attention in technical journals, although it is widely and successfully used in practice, and the paper by Messrs. Rix and Whitaker is the more welcome on that account. By using an aluminium bronze containing iron, excellent results have been obtained with complicated castings. The discussion turns largely on the behaviour of the dies. Aluminium bronze is also studied from the point of view of the hardness of alloys by Mr. Greenwood, and other matters dealt with are the determination of the grain size of metals and the annealing of aluminium. The volume also includes abstracts of metallurgical papers from all sources.



## LETTERS TO THE EDITOR.

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

### Science and the Civil Service.

IN the article on the above subject in NATURE of August 8, the unsatisfactory method of selecting candidates for Civil Service appointments is very justly emphasised. I desire to make the following suggestion, which will obviate the system of patronage and to a great extent that of competitive examination, both of which suffer from serious inherent defects which need not be discussed.

My suggestion is that each university of the United Kingdom be granted the right to nominate each year one or more candidates (according to the number of vacancies) from its most promising honours graduates. A further selection from among the nominees might, if necessary, be made by some form of oral or written examination.

It is improbable that any university would abuse this privilege and thereby discredit itself by nominating a student who is likely to prove a failure. The experience in the selection of the 1851 Exhibition scholars is a sufficient guarantee of the highly satisfactory results of such a system.

The most promising arts and science men in the country would thus become available for Government appointments, and it is to be hoped that with this choice the science departments of the State will in future be administered by men whose training has not been exclusively classical.

J. B. COHEN.

## THE ROYAL INSTITUTION: A RETROSPECT.

A RECENT issue of the Proceedings of the Royal Institution contains a reprint of a lecture delivered in its theatre on March 3, 1810, by the then professor of chemistry, "H. Davy, Esq., Sec., R.S." This lecture, as its title-page informs us, was originally published by desire of the managers; it is now reproduced at the suggestion of the Fullerian professor of chemistry. It is entitled "A Lecture on the Plan which it is Proposed to Adopt for Improving the Royal Institution and Rendering it Permanent." To understand the significance of this wording it is necessary to recall some circumstances connected with the early history of the institution.

As conceived by its founder, Benjamin Thompson, a Royalist American who had been created a Count of the Holy Roman Empire by the Elector Palatine of Bavaria, it was intended to be part of an establishment for the benefit of the poor. In 1796 Rumford, who was a practical philanthropist on a pretty broad gauge, and an early worker in what is now styled "domestic science," put forth a

proposal for forming in London by private subscription an establishment for feeding the poor and giving them useful employment, and also for furnishing food at a cheap rate to others who may stand in need of such assistance, connected with an institution for introducing and bringing forward into general use new inventions and improvements, particularly such as relate to the management of heat and the saving of fuel, and to various other mechanical contrivances by which domestic comfort and economy may be promoted.

Rumford, as he says in one of his letters to Thomas Bernard, who was associated with him in this project, was

deeply impressed with the necessity of rendering it *fashionable* to care for the poor and indigent.

A "Society for Bettering the Condition of the Poor" was duly founded, but as regards the associated institution it was decided that it would be

too conspicuous, and too interesting and important, to be made *an appendix* to any other existing establishment, and consequently it must stand alone, and on its own proper basis.

In 1799 Rumford again broached the subject of his institution for promoting domestic comfort and economy, and conferred with the committee of the "Society for Bettering the Condition of the Poor" concerning the steps to be taken in order to establish,

by private subscription, a public institution for diffusing the knowledge and facilitating the general and speedy introduction of new and useful mechanical inventions and improvements; and also for teaching, by regular courses of philosophical lectures and experiments, the applications of the new discoveries in science to the improvement of arts and manufactures, and in facilitating the means of procuring the comforts and conveniences of life.

It is unnecessary to state the steps by which the sympathies of people of rank and fortune were enlisted in this enterprise. The moral, social, and political conditions of the time were not without their influence. The idea, as Rumford hoped, became fashionable, and, being fashionable, became popular. Mr. Mellish's house in Albemarle Street was secured as the future home of the institution, and its spacious apartments were quickly transformed into lecture-rooms, museums, library, and offices. Moreover, "a good cook was engaged for the improvement and advancement of the culinary art—one object, and not the least important—for the Royal Institution." The president of the Royal Society, Sir Joseph Banks, who had taken an active part in promoting its foundation, was chosen as the first chairman of its board of managers, Rumford became secretary, and Bernard treasurer. The second volume of the "Reports of the Society for Bettering the Condition of the Poor" contains a long account of the institution, "so far as it may be expected to affect the poor," from the pen of the treasurer, concerning which Dr. Bence Jones, a former secretary and the historian of the foundation, dryly remarks: "It is difficult to believe that the Royal Institution of the present day was ever intended to resemble the picture given of it in this report."

Although ushered into the world under such favourable auspices, the enthusiasm which greeted its birth quickly spent itself, and the infant institution had a struggling and precarious existence. The first appointments of the managers were not altogether fortunate. Rumford, by his arbitrary action, soon created difficulties and alienated powerful supporters. But the advent of Humphry Davy, a small, spare Cornish youth of twenty-three, was the turning-point in its career. On Garnett's resignation in 1801 as lecturer in chemistry, Davy, who had already given proofs of his ability, succeeded to that position. By his extraordinary and rapid success as an investigator, and by a series of discoveries which profoundly impressed the scientific world, combined with his eloquence and power as a lecturer and his remarkable gift of lucid exposition, he quickly changed the whole current of its fortunes, and during the twelve years he occupied its chair of chemistry he gradually stamped upon it the main features of its present character.

The theme of the lecture which the managers have now reprinted was not unfamiliar to Davy's audiences, for, although presented under the guise of a new plan, its general purport had been dealt with by him on several previous occasions. Its leading argument is, in fact, almost identical with that of the no less historic discourses with which he took the fashionable world of London by storm in 1802; and it was repeated in 1809 when he referred to the fund which had been raised to supply him with a powerful voltaic battery, and to which he again alludes with equal pleasure and appreciation in this reprinted address. But in the lecture of 1810 he enters, with his characteristic felicity of phrase, into rather more detail concerning what he considers to be the true function of the Royal Institution, and, on the basis of his ten years' experience of its working, indicates the means by which he considers its aims might be secured. Although he is careful to explain, with that tact and "flexibility of adaptation" which were among the secrets of his success in guiding the fortunes of the institution, that he is only to be regarded as an unofficial exponent of what he apprehends to be in the minds of the managers, visitors, and proprietors, his audience could have been in little doubt with whom the principles of the plan originated.

In 1810 it was fully realised that the continued existence of the institution depended upon Davy, and he certainly was not unconscious of that fact. He was then thirty-two years of age and near the summit of his scientific fame. But however proud the patrons of the institution might be of the achievements of their professor, and however grateful they might feel to him for the lustre he had conferred upon it, its financial position afforded no assurance of even a moderate provision for his future. He had become a social force in what he had styled "the great hot-bed of human power," and his society was courted by all. But the roseate vision of affluence which he had conjured up when exchanging the Pneumatic Institution of Beddoes for the Royal Institution of Rumford had been gradually dissipated in the fuller light of his knowledge of a position which depended upon the vagaries of fashion and the fickleness of popular favour. At this time he had serious thoughts of again turning to a career in medicine, for which, indeed, he was originally intended. It was practically the only career then open to a man of science unless he had the means of a Cavendish or a Banks.

Influential persons, moreover, who thought that Sydney Smith's lectures on moral philosophy would somehow better the condition of the poor, by dangling promises of preferment before him had sought to induce him to devote his eloquence and his talents to the service of the Church. But the little god that so often shapes the destinies of men and women had willed it otherwise. Unmindful of the injunction that a philosopher of another type and of a later age has crystallised in a phrase that has become classical, Davy succumbed to the fascination of a rich and handsome widow, who, as Sir Joseph Banks wrote to his friend Stanton, "had fallen in love with Science" and had elected to marry one of its votaries "to obtain a footing in the academic groves."

Although now within a social sphere very different from that into which he had been born, and to the attractions of which he was by no means insensible, Davy's heart was still true to the mistress that controlled his strongest inclinations and inspired his finest efforts. Science still claimed and secured his allegiance, but, like his contemporaries, Wollaston and Young, he was not destined to grow old in her service. The constant strain of ten years of almost delirious excitement, in which he seemed to pass from triumph to triumph, began to tell upon his nervous and impressionable nature. He had already experienced more than one serious breakdown. After his great discovery of the alkaline metals he utterly collapsed, and for a time his life hung upon a thread. Accordingly, after his marriage in 1812 he decided to resign his lectureship, and, although in deference to the wishes of the managers he still remained titular professor and director of the chemical laboratory, after 1813 he took no very active part in the management of the institution. But a beneficent Fortune still seemed to wait upon it. In the very year of his resignation he discovered Faraday—the greatest of all his discoveries—and the continued existence of the Royal Institution was thereby assured.

The lecture of 1810 may, then, be regarded as a sort of testament in which its author lays down his views concerning the true end and aim of the institution which he had laboured so strenuously and so successfully to establish. Stated in their simplest terms and in his own words, these were: "to apply its funds to useful purposes; to promote the diffusion of science; to encourage discovery; and to exalt the scientific glory of this country." In reviewing its history during the ten short years of its adolescence, Davy could at least claim that it had not been useless to the British public.

It might, I conceive, be demonstrated (he says) that it has not only assisted the progress of genuine science, but has likewise diffused a general knowledge of the advantages and importance of scientific pursuits, and as far as it has been subservient to amusement, that amusement has been at least of a rational kind, of a moral tendency, and connected with no improper, no undignified objects.

But he is more concerned to dwell upon the promise of its future than upon the performances of its early youth, striking and brilliant though these were, and as his audience knew them to be. The very modesty with which he referred to those achievements must have struck and, indeed, strengthened a sympathetic chord. In a few graphic sentences, with all the charm and elegance of diction which astonished and delighted the intellectual world of London, he rapidly sketched the rise of the sciences and traced their ennobling influence upon civilisation and the progress of the human mind.

The pursuit and cultivation of science and the diffusion of knowledge being then admittedly the primary and fundamental objects of the Royal Institution, he next turned to the details of his plan for attaining them. He dealt with the original scheme of the foundation, pointed out its imperfections, demonstrated the necessity of modifying and enlarging its constitution, and, last but not least in importance, showed how its financial position could be strengthened in view of the extension of its functions that he contemplated.

To the ideals thus developed the institution has been consistently faithful. Its history during the 108 years that have elapsed since the delivery of this historic discourse is, in effect, an epitome of contemporary science, and especially of British science. Its professors and lecturers have always been leaders who have left their impress upon the science and learning of their time; its laboratories have continued to contribute to and augment that renown which the genius of Davy first showered upon it, and its achievements are among the greatest scientific glories of this country.

There is one circumstance associated with this lecture which deserves a passing reference. In 1810, as now, we were at a crisis in our national history, and those who are at all familiar with the conditions of that time will find a hundred analogies in the present happenings. We were then in the throes of a life-and-death struggle with the greatest military genius of his age, the despot who was practically master of Central Europe, and was bent upon the subjugation and humiliation of this kingdom. But there is only the slightest possible allusion in the lecture to the critical conditions of the time—so slight, indeed, that it might well escape the notice of a reader of to-day—merely a half-veiled, contemptuous reference to "all the armies and all the edicts which have lately been so vainly opposed to our prosperity." The calm and resolute courage with which the lecturer and his audience faced the peril of that time may surely inspire and strengthen us with an equal confidence. History is now repeating itself. Let us hope that it will continue to repeat itself, and that, taking heart of grace from the example which has been set us, we may find our faith abundantly justified.

T. E. THORPE.

Antarctic exploration — Shackleton expeditions



## THE DRIFT OF THE "ENDURANCE."

OWING to the circumstances of the time, the preparation of the preliminary reports by the men of science attached to the Weddell Sea contingent of the Shackleton Expedition has been unavoidably retarded, that of Lieut. Wordie, dealing with the oceanography, being the first to appear.[1] It is a report of great interest, and that so much valuable research was accomplished on a vessel specially equipped to meet the requirements of a land expedition reflects much credit on all concerned.

Sir Ernest Shackleton, meeting with extremely unfavourable ice conditions in Weddell Sea during the summer of 1914–15, was unable to establish the contemplated base on Luitpold Land for his trans-Antarctic sledge journey. After a long struggle with pack, the *Endurance* was beset in the middle of January, 1915, when only fifteen miles from the land, in lat. 76½° S. A strong N.E. wind that had blown for several days with gale force packed the ice tightly, so that, in spite of every effort, no progress could be made. A month later the young ice was 6 in. thick, and by the end of February, which corresponds with the month of August in the northern hemisphere, had increased to the thickness of a foot.

During the drift of the vessel until she was crushed on October 27, the natural history of sea ice was studied and other physical observations made. These included meteorological observations every four hours by Mr. Hussey, absolute magnetic determinations at regular intervals by Mr. R. W. James, while frequent soundings and numerous series of ocean temperatures and densities were made by Lieut. Wordie. Systematic collections of plankton and other biological material from the surface to depths of more than 400 fathoms were made by Mr. Clark, the biologist, but, unfortunately, this rich material so laboriously brought together had to be abandoned when the *Endurance* was crushed. The greatest interest attaches to the soundings, which show that a line of relatively deep water runs south from 74° to 76° S. to the Wilhelm Barrier. Off the Luitpold coast to the east there is shallow water less than 100 fathoms deep, while in a westerly direction the edge of the continental shelf is marked by depths under 250 fathoms.

The drift of the vessel lay over the continental shelf from the end of March until the end of July, so that it was possible to investigate it over a length of 270 miles from S.E. to N.W. As the ship drifted to and fro the breadth of the shelf was shown to vary from forty miles in the S.E. to seventy miles in the N.W. No idea as to the distance of the coast could be obtained, as the water did not shallow gradually in any direction. "The shelf . . . is made up of a group of terrace-like levels the edges of which are steep and nearly parallel to each other along a S.W.–N.E. line." The shallow water ends abruptly a little north of lat. 73½° S., long. 48° W., the ship's position on July 31. A sounding made five days later, when a gale from the S. had driven the *Endurance* into lat. 71° 42′ S., long. 49° 21′ W., gave 1146 fathoms.

This sharply defined margin of the so-called "continental" shelf seems to be characteristic of Antarctic areas, as shown by pairs of soundings a few miles apart on the *Belgica*, *Gauss*, and *Scotia* operating in widely separated regions. Until the *Endurance* sank, six other casts were made in depths between 1500 and 1900 fathoms, so that the land to the *east* in lat. 68° S., reported by Morrell in 1823, must, if it exists, be an island, and not a part of Antarctica proper. Sir James Ross had reported a "strong appearance of land" some 5° due north of the position given by Morrell for his land, so that it is not improbable that in the unexplored area 165 miles broad at the narrowest point lying between the tracks of Shackleton and Filchner there may be a large island or a cluster of small ones, as suggested by Ross. There seems little doubt that Morrell did visit Weddell Sea in 1823, and that the land he saw and coasted along to its north cape was the east coast of Graham Land previously reported by Capt. Johnson and explored by Larsen seventy years after Morrell's visit. In 1823, as shown by Capt. Weddell's voyage a few weeks earlier, the sea south of the circle was free of pack, so that an approach from the east to the normally ice-congested waters off the coast of Graham Land was quite a feasible proposition. Morrell's longitudes were, however, some 10° out, owing to an error in his chronometers, so that his most southerly position on March 14, 1823, would coincide with that of the *Endurance* on August 25, 1915. The land reported on March 17 was evidently the southern point of Föyn coast, as determined by Larsen, while the N. cape of New South Greenland, which Morrell by dead reckoning two days later placed in lat. 62° 41′ S., long. 47° 21′ W., was obviously the north point of Joinville Island, 8° of longitude further to the west than the position assigned by him.

Lieut. Wordie's paper contains much interesting matter, to which full justice cannot be done until the physicist and the meteorologist of the expedition have submitted their reports. A special feature of the Weddell Sea winter climate in high latitudes seems to be the absence of low temperatures. In the winter months of 1912 the absolute minima on the *Deutschland* were but little lower than those at the S. Orkneys, some 500 miles to the north, and in 1915, the coldest winter of the coldest and calmest year on record at this island station, mercury never froze on the *Endurance,* although the vessel was from 550 to 800 miles farther south. Meanwhile, it is not possible to say why this should be so. Above the cold surface cap, Barkow has shown that a relatively warm stratum of air is usually present in winter, which under certain conditions might replace the film of cold air lying over the pack ice. It is not unlikely that the seasonal march of temperature in

[1] Lieut. J. M. Wordie, R.F.A., "The Drift of the *Endurance*." *Geographical Journal*, vol. li., No. 4, April, 1918.

the southern parts of Weddell Sea resembles that of the McMurdo Sound area in having a uniform winter temperature, instead of a sharp descent to a minimum. A steady Föhn effect of wide radius from the mountains of the Antarctic continent would explain this anomaly, as would also the incursion of relatively warm air from lower latitudes associated with incurved cyclonic N.E. winds in the eastern part of Weddell Sea. Dynamic heating in the *free air*, without the intervention of high land, is also within the bounds of possibility.

R. C. MOSSMAN.

## NOTES.

WHILE the British Association has suspended its annual gatherings for the last two years, the Società italiana per il Progresso delle Scienze, the head offices of which are at 26 Via del Collegio Romano in Rome, sends us a very attractive programme of the tenth meeting, which is to be held in Pisa on October 16–19 under the presidency of Prof. Ferdinando Lori and the secretaryship of the indefatigable Prof. Vincenzo Reina. The success of the meetings at Rome in 1916 and at Milan and Turin in 1917 has convinced the council that it will be interpreting the wishes of the members in continuing even in war-time to maintain its activity in promoting the advancement of knowledge in the country. We notice that such subjects as mathematics, physics, chemistry, and aeronautics do not figure in the proceedings of the sections, which are to be devoted mainly to geological and mineralogical papers in Class A, biological and medical in Class B, and economical in Class C. It is the object of the meeting to pay a large amount of attention to the study of the mineral resources of Italy. At the same time the Italian Thalassographic Commission is organising a subsection of Class B on fisheries, and is presenting an annual report, while similar reports are being presented by the Glaciological Committee and the National Commission for the Development of Scientific and Industrial Progress. The Italian Association for the Study of Building Materials is to meet in Pisa at the time of the congress. The opening meeting of the scientific gathering is to be held on Wednesday, October 16, at 10 a.m., in the Aula Magna of the University, when an inaugural address will be given by Prof. Raffaello Nasini on "A Proposal for an Inventory of Italy's Mineral Wealth." In addition to the sectional meetings, nine general lectures have been arranged for the mornings of the subsequent days, while the sections will meet in the afternoons, and an excursion will take place on the Sunday.

THE recent flight from England to Egypt, made by two R.A.F. officers and two mechanics, is an excellent example of the possibilities of aircraft with regard to long cross-country flights, and shows in an unmistakable way that the commercial use of the aeroplane after the war could be very rapidly developed. If a flight of 2000 miles can be satisfactorily made without special preparation on an ordinary service machine, it is fairly obvious that there are practically no limits to the possibilities of commercial aviation when the whole attention of designers can be given to the subject, and when the excellent research facilities which we possess can be devoted to the elucidation of the new problems involved. The war has worked wonders in promoting the development of aeronautical engineering, and such feats as the above leave little doubt that one of the good after-effects of the war will be the immediate application of our greatly increased knowledge of aviation to the problems of international commerce. The question of long oversea flights is fraught with more difficulties than attend long flights overland, but there are many who think that a cross-Atlantic flight is already within the bounds of possibility. The future of the aeroplane is bright with promise, and the declaration of peace will doubtless inaugurate a new era in the annals of commercial transport.

MR. CHARLES HERBERT SCOTT, whose death is announced, was born in 1860 at Lincoln, and was a member of the Institution of Mechanical Engineers. He was an authority upon linoleum manufacturing machinery, and was the patentee of many of the machines used for this process.

WE regret to note that *Engineering* for August 16 announces the death of Mr. Daniel Makinson Fox in his eighty-ninth year. After a varied railway experience at home and abroad, Mr. Fox acted as principal engineer of the Sao Paulo Railway in Brazil. He was a member of the Institution of Civil Engineers, and read a paper in 1870 on the Sao Paulo Railway.

THE death of Mr. Bramah Joseph Diplock, announced in the *Engineer* for August 16, will be regretted by many who took an interest in his well-known invention, the pedrail. Although he had no early technical training, Mr. Diplock's insight into things mechanical was remarkable, and he held some 100 patents in connection with transport machinery.

THE Mary Kingsley medal of the Liverpool School of Tropical Medicine for research in tropical diseases has been awarded to Dr. Griffith Evans, the discoverer of the trypanosome of Surra, a disease of horses and camels of India, Burma, and the East. Dr. Evans, who was born in 1835, has been a member of the Veterinary Department of the Army, and made his discovery in 1880. He contributes on the occasion of the award of the medal an interesting autobiographical note to the *Annals of Tropical Medicine and Parasitology* for July (vol. xii., No. 1).

SOME additional information regarding the Hog Island shipyard has been obtained by Lloyd's Register of Shipping, and appears in an article in the *Engineer* for August 16. The methods adopted for training the men are of interest. No skilled labour could be obtained, and a school was started, which provides daily from 300 to 400 men for the yard. A section of a ship has been built, where men are taught riveting, caulking, erecting, bolting up, pipe fitting, and any trade necessary. It is marvellous to see how quickly and how well they learn. The first ship was launched on August 14. and when it is considered that not fewer than two-thirds of the men who have built her never saw a shipyard until about six months ago, it must be admitted to be a wonderful performance.

THE U.S. National Research Council, acting as the Department of Science and Research of the Council of National Defence, has appointed a committee to investigate the fatigue phenomena of metals. Prof. H. F. Moore, of the engineering experiment station of the University of Illinois, is chairman. The committee is charged with the responsibility of developing a knowledge of the strength and durability of metals subjected to repeated stresses, such as ship structures, crank-shafts of aircraft engines, and heavy ordnance. It is expected that much of the experimentation required will be done in the laboratories of the University of Illinois at Urbana under the personal direction of Prof. Moore.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Westminster, on Thursday and Friday, September 12 and 13. Among the papers that are expected to be submitted are:—The Rate of Change at 100° C. and at Ordinary Temperatures in the Electrical Resistance of Hardened Steel, E. D. Campbell; Some Experiments on the Reaction between Pure Carbon Monoxide and Pure Electrolytic Iron below the $A_1$ Inversion, H. C. H. Carpenter and C. Coldron Smith; Influences of Hot Working on the Qualities of Steel, G. Charpy; The Casting of Steel in Ingot and other Moulds, J. E. Fletcher; Magnetic Analysis as a Means of Studying the Structure of Iron Alloys, K. Honda; Standardisation of Tests for Refractory Materials, Cosmo Johns; The Utilisation of Waste Heat from Open-hearth Furnaces for the Generation of Steam, T. B. Mackenzie; and Influence of Elements on Tenacity of Basic Steel, A. McWilliam.

ACCORDING to the June issue of *Terrestrial Magnetism and Atmospheric Electricity*, the magnetic survey ship *Carnegie* arrived safely at her home port in June last after having been detained for nine months last year at Buenos Aires owing to the methods of sea warfare adopted by our enemies. Her survey work is to be suspended until it can be resumed with safety. The results of the survey of the eastern portion of the Pacific between the middle of Chile and the Bay of Panama, which she was able to make during her journey home in the early months of the present year, are given in the same issue. The United States and British charts are in close agreement with the new measurements so far as the deviation of the compass is concerned, but both charts are seriously wrong in their values of the dip. Errors of three or four degrees are frequent, and errors of five degrees are occasionally present.

IN a letter to the *Daily Telegraph* of August 13, Mr. F. W. Twort, professor-superintendent of the Brown Institution, criticises the procedure of the War Office with reference to the epidemic of dysentery in the Salonika area during 1915 and 1916. Towards the end of 1915 Mr. Twort was appointed in charge of a laboratory at Salonika, and came to the conclusion that much bacillary dysentery occurred in the district. The War Office set up a Medical Advisory Committee for the Eastern area of operations, and this Committee in Egypt issued a report on Salonika. It apparently considered the dysentery of Salonika to be the amœbic form. In consequence of these findings, which he considered to be erroneous, Mr. Twort retired from the Army Medical Service. At the end of 1917 Lt.-Col. Buchanan, a member of the War Office Advisory Committee, admitted that the diagnosis of dysentery by this Committee was wrong; that bacillary dysentery occurred at Salonika; and that certain large cells in the mucus had been mistaken for amœbæ. In spite of these findings, the War Office, Mr. Twort asserts, has so far taken no action to put matters right so far as this is now possible.

THE REV. W. LOWER CARTER, who died on June 19, was from early youth an indefatigable worker in the interests of geology, but it was relatively late in life that he took up scientific work as a profession. He began business life as a bank clerk, and doubtless the experience he gained in that capacity developed the organising abilities for which Mr. Carter was justly known. After a successful university career at Birmingham, Cambridge, and Halle, he entered the Congregational ministry. What time he could spare from his pastoral work was devoted to stimulate and assist scientific research, particularly in connection with the Leeds Geological Association and the Yorkshire Geological and Polytechnic Society. For many years he edited the Transactions of these societies, and, as honorary secretary, organised their various activities. When, in 1908, Mr. Carter resigned his charge in Birkenhead to become lecturer in geology at East London College, and afterwards lecturer in geography at Queen's College, London, he still retained his interest in the Yorkshire societies, and it is largely due to his work that the Yorkshire Geological Society became so prominent among provincial societies. Further scope was afforded his powers of organisation when he acted for several years as recorder of Section C (Geology) of the British Association. The time and energy given to assist the spread of scientific knowledge through these bodies limited his original research work. This, chiefly in the form of short notes, was published in the Transactions of the Yorkshire societies, as also more important contributions on the development of certain river systems in Yorkshire. It is, however, as an organiser and teacher rather than as an investigator that Mr. Carter's name will be remembered among geologists.

THE pleomorphism and developmental cycles of the bacteria is the subject of a paper by Dr. Sopp in *Naturen* (Bergen) for May (No. 5, 1918). In particular he reviews the work of Almquist on pleomorphism and that of Löhnis on the developmental cycle of Azotobacter, in which he claims that conjugation occurs with the formation of various spore-like bodies.

THE July issue of the *Archives of Radiology and Electrotherapy* (vol. xxiii., No. 2) is devoted to the consideration of the treatment of paralysis due to nerve injury, a subject of great importance at the present time. The principal paper is contributed by Lieut. Noel Burke, R.A.M.C. He concludes that rational treatment of this form of paralysis must be directed to the nerve as well as to the muscle. It takes the form of the galvanic current with or without ionisation. Pain can usually be relieved by electrical means or by heat. The muscles should be treated both with massage and with the galvanic or sinusoidal current. A discussion of the paper followed, in which many speakers took part.

THE *National Geographic Magazine* for May is devoted to a survey of the smaller North American mammals by Mr. Edward Nelson. This is a really wonderful achievement, for the author has contrived to crowd a vast amount of information concerning the chief characteristics, and habits, of a very remarkable series of animals into a surprisingly small space. Yet he seems to have omitted nothing material in his task of condensation. A comment of his on the brown rat in South Georgia is worth bearing in mind. This animal, he tells us, was introduced into the island from whaling ships, and now, owing to the abundant supply of food furnished by the great number of whale-carcasses which drift ashore each season, it may be found there in millions. Sooner or later this source of food will cease, and it will then go hard with the great colonies of penguins which still nest there unless means for the destruction of this pest are speedily devised. In addition to a large number of coloured plates of great beauty are numerous text-figures, illustrating the tracks made by various animals when walking and running.

THE *Journal of Agricultural Research* (Washington) for June (vol. xiii., No 10) contains an account by Mr. R. W. Glaser of a new bacterial disease of gipsy-moth caterpillars. It was apparently introduced with some eggs of the Japanese gipsy moth, and the infection later spread to the American race. The disease manifests itself in the caterpillars, which suffer from diarrhœa, cease to eat, lose muscular co-ordination, and die. The microbe is a streptococcus and is conveyed by ingestion, and the muscular tissue of the insect is first attacked. The disease was introduced into woods heavily infested with the gipsy moth, and in two localities severe epidemics were produced. It is hoped that it may be of service in helping to combat the ravages of the gipsy moth. In another paper in the same journal Mr. J. Rosenbaum discusses the survival of the blackleg organism of the potato in the soil during winter. The organism (*Bacillus phytophthorus*) does not seem to be able to survive in the soil or in diseased tubers that may remain there under winter conditions.

THE Kew Bulletin, we are glad to notice, is being published this year with regularity, and five numbers have already appeared. In No. 5 there is a valuable article on the preservation of wood by the application of chemicals, which plays so important a part in timber economy. The chief value of preservatives is to render the wood less susceptible to the attacks of parasitic fungi, to make it waterproof and less inflammable, and to prevent the attacks of boring insects. A general account of the subject is given, and then attention is directed in detail to the important book on the subject recently published by Mr. A. J. Wallis-Tayler. The various chapters of the book are reviewed, and this is followed by a bibliography of works upon other definite branches of wood preservation, such as wood pavement, creosoting railway sleepers, etc. A number of the works cited have been published in the United States and some from India, while others dealing with the treatment of timber for estate purposes have been published in the *Quarterly Journal of Forestry*.

THE Journal of the Royal Agricultural Society (vol. lxxviii.) contains two papers relating to milk production and distribution which are of interest to a far wider circle of readers than the members of the society. Mr. James Mackintosh, adviser in dairying to University College, Reading, discusses the effect of the new agricultural policy on the dairy-farming industry. The increase in arable area at the expense of the grass area is thought by many dairy-farmers to necessitate a reduction of herds, but although Mr. Mackintosh declines to accept this conclusion, and offers evidence that more food for cows can be produced when a certain amount of grassland is broken up, he anticipates that the higher cost of production and the greater labour involved in arable dairying as contrasted with other systems of farming, which may in the future be equally remunerative, may lead to a decline in milk-production in districts best adapted for corn-growing, such as the Eastern Counties, and hence possibly to difficulties of supply in these areas. In the West a decline is less to be feared if the prices of milk and milk products allow of reasonable profit, and adequate means of education are provided. In a paper on the wastage of milk Dr. R. Stenhouse Williams gives some striking figures as to the extent to which milk is at present lost by souring, splashing, and in other ways, and indicates the lines along which a rational system of production and distribution of clean milk might be organised.

THE unknown Belcher Islands, in the south-east of Hudson Bay, were explored in 1914 and 1915 by Mr. R. J. Flaherty, who for the last six years has been examining the Hudson Bay region, the Ungava Peninsula, and Baffin Land for iron-ore and other mineral deposits. Mr. Flaherty has an article on the islands in the June number of the *Geographical Review* (vol. v., No. 6). The article contains several illustrations and the first map of the islands to be published. Previously they were represented on charts by dotted outlines of incorrect shape and position. It appears that the Belcher Islands consist of several long, narrow islands extending north and south for ninety-one miles, with an extreme width of fifty-seven miles. Their area is more than 5000 square miles. The islands are low, rising barely to 500 ft. at most, and studded with lakes well supplied with salmon and other fish. Harbours are numerous. Vegetation is scanty, and there are no trees, but animal life is abundant. A tribe of Eskimos, consisting of only five families, permanently inhabit the islands. Other Eskimo from time to time migrate from the mainland in search of walrus, sea-fowl, and, before their disappearance, caribou. Mr. Flaherty reports large deposits of iron-ore, not, however, of high quality. It is remarkable that such a large and not unimportant group of islands, comparatively near to civilisation and easy of access, should have remained so long unexplored.

KISSKALT'S view that the action of the sand filter in water purification is biological and due to the destruction of bacteria by other organisms is contested as the result of experience at the Zürich waterworks, where the lake-water is filtered in two stages through sand. According to L. Minder (*Journal für Gasbeleuchtung und Wasserversorgung*, No. 61, 1918), the first layer retains most of the fresh-water planktons, but allows some of the bacteria to pass. The bacteria are retained by the second filter and at the surface, so that at a depth of 10 cm. the number per cubic centimetre has already fallen to one-tenth. Furthermore, the retention of bacteria is satisfactory even when there are considerable fluctuations in the number of bacteria in the water. Thus it is concluded that the process is mechanical rather than biological.

ACCORDING to the *Annali d'Ingegneria e d'Architettura* for June 16, a strong committee of business men has been formed to consider the possibility of constructing, after the war, a canal connecting Milan with Lake Como, and joining the important waterway which it is proposed to make from Milan to Venice, thus opening up the rich plains of Lombardy to cheap means of transit. The works involved would comprise a canal from Milan to Vimercate, a vast tunnel from Vimercate to the River Adda, and the canalisation of the Adda from Paderno to Lecco. The scheme has the approval of the city of Milan, and will be supported by the Edison Company, which is the chief user of the waters of the Adda. Some of the features of the new undertaking are discussed, and the advantages which the new canal would confer on Milan are explained. The distance by water from Milan to Lake Como would be reduced by about eleven miles.

IN a paper on the limit of sensibility of the eye and the minimum of power visually perceptible, which appears in the March–April issue of the *Journal de Physique*, M. Buisson claims that the eye is much more sensitive than it has been thought to be. A number of discs of diameters from 2·5 to 5 millimetres were covered with phosphorescent material, and the light sent out by them determined by the Fabry-Buisson micro-photometer to be between two and four candles per square centimetre. Two of these discs of the same size and strength were mounted on a screen, which was gradually removed from the observer and at the same time rotated about his line of sight, and he was required to state the direction the line joining the two discs made with the horizontal until with increase of distance it became impossible. For discs of different diameters and strengths the limit of perception was found in all cases such that if there were no absorption of light by the atmosphere a candle would be visible at a distance of 27 kilometres. This is equivalent to a star of the eighth magnitude, and it is probably the light of the sky which prevents stars of higher magnitude than the sixth being visible.

*Engineering* for August 9 has an illustrated article descriptive of an electrically welded barge, which has been built at a yard on the south-east coast under Government control. This barge is 120 ft. long and 16 ft. beam, and has a displacement of 275 tons. The vessel, with full cargo, has been at sea during exceptionally rough weather, and answered satisfactorily in every way to the test imposed. No rivets were used in the construction, the whole of the structure being put together by electric welding. The adoption of this system was a direct consequence of experience in welding by means of the flux-coated metal electrode process at the Admiralty dockyards. There are seventy-one transverse frames in the barge, with three bulkheads; plates of thicknesses $\frac{1}{4}$ in. and $\frac{5}{16}$ in. were used for the shell plating. It is estimated that future vessels of this size should be built with a saving of 25 to 40 per cent. of time and about 10 per cent. of material as compared with ordinary riveted barges. The United States Shipping Board is making arrangements for the building of a number of 10,000-ton standard ships in which the use of rivets will be reduced to about 2·5 per cent. of the normal number.

THE problem of ascertaining the distribution and magnitudes of the stresses in a revolving disc by means of mathematical formulæ is tedious and complicated. With the exception of the cases of discs of constant thickness and constant strength, for which definite integrals can be found, the analytical solution involves highly complex equations, and the ultimate result is doubtful. In the course of an article in *Engineering* for August 9, Mr. H. Haerle describes a method which can be applied to any sectional profile and reduces the mathematical work to a minimum, while at the same time results are obtained which are sufficiently accurate for all practical purposes. The general formulæ are given by Dr. Stodola in his book on steam turbines, and from these other expressions are deduced for the sum and difference of the principal stresses. Mr. Haerle has prepared a chart showing the relation of these sums and differences with tangential velocities, and shows how the chart may be applied to the solution of discs of uniform thickness with and without a central hole, discs of hyperbolic profile, and turbine discs having the tapered sides usually employed in practice. An example of an impeller disc for a turbo-compressor is also worked out. Mr. Haerle's method gives remarkable agreement with the mathematical method, and certainly simplifies greatly an exceedingly complicated problem.

MRS. M. T. ELLIS contributes to the June issue of the *Biochemical Journal* three interesting papers on the plant sterols. In the first is recorded the failure to isolate a typical phytosterol from the vegetative organs of the cabbage plant or from the fæces of rabbits fed on a cabbage diet, although from the latter source a small quantity of a substance giving the cholesterol colour reactions was separated. On the other hand, cabbage-seeds contain a relatively large amount of crystalline matter apparently similar to the mixture of phytosterols present in rape-oil, which is interesting in view of the fact that both rape and cabbage belong to the genus Brassica. Grass-fruits also contain phytosterol, but a larger amount of chortosterol. The second paper deals with the sterol content of wheat, and it was found that the chief phytosterol present both in the grain and in the embryo is sitosterol. The bran contains a phytosterol, but one different from sitosterol. A method of estimating phytosterol was devised based on the insolubility of the compound of this substance with digitonin. The quantity of phytosterol in the etiolated wheat-plant is approximately the same as in the grain, but it is higher in the adult plant. In the embryo the percentage of phytosterol is much higher than in the plant, thus suggesting an essential function in germination and growth. In the third paper ("The Occurrence of Phytosterol in some of the Lower Plants") it is shown that a mixture of ergosterol and fongisterol, previously known to occur in fungi, is present in *Polyporus nigricans,* and probably also in *P. betulinus.* From the alga Laminaria, the Musci Sphagnum, and the fungi *Agaricus rubescens* and *Lactarius subdulcis* oils were obtained which gave the cholesterol colour reactions.

MESSRS. BUTTERWORTH AND CO. (INDIA), LTD. (Calcutta), have sent us a copy of their Medical Catalogue for 1918. It is a very comprehensive list of works published in Great Britain, India, and America on medicine, surgery, dentistry, obstetrics, pharmacy, ophthalmology, and the allied sciences. As it is carefully arranged according to subjects, and the prices are given in Indian currency, it should be very useful to medical men resident in India and the Far East, to whom it will be sent free by the publishers upon application.

MESSRS. T. C. AND E. C. JACK, LTD., announce two forthcoming books by F. Martin Duncan, viz. "Wonders of the Seashore" and "How Animals Work." They also promise "Water in Nature," by W. Coles Finch and Ellison Hawks.

THE Oxford University Press is about to begin the publication of "Neurological Studies," from the Seale Hayne Military Hospital, Newton Abbot. It will be edited by Major A. F. Hurst, with assistance.

## OUR ASTRONOMICAL COLUMN.

WOLF'S PERIODIC COMET.—Mr. M. Kamensky has further revised his orbit of this comet, applying perturbations by the earth, Mars, Jupiter, and Saturn. His elements are given in *Ast. Journ.*, No. 738:—

$$T = 1918 \text{ Dec. } 13{\cdot}3909 \text{ G.M.T.}$$

$$\left.\begin{array}{l}\omega = 172^\circ\ 54'\ 41{\cdot}83'' \\ \Omega = 206^\circ\ 41'\ 31{\cdot}71'' \\ i = 25^\circ\ 17'\ 31{\cdot}54''\end{array}\right\} 1918{\cdot}0$$

$$\phi = 33^\circ\ 58'\ 31{\cdot}85''$$

$$\mu = 522{\cdot}42893''$$

The Greenwich observations in July indicate the very small correction +0·0046d. to the value of T.

*Ephemeris for Greenwich Midnight*

| | R.A. h. m. s. | N. Decl. ° ′ |
|---|---|---|
| Sept. 3 | 20 0 38 | 22 20 |
| 7 | 20 0 17 | 21 13 |
| 11 | 20 0 36 | 20 0 |
| 15 | 20 1 36 | 18 43 |
| 19 | 20 3 17 | 17 23 |
| 23 | 20 5 39 | 16 1 |
| 27 | 20 8 44 | 14 37 |
| Oct. 1 | 20 12 31 | 13 12 |

Values of log $r$, log $\Delta$: September 3, 0·2726, 0·0274; October 1, 0·2415, 0·0242 respectively.

The comet is nearest to the earth on September 20, and the theoretical brightness is greatest on October 12.

Faint Stars with Large Proper Motions.—Mr. Furuhjelm's investigation of the proper motions of the stars in the Helsingfors astrographic zone (39° to 46° N. decl.), between R.A. 9h. and 12h., has already been noticed in Nature. He has now published a smaller list (*Öfversigt af Finska Vetenskaps-Societetens Förhandlingar*, Bd. lix., Afd. A., No. 22), which extends from R.A. oh. to 24h., but includes only stars the annual proper motion of which is 0·5″ or more. They are sixty-three in number, but the proper motions of more than half of these had already been published. However, more than twenty are new, being faint stars of the 10th or 11th photographic magnitude. They have been derived by the aid of the blink microscope from pairs of plates taken at intervals of several years. The author believes that the list contains all the stars in the zone down to the 11th magnitude, whose P.M. amounts to 0·5″. In a separate publication he gives a detailed study of the faint star which he found in 1914 to have the same P.M. as Capella. His final result for its P.M. is +0·0071s. in R.A., −0·434″ in decl., Boss's values for Capella being +0·0082s., −0·429″. The place of the small star (the photographic magnitude of which is 10·6) for 1900·0 was 5h. 10m. 1·20s., +45° 44′ 21·5″, that of Capella being 5h. 9m. 18·04s., +45° 53′ 47·0″. The distance between them is 12′ 4″. Making allowance for the greater distance of Capella from the sun, the system shows a close analogy to that of $\alpha$ Centauri and its distant companion, which Mr. Innes has named Proxima.

Periodicity of Solar Radiation.—In continuation of the preliminary work of Clayton (Nature, vol. c., p. 14), Dr. C. G. Abbot has made a further investigation of possible periodicities in the short-interval variations of the "solar constant" (Smithsonian Miscell. Collections, vol. lxix., No. 6). The method adopted was to calculate the coefficients of correlation between the solar constants of given days and those of one to forty days later, as observed from 1908 to 1916. There appears to be no well-marked periodicity which persists through the whole period of observation, but some of the results for individual years are of interest. Thus, in 1915, a period of about twenty-seven days, doubtless associated with the solar rotation, was strongly shown, the observations suggesting that one side of the sun was hotter than the other during several rotations. This result is of considerable importance as furnishing additional evidence that the short-period variations are of truly solar origin. The year 1916 was unique in giving indications of a period of about $3\frac{1}{2}$ days.

The Spectrum of Mira.—The bright lines recorded in the spectrum of Mira by Stebbins in 1903 have been further investigated by W. S. Adams and A. H. Joy (Pub. Ast. Soc. Pac., vol. xxx., p. 193). Some additional lines are shown in a photograph taken on March 2, but the principal interest attaches to the suggested identifications of the lines. Apart from the well-known lines of hydrogen, the bright lines appear to be mainly due to iron and magnesium, and in each case the lines involved are those which have their greatest intensity at low temperatures. The brightest line, next to the lines of hydrogen, is the magnesium line $\lambda$ 4571, which is the most characteristic line of the flame spectrum. Similarly, the iron lines which occur are those of the low-temperature groups *a* and *b* of the classification of Gale and Adams. The lines in question make their appearance, or at least become more intense, as the star approaches its minimum of light, and it would seem that the radiating gases undergo a reduction of temperature as the star becomes fainter.

## THE NEW STAR IN AQUILA.

The following estimates of brightness of Nova Aquilæ made by M. Paul Blanc at Fourcalquier are included in Circular No. 27 of the Marseilles Observatory :—

| Date | h. | m. | Mag. | Date | h. | m. | Mag. |
|---|---|---|---|---|---|---|---|
| June 8 | 21 | 10 | 1·0 | June 21 | 22 | 20 | 2·8 |
| 9 | 21 | 55 | 0 | 22 | 21 | | 2·8 |
| 9 | 22 | 40 | 0·2 | 23 | 21 | 40 | 2·9 |
| 10 | 22 | 15 | >1·0 | 24 | 21 | | 3·0 |
| 13 | 22 | 15 | 1·0 | 25 | 21 | 15 | 3·3 |
| 14 | 21 | 45 | 1·2 | 27 | 22 | | 3·9 |
| 15 | 22 | 15 | 1·5 | 28 | 22 | 50 | 3·9 |
| 18 | 21 | | 2·3 | 29 | 21 | 20 | 3·6 |
| 19 | 21 | 30 | 2·3 | 30 | 22 | 50 | 3·6? |
| 20 | 22 | | 2·5 | | | | |

Details are also given of determinations of the brightness of the nova in the wave-lengths 645, 558, and 412 made at Florence by M. Maggini. The observations indicate that the nova did not radiate as a black body.

The following collection of references to the history of the nova prior to the outburst in June has been communicated by Dr. C. Easton, of Amsterdam :—1892, August 14, Algiers Astrogr. Chart No. 341 (Zwiers), mag. 8·8; 1894, September 21, Barnard's Photographs of the Milky Way, Publ. of Lick Obs., vol. xi., plate 59 (Easton), mag. 10·5; 1895, June 26, Algiers No. 141 (Jonckheere), mag. 8·8; *id.*, 1909, August 20, mag. <8·8 (*vide* Nature, No. 2537); 1909, June 20, M. Wolf, *Ast. Nach.*, No. 4949, mag. 10·5; 1910, Franklin Adams Chart, mag. <8·8; 1912, July, Bailey's N. Milky Way, Harvard Annals, vol. lxxx., No. 4 (Nijland). In Barnard's photograph of 1894 the nova is 20 mm. from the left, and 5·5 mm. from the bottom of the plate. Dr. Easton remarks that there seems to be sufficient evidence of the variability of the nova.

Messrs. I. Yamamoto and Y. Ueta, of the Kyoto University, inform us that they independently discovered the new star on June 11, during an expedition to observe the recent total eclipse of the sun. Owing to the rainy season very few observations were secured, but it was observed that the star became fainter and redder until June 29, when there was a slight recovery.

The star is still easily visible to the naked eye, being now between the 4th and 5th magnitudes. On August 10 Prof. Fowler noted that the green nebular line was the most conspicuous feature of the visible spectrum.

Father Cortie sends the following records of observations on August 13 and 15. On the former date the star, according to Mr. Butterworth, was of magnitude 4·3 visually and 4·7 photographically. The maximum of brilliancy has shifted from the red to the green, and the image in the telescope has lost its ruddy hue, and is of a blue tint. In a McClean spectroscope $H_\alpha$ was very much reduced in brightness; a yellow line, presumably D, was seen, and vivid bright lines at 5007, $H_\beta$, 4640, and about $H_\gamma$. The following wave-lengths of the principal bright bands were determined from a photograph: 3867, $H_\zeta$, $H_\epsilon$, $H_\delta$, $H_\gamma$, 4363, 4640, 4680, 4713, $H_\beta$, 4958, and 5007. The bands about $H_\gamma$ and 4640 were the brightest. On August 15 $H_\gamma$ and 4363 were the brightest. The mean width of the hydrogen bands is about 50 Ångström units. While the bands at $H_\gamma$ and 4640 are triple in character, $H_\delta$ is composed of a double band. The spectrum on the dates named was almost exactly like that of Nova Persei in August and September, 1901, when its magnitude was between 6 and 7.

## THE DEVELOPMENT OF SCIENTIFIC INDUSTRIES.

ONE interesting feature of the British Scientific Products Exhibition, arranged by the British Science Guild at King's College, London, is the series of short lectures and demonstrations given with the special aim of directing public attention to the necessity of developing the scientific industries of the country. These lectures cover a wide range, and by reminding us how ill-prepared we were at the outbreak of war to cope with the vast industrial tasks involved in the supply of munitions of war, they should help to stimulate effort with the view of preventing the occurrence of a similar disadvantage in commerce when hostilities cease.

Lord Sydenham, who opened the exhibition on August 14, pointed out in his address that the Germans with deliberate design had penetrated our whole commercial system, and had obtained control of some of our key industries. We were at first not in a position to start the new industries which were vital to success, and which the Germans had laboriously built up. At present, as Lord Sydenham pointed out, there is not a single branch of the industries of war in which we cannot excel the Germans, and from this fine achievement we can draw lessons of supreme importance for the future. Lord Sydenham also emphasised a lesson which the war had taught us, that small quantities of material had enormous influence in determining production, and large industries were vitally affected by small industries. The dye industry, which Germany had largely developed with an eye to war as well as to industrial supremacy, was quoted as an example of this. We paid Germany nearly 2,000,000*l.* per annum for dyes, upon which depended an industry of more than 200,000,000*l.* per annum. The great chemical works of Germany had almost monopolised this and other key industries, and when war broke out the works engaged thereon were ready to be turned on to the production of explosives and propellants. Lord Sydenham expressed the opinion that the new Education Act, if properly used, would provide the machinery to add largely to the number of our science-workers. When the Bill was before the House of Lords he endeavoured to introduce the word "science" into it, but the official objection was that it would be inappropriate to specify a particular item in such a Bill. In conclusion, Lord Sydenham pointed out that two factors were operating to bring about certain victory in the field. The first was the splendid gallantry and devotion of our fighting men; the second, the resourcefulness and hard work of our men and women, which had enabled them to be supplied with the best weapons science could produce. If, when victory was ours, we diligently applied that resourcefulness to the arts of peace, we should be able to recreate national prosperity on a broader and more enduring basis than it had possessed in the past.

A German chemist, Dr. Otto N. Witt, soon after the declaration of war, expressed the opinion that the manufacture of dyes could never be established in this country because we lacked the knowledge and experience as well as, according to his view, the moral qualities requisite for so great an undertaking. Sir William Tilden, in the first of two lectures on "Lessons of the Exhibition," pointed to the products exhibited, which, he said, demonstrated that these estimates of the British men of science were altogether mistaken, and he claimed that we had every reason to be proud of the result. Sir William Tilden explained and illustrated the use of the word "research," which is now so freely used, but the true meaning of which is rarely understood. Some of the modern applications of scientific knowledge in chemical manufactures afford excellent examples, such, for instance, as the successful establishment of the contact process for making sulphuric acid, the production of ammonia from gaseous hydrogen and atmospheric nitrogen, and the oxidation of ammonia into nitric acid. In the second of his lectures Sir William Tilden mentioned that research in science is undertaken by two distinct classes of people. There is, first, the divinely gifted genius who pursues investigation for the purpose of finding out the laws of Nature and answering the eternal question, Why? Such a man was Faraday, and such a man is the president of the Royal Society, Sir Joseph Thomson. These lead the way, and provide stepping-stones for the second type of man, who wants to get practical results from his labour; and so we have what is called pure science and applied science. In both directions the first requirement is exact observation. This generally means measurement of weights, volumes, temperatures, times. In the first lecture Sir William Tilden illustrated this by referring to progress in chemistry; in the second, he referred to the modern developments in the use of steel. This is an age of steel. But the steels in use at the present time present extraordinary characteristics in strength, hardness, and cutting properties. These are produced by adding small quantities of manganese, nickel, chromium, tungsten, or other metals, of which practically nothing was known in the pure state until the use of the electric furnace by Moissan twenty-five years ago. Moissan was the pioneer in pure science whose discoveries rendered possible the practical achievements of Sir Robert Hadfield and other great steel-makers.

Metals generally are distinguished by their remarkable surface actions. The property possessed by platinum of causing the combination of oxygen gas with hydrogen and other combustible substances was discovered by Sir Humphry Davy just one hundred years ago. But many other metals present still more remarkable powers. One of the most valuable is the power possessed by nickel of causing hydrogen to combine with heated oil, converting it into a fat which is solid when cold. A substance which acts in this way is called a catalyst, and catalytic actions are now being turned to account on a large scale in a great variety of ways in making sulphuric acid, nitric acid, and ammonia, in the surface combustion of gas, in obtaining solid fats from whale-oil, and in a variety of manufacturing processes. Here again the pioneering study of the facts precedes their application. A great field is open in the study of catalytic effects.

In both his addresses Sir William Tilden referred to the question of training chemists. We are still very short of chemists, physicists, and skilled technologists, and he emphasised the fact that, unless steps are taken to train a large number of boys and girls, we shall be as badly off as ever after the war. In passing, he mentioned the valuable work done by many women chemists, and expressed the view that this was a calling to which many educated girls might advantageously devote themselves. The supply of men, he said, will depend chiefly upon the use of scientific method and the more extensive teaching of facts and principles in the secondary and greater public schools, where the education of the governing class is chiefly carried on, and where reform is most urgently needed.

Mr. R. R. Bennett, of the British Drug Houses, Ltd., in the course of a lecture on "Progress in Pharmaceutical Products," said that the total number of vegetable drugs which have become unobtainable owing to the closing of enemy countries is remarkably small, but the cultivation of drug-yielding plants should be prosecuted in this country to the utmost, and the resources of our Colonies should be developed to an increasing extent for the supply of vegetable drugs which cannot be grown in this country. In dealing with fine chemicals Mr. Bennett said that quinine, morphine, and strychnine, three of the most important of the vegetable alkaloids, and ether and chloroform, the two most important anæsthetics, have all along been British products, while the production of many other alkaloids, such as atropine, hyoscine, eserine, and emetine, and very many synthetic organic chemicals, has been stimulated during the war. In 1914 the manufacture of salicylates was practically a German monopoly, but in 1918 it is an established British industry. So far, during the war, whenever a particular substance has been required for a particular purpose, whether it be for medicinal, technical, or war purposes, British chemical science, *plus* British chemical industry, have not failed to produce it in requisite amount and of requisite purity within a reasonable time. Mr. Bennett next reminded his audience that for analytical and research purposes chemical reagents are required to be of a very high degree of purity. Previous to the war such chemicals were to a large extent, though not exclusively, imported from a few well-known German manufacturers, but several British firms have successfully undertaken the manufacture of these chemicals, so that the supply of analytical reagents has not failed. The lecturer next showed a series of dyes used as microscopic reagents. These dyes were from two to four times the strength of the microscopic reagents by German manufacturers. Mr. Bennett said that if the fine chemical industry is to be developed in this country on a scale anything like commensurate with its importance—and it must be borne in mind that it is a key industry, and therefore of paramount importance to the general development of national industry—Government assistance at the conclusion of hostilities will for a time be absolutely essential.

Mr. Edmund White, managing director of Hopkin and Williams, Ltd., lectured on the monazite and thorium industries as key products, pointing out their importance in relation to the gas-mantle industry.

Before the war the German ring had secured almost complete control of monazite, not only in Brazil, but also in Travancore—a protected native State in our Indian Empire. During the year preceding the outbreak of war this trust was endeavouring to bring about a virtual monopoly of the gas-mantle business, and had called in Berlin a meeting of the chief manufacturers of the world. Thorium nitrate is the one essential constituent of gas mantles, without which they cannot be made, and the trust notified these manufacturers to join the combination under threats to withhold supplies of thorium nitrate if they refused to do so. This would mean closing down the business of any manufacturer who would not come into the arrangement. A further proposal was to add 1*d.* on the price of each mantle sold, of which two-thirds of a penny should be taken by the German trust, and one-third of a penny retained by the manufacturer. The world's consumption of gas mantles is estimated at 400,000,000 per annum, and the two-thirds of a penny to be abstracted from the public on each mantle meant an additional profit of about 1,000,000*l.* sterling per annum for the German ring. In September, 1914, Mr. White, thinking the time propitious, proceeded to India and succeeded in obtaining concessions to work monazite sand in private lands outside the territorial limits controlled by the Travancore Minerals Co., which was under contract to dispose of the whole of its sand to the Berlin Auer Co. The Travancore Minerals Co. had been financed from Berlin, although it was nominally an English company registered in London. Messrs. Hopkin and Williams, Ltd., have now established their works in Travancore, and have also founded a thorium nitrate factory in England, which is actually working to-day and producing thorium nitrate of unquestionable quality at an increasing rate. Mr. White exhibited a series of lantern-slides showing the different stages in obtaining monazite in Travancore, and finally stated that this country was now absolutely independent of Germany in these important branches of industry. He also stated that his firm was quite able to hold its own with the Germans in the markets of the world, even though our post-war arrangements gave them no assistance. If the Government so desired, arrangements could easily be made by which Germany should receive for its gas-mantle industry a quantity of raw material in the form of monazite sand or thorium nitrate under the control of ourselves and our present Allies, thus reversing the conditions which existed before the war.

Prof. A. Keith lectured on Monday, August 19, on the value of science to medicine. He remarked that it was not the medical men in hospitals who discovered the scientific principles on which their instruments were based, but the physicists and other workers in laboratories. Beginning with a case just brought from the field of battle into the operating-theatre of a London hospital, he pointed out that the iodine with which the inflamed limb was painted was discovered by a chemist; that Davy, who was one of the first to study the element closely, was the discoverer of the nitrous oxide used as the anæsthetic for the operation; that it was by microscopic observations of a frog's tongue that the method of formation of new nerve-fibres when an injured part has been cut away was found; and that the valuable X-ray bulb was the outcome of purely scientific investigations by Sir William Crookes and others. Finally, Prof. Keith pleaded for more generous provision of laboratories for scientific research carried on solely with the intention of increasing natural knowledge. It used to be said that wars were won on the playing-fields of Eton, but in future they would be won in the laboratories of the country.

Dr. F. Mollwo Perkin, lecturing on the same day on oil from mineral sources, took a broad view of his subject, and referred to oils produced by the distillation of bituminous materials as well as to oils produced directly from the earth. He described the various methods employed for obtaining oil from bituminous materials, and dwelt at length on the means of obtaining these from gas-works retorts. Experiments had been made by the Admiralty with the object of carbonising cannel-coal in vertical gas retorts and producing the fuel-oil. Under the conditions of carrying out these operations it had been found that low-temperature products could be obtained and a good yield of gas produced, together with a rapid throughput, if a large amount of steam were passed through the incandescent coke at the bottom of the retort and then through the descending coal mass. Another source from which low-temperature oils are obtained is producer-gas plant tar. The chief difficulty met with, according to Dr. Perkin, is to design a retort which will carbonise at a low temperature, and at the same time give a rapid throughput of coal—that is, a unit which will pass a large tonnage of coal through in twenty-four hours and at the same time give a maximum yield of oil.

## TREATMENT OF CROPS BY ELECTRIC DISCHARGES.

PROF. HENDRICK has described in the *Scottish Journal of Agriculture* (vol. i., 1918, pp. 41–51) the results of some extensive experiments on the treatment of growing crops with an overhead electric discharge. The work was carried out during the years 1913, 1914, 1916, and 1917 on Mr. Low's farm of Mains of Luther, Kincardineshire. The apparatus was that of the Agricultural Electric Discharge Co., Ltd., consisting of an interrupter, induction coil, and Lodge valves. The overhead installation consisted of a number of fine wires (the diameter is not stated) arranged 15 ft. apart, and alternately bare and cotton-covered; these wires were about 11 ft. from the ground at the centre and 15 ft. near the supports. The experimental area consisted of ten plots, each 0·56 acre, half of each plot being electrified and half used as a control; the control areas lay south-east of the electrified ones. In 1914 a galvanised-wire netting (½-in. mesh) was placed between the electrified and control areas. A five-course rotation was followed (turnips, barley, hay, potatoes, and oats), and the ten plots were so arranged that in each season "two whole plots were under each of the crops of the rotation." In 1917 the treated barley showed an increase in grain of 31 per cent. over the control, but this result was not obtained in other years, and the general conclusion is arrived at that no persistent improvement was obtained in any of the crops grown.

These careful experiments show clearly the necessity for caution in this type of work, but, unfortunately, they do not advance our knowledge of the subject. In investigations on electro-culture there are two main aspects, the agricultural and the electrical; in these experiments, however, while the agricultural conditions have been carefully considered, the electrical conditions have been treated with comparative neglect. The information is given that the apparatus was capable of giving a current at 60,000 to 100,000 volts, but no measurements appear to have been taken of the actual voltage employed or of the discharge current from the wires, and no data are given as to the number of hours, or the time of day, during which the discharge was employed. The experiments were certainly a failure, but we cannot say under what electrical conditions the failure occurred. It is thus impossible to repeat the experiments or to compare them with experiments in which more successful results have been claimed.

## IRON-ORE OCCURRENCES IN CANADA.

THE Canadian Department of Mines has just issued the second (final) volume of a report upon iron-ore occurrences in Canada by Messrs. E. Lindeman and L. L. Bolton. The first volume contains an account of the principal operating mines that may be considered active producers of iron-ore, and the second volume gives brief descriptions of a very large number of occurrences, some of which have been worked in the past, but are not now contributing to the output, whilst others have not been attacked. A considerable number of more detailed memoirs, such as those on the iron-ore deposits of Nova Scotia, on the Wabana iron-ore of Newfoundland, etc., have already been published by the Department of Mines, but the present work is particularly useful, as it not only summarises these, but also describes a very large number of occurrences about which no information has hitherto been available. A very useful feature, too, is the very complete series of references to any previously published descriptions of the mines or occurrences. Another, to which attention may with advantage be directed, is the large number of magnetometric maps that accompany the present report. It is pointed out in the introduction that particular attention has been devoted to these magnetometric methods, which have hitherto been but rarely employed outside Scandinavia, where they originated, because it is desired to impress the value of this method of working upon Canadian mining engineers, since definite information can thus be obtained as to the size, shape, and distribution of deposits of magnetite, while magnetometry provides a permanent record that will serve as a guide in the further exploration or development of these deposits.

## BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

THE British Science Guild has carried out successfully a very useful enterprise in the British Scientific Products Exhibition, which was opened by Lord Sydenham, president of the Guild, on August 14, at King's College, London. The exhibition contains many examples of products and appliances of scientific and industrial interest which, prior to the war, were obtained chiefly from enemy countries, but which are now produced in the United Kingdom. It is an impressive reminder to all of the great advance made in the production of articles of prime importance for the home and foreign markets hitherto obtained from other countries. The exhibits cover a wide range, and include chemical products and processes, physical and electrical appliances, optical apparatus, measuring and mechanical instruments, surgical, bacteriological, and pathological appliances, including X-ray apparatus, etc. In practically all the sections the degree of progress indicated by the exhibits is surprisingly great, and even where no striking development has occurred in the way of new invention, there is noticeable a marked general improvement in apparatus constructed on the recognised lines of pre-war days.

Interest naturally centres round those exhibits associated with aircraft production. Here the developments and the differences between present-day aeroplanes and those of a few years ago are clearly marked. Modern spars, for instance, are much stronger for a given weight, engines have been developed as regards both material and construction to the extent of reducing their weight by more than one-half, whilst the size and power have grown enormously and are still making advances. The metallic materials which have been produced since the outbreak of the war, and of which aircraft constructors have been able to avail themselves, have made it possible for the greater part of an aero-engine to be made of light alloys. In non-metallic materials the investigation of timber has led to some interesting results. With regard to the many fittings which go to make up the complete aeroplane, one item of outstanding interest is the magneto. Before the war the Germans had practically a monopoly in the manufacture of this article for both car and aeroplane use, the Bosch magneto undoubtedly being the most popular throughout the world. The war has changed that, and the British manufacturers have seen to it that the home-built magnetos are worthy of their name. There are now nine British firms engaged in this work, with the result that during the past four years 300,000 magnetos have been manufactured for war service alone. What is equally important is that the home-made magneto is now as good as, or even superior to, the previously imported Bosch machine. The development of dope for the fabric of aeroplanes has been the subject of many investigations, and the planes of the present-day machine are rendered taut and weather-proof by means which, though slightly more complicated than varnishing, are many times as efficient. The British dopes consist of a solution of cellulose acetate made from paper or some cheaper form of cellulose, or of guncotton dissolved in suitable solvents and diluted in order to reduce the solution to a workable viscosity.

Another direction in which this country was largely dependent on Germany and Austria was in carbons for arc lamps. Fortunately, one British firm undertook the manufacture of such carbons, and through its foresight and enterprise we are now in a position to be self-supporting in this direction also.

During the war much progress has been made in the manufacture of insulation and of resistance wires, both of which were largely imported from Germany. The same is true of electro-medical apparatus. The examples of these displayed at the exhibition show that British manufacturers are capable of supplying our needs and of producing thoroughly sound products. We may pass over the interesting display which furnishes a fine example of successful British production on scientific lines of instruments of a high standard, and of the exhibits of refractory materials, in which direction progress has been very marked during the past four years. This is another industry which has been established here; and with proper care British manufacturers should be able to maintain their positions in this trade after the war.

Before the outbreak of war lens-grinding machinery was either made by the individual user or imported from abroad. Now such machinery, at least equal to any imported machines, is available in sufficient variety to cover all the ordinary types of work. At the same time entirely new methods of working glass have been developed and brought into ordinary use. Some of these methods are particularly well adapted to the manufacture of standardised optical systems. The most striking development in this respect has been the way in which enormous numbers of prism binoculars, sighting and other small telescopes, have been made to meet the demands of the military and naval authorities.

The gradual awakening of the British glass industry since the early days of the war, as revealed by the exhibition, is a feature which deserves particular mention. The two immediate needs were chemical glass and optical glass. Let it be said to the credit of British industry that in regard to optical glass a well-known British firm near Birmingham started the manufacture of this in 1848 and kept it alive at considerable pecuniary sacrifice. Since the outbreak of war this firm's output has increased twenty-fold. Up to nine months after the outbreak of war there was no general and active movement among manufacturers to take up new work. Since then steps have been taken to speed up glass manufacture in general, and from the beginning of 1916 the trade has rapidly progressed from a state of dependence or doubt to one of determined optimism. The exhibition provides some measure of the material results of the reawakening of the glass industry in this country.

The Munitions Inventions Department of the Ministry of Munitions exhibits some of the results which have accrued from the research undertaken on the nitrogen problem. This takes the form of a unit plant for the oxidation of ammonia to oxides of nitrogen. This process was not in extended use outside Germany before the outbreak of war, but there is reason to believe that the Germans have relied on it very largely for their output of nitric acid for explosives, as well as in the manufacture of sulphuric acid by the chamber process, as a substitute for Chile nitrate, which, owing to our blockade, they have been unable to obtain. The method is now in use in this country, and several large firms, such as Brunner, Mond, and Co., Ltd., and the United Alkali Co., Ltd., are using apparatus similar to that shown. The apparatus is on view continually during the period of the exhibition. Demonstrations are given by an officer of the Munitions Inventions Department on Wednesdays at 4.30 p.m.

In a preliminary review of the exhibits which will be displayed at King's College until September 7 it is difficult to do more than give an outline of the development which has been achieved under the pressure of war conditions. For instance, much can be said about the development of the dye industry, which was so backward in this country prior to 1914 that the outbreak of war disclosed a dependence on Germany for our supplies of dyes that was little short of appalling. The serious position in which we were placed is evident when it is realised that our trade in cotton and woollen goods, as well as the requirements for leather staining and a multiplicity of minor industries, could be carried on only with the aid of these essential materials. How the difficulties have been overcome and the dye industry and industries associated with it placed on a firm footing will provide a most interesting chapter in the industrial history of these days. What has been achieved can be seen at King's College, and is certainly worthy of attention. Dependent upon the dye industry is that of drugs and fine chemicals, and the progress made during the war has rendered the Empire self-supporting in regard to its supplies of these essential articles.

The aim of the exhibition is to stimulate public interest and confidence in the capacity of British science combined with industrial enterprise to secure and maintain a leading place among progressive nations; and the object is the full development of our mental and material resources. It has been popularly assumed that useful scientific work was almost a prerogative of Germany, whereas a slight acquaintance with scientific history would show that most modern industries have originated with British science and invention. In purely scientific research of initiative quality we have been the pioneers; where we have been deficient is in the practical use of the results obtained and the application of our natural scientific genius to the solution of industrial problems. In order to ensure that full use is made of our capacity in this respect in the future, it will be necessary to provide for the training and employment of many more scientific technologists than have hitherto been available in this country. The adequate supply of highly trained scientific workers and technologists is, indeed, a matter of the utmost gravity and urgency, and upon it undoubtedly depends the prosperity and safety of the country after the war, as well as the development of the natural resources of the Empire and the production of our industries on a scale greatly in excess of anything we have hitherto achieved. The Education Act has provided for elementary and continuative education by which the rank and file will be equipped for the struggles of the future, but from the point of view of industrial development it is even more important to secure a supply of highly trained captains of industry and pioneers of applied science. Modern progress in industrial and commercial fields depends upon these leaders, and the State that neglects the training of them in adequate numbers cannot expect to maintain a high place among the progressive Powers of the world.

## THE ERUPTION OF KATMAI.[1]

THE Katmai expeditions of the National Geographic Society, under the leadership of the present writer, have been exploring the district devastated by the great eruption of Katmai in 1912. As knowledge of this eruption increases, it becomes more and more apparent not only that it was one of the greatest of all eruptions, but that it had many peculiarities which set it apart in a class by itself, without parallel in historic times.

Until the eruption in 1912 there were no definite records of activity in the Katmai district since the occupation of the country by white men, although the natives reported that some of the volcanoes "occasionally smoked." The district was so little known that, so far as can be learned, the volcano was never photographed before the eruption. Fortunately, however, its altitude was precisely determined and its configuration was roughly indicated by contours on the United States Coast and Geodetic Survey's chart of the district. Before the eruption the volcano was a three-peaked mountain rising nearly 7500 ft. above the broad valley of Katmai River, which stretched from the sea inland to the very foot of the mountains.

In the eruption the whole summit was blown away, and in its place was left an enormous crater. The preliminary explorations of the National Geographic Society's expedition of 1916 revealed the general condition of the volcano, and indicated that this crater was of enormous size. In 1917 the whole area was mapped on a scale of 1 : 250,000, following the methods and standards of the United States Geological Survey. This survey showed that Katmai is the largest active crater in the world, surpassing Kilauea, which had previously laid undisputed claim to this distinction, in every dimension. The comparative measurements are:—

| | Katmai | Kilauea |
|---|---|---|
| Length ... ... | 3·0 miles ... ... ... ... | 2·93 miles |
| Width ... ... | 2·75 ,, ... ... ... | 1·95 ,, |
| Circumference | 8·4 ,, ... ... ... | 7·85 ,, |
| Depth ... ... | 3700 ft. ... ... ... | 500 ft. |
| Cubage... ... | About 2·0 cubic miles ... | 0·4 cubic mile |

Because of its much greater depth, the crater of Katmai forms a much more awe-inspiring spectacle than that of Kilauea. The two are, however, so different in character that they are scarcely comparable. The bottom is occupied by a lake of hot water, through which emerges a single-breached cone, the remnant of the last spasms of the great eruption.

The violence of the explosion was so great that the whole of the tremendous mass thus thrown off the mountain was reduced to fine fragments. No rocks or cinders of large size are to be found anywhere among the *débris*. The largest piece of pumice observed among the ejecta from Katmai is less than a foot in its longest dimension. A further consequence of the violence of the eruption was the very wide distribution of the ejecta. On the crater-rim the depth of the deposit was only 45 ft., less than in many a minor eruption. But Kodiak, a hundred miles to the eastward, was covered by about a foot of ash, while appreciable falls, accompanied by the corrosive fumes of sulphuric acid, were detected so far away as Victoria, B.C., more than 1600 miles distant. Worldwide atmospheric effects were also observed, but these were much less pronounced than after the explosion of Krakatoa.

But in the great mantle of ash and pumice thrown out over a wide expanse of country Katmai far sur-

*Photo*] [*D. B. Church*

FIG. 1.—Mount Katmai, the greatest of active volcanoes, after the eruption of 1912. The whole of the former three-peaked top was blown away in the explosion of June, 1912, and in its place is left an enormous crater three miles long, the rim of which forms the present crest of the mountain.

[1] Copyright in the United States of America.

passed Krakatoa. The study of the return of vegetation to these ash-covered areas was one of the primary objects of the expeditions, which have laid out about a hundred vegetation stations, wherein the progress of returning vegetation can be accurately observed. From some of these stations photographs and records have already been obtained for three years.

At Kodiak, and wherever the ash-fall was less than 2 ft., an abundant growth of plants has come up through the ashy covering from old roots, resulting in an almost miraculous recovery of vegetation. But where the ash-fall exceeded 3 ft. none of the old plants were able to penetrate the ashy blanket, although there is abundant evidence that they survived the fury of the eruption even on the slopes of the volcano itself.

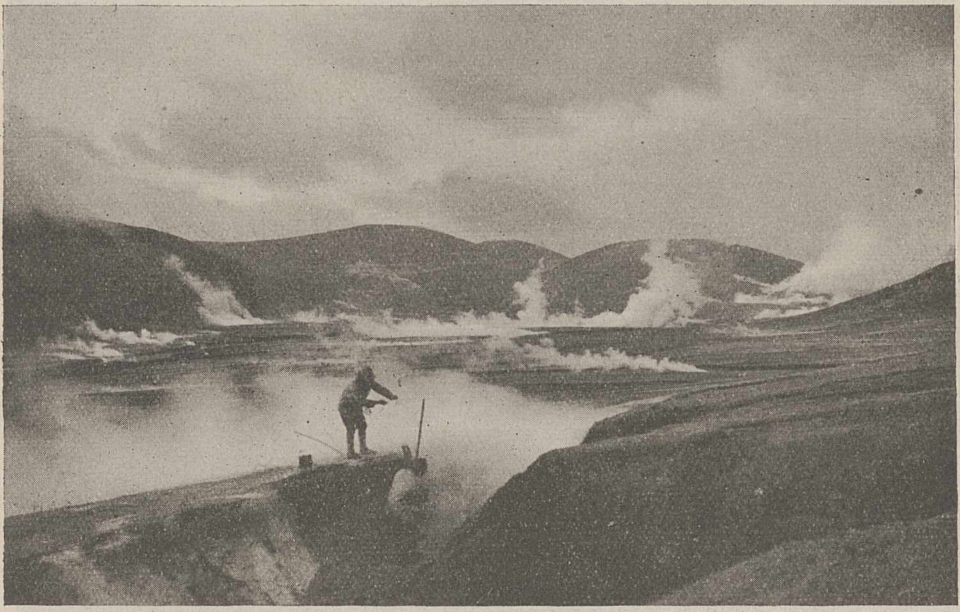
There are, therefore, large areas which were denuded of both plant and animal life and rendered absolutely sterile by the eruption. These present an unparalleled opportunity for the study of the conditions necessary for the establishment of life on a raw mineral soil without humus or organic matter of any sort. In 1917 chemical and bacteriological studies of the condition of these soils were carried out by J. W. Shipley and Jasper Sayre respectively, in addition to the botanical investigations of the previous expeditions. The zoologist of the expedition, James S. Hine, made extensive studies of the animal life, especially the insect fauna, in the uninjured district to one side of the devastated area. It is expected that the results of these and other investigations will be issued in a series of technical papers to be published in the *Ohio Journal of Science* as soon as they are completed.

But the most sensational, as well as the most important, of the results of the expedition was the discovery of certain phenomena concomitant with the eruption of Katmai, which are even more interesting than the explosion itself.

The most striking of these is the Valley of Ten Thousand Smokes, which occupies an area of about seventy square miles north of Mount Katmai. Before the eruption this was a system of grass-covered valleys with no sign of volcanic activity. Now it is traversed by hundreds of fissures extending along its margin or criss-crossing its floor. These fissures are the seat of several millions of volcanic vents of all sizes, from great volcanoes pouring forth columns of vapour more than a mile high, down to minute jets of gas which pass unnoticed amongst their greater neighbours. This valley was discovered by the Geographic Society's expedition of 1916; but it was not possible to explore it until 1917, when its study was the principal objective of the party. Four weeks were spent within its confines in the past season; but it cannot be said that its study was more than well begun, so numerous and varied are its phenomena.

In the cataclysm by which the present condition of the valley was produced all traces of the vegetation which formerly clothed its sides were destroyed, so that there remains no wood for use as fuel or otherwise. But it was found that one of the small fumaroles furnished a very acceptable substitute for a cooking-stove. The whole area is so broken up and permeated with escaping vapours that it was impossible to find a cool spot for a campsite. A thermometer inserted in the ground 6 in. below the floor of the tent promptly rose to the boiling-point.

By analogy with other regions, it was expected that hot springs and geysers might be found accompanying the gas-emitting volcanoes, but such are altogether absent. The study of the conditions of the valley showed that their presence is impossible by reason of the high temperatures prevailing throughout the area. The vents are so hot that they would instantly vaporise any water that might reach their throats. The expedition, not expecting such high temperatures, was not equipped with the pyrometers necessary for their measurement. All the major vents were hot enough to boil mercury, but how much hotter they

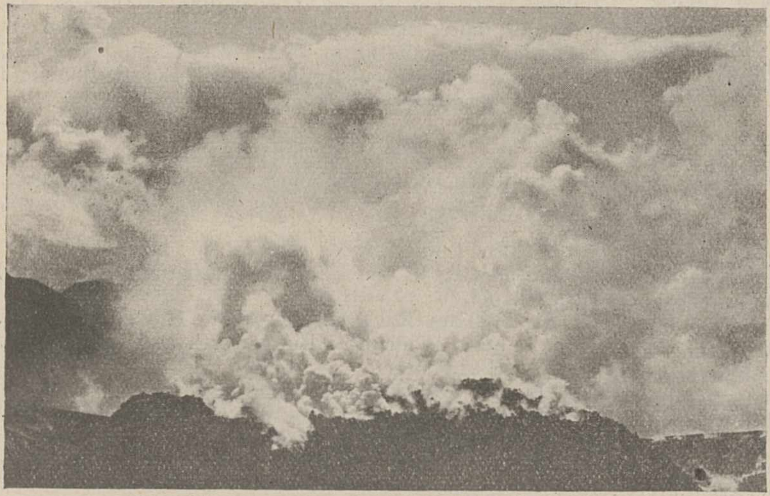


*Photo*] [*D. B. Church*

FIG. 2.—A corner of the Valley of Ten Thousand Smokes. The "cookstove" at which the members of the expedition prepared all their meals is in the foreground.

are than that it is impossible to tell until further observations have been made.

Collections of the gases from the volcanoes were made for study by the Geophysical Laboratory of the Carnegie Institution. The conditions of emission are such that the valley offers a unique opportunity for the collection of volcanic gases without danger of contamination with the atmosphere. Samples from representative vents were taken, both in vacuum tubes and by pumping the gases through tubes filled with barium hydroxide. Observations on the ground were sufficient to indicate the presence of a considerable variety of gases. The vents likewise produce a great variety of solid deposits. These are of all colours of the rainbow, and represent a considerable diversity of chemical composition. Their study is likewise being prosecuted by the Geophysical Laboratory.



*Photo*] [*R. F. Griggs*

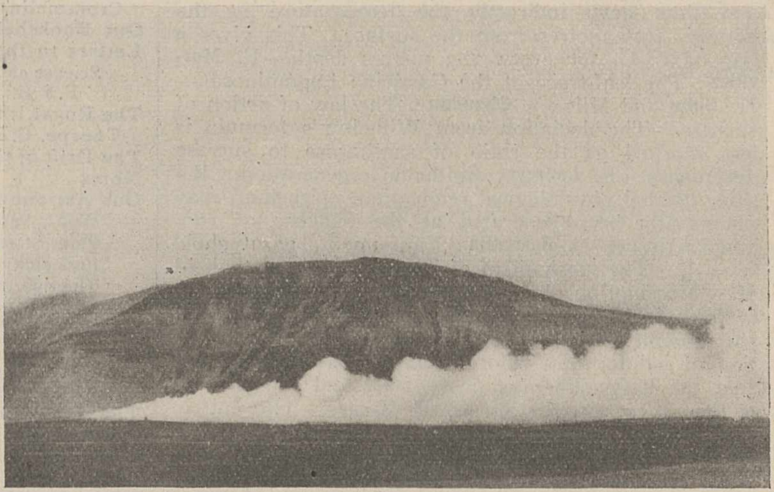
FIG. 3.—Novarupta Volcano. The column of dust and vapour from this great volcano, which has burst up through the sandstone floor of the Valley of Ten Thousand Smokes, often obscures the sky for miles around.

It is not possible, in advance of the completion of the analyses now under way, to give a definite statement concerning the chemistry of the vents. But the field observations on the volcanoes, on the temperatures of the vents, and on the character of their emanations and sublimations make it manifest that the Valley of Ten Thousand Smokes is not a superficial phenomenon due to the cooling off of a hot body of ejecta or some such circumstance. It is clear, rather, that its fumaroles are truly volcanic vents furnishing avenues of escape for an immense body of magma lying somewhere beneath the surface. What the relations of this mass of magma may be to the explosion of Katmai and to the geology of the country round about are problems which must await further study.

But while the phenomena of this district present a unique opportunity for the study of some features of volcanism not hitherto revealed, its remarkable character is destined to appeal to a wider circle than that comprised by scientific vulcanologists.

As a spectacle of the action of the grandest of all the forces of Nature, the Valley of Ten Thousand Smokes is so far beyond anything else known to us on the globe as to make it quite certain that it will rank as the first wonder of the world when once its remarkable features are understood by the public. For here, continually rising quietly from the ground without explosive action of any sort, is more vapour than is given off by all the rest of the world's volcanoes put together (except during a period of dangerous eruption). The majesty of the sight presented by its myriads of steam columns, gracefully circling up from the ground to mingle with the common cloud which habitually hangs over the valley, is a matchless and awe-inspiring spectacle. No pictures or descriptions, interesting as they may be, can convey the slightest conception of the beauty and magnitude of this wonder of wonders.

At the present time this Valley of Ten Thousand Smokes is so difficult of access that the only human beings who have ever set foot in it are the members of the National Geographic Society's expeditions. But this difficulty is due not so much to its remoteness from ordinary means of travel as to the generally primitive and unsettled condition of the part of the world in which it lies. Were means of transportation provided, it would be quite possible to land from an ocean liner in the morning and cover the whole of the district in a single day by automobile. It would, of course, require a longer period to see its manifold wonders, and the readers of NATURE will, I am sure, be glad to know that the first steps towards making it accessible are now being taken.



*Photo*] [*R. F. Griggs*

FIG. 4.—One of the Ten Thousand Smokes. The man seen standing silhouetted against the cloud near the vent gives an idea of the magnitude of the vent.

ROBERT F. GRIGGS.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE have received a copy of the prospectus of the Merchant Venturers' Technical College, which provides and maintains the faculty of engineering of the University of Bristol, and we note that the courses include schemes of study for persons intending to engage in civil, mechanical, and electrical engineering. The department of automobile engineering has been closed for the duration of the war, as the professor of that department is doing important work in connection with munitions.

## SOCIETIES AND ACADEMIES.

PARIS.

**Academy of Sciences,** July 29.—M. Ed. Perrier in the chair.—G. **Humbert**: Ternary indefinite quadratic forms.—J. **Boussinesq**: The fundamental formula of Tresca for punching a cylindrical block of lead.—G. **Bigourdan**: Delisle at the Hôtel de Taranne; Lalande, Bailly, and Coulvier-Gravier at the Luxembourg.—M. **Balland**: The use of lime-water in the preparation of munition bread. An account of some experiments made in 1917 by order of the Minister for War on the use of lime-water in bread-making.—P. **Bruère** and Ed. **Chauvenet**: Zirconium nitride. Starting with the ammonia compound of zirconium chloride, $ZrCl_4.4NH_3$, a rise of temperature gives successively the amide, $Zr(NH_2)_4$, the imide (impure), $Zr(NH)_2$, and finally, at about 350° C., the nitride, $Zr_3N_4$. This last appears to be the only nitride, and no evidence of the compounds $Zr_2N_3$ and $Zr_3N_8$ has been obtained.—M. **Verzat**: The measurement of temperature in very deep soundings. Two thermometers were cut at a temperature (40° C.) lower than that expected; after remaining at the bottom for an hour they were raised, and some mercury was found to have escaped. Comparison with a standard then showed the temperature (62·5° C.) at which the mercury exactly filled the tube, and thus gave indirectly the temperature at the bottom, 1616 metres from the surface. This gives a rise of 1° C. for every 32·3 metres depth.—F. **Morvillez**: The leaf-trace of the Cæalpine Leguminosæ.—H. **Colin** and Mlle. A. **Chaudun**: The law of action of sucrase. The deviation from Wilhelmy's formula is less marked as the ratio of saccharose to sucrase diminishes.—F. **Ladreyt**: Epithelial regeneration. Besides normal physiological renovation, epithelium may abnormally be regenerated at the expense of conjunctive tissue.—A. **Besredka**: Experimental paratyphoid fever B. The mechanism of immunity in paratyphoid B. Vaccination by the mouth.—H. **Bordier**: A radio-therapic unit of quantity. The unit is based on the amount of iodine set free from a 2 per cent. solution of iodoform in chloroform. It has been proved that the iodine liberated is regular, and proportional to the time of irradiation by the X-rays. The unit is then defined as the quantity of X-rays capable of setting free 0·1 milligram of iodine in 1 c.c. of a 2 per cent. solution of iodoform in chloroform, thickness 1 cm., and in the dark.—A. **Paine** and A. **Peyron**: Seminome of the testicle of the rabbit, with graft and generalisation to the second generation.

VICTORIA.

**Royal Society,** May 9.—Mr. J. A. Kershaw, president, in the chair.—G. F. **Hill**: Relationship of insects to parasitic diseases in stock. Part I. Life-histories of three nematode parasites of the horse, *Habronema muscae, H. microstoma*, and *H. megastoma*. Part II. Certain points in the life-history of *Melophagus ovinus*, the sheep "louse-fly" or sheep "tick."—F. **Chapman**: Ostracoda from the Upper Cambrian Limestone of South Australia. Three new species of Leperditioid Ostracoda are described from the Archæocyathina Limestone of Curramulka, namely, *Leperditia tatei, L. capsella*, and *Isochilina sweeti*. *L. tatei* has its nearest analogue in *L. anna* of the Upper Cambrian of St. Ann's, Canada, whilst *L. capsella* bears a certain resemblance to *L. canadensis* of the Canadian Lower Palæozoic. The species of Isochilina is of large size (length more than 7 mm.), and has a general resemblance to some forms of Aristozoe (cephalic region), but is a true Ostracod from its swollen proportions and thickly calcified carapace.

## BOOKS RECEIVED.

Studies in Electro-Pathology. By A. W. Robertson. Pp. viii+304. (London: G. Routledge and Sons, Ltd.) 12s. 6d. net.

Wealth from Waste. By Prof. H. J. Spooner. Pp. xvi+316. (London: G. Routledge and Sons, Ltd.) 7s. 6d. net.

Sir William Ramsay. By Prof. T. C. Chaudhuri. Pp. ix+66. (Calcutta: Butterworth and Co. (India), Ltd.) Rs.1.8 net.

On the Determination of the Principal Laws of Statistical Astronomy. By W. J. A. Schouten. Pp. 128. (Amsterdam: W. Kirchner.)

Modern Dyeing Methods. By C. M. Whittaker. Pp. xi+214. (London: Baillière, Tindall, and Cox.) 7s. 6d. net.

Industrial Electrometallurgy, including Electrolytic and Electrothermal Processes. By Dr. E. K. Rideal. Pp. xii+247. (Baillière, Tindall, and Cox.) 7s. 6d. net.

The Science of Health and Home-making. By E. C. Abbott. Pp. xv+302. (London: G. Bell and Sons, Ltd.) 3s. 6d. net.

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