THURSDAY, OCTOBER 25, 1917.

A RETROSPECT OF MODERN BRITISH SCIENCE.

The Cambridge History of English Literature. Edited by Sir A. W. Ward and A. R. Waller. Vol. xiv., *The Nineteenth Century.* Pp. xii + 658. (Cambridge: At the University Press, 1916.) Price 9*s.* net.

THIS the concluding volume of the great history of English literature produced by the Cambridge University Press, on the "collective responsibility" of the Master of Peterhouse and Mr. A. R. Waller, of the same college, contains a chapter of nearly fifty pages devoted to the literature of science in the eighteenth and nineteenth centuries. For this chapter, science is scheduled in three bibliographies grouped under physics and mathematics, chemistry, and biology respectively. The chapter is accordingly given in sections with those headings. Mr. Rouse Ball contributes the section on physics and mathematics, Mr. Pattison Muir that on chemistry, and Dr. Shipley, Master of Christ's, that on biology.

The sections on physics and mathematics and on chemistry are disappointing, for different reasons in the two cases. The development of physical science in the nineteenth century, as it appears in scientific literature, is a most attractive subject for an essay. It began with the law of conservation of matter and the atomic theory; it found the law of conservation of energy in its middle course; and in the end offered us unlimited possibilities for new views of the physical universe in the story that radiation was made to tell, in its many forms, some new, some old. We are carried on to new ideas of the constitution of matter and the exploitation of the energy of atoms. Mr. Ball does not show us the reflection of this moving picture in the English literature of the century. After leading up to Whewell and the British Association, he gives us silhouettes of Faraday, de Morgan, Boole, Rowan Hamilton, Sylvester, Adams, Cayley, Henry Smith, Green, Stokes, Kelvin, and Maxwell, with passing shadows of a few other names. No one would suppose from reading the chapter that the great principle of the conservation of energy was a subject of lively discussion almost within the author's personal experience.

Nor among the achievements in physics of the nineteenth century is any place found for solar and stellar physics. Whewell would have taken a wider view of physics because it is still an inductive science. Mr. Ball's mental process is plain enough. "Faraday was recognised as an exceptional genius, and time has strengthened the recognition of his claim to distinction; but, in general, theoretical physics had, by now, become so closely connected with mathematics that it seemed hardly possible for anyone without mathematical knowledge to make further advances in its problems." It is a very limited science that can live on the "advancement of *its* problems." Physics had a very different kind of career in the nineteenth century. The new problems added by experiment are quite as impressive as the advancement of the old. For some reason not given, "with observational and practical astronomy we are not here concerned," and with astronomy go the other observational branches of physical science. So the name of Sabine does not appear, and Huggins is only accessible to the reader by a reference to Miss A. M. Clerke's books.

One other of Mr. Ball's sentences must be quoted. "Faraday had been brought up in humble circumstances, and his career is interesting as an illustration of the fact that, in England, no door is closed to genius." Surely that is a misreading of history. What one gathers from Faraday's career is that in all England there was just one door open to his genius, and he knocked at the right one. If he had knocked at the Cambridge door instead, or at any other door, he would have found thirty-nine articles, at least, in his way. Instead of sunny complacence at the perfection of our arrangements, the circumstance seems to suggest a shudder at a very narrow escape. No doubt Adams, Stokes, and Cayley would have gone on the even tenor of their way in any case, but the literature of science might have been quite different if Faraday had missed the unique opportunity afforded to him by Davy at the Royal Institution. How many Faradays have remained mute and inglorious because doors were closed does not appear in the literature of science.

The literature of chemistry is also disappointing, but for another reason; there are great names in the story which is skilfully woven by Mr. Pattison Muir, but how few! Priestley, Black, Dalton, Cavendish, Davy, Faraday, Alexander Williamson, Frankland, Graham. We can add Roscoe, Perkin, and Ramsay, who have passed away more recently. During a hundred and fifty years we seem always to have been able to produce a chemist of the highest distinction, but always in comparative isolation.

Dr. Shipley's contribution, in a style which is embroidered with gentle gossip, carries us through the botany of the eighteenth century, the establishment of public museums, of scientific societies, including the British Association, and of scientific journals, to the period of scientific exploration which gave Sir Joseph Banks his opportunity and culminated in the *Challenger* expedition, before he settles down to the biological literature of the nineteenth century. A rapid survey of the work of the leading geologists and zoologists, with a well-merited note on the contribution of Sir F. D. Godman, erroneously printed as Goodman, and Osbert Salvin, leads up to the doctrine of evolution, the origin of species, and the work of Darwin and Wallace and Huxley. The more recent developments are only lightly touched upon.

But there is much more in the volume that will interest men of science than the single chapter which is specifically devoted to the literature of science. The whole volume is full of interest. In Prof. Sorley's chapter on philosophers and in one by Mr. F. A. Kirkpatrick on the literature of travel we meet a number of scientific names in circumstances in which physical and biological science find much of their primary impulse for research. Prof. J. W. Adamson contributes a most valuable chapter on the history of education; and, finally, a chapter on the changes in the language since the time of Shakespeare, by Mr. W. Murison, may be commended to all those who are interested, as all of us ought to be, in the literary exposition of scientific work.

THE RARER ELEMENTS.

Introduction to the Rarer Elements. By Dr. P. E. Browning. Fourth edition, thoroughly revised. Pp. 250. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7s. net.

WE are pleased to find that in spite of the unrest of the present time it has been possible to publish a fourth edition of the above well-known work. Browning's Introduction to the study of the rarer elements was first published in 1903 as a hand-book for the use of students. The work was successful from the first; a second edition appeared in 1908, and a third in 1912. Since then many new facts have been established, and the present issue has been revised and brought up to date, forming a valuable book of reference for practically all that is known about the history, sources, and properties of the rarer elements; numerous reactions are included that will help in the separation and analysis of these little-known bodies.

The general plan of the work is to give particulars of the discovery, occurrence, extraction, and properties of each element, etc., and to conclude with some practical laboratory work; although the author disclaims any attempt at exhaustive treatment, the student will find much valuable information in its 250 pages. It may be a little startling to the English reader to find in the index to the literature of the subject that, out of twenty-five references quoted, fifteen are American, seven German, two French, and one British! It is only fair, however, to note that most of the American references are from the Smithsonian Collection of Miscellaneous Papers.

All the rarer elements, including the rare earths and the rare gases of the atmosphere, are detailed, and a special chapter is devoted to the radio-elements. This latter section, contributed by Prof. B. B. Boltwood, is brief and is confined to the well-established data and reactions of these interesting bodies, and their position in the periodic table. The significance of atomic numbers and the theory of isotopes are also discussed.

In this chapter a good deal of new matter is introduced; among other things it is stated that "the chief source of radium has been the minerals containing a higher proportion of uranium, principally carnotite, and the present supply has been largely obtained from the carnotite ores of south-western Colorado." We rather hesitate to endorse this. Carnotite is a uranium-potassium-vanadate, and authoritative analyses of picked specimens give about 60 per cent. uranium; but the records of the Bureau of Standards, Washington, show that the commercial ores that are being worked do not contain much more than 2 per cent. uranium. On the other hand, the pitchblende deposits of St. Joachimsthal give 60 per cent. to 80 per cent. U_3O_8, and those from Cornwall and other localities are of the same character.

In the section devoted to spectroscopic reactions, a spectrogram is given of certain gallium and iridium products; this illustration may be of interest from the point of view of pure research, but as a spectrum reproduction it falls very short of what it is possible to do at the present day. The same must be said of the set of six examples of the absorption spectra, of didymium, erbium, etc.; some of these have scales of wave-length that are difficult to read, others are so bad that their value is quite lost, while the erbia series has no scale at all, and in the table of spark spectra of sixteen elements an arbitrary scale is used—this scale could have been given in Ångström units, which would have added greatly to its value. The list of wave-lengths of the dominant arc and spark lines of the elements is a very good feature and of real value.

A short chapter is devoted to "some technical applications," and many of the more prominent uses to which the rarer elements have been applied are described. This is an exceedingly important section. When we consider that from this group of bodies, many of which but a few years ago were quite unknown and others simply regarded as chemical and mineral curiosities, have come the incandescent mantle, the metal filament lamp, the pyrophoric alloys, the new steel alloys that are playing such a prominent part in ordnance, naval construction, and engineering, the production of X-rays as in the Coolidge tube, and a host of other minor applications, it must become evident to the most casual observer that the study of these substances gives promise of very substantial reward.

It does not seem too much to suggest that the application of the rarer elements may, in the near future, rival in value the coal-tar and other industries that are at the moment occupying so much attention.

A very interesting diagram is given showing at a glance the chief associates of the rare elements in natural and commercial products, but for some reason that is not clear the radio-elements have been left out of this scheme.

We congratulate the author upon the original form of index that has appeared in the last two editions—a device of very great convenience. Against each element is noted the page where the discovery, extraction, compounds, separation, experimental work, spectrum, and technical application are to be found: this enables one to put one's finger in a moment upon any subject needed and is of the greatest convenience.

J. H. GARDINER.

THE STUDY OF LIFE.

The Study of Animal Life. By Prof. J. A. Thomson. Revised edition. Pp. xvi+477. (London: John Murray, 1917.) Price 6s. net.

"FOR about a quarter of a century this book . . . has had an apparently useful life as an introduction to zoological science." With these words Prof. J. Arthur Thomson begins his short preface, and he is well and handsomely entitled to them. The book is not a large one, but it abounds in information, and the author sets it all forth in an easy way, with the practised skill of an old hand at teaching. The first part contains a few eloquent chapters on such themes as the "Wealth of Life," the "Web of Life," and the "Social and Domestic Life of Animals," and closes with a slighter sketch of the physiological functions and activities of the body; the second part, which is copiously illustrated, deals with structure and classification; the third, in like manner, with embryology; and the fourth and last with the facts and theories of evolution.

The array of facts is remarkable, and not less so is the immense number of recent or current theories which are dealt with or touched on in the book. Lamarck and von Baer, Spencer and Haeckel, Galton, Mendel and De Vries, and a hundred more, all find their place in a brief historic survey; they are all duly honoured, and occasionally criticised—but the book is not written for the sceptic. In writing a chapter on "Vitality" (as Prof. Thomson does not shrink from doing) he calls in a little host of thinkers and philosophers to help him—Huxley and Haeckel, Clifford and Joly, Child and E. S. Russell and Driesch; he leans in the end to views which he himself has done much to promulgate: "that we require ultra-material, notably *historical,* concepts for describing organisms. For the organism is a psycho-physical individuality (a mind-body or body-mind) which has enregistered within itself the gains of experience and experiment and has ever its conative bow bent towards the future."

In all popular books, however good they be, even as this one is, there is an inevitable tendency to make use, without more ado, of old familiar elementary statements, which are by no means always sound; just as the classical scholar, for instance, is (or used to be) too apt to take his texts for gospel, and to shirk the weary work of searching manuscripts. There is at least one such case, I think, where Prof. Thomson falls into error—in regard to the very common and familiar subject of the retraction or "sheathing" of a cat's claws; at the same time, if he offends, he does so in good company. His drawing (on p. 35) is a familiar one, closely resembling Mivart's, but it is not accurate; the figure "III.," for the third phalanx, points to the head of the second. But, and this is the important thing, Prof. Thomson explains the mechanism by saying that "the claw is retracted into its sheath—an adaptation for keeping it sharp when the animal is at rest or is simply walking." In like manner, Huxley talks of the claws being "completely retracted within the sheaths of the integument, when the animal does not desire to use them"; and Max Weber speaks of "die in der Haut zurückziehbaren Krallen, wodurch sie scharf bleiben." But the fact is that the "sheath" is a very unimportant, if not wholly superfluous, part of the mechanism. Owen and Mivart do not mention it at all. It is a mere ruckle of skin, which neither covers nor protects the sharp point of the claw. John Hunter describes it with perfect accuracy: "The skin which covers the last phalanx is very loose; and when this phalanx is drawn up or back, the skin covers a great deal *of the root of the claw.*" But the really important fact is (as John Hunter was, I think, the first to show) that the last phalanx, claw and all, is crooked up or back, in a state of over-extension; so that the claw *is raised off the ground*—almost precisely as the hammer in a pianoforte is raised off the string.

D. W. T.

OUR BOOKSHELF.

The Cancer Problem: A Statistical Study. New edition. By C. E. Green. Pp. ix+140. (Edinburgh and London: W. Green and Son, Ltd., 1917.)

IT is well known that the incidence of cancerous diseases varies considerably in different districts and in different occupations. In this book Mr. Green has attempted to find some factor which will explain this difference in incidence, and he has critically examined the local distribution of cancer in different districts, particularly in Scotland, and the conditions which obtain in those districts. He finds that cancerous districts, as a rule, are particularly associated with the burning of coal as fuel, while in the non-cancerous ones wood or peat is the staple fuel. Thus in Nairnshire, which has the highest mortality figure from cancer in Scotland, the cancer deaths for the last ten years are confined to a definite area, while the rest of the county (100 square miles) is entirely free, and in the cancerous area coal is entirely or partially used as fuel, while in the non-cancerous area peat is universally used. The same holds good for other parts of the country. Thus, in the Orkneys, which, as a whole, have a cancer mortality slightly above that for Scotland, Stenness has a cancer death-rate of 1 out of 42 from all causes and peat is the only fuel, while in Sanday, where coal alone is burned, the cancer death-rate is 1 out of 9 from all causes. A strange anomaly, however, was met with. In Birsay and in St. Andrews, in the Orkneys, the cancer mortality is practically as great as in Sanday, yet peat only is burned. Investigation showed that the peat used in these two districts is peculiar, being hard and stony and having a high content of sulphur like coal. From these and other facts the author concludes that a high sulphur content of the fuel is the factor correlating it with cancer. It must be admitted that the array of facts and figures produced by Mr. Green entirely favours his main proposition, and it is difficult to arrive at any other conclusion.

With considerable ingenuity Mr. Green applies his hypothesis to explain the incidence of cancer in certain occupations and in certain localities, and attempts to formulate an explanaton as to how sulphur compounds may give rise to cancer. Here he is on much less sure ground, and this part of the subject may well be left for the present. The book is illustrated with maps and diagrams, and is very readable and interesting.

R. T. HEWLETT.

A German-English Dictionary for Chemists. By Dr. A. M. Patterson. Pp. xvi+316. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 9*s*. 6*d*. net.

DR. PATTERSON has filled what has long been an irritating lacuna in the average chemist's library. Certain scientific and technical terms are by no means easy to translate from the German, and recourse to the dictionary usually available is generally hopeless. The book under review should therefore be eagerly welcomed by the steadily increasing number of young chemists in England and America and by those who, even if they have already a good working knowledge of the language, are occasionally at fault. Not only is it a good general dictionary of the German language, but it contains also a very complete collection of chemical terms belonging both to the pure science and to technology.

The book is prefaced by a useful introduction explaining, for example, the new official German spelling, and giving a short but valuable account of the special points of German chemical nomenclature and how they should be rendered into English according to the rules of the London and American Chemical Societies. It does not seem at all unnecessary, also, that the author should point out the danger of confusing chemical endings and case-endings; thus the student is often apt to translate "ketone" by "ketone" instead of "ketones."

Past participles, preterites, and present third singulars of simple verbs are a very convenient inclusion.

The book is clearly printed, the German being in roman type.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, February–July, 1917. Edited by R. M. Milne. Pp. 32. (London: Macmillan and Co., Ltd., 1917.) Price 1*s*. 3*d*. net.

MATHEMATICAL masters who prepare Army candidates for their entrance examinations will be glad to be able to procure this year's questions in this handy form, before they are incorporated later in Mr. Milne's large volume of examination papers.

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.*]

Transparency of the Atmosphere for Ultra-violet Radiation.

IT is well known that the solar spectrum, even when observed from a mountain-top, so that there are fewer than four miles of "homogeneous atmosphere" overhead, does not extend so far as λ 2900, however long an exposure is given. It has further been long suspected that absorption by ozone is the cause, as originally suggested by Hartley. Perhaps it may be claimed that the recent work of Prof. A. Fowler and myself (Proc. Roy. Soc., A, vol. xciii., p. 577, 1917) leaves little or no room for doubt that this is the true explanation.

As a sequel to the work just mentioned, I have photographed the spectrum of a mercury-vapour lamp four miles distant, and found that it extends as far as the line λ 2536, and perhaps farther. This line lies near the maximum intensity of the ozone absorption band, and therefore ozone can have nothing to do with the limit of the spectrum in this case. To reconcile the two results, it is necessary to assume that there is much less ozone near the earth's surface than at high levels, a conclusion in agreement with the published chemical determinations of atmospheric ozone by Hayhurst and Pring.

The distant mercury lamp spectrum showed a considerable falling off of intensity in the region of short wave-lengths, long exposures being required to bring out λ 2536, which is one of the brightest lines when atmospheric absorption does not intervene. Such a result is to be expected according to known data on atmospheric scattering of light, apart from the action of ozone.

In this connection I may mention that I have succeeded in observing the scattering of light by pure dust-free air in a laboratory experiment with artificial illumination. Details of these investigations will be published later.

R. J. STRUTT.

Imperial College of Science, October 22.

The Cure of the Isle of Wight Disease in the Honey Bee.

THE publication of Mr. S. H. Smith's advertisement on p. 324 of the *British Bee Journal* for October 11, in which he mentions "proflavine" and "acriflavine" as being efficacious in the treatment of Isle of Wight disease, impels me to publish the following account, which I originally intended to keep back until further experiments had confirmed and extended the results.

On April 14 last I attended the annual meeting of the Leicestershire Beekeepers' Association, to offer my services in a full investigation of the Isle of Wight disease, which I proposed should be undertaken with the co-operation of the members. The meeting showed the greatest appreciation of my offer, and those present undertook to supply me with all the information and help they could.

Efforts were first directed to securing specimens of diseased bees for investigation, but, owing to the fact that I was unable to hear of any members who then possessed affected stocks, I did not come into contact with an actual case until July, 1917. In the meantime I had been discussing the general properties of the disinfectant flavine, which has been successfully used in the treatment of wounds in the British Army, with Col. C. J. Bond, C.M.G., of Leicester, and it occurred to both of us that, if an opportunity could be found, it would be well worth while to experiment with acriflavine in connection with the Isle of Wight disease.

On July 6 I obtained an apparently healthy swarm of bees, which was at once successfully hived at the Leicester Museum. On July 11 numbers of the bees were seen crawling on the grass in front of the hive, and a batch had congregated on one of the legs. Previous to this the bees had been noticed to be slow in taking wing from the alighting board and to have a distended look. On July 16 I had a visit from Mr. S. Jordan, of 25 Longfield Road, Bristol, a well-known bee expert of many years' standing. We went to the hive and carefully examined the stock, and Mr. Jordan expressed his conviction that the bees were suffering from Isle of Wight disease, pointing to the "crawlers," the brown excrement which he squeezed from their distended bodies, and the dislocated wings of many as symptoms confirmatory of an opinion based on a lifetime's experience. Having already obtained some acriflavine, through Col. C. J. Bond, from Dr. C. H. Browning, director of the Bland-Sutton Institute of Pathology, Middlesex Hospital, W., I at once placed a feeder on the top of the brood box, containing a pound of honey to which had been added forty cubic centimetres of a solution of acriflavine (strength 1 in 1000, *i.e.* one gram of acriflavine to a thousand cubic centimetres of water). In addition to this, I sprayed the bees, over the top of the frames, with a quantity of the acriflavine solution (1 in 1000) until most of the bees were distinctly wet. The next day the bees appeared much livelier and more alert than at any time since their arrival, but during the subsequent week crawlers appeared from time to time. They were, however, much more active than those previously seen, and were generally engaged in vigorously working their abdomens and rubbing their sides with their hind-legs. I was glad to notice that the bees were taking the acriflavine-honey down quite freely from the feeder, which I continually replenished, and gradually the crawling symptoms disappeared.

On opening the hive in the latter part of August I found the colony much reduced in numbers, but looking beautifully clean and healthy, with a quantity of acriflavine-honey stored in the brood frames. This was very obvious, owing to the greenish fluorescent tinge which acriflavine imparts to mixtures. There were no signs of crawling, but the small size of the colony led me to think that most of the crawlers had probably not been cured but had died off, the inference being that the acriflavine had prevented the infection from spreading to the young bees which had taken their place. I am inclined to think that if I had mixed a little honey with the spraying solution of acriflavine I should have possibly saved the diseased members of the hive, because they would have taken in the solution much more readily. This is a point calling for further trial.

During the course of my experiments I tried feeding the bees with a syrup made from cane-sugar, to which acriflavine solution (1 in 1000) had been added, at the rate of twenty cubic centimetres of solution to each pound of syrup. The bees, however, refused to take this mixture, and I had to return to honey. Latterly, since the advent of colder weather, the bees have refused to take down even honey when acriflavine was mixed with it to the above strength, and I am forced to conclude that it is only during that part of the year when they are fairly active that they will take the acriflavine from a feeder. This is confirmed by Mr. J. Waterfield, of Kibworth, to whom I gave a supply of acriflavine solution for the purpose of experiments upon his own bees. They, like mine, refused to take down the solution, although supplied in honey.

I have given out several supplies of acriflavine solution to beekeepers whose stocks have been attacked by the disease, within the last three or four weeks, but owing to the lateness of the season there have been no visible effects to report, and although I consider my own results distinctly encouraging, I should not have ventured to mention acriflavine at this stage but for Mr. Smith's advertisement. It now seems important to have all possible information regarding it, and I hope Mr. Smith will publish his experiences, which would appear to be more extensive than mine.

Turning to the question of the cause of the Isle of Wight disease, I have been quite unable to detect any trace of the Protozoan parasite *Nosema apis* in any of the diseased bees which I have examined. I have submitted dozens from the infected hive at the museum to a very careful microscopic examination, and have also examined specimens from three other localities in Leicestershire, all of them "crawlers" from hives showing all the ordinary symptoms of Isle of Wight disease, without finding *N. apis* in a single case. I am, therefore, at present in complete agreement with Messrs. Anderson and Rennie, who state, in an important paper in the Proceedings of the Royal Physical Society of Edinburgh, 1915–16, vol. xx., part 1, pp. 16–61, that, after extensive observations and experiments, they are "unable to recognise any causal relation between the presence of this parasite and the disease."

In all the specimens I have examined, bacteria were abundant in the contents of the rectum, and it is difficult to resist the impression that the trouble may be due directly or indirectly to these organisms, although the statement is made by Dr. Malden, in the Board of Agriculture's second report on the Isle of Wight disease, in July, 1913, that "investigations have failed to reveal any species of bacteria constantly associated with the symptoms of the Isle of Wight disease."

As a beginner in beekeeping and a new worker in the field, I am impressed by the need for much further investigation as to the cause and cure of this troublesome disease. I hope, however, that in view of the good results which have been claimed for bacterol, and the possibilities presented by acriflavine, beekeepers may take courage and face whatever risk may be involved in beekeeping, as a national duty in these days of sugar shortage.

It should be mentioned that my work is being carried out under the auspices of the Museum and Libraries Committee of the Leicester Corporation, which has provided me with every facility. On its behalf I should be glad to supply, free of charge, sufficient acriflavine for a good trial to any beekeeper having the disease among his stocks who will apply to me at the Leicester Museum, and undertake to send me an account of the result.

E. E. LOWE.

The Museum, Leicester, October 16.

Tidal Energy Dissipation.

IN regard to my estimate of viscous dissipation of oceanic energy in its bearing on the slowing of the earth's rotation (Proc. Roy. Soc., A, 93, p. 348), I quite assent to Mr. Jeffreys's position (NATURE, vol. xcix., p. 405, July 19, 1917) that it is still open to doubt whether the viscosity of the ocean causes a very appreciable part of the earth's retardation. The formula for calculating the rate of dissipation of internal energy by viscosity, in the absence of disturbing forces, from a knowledge of the surface currents alone, is not challenged. But, irrespective of his argument, this internal energy, especially that associated with the longer-period motions, will be in part energy of currents arising from temperature differences, and therefore supplied by the solar heat and not by the energy of the earth's rotation. The contribution from the shallower parts of the ocean may have more chance of falling under the latter head. In any case, the whole question can be discussed only when more is known as to the distribution of the oceanic currents. At present the only motion known at a considerable distance from land is the residual drift, and this only in a few places, chiefly where it exceeds one knot. But as this does not change with the tide, its energy is of thermal origin.

It is more difficult to agree with Mr. Jeffreys's contention that viscous action in a solid earth cannot be an appreciable cause of the slowing of its rotation. By using a special law of viscosity quoted by him (M.N. Roy. Astron. Soc., vol. lxxvii., p. 449) as suggested amongst other possibilities by Sir J. Larmor as a reasonable alternative to the Maxwell-Darwin law used by him previously (M.N. Roy. Astron. Soc., vol. lxxv., p. 648), he himself has considerably modified his previous views. But a wide field of choice is open, of which this is one example. Thus the law might be that the ratio of the stress to strain is $n+f(d/dt)$, where f is any function. In order to give the required values of the earth's retardation and of the Eulerian nutation, the function f is defined for only two values of the argument, and so is to a great extent arbitrary. Evidently suitable forms may be chosen in very many different ways, so as, in addition, to allow for the properties of earthquake waves.

R. O. STREET.

University of Liverpool.

Stereo-Radioscopes.

WE have read with interest in the Notes columns of NATURE of October 18 a description of what is called a stereo-radioscope, said to be invented by one Major Lièvre. What interests us so much is the fact that Sir J. Mackenzie-Davidson invented the same thing no fewer than twelve years ago. The instrument was made by our firm and put on the market for several years. As the two sources of rays have to be about 6 cm. apart, the only practical method was found to be to build a special X-ray tube with two anti-cathodes in the same bulb.

The apparatus was exactly the thing described in your paragraph. A motor drove an interrupter having two contact blades opposite each other, exciting the two sides of the tube alternately and driving a stroboscopic shutter synchronously with the interrupter.

The great objection to the instrument is that the operator must look into the view-box in front of the shutter, thus fixing his position with regard to the large and heavy instrument. Either this latter or the patient must be adjusted to obtain the proper view.

The difficulty of this is obvious, and results in an expensive and cumbersome apparatus.

HARRY W. COX AND CO., LTD.

161 Great Portland Street, London, W.1.

An Optical Phenomenon.

CAPT. C. J. P. CAVE'S letter in NATURE of October 18 reminds me of a similar effect experienced when travelling in a *coupé* compartment at the rear of a train some years ago. From a window at the back of the *coupé* one could watch the ever-disappearing landscape as the train travelled along. The impression created was that every object seen appeared to be rushing away from the train. But a stranger sensation occurred when turning my eyes from the window to objects in the *coupé*, for, during a space of a few seconds, they appeared to be moving rapidly in a contrary direction.

C. CARUS-WILSON.

October 19.

THE effect described by Capt. Cave in NATURE of October 18 can be observed after walking rapidly along the top of a wall and keeping the eyes fixed on the road. On stopping, still looking at the road, part of the field of view seems to be slipping away backwards.

H. M. ATKINSON.

45 Denman Drive, N.W., October 19.

INFANT AND CHILD MORTALITY.

POLITICAL economists are generally agreed that, if a country is to be prosperous and to maintain its place among the nations, its population must substantially and progressively increase. Two cardinal factors are essential to ensure a satisfactory increase of population: (1) a birth-rate maintained at a proper level, and (2) a death-rate not excessive. A falling birth-rate and an excessive mortality are both national calamities; indeed, it may be questioned if France would be quite in her present position had her birth-rate equalled that of Germany. In France the birth-rate, already abnormally low, fell from 23·5 per 1000 in 1887 to 19·0 in 1914, while for Germany for the same years the figures were respectively 36·9 and 28·3, with the result that during this period the population of France only increased from about $38\frac{1}{4}$ millions to 40 millions, whereas that of Germany increased from 49 millions to 65 millions.

We are in a similar parlous state as regards our birth-rate, for this has been steadily declining from 36·3 in 1876 to 23·0 or thereabouts in 1916 per 1000 of population. The effect of this has been that our increase of population for 1914 was *less* by nearly half a million than it would have been had the birth-rate obtaining in 1876 been maintained. Fortunately, our mortality-rate is one of the lowest in the world, and this, together with a considerable saving of infant and child lives, has enabled us to show a substantial increase of population. We are, nevertheless, still faced with a low and apparently falling birth-rate (for the County of London the birth-rate was 21·5 for 1916, against 22·5 for 1915), and we must, moreover, take into account the serious losses among the adult male population, the potential and prospective fathers of children, owing to the present war. It does not, therefore, appear that any substantial increase in the birth-rate can at present be anticipated.

We are, then, more than ever dependent upon a diminution of mortality if our increase of population is to be maintained. But with a death-rate among the whole civil population of 14·7 per 1000 (1916), we can scarcely expect any considerable diminution in the general mortality. Is there any section of the community among whom the mortality is excessive and might be reduced? An analysis of the mortality statistics brings out some startling facts. Of the total deaths occurring in England and Wales during the four years 1911–14, 28·2 per cent., or *more than one-quarter*, occurred during the first five years after birth; the number of deaths of persons sixty-five to seventy years of age is less than of children one to five years of age, and it is not until the age of seventy years and upwards is reached that the mortality is greater than that of infants up to one year of age. For England and Wales the present infant mortality (*i.e.* deaths of infants up to one year of age) per 1000 births is about 110. This means that of the 800,000 infants born in a year some 100,000 never live to see their first birthday. Further, probably at least as many prospective children die before birth, and half the number between one and five years of age, so that out of 900,000 possible children 250,000 have succumbed by the end of the fifth year. What should we think of 250,000 casualties—all fatal—out of 900,000 in action? And what of the uncounted wounded and disabled?

It may be said that, high as our present infant mortality appears from such figures, it is, at any rate, much less than formerly. Fortunately for the nation, this is quite true; the infant mortality has fallen from 165 in 1899 to 110 at the present time. But, even so, there is still an appalling mortality among infants and young children, and the pity of it is that it is undoubtedly largely preventable. The best proof of this statement is, perhaps, the startling difference in child mortality in different districts. We find, for example, that during the first year of life:

In Burnley	172	die against	67 in Hornsey
In Stoke-on-Trent	161	„ „	70 in Ilford
In Wigan	159	„ „	78 in Bath

If, instead of taking the death-rate of infants, we take that of children up to five, the result is the same:

In Middlesbrough	251	die against	109 in Bournemouth
In St. Helens	242	„ „	110 in Ealing
In Oldham	223	„ „	127 in Croydon

But this is not all. So far these towns have been considered as a whole, but the worse have their good and bad parts. Thus, while the general child mortality up to five in Middlesbrough is 251 per 1000 births, for the Canon Ward it is 328, and for the St. Hilda's Ward 369! If we survey the country generally, it will be found that child mortality is greatest in the large industrial towns and mining centres, less in the smaller towns, and least in the rural districts. Poverty is not the dominant factor, for the highest child mortality occurs in areas where, on the whole, wages are good, and Dr. Findlay, in a report to the Medical Research Committee, notes that in times of famine and industrial trouble the infantile death-rate usually falls. He emphasises the importance of environment (housing, etc.) as a factor in causing the present high infantile mortality.

Of the total deaths of children up to five years of age 12·3 per cent. are due to measles and whooping cough, 19·5 per cent. to bronchitis and pneumonia, 15·8 per cent. to diarrhœal diseases, and 23·0 per cent. to "congenital debility." It is fairly obvious that diarrhœal diseases and congenital debility are largely dependent upon the conditions under which the people live, and the same holds good also for the other diseases mentioned. We find, for example, that, as regards measles and whooping cough—two diseases over which we have the least control—6 per 1000 die of these diseases in Harrogate and Weymouth, against 41 in Sheffield and Stalybridge. With facts of this kind before us it is patent that a considerable saving of child-life might, and ought to, be accomplished. Of the factors conducing to child mortality, the principal are ignorance and carelessness, intemperance, disease, and poverty, overcrowding, vitiated atmosphere, impure milk supply, and defective sanitation.

The remedies are, for the most part, obvious; they comprise: (1) A better training for motherhood on the part of girls of all classes; (2) improved care of the prospective mother and the provision of well-trained midwives, health visitors, and maternity and child-welfare centres; (3) the clearing out of slum areas; (4) improved housing of the masses, with a wider distribution of the population and better sanitation; and (5) an equitable solution of the drink problem. A great deal can be done by certain measures of care and supervision alone. Mr. Benjamin Broadbent, when Mayor of Huddersfield in 1905, tried such an experiment, with the result that of 112 babies born in that year, 107 survived the first year, and ninety-seven were surviving in 1915, ten years later, whereas, according to the average rate of mortality, only eighty-four would have been alive in 1915!

It ought to be appreciated by every right-thinking man and woman that the child is a national asset of great price, and that the saving of child-life is a duty, national as well as humanitarian. The problem is a vast and complicated one and worthy of the best efforts of the State, yet how little has hitherto been done to grapple with it on anything like a national scale. Mr. Hayes Fisher has recently promised to introduce, and if possible to pass by Christmas, a Maternity and Infant Welfare Bill to deal with the problem. He indicated, however, that delay might be caused by sources of opposition much the same as have apparently obstructed the formation of a Ministry of Health. Let us see to it that Mr. Hayes Fisher's hands are strengthened by the force of public opinion. The call is urgent, and human lives, so much needed by our country, are at stake.[1]

R. T. H.

[1] For data bearing on this subject, see "Report on Maternal Mortality in connection with Child-bearing and its Relation to Infant Mortality"; "Report on Child Mortality at Ages 0–5 in England and Wales" (L.G.B. Reports, Cd. 8085 and 8496); "The Problem of Infant and Child Mortality," by J. Sheldon Withers, Medical Officer of Health for Sidmouth; "The Mortalities of Birth, Infancy, and Childhood," by Drs. Brend, Findlay, and Brownlee (Special Report Series, No. 10, Medical Research Committee).

THE STUDY OF A GENUS OF LAND SNAILS.[1]

THE Rev. J. F. Gulick, in an important paper published by the Linnean Society in 1873, described the distribution of the land snails belonging to the family Achatinellinæ that are found in the Hawaiian islands, and pointed out that neighbouring valleys in these islands, although presenting the same environmental conditions, are inhabited by distinct species. He regarded this as an example of a diversity of evolution under one set of external conditions which was rendered possible by isolation in the different valleys.

Darwin had stated in "The Origin of Species" that isolation is an important element in the modification of species through natural selection. But if the environmental conditions in the localities inhabited by distinct species are in all essential respects the same, natural selection takes no part in the evolution of species, and we must assume some inherent tendency to evolution, some *vis a tergo* which works along definite lines of divergence independently of external conditions. The question is one of very great importance, and further investigations both on the variations of the shells and on the conditions of their environment were greatly needed. In the magnificent memoir before us Prof. Crampton supplies the materials for reopening the discussion.

Partula, belonging to the family Bulimulidæ, is one of the genera of snails, confined to certain islands in the South Pacific Ocean, which show a distribution of distinct species in adjacent valleys similar to that of the Achatinellinæ in Hawaii.

The author has collected and examined an enormous number of shells, has personally studied the habits of the snails in their localities, and has put together his copious notes on the vegetation, meteorology, and topography of the islands. The present volume deals only with the species of Tahiti, but we are promised further volumes on the species of the genus from other localities.

As a detailed study of a single genus, however, this volume is the most complete of anything of the kind that has yet been attempted, and we may congratulate the author on the conclusion of this the first stage of his most laborious task.

To illustrate his study of the local conditions, we are provided with a large number of maps and sketches of a topographical model of the island, with many excellent photographs of the vegetation, and with tables of temperature and rainfall; and to illustrate the species he describes there are fifteen excellent coloured plates. For each of the species and varieties of the species in the island the author gives us the mean value of the measurements of the shells and of the apertures of the shells, together with the standard deviation, and in many cases the results are plotted out in frequency polygons.

Limitations of space do not permit further reference to the details given in this very laborious piece of work—a work which will prove essential to those who are interested in the problem of the differentiation of species.

It may be disappointing that the author does not state more decisively what his conclusions are from this elaborate study, but, although the material is already so extensive, it is perhaps wise, on his part, to delay his statement of conclusions until the series of memoirs is completed. It is clear, however, that the author is convinced that differences of environmental conditions cannot be held responsible for the differentiation of the species and varieties. In dealing with the widely spread species, *Partula otaheitana*, for example, he says that "the *rôle* of the environment is to set the limits to the habitable areas, or to bring about the elimination of individuals whose qualities are otherwise determined—that is, by *congenital factors*"; but, of course, there is no suggestion as to the cause of the change or diversity of the congenital factors.

The facts that are given in various chapters which seem to have a bearing on Mendelian inheritance are, as the author admits, not very satisfactory. Breeding experiments on an extensive scale can alone determine whether there is in Partula a Mendelian segregation similar to that described by Lang in Helix. The evidence of the occurrence of mutations, also, other than the dextral-sinistral mutation, which does not, as a rule, help to differentiate species, is not by any means conclusive.

It seems quite possible that, with the wealth of species, sub-species, and varieties which this memoir reveals and illustrates, the conclusion may be drawn that, after all, the genus Partula may afford an example of the evolution of species by the accumulation of small variations, although the cause of this accumulation still remains a mystery. S. J. H.

[1] "Studies on the Variation, Distribution, and Evolution of the Genus Partula." By Prof. H. E. Crampton. Pp. 342+34 plates. (Carnegie Institution of Washington, 1916.) Price 15 dollars.

CONTINUATIVE EDUCATION AND ITS OBJECTS.

A COMMITTEE of Scottish teachers, chosen from all branches of school education, has recently issued a report entitled "Reform in Scottish Education,"[1] which covers a wide field and embraces a large variety of topics. Many of the reforms advocated have already been set forth by others, and, in particular, by the Workers' Educational Association. In common with the latter body, the Scottish committee recommends the raising of the leaving-school age of the primary school to fifteen years; the reduction of the size of classes, so that every teacher shall have not more than forty pupils under his charge at any one time; and the establishment of day continuation schools, to which all shall be compelled to go from fifteen to eighteen, unless they are already in attendance upon a course of secondary instruction. The committee also demands the abolition of the

[1] Report of the Scottish Education Reform Committee. (34 North Bridge, Edinburgh.) Price 1s. net.

Evening + continuation schools

huge "factory" school, found so often in our large towns, and would limit the enrolment so that no school should accommodate more than 600 pupils.

These reforms, it is declared, would tend not only to the efficiency of education, but also to the betterment of the teacher's position as regards both emoluments and social status. But the fallacy underlying a large number of the propositions laid down in a more or less arbitrary manner (for there is little or no attempt made to adduce reasons for the changes advocated) is that education may be improved by a mere extension of time. Education is at present compulsory in Scotland until fourteen years of age, and even then a considerable percentage of the children in attendance fail to attain any satisfactory standard in the "three R's." Extend this by one year, and all will be well. It seems never to have occurred to the committee that a change in the methods of elementary education might bring about better results than the present, even at the earlier age. The object of education is to supply the child with ideas which shall be instrumental in after life, and these instruments can be intelligently and efficiently used just in so far as the child understands not only the instrument, but also the principles upon which it has been constructed.

Now, few teachers realise the instrumental character of ideas, or that the activity of knowing arises either to satisfy a need or to meet a new situation, and that the failure of education is due largely to the neglect of these considerations. To take an example: If the continuation school, on the technical side, is to achieve its object, it must provide opportunities for the meeting and solving of the real situations and problems of the workshop. If this is borne in mind, then it must be obvious that continuation schools can be instrumental in solving only a limited number of the real problems which arise in life, and that in many cases a boy or girl will obtain the best technical education in learning how to meet the situations which arise from real work. The boy, *e.g.*, whose desire is to become a fisherman will obtain the best training by his daily work, and will benefit little by being compelled to attend a continuation school until eighteen years of age. Rather, he will probably waste his time, and so render himself less fit for his daily avocation; and if we go on, we shall come to other exceptions, and find that, like all general rules, the particular principle that all boys and girls should be compelled to attend some kind of school until eighteen is too wide to be of any practical value in solving the real problems of life and of education.

A somewhat similar fallacy arises from the demand made for more science teaching in schools. Because science deals with realities in contrast to the humanities which are said to deal only with ideas, therefore education in science will be real because it deals with realities. But real problems, real situations, are often absent in the teaching of science in schools. A boy learning chemistry may throughout deal with realities, and yet never be called upon during his course to solve a real problem, since for him the need never arises. Generally we must ever keep in mind that education is taking place only when our pupil is "thinking"; that thinking arises only when there is some problem to solve, some new situation to meet, or some obstacle to remove; and that when these conditions are absent all instruction becomes, and must become, mere unintelligent memorising, which develops neither the intellectual powers nor the ability to meet the after demands of life.

In conclusion, the one reform needed at present is to form a clear idea of what education really is—to understand that it takes place only when our pupils are being trained to think out solutions to real problems, or to devise means to meet real situations. Thereafter we may fruitfully discuss the agencies best fitted to attain this end, and, as a consequence, we may be less chary of believing that a new earth is to be attained by the extension of the leaving-school age and by the compulsory school education of all until eighteen. We may even doubt whether "compulsory" education is education at all.

A. D.

NOTES.

THE death is announced, at seventy-three years of age, of Prof. A. J. F. Dastre, director of the laboratory of animal physiology at the Sorbonne, and a member of the Paris Academy of Sciences.

WE regret to see the announcement of the death on October 18, in his eighty-ninth year, of Prof. Edward Hull, F.R.S., late Director of the Geological Survey of Ireland, and professor of geology in the Royal College of Science, Dublin.

MR. W. B. WORTHINGTON, who was elected president of the Institution of Civil Engineers at the last annual general meeting, has resigned the position from reasons of health, and Mr. H. E. Jones, a vice-president, has been nominated president for the year 1917–18.

AT a meeting of the Royal College of Physicians of London, held on Thursday, October 18, the Baly medal, for physiological work, was presented to Prof. W. M. Bayliss, and the Bisset-Hawkins medal was given to Sir Arthur Newsholme, in recognition of his efforts for the advancement of sanitary science.

THE death is announced of Sir John Prichard-Jones, Bart., principal of the firm of Messrs. Dickins and Jones, the London drapers. He took an active interest in higher education in Wales; he was treasurer of the Welsh National Museum, and a member of the council of the North Wales University College, Bangor, of which he was senior vice-president from 1909 to 1913. The University of Wales conferred upon him the degree of LL.D.

ON the occasion of the recent Glasgow meeting of the Refractory Materials Section of the Ceramic Society, the council appointed two sub-committees (with power to co-opt additional members) to prepare reports respectively on (1) standardisation of methods of testing, (2) refractories for spelter furnaces. It is anticipated that the former will be ready for the spring meeting in Sheffield, and the latter for the following autumn meeting at Cardiff.

WE learn from the *Times* that Mr. Walter Long has appointed Sir Boverton Redwood, Bart., Director of Technical Investigations in the recently created

Petroleum Executive, with the view of his dealing with technical questions of the highest importance, including the co-ordination of the work of petroleum production and that of petroleum research. In order to devote himself to his new duties Sir Boverton Redwood will cease to act as Director of Petroleum Research.

IN answer to a question asked in the House of Commons on October 18 the Chancellor of the Exchequer said :—"The proposal of a Ministry of Health is under careful consideration; at present the various difficulties needing to be provided for in the establishment of such a Ministry have not reached any widely agreed solution, and so long as this is so it is not possible to undertake to introduce a Bill for the purpose.' Steps are, however, being taken which will, it is hoped, secure substantial agreement amongst those who are actively engaged in the work of national health."

THE *Times* of October 24 announces the death of Surgeon-General Sir Charles Pardey Lukis, K.C.S.I., Director-General of Indian Medical Services, at sixty years of age. Sir Charles received his professional education at St. Bartholomew's Hospital, and entered the Indian Medical Service in 1880. In 1905 he was appointed principal and professor of medicine in the Calcutta Medical College, and was selected to be Director-General at the beginning of 1910. He took especial interest in original research in medicine in India, and edited a journal devoted to this subject, as well as two or three well-known tropical medical text-books; he was also the author of "A Manual of Tropical Hygiene."

AT the annual statutory meeting of the Royal Society of Edinburgh, held on October 22, the following office-bearers and members of council were elected :—*President*, Dr. J. Horne; *Vice-Presidents*, the Right Hon. Sir J. H. A. Macdonald, Prof. R. A. Sampson, Prof. D'Arcy Thompson, Prof. J. Walker, Prof. G. A. Gibson, and Dr. R. Kidston; *General Secretary*, Dr. C. G. Knott; *Secretaries to Ordinary Meetings*, Prof. A. Robinson and Prof. E. T. Whittaker; *Treasurer*, Mr. J. Currie; *Curator of Library and Museum*, Dr. A. C. Mitchell; *Councillors*, Dr. J. H. Ashworth, Prof. C. G. Barkla, Prof. C. R. Marshall, Dr. J. S. Black, Sir G. A. Berry, Dr. J. S. Flett, Prof. M. Maclean, Prof. D. Waterston, Prof. F. O. Bower, Prof. P. T. Herring, Prof. T. J. Jehu, and Dr. A. Lauder.

THE series of meetings arranged by the director of the Meteorological Office since 1905 for the informal discussion of important contributions to meteorological literature, particularly those by Colonial or foreign meteorologists, was reopened on Monday, October 22, at 5 o'clock, and will be continued until March next. Among the subjects to be considered are :—The distribution of cyclonic rainfall in Japan; the Aurora Borealis expedition of 1913 to Bossekop, Norway; the height of the Aurora Borealis; monthly mean temperatures of the surface water in the Atlantic north of lat. 50° N.; (1) types of storms in the United States and their average movements, (2) types of anticyclones; the properties of revolving fluid; meteorology of Norway; and aerography.

DR. ROBERT BRAITHWAITE, whose death on October 20, in his ninety-fourth year, is announced, was a fellow of the Linnean and Royal Microscopical Societies, as well as of several foreign natural history societies. He entered the medical profession in 1858, and became M.D. of St. Andrews in 1865. His three elaborate volumes on "The British Moss-Flora," of which the publication was completed in 1905, constitute the standard work upon their subject. All the 128 pages of plates which illustrate this work were engraved from drawings made by the author himself, and the whole work forms a remarkable monument of his skill and industry. The Sphagnaceæ were not included in the volumes, but Dr. Braithwaite published an interesting monograph upon these, namely, "The Sphagnaceæ, or Peat Mosses of Europe and North America."

THE Minister of Munitions has issued an order that no person shall deal in potassium compounds except under a licence issued by the Controller of Potash Production. No licence will be required (*a*) by the Admiralty or War Office; or (*b*) by any person for the purchase of potassium compounds in quantities not exceeding 3 lb. in any one calendar month. All persons must furnish returns to the Controller of Potash Production of all potassium compounds under their control, manufactured, or dealt in by them. The potassium compounds to which the order relates are the hydrate, chloride, carbonate, and sulphate, whether in a pure or in a commercial form, and any material (other than blast-furnace dust referred to in the order of the Minister of Munitions of August 7, 1917) of which more than 10 per cent. consists of any one or more of the above.

A MEETING is to be held at the Manchester School of Technology in the afternoon of Saturday, November 10, under the chairmanship of Dr. Alfred Rée, for the purpose of inaugurating a British Association of Chemists. The objects of the proposed association are "(*a*) to obtain power to act as sole registration authority for all chemists; (*b*) to have the word chemist legally redefined; (*c*) to safeguard the public by obtaining legislation ensuring that certain prescribed chemical operations be under the direct control of a chemist; and (*d*) to raise the profession of the chemist to its proper position among the other learned professions, so that it may attract the attention of a larger proportion of the best intellects, and thereby secure a supply of highly trained chemists adequate to the industrial needs of the country." The meeting is open to all chemists. The hon. secretary of the Provisional Committee is Mr. R. E. Crowther, 3 Langford Road, Heaton Chapel, near Stockport.

A PRIVATE letter from Dr. Paul Bertrand announces the death of his father, Prof. C. E. Bertrand, the distinguished plant-anatomist and palæobotanist. Among recent plants Prof. Bertrand elucidated the structure of Gnetaceæ and Conifereæ (1874), of Tmesipteris (1881), and of Phylloglossum (1882), and in 1902 published, in conjunction with Prof. Cornaille, a remarkable theory of the construction of the vascular strands of the ferns and other plants. In fossil botany he investigated the problematical fossil Algæ of the Boghead Coal (1892–94), worked out the detailed structure of the famous *Lepidodendron Harcourtii* (1891), discovered the minute Carboniferous Lycopod, Miadesmia (1891), and described one of the first examples of a ribbed Sigillaria, with structure preserved. Perhaps his most important palæobotanical work was his researches, in collaboration with Renault, on the Poroxylons, a most elaborate study of a remarkable group. His latest papers were on the comparative structure of various Palæozoic seeds (1907–11). He also wrote on the formation of coal and on the Iguanodon coprolites of Bernissart. His work was characterised by the most careful accuracy and an almost mathematical precision. Bertrand was professor of botany at Lille, and lived there for the last three years of his life under German rule. Under these difficult and painful conditions, he was still able to carry on both his university courses and his private research, as long as his health permitted. His death took place in August, but the sad news only reached his son this month.

Mr. W. Thomson, in his presidential address to the Manchester Literary and Philosophical Society on October 2, gave a sketch of the very important work which had been done by the society since its inauguration in 1781, as a continuation of the Warrington Academy, which was established twenty-four years earlier (1757), in which it is believed that Marat, the great French revolutionist, taught languages. Joseph Priestley, the discoverer of oxygen in 1774, was teacher of languages and *belles lettres* at that academy in 1761. Later, whilst at Warrington, he began the study of science, and was afterwards a member of the society. Both Dalton and Joule were closely connected with the society: the former had his laboratory in the present society's rooms. He was elected a member in 1794, and was president from 1817 until 1844. During the last 136 years most of the eminent scientific men of Manchester have been members of this society, and have contributed to its memoirs. Dr. Henry Wilde, with others, subscribed handsomely to the extension of the present premises in 1883, and then bequeathed to it an endowment of 8265*l.*, the interest of which is at present employed for the purposes of the society. The members of to-day include the most eminent men of science in Manchester, and there are at present about 150 members. Since the war commenced the value of scientific knowledge has been more highly appreciated in England than ever before, and it is to be hoped that manufacturers and others in Manchester will show their appreciation of science by joining the society.

We regret to announce the death on October 18 of Mr. George Charles Crick, assistant in the geological department of the British Museum. Mr. Crick was born at Bedford on October 9, 1856, and received his scientific education at the Royal School of Mines, of which he was an associate. He was appointed to the staff of the British Museum in 1886, and devoted himself to the care and special study of the fossil Cephalopod Mollusca. Though he had been in failing health for some years he continued to attend to his museum duties until the end, and on the day before his death he was able to discuss with Dr. Kitson the geological age of some new ammonites from Nigeria. His knowledge of the fossil Cephalopoda was, indeed, so profound that his services were in constant request by geologists investigating new countries, and his published writings, though numerous, give only an imperfect idea of the extent of his researches and their importance for the progress of stratigraphical geology. He was of too diffident a nature to do full justice to his powers. Most of his papers were naturally technical descriptions of genera and species, but among those of wider scope may be specially mentioned his memoir on the attachment of the fossil Cephalopoda to the shell, published by the Linnean Society, and his valuable report on the Cretaceous Cephalopoda of Natal. Mr. Crick was awarded the Barlow-Jameson fund by the Geological Society in 1900, and the general appreciation of his scientific worth was equalled by the esteem in which he was held by his colleagues and all who were associated with him.

The Herbert Spencer lecture was delivered at Oxford on October 20 by Prof. Emile Boutroux, member of the Institut and of the French Academy. The lecture, which was given in English, embodied a careful analysis of the relation between thought and action from the German and classical points of view. The contrast between the two conceptions was well brought out by the lecturer, whose treatment of the subject was, however, metaphysical rather than scientific. The modern German view was traced back to Kant, according to whom thought is conditioned in such a way that by the nature of things the present is entirely controlled by the past; hence the laws of thought are determined mechanically. The only true action is that where the effect is conditioned by the subject. From this follows the radically dualistic conception that thought and action move in two worlds which have nothing in common. But by Fichte and others it was recognised that action was only possible through the world of sense. Hegel applied to the content of action the law which Fichte had applied to its production. "The world of phenomena *creates* the world of freedom." Germany proceeded to preach that the ever-increasing control of *our* world was the only field of action. Thus action bears its own law in itself; all scientific explanation resolves itself into mechanism. Phenomena come within the sphere of action. If the Kantian conception with its implications be admitted, the attitude of modern Germany is justified. Contrast with this the truer view of antiquity, especially as brought out by Plato, viz. that thought and action are not mutually exclusive, but interdependent constituents of human life, neither being self-sufficient. With the Aristotelian τὸ καλὸν we get a living medium between action and thought; hence comes individuality and with it an indefinable enlargement of the inner life. We are free when we exercise self-control—

Vis consili expers mole ruit suâ:
Vim temperatam di quoque provehunt
In maius.

Carcinologists are indebted to Dr. J. J. Tesch, who, in *Zoologische Mededeelingen* for July, gives a long synopsis of the marsh-crabs of the genus Sesarma and allied genera, illustrated by numerous plates and text-figures. The special feature of this contribution is the key which the author has devised for the identification of the Indo-Pacific species, a task which so far has not been attempted. He also gives a brief summary of what is known of the habits of these creatures.

Dr. E. C. Hort, in the Journal of the Royal Microscopical Society for August, gives a detailed account of his attempts to unravel the life-history of the meningococcus of cerebro-spinal fever, and if the statements of his results provoke criticism his investigations will have served a very useful purpose. Perhaps the most important of his results is his claim to have demonstrated the presence of excessively minute, filterable organisms which are quite as pathogenic as unfiltered cultures. In so far as prophylaxis is concerned he does not seem to have made any advance on the admirable work in this field by Lt.-Col. Gordon, summarised in these pages in April last.

In 1886 Dr. W. E. Hoyle named a Cephalopod, taken in the Pacific by the *Challenger* Expedition in 1874, *Moschites verrucosa*, believing it to be identical with the species of that name common in the Atlantic. Mr. S. Berry, in the Proceedings of the Academy of Natural Sciences of Philadelphia, vol. lxix., part 1, negatives this decision, showing conclusively that, though closely resembling this species, it nevertheless presents so many structural peculiarities that it is entitled to rank as a distinct species, which he proposes to call *Moschites challengeri*. Mr. Berry has not examined the original specimen in the British Museum of Natural History, but he contends that photographs of the specimen which have been sent him justify his contention. He bases his decision on the form of the "hectocotylus," the distribution of the tubercles of the umbrella, and the relative lengths of the arms. This issue of the Proceedings also contains a paper by Messrs. H. A. Pilsbury and A. Brown on Oligocene fossil Mollusca from the neighbourhood of Cartagena, Colombia, wherein they describe eighteen species and two subspecies new to science. Finally, Messrs. J. Henderson and L. E. Daniels contribute a long paper, likely to interest malacologists, on hunting Mollusca in Utah and Idaho, since they record some valuable ecological observations.

WE have received from the Royal Italian Oceanographic Committee a memoir (No. xxi., 1916) by the secretary, Prof. Giovanni Magrini, setting forth its objects and giving a short account of its activities. The committee was established in 1910 for carrying out physico-chemical and biological investigations in Italian seas and for the study of the higher atmosphere. There are influential provincial sub-committees at Genoa, Naples, and Venice, which undertake work of especial importance in their respective areas, *e.g.* the Venetian sub-committee has carried out experiments with the object of developing the fisheries off the Albanian coast. The committee has, in an excellent situation at Messina, a central Institute of Marine Biology, capable of accommodating eighteen workers, besides the staff, and a motor-boat provided with the usual apparatus for plankton and other work. In addition, the committee has a well-equipped steamer 124 ft. long, with accommodation for eight technical experts and two assistants. During the years 1909–14 fourteen cruises for physico-chemical investigations were made in the Adriatic, and researches on the currents of that sea have also been carried out by means of 685 couples of drift-bottles, set free in 1912–14, 32 per cent. of which have been recovered. Six biological cruises were made during the years 1912–14 in the neighbouring seas; a list of the publications resulting from these is given. A short account is added of the Royal Italian Aerological Service.

IN the *Atti dei Lincei* (vol. xxvi., (1), p. 9) Dr. R. Perotti describes his examination of samples of bread damaged by the attacks of fungus growths which he refers to *Oospora variabilis*, Lindner. In the sample submitted every hole in the bread was carpeted over with a milk-white growth which rendered the bread unfit for food. By experimenting with cultures, the author has proved that infection takes place through the leaven, and he finds that thorough baking at a sufficiently high temperature, especially with small loaves, prevents the growth, while incomplete cooking in a cool, damp oven is favourable to development. Moreover, the leaven should be carefully prepared and stored, so as to avoid risk of infection.

FROM observations made by Dr. B. Grassi and M. Topi, under the direction of the Italian Ministry of Agriculture, and described in the *Atti dei Lincei* (vol. xxvi., (1), p. 5), it would appear that the phylloxera of the vine has undergone considerable variation, different races having developed which infect varieties of vines growing in different localities. The existence of such varieties had been previously noted by a previous writer, who proposed the name *pervastatrix* for the phylloxera attacking the vines of certain districts. In the present experiments, which date from 1914, numerous cases are described in which galls taken from one selected vine failed to infect other varieties. For example, on being infected with galls from Ventimiglia, the infection developed regularly on two varieties of vine, while on three others it completely failed to develop, and somewhat different results were obtained with galls from Arezzano.

AN account of *Hedychium coronarium* growing in the wild state in the States of Rio and Parana, Brazil, is given in *Kew Bulletin*, No. 3, by the late Mr. Clayton Beadle, whose recent death is much to be deplored. Mr. Beadle had taken great interest in Hedychium as a plant for paper-making, and his journey to Brazil was undertaken with the object of studying the growth of the plant under natural conditions. The plant grows in abundance in the low-lying lands, especially near Morretes, in Parana, the stems reaching a height of as much as 12 ft. Mr. Beadle found it was possible to make a very fair white paper from the stems growing in Brazil.

THE occurrence of boreal types in the southern hemisphere is always a matter of interest to biologists studying animal and plant distribution, and the occurrence at the Cape of Good Hope of the composite genera, Matricaria and Chrysanthemum, is worthy of note. Six species of Matricaria and five of Chrysanthemum are recorded from the Cape region by Mr. J. Hutchinson in *Kew Bulletin*, No. 3. Both genera belong to the northern regions, Matricaria having only one species in tropical Africa, while Chrysanthemum, except for the Cape species, does not occur south of the Canary Islands. The five species at the Cape are all endemic, and one of them, with fleshy stems and leaves, from Námaqualand, is here described for the first time. The Matricarias are also all endemic, with very restricted distribution.

THE annual report of the Agricultural Department, Dominica, for 1916–17 is, as usual, a document of considerable interest. Unfortunately a great deal of damage by the hurricane of August 28, 1916, is recorded, and there is a long account of the steps taken for the treatment of the storm-damaged lime trees, some photographs of which are reproduced. Reference is also made to the varietal forms of *Pimenta acris*, the bay-oil tree. As in the case of Camphor, there are two or more forms, one of which gives the valuable economic product, while the other is of little value. The Camphor tree, which has been planted in many of our English Colonies, appears to yield oil only and no solid camphor, and reference is made to this in the *Agricultural News* of June 16, 1917, and in other periodicals. Both in the case of Pimenta and Camphor it is scarcely possible to separate the two forms on morphological characters.

IN the *Annals of Botany* (vol. xxxi., No. cxxii., pp. 181–87) Dr. Spencer Pickering gives a summary of his investigations of the effect of one plant on another growing near it. These experiments originated in 1895 in his well-known observations on the effect of grass on fruit-trees. Proceeding from this complex case to the simplest conditions, conclusive evidence of toxin production in the soil by the growing plant has now been obtained. The deleterious effect of one growing plant on another appears to be a general phenomenon. By means chiefly of pot experiments the following plants have been found susceptible to such influence:—Apples, pears, plums, cherries, six kinds of forest trees, mustard, tobacco, tomatoes, barley, clover, and two varieties of grasses; whilst apple seedlings, mustard, tobacco, tomatoes, two varieties of clover, and sixteen varieties of grasses have been found capable of exercising toxic effects. In no case have negative results been obtained. The magnitude of the effect varies greatly, but the average effect in pot experiments is placed at a reduction of roughly one-half to two-thirds of the normal growth of the plants. The evidence that these detrimental effects are due to toxin production is regarded as conclusive. A plant affects its own kind just as much as any other kind, and hence it follows that the toxin formed by any individual plant will affect that individual itself. The practical bearing of these observations in various directions is discussed in the light of experimental results.

AN interesting example of the awakening of a national consciousness and political organisation among a nomadic people is recorded in *La Géographie*, vol. xxxi., No. 5. In February of this year the Lapps of northern Norway and Sweden held a conference at Trondhjem, to consider certain questions affecting their interests. More than a hundred, including several women, attended, and the conference claimed to be representative of all the Lapps in Scandinavia. The chief complaint of the Lapps, and one felt more in Norway than in Sweden, is that their grazing grounds are being steadily restricted, and they themselves frequently fined heavily for damage done to crops by their reindeer. This is merely one expression of the usual contest between nomadic and settled people whose territories adjoin. The conference resolved to press for modifications of the Norwegian law of 1883, by which penalties must be paid for damage to crops, and to demand reserves where reindeer can be pastured without interference.

THE winter of 1917 in Norway and Sweden is the subject of an article by M. Charles Rabot in *La Géographie*, vol. xxxi., No. 5. Scandinavia, like other parts of western Europe, experienced a severe winter, with temperatures considerably below the average. The most interesting part, however, of M. Rabot's article deals with the unusual ice-conditions in the Baltic in the first three months of the year, and their effect in hampering German shipping with Sweden. From the middle of January to the end of March the ports on Christiania fjord, including Christiania, were blocked with ice, and often quite inaccessible. For two months the Kattegat was full of ice, and the Sound virtually impassable; even an ice-breaker nearly came to grief. The ports of southern and central Sweden, as far as Stockholm, during all the winter months were only kept open with the help of ice-breakers. In normal winters these ports may be closed to sailing vessels, but are open to steamers. The ferry-boats from Helsingborg and Malmö to Elsinore and Copenhagen suffered frequent and long interruptions, and Oxelösund, the port for shipping Swedish iron-ore to Germany, was practically closed for two months.

IN the September number of *La Science et la Vie* Signor Funaioli, engineer of the Società Boracifera di Lardarello, gives an interesting account of the utilisation of the natural steam from the volcanic area of Tuscany, and of the manufacture of boric acid and borax. The highly saturated steam issues from the ground often at fairly high pressures, but for purposes of conversion it is utilised for heating a series of tubes containing water, the steam pressure in these tubes being two atmospheres (say 30 lb. per sq. in.). The steam drives low-pressure turbines, which in turn are coupled to alternators. The steam and water of these "soffioni," as they are termed in the vernacular, contain quantities of boric acid, which is concentrated in a special apparatus and gives a product of about 99 per cent. purity. The acid, treated with sodium carbonate, gives borax, which is manufactured in the form of crystals and powder. Ammonium carbonate is also manufactured, the carbonic acid necessary for the process being also derived from the "soffioni." Prof. Nasini, the chemist in charge of the research department of the establishment, is now carrying out investigations on the radio-activity of the gases of the "soffioni," and on the separation of the helium, which is another element present.

REPORTS have lately been current with regard to a method of making ships "invisible" which is attributed to Mr. Edison. The method is said to consist of a kind of "camouflage," which makes a vessel "absolutely invisible at a short distance." The idea is not new, though possibly some new device may have made its application more successful. The difficulty as regards submarines lies in the fact that to a submarine periscope every vessel is seen against the sky, and usually "hull down." A vessel disguised by camouflage may therefore be "invisible" against a background of water, and yet very obvious to a submarine observer, who sees it against a varying sky. Much can, no doubt, be done to deceive the submarine as to the course of the vessel by suitably "breaking up" its outline, and this seriously affects the aim of a torpedo. But the problem of naval camouflage remains quite different from similar problems on land, where a definite background can be counted upon.

MESSRS. ARNOLD AND READ showed in 1914 that two carbides, Fe_3C and WC, are probably present in tungsten steels. Messrs. Kotaro Honda and Murakami conclude, in a research just published, that these can exist either as a double carbide or as two carbides in magnet steels according to the heat treatment. If the steel is heated to from 800°–900° C., and then slowly cooled, a double carbide is formed. Above Ac_1 this decomposes into its components, but both remain dissolved in the austenite. On heating still further, the tungsten carbide begins to dissociate into tungsten and carbon, and the dissociation is complete at about 1100° C. On cooling the steel from above this temperature, Ar_3 begins at about 550° C., and Ar_1 at 500° C. On reheating to 900° C the double carbide is once more formed. Magnet steels cooled from 900° C. deposit granular ferrite and eutectoid. If, however, they are cooled from above 1100° C. the ferrite is needle-shaped. The granular ferrite is regarded by the authors as pure iron, while the needle-shaped ferrite is a solid solution of tungsten in iron. These conclusions agree with those drawn from the magnetic experiments. Some specimens exhibiting the Ar_1 change, partly at 700° C. and partly at 500° C., have both granular and needle-shaped ferrite. In some of the above conclusions the authors merely confirm well-established work done in England and France several years ago.

THE Journal of the Department of Agriculture and Technical Instruction for Ireland (vol. xvii., No. 4) contains the report of a lecture entitled "Chemistry in Industry," delivered by Prof. G. T. Morgan to a gathering of teachers. Perhaps even yet the general public does not realise the fundamental importance of the application of chemistry to industry. If so, Prof. Morgan's answer to the question: What part does chemistry play in satisfying the two primary wants of mankind, food and shelter? may perhaps serve to make the whole subject more "understanded of the people." He points out that scientific agriculture is absolutely essential in food production, and that the exhaustion of soils following intensive cultivation must be made good by artificial fertilisers. The methods of preparing calcium nitrate used in Norway and that of Kilburn Scott are described, and stress is laid on the necessity of burning coal in a rational manner so as to recover all the ammonia and other by-products. The production of superphosphate by the use of nitre-cake and the recovery of potash from the flue-dust of cement kilns are mentioned. As regards the provision of shelter, Prof. Morgan points out that in the production of Portland cement the chemist is supreme, and very few stable structures are built nowadays in which it is not employed. Glass is another important material in building construction of which the manufacturer requires the continual intervention of the chemist. Chemistry is no less important in industries providing the munitions of war. As the raw materials for the latter are obtained from coal-tar, which also supplies the organic compounds necessary for the production of dyes and drugs, the latter industries become interdependent with that of munition-making. The synthesis of one dye or drug is not only important *per se,* but also frequently the incentive in the synthesis of others. Thus, since the synthetic production of indigo many other vat dyes not found naturally have been produced.

WITH reference to our note on ferro-concrete ships (NATURE, October 11, p. 114), *Engineering* for October 19 contains an interesting account of the launch of the ferro-concrete ship *Beton I.,* with illustrations from photographs. As indicated in our former note, the ship was built bottom upwards and launched in this position. On taking the water, the air contained in the structure caused the draught to be comparatively small, the water plane was therefore large, and the vessel was in stable equilibrium. On permitting some of the air to escape, the vessel sank in the water; owing to the shape of the bottom, the area of the water plane was thus reduced considerably. Ultimately a draught was reached in which the centre of gravity was above the centre of buoyancy, and an upsetting couple was established which caused the ship to turn right side upwards, in which position stable equilibrium was again attained. The uprighting, to begin with, proceeded slowly, and accelerated in the intermediate stages in which the couple was greatest, and then again more slowly. The turning took place very neatly, without any shock, and the vessel had then, of course, to be emptied of water.

AMONG the forthcoming books of Mr. Humphrey Milford, of the Oxford University Press, are the following:—"Agriculture in Berkshire," J. Orr (a survey made on behalf of the Institute in Agricultural Economic, University of Oxford), illustrated; "A Weather Calendar," Mrs. H. Head, with a bibliography; "Dr. John Radcliffe, his Fellows and Foundations," J. B. Nias; "Dynamic Psychology," R. S. Woodworth (The Jesup Lectures); "Aristotle: Meteorology," edited by F. H. Fobes; "The Principles of Acidosis and Clinical Method for its Study," A. W. Sellards; "The Self and Nature," De Witt H. Parker; "The Problem of Space in Jewish Mediæval Philosophy," I. Efros.

THE new announcements of Messrs. Longmans and Co. include:—"Rhododendrons and their Hybrids," by J. G. Millais, with coloured plates by A. Thorburn, B. Parsons, E. F. Brennand, and W. Walker; "Mysticism and Logic and other Essays," by the Hon. B. Russell; "Reality and Truth: a Critical and Constructive Essay concerning Knowledge, Certainty, and Truth," by the Rev. Prof. J. G. Vance; and "The Works Manager To-day," by S. Webb.

MESSRS. J. M. DENT AND SONS, LTD., will shortly publish in "Everyman's Library" an anthology from the works of the late Prof. William James, which will form an introduction to the writings of the philosopher. The book is edited by Prof. C. Bakewell, of Harvard University.

OUR ASTRONOMICAL COLUMN.

THE HUNTER'S MOON.—The following particulars as to the visibility of the moon during the next fourteen days may be of interest:—

Rises		Souths		Sets		Altitude on meridian
	P.M.		P.M.		A.M.	°
Oct. 25,	2.26	Oct. 25,	7.52	Oct. 26,	1.32	31
26,	2.45	26,	8.43	27,	2.57	37
27,	3. 5	27,	9.35	28,	4.22	44
28,	3.26	28,	10.28	29,	5.47	50
29,	3.49	29,	11.22	30,	7.13	55
			A.M.			
30,	4.19	31,	0.19	31,	8.34	59
31,	4.56	Nov. 1,	1.17	Nov. 1,	9.49	62
Nov. 1,	5.41	2,	2.15	2,	10.50	63
2,	6.38	3,	3.11	3,	11.39	62
					P.M.	
3,	7.42	4,	4. 4	4,	0.16	60
4,	8.49	5,	4.53	5,	0.43	58
5,	9.59	6,	5.39	6,	1. 4	54
6,	11. 8	7,	6.23	7,	1.23	50
	A.M.					
8,	0.15	8,	7. 4	8,	1.39	45

The times along the same horizontal line refer to the same appearance of the moon above the horizon.

Full moon occurs at 6.19 a.m. on October 30, and last quarter on Nov. 6 at 5.4 p.m. It may be noted that the half-moon gives only about one-tenth of the amount of light given by the full moon at the same altitude.

THE ORBIT OF COMET 1914*c*.—A definitive investigation of the orbit of comet 1914*c* (Neujmin) has been made by J. Svärdson (*Ast. Iaktt. Stockholms Obs.*, Band 10, No. 6). The comet was never very bright, but was observed during a period of 182 days, from June 27 to December 22. Corrections have been applied for the perturbations due to Jupiter, and it is concluded that the observations are best satisfied by the following hyperbolic elements:—

$$T = 1914,\ \text{July } 30{\cdot}15783 \pm 0{\cdot}13374 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \omega &= 14^\circ\ 2'\ 12{\cdot}5'' \pm 92{\cdot}4'' \\ \Omega &= 270^\circ\ 18'\ 26{\cdot}7'' \pm 3{\cdot}3'' \\ i &= 71^\circ\ 2'\ 18{\cdot}4'' \pm 10{\cdot}1'' \end{aligned}\right\} 1914{\cdot}0$$

$$\log q = 3{\cdot}747131 \pm 0{\cdot}000243$$

$$e = 1{\cdot}003672 \pm 0{\cdot}000296$$

The orbit is remarkable for the exceptional value of the perihelion distance; in this and other respects it shows considerable resemblance to the orbit of the comet of 1729.

MAXIMUM OF MIRA CETI.—This well-known variable star may be expected to reach a maximum about the end of the current month. The magnitude ranges from 2·0 to 9·6 in a period of about 331 days, but the period and magnitude at maximum are subject to variation. The star is now well placed for observation, crossing the meridian near midnight, and thus being above the horizon for practically the whole night. On October 20 the star was of about 4th magnitude.

BRESTER'S THEORY OF THE SUN.—In anticipation of a further volume on the constitution of the sun, Dr. A. Brester has issued the introduction and general conclusions in pamphlet form (La Haye: P. van Stockum et Fils, 1917). As is well known, Dr. Brester does not accept the general view that the surface of the sun is subject to violent disturbances, and seeks to explain solar phenomena on the basis of a relatively tranquil gaseous globe which is practically undisturbed by convection currents. The solar gases decrease in density and luminosity from the centre outwards, but on account of their opacity their light never reaches us. The photosphere is a condensation stratum which is rendered luminous in the same way as a mantle in an ordinary gas flame, while a sun-spot is a perforation through which the less luminous surface layer of the interior gases becomes visible. The varying frequency of spots is accounted for by supposing that at minimum the heat of the central nucleus is prevented from escaping by a photosphere of relatively great thickness, and that afterwards, owing to contraction, the temperature of the nucleus increases to such an extent that the photosphere becomes attenuated and subject to perforations in the form of spots and pores. Radiation from the nucleus is then facilitated, so that the photosphere again increases in depth, and eventually produces another minimum. The chromosphere, prominences, and corona are regarded by Dr. Brester as effects of a permanent aurora, which is maintained by electrons projected from the photosphere.

THE NEW PHYSICS.

COPIES have reached us of five of Prof. Levi-Civita's recent mathematical papers,[1] three of which deal directly with Einstein's theory of gravitation, and suggest some remarks on the aspect of theoretical dynamics, as it appears at present to a comparative layman unable to criticise rival theories in detail. Speaking broadly, we may say that the theory of mathematical physics is based upon a comparatively small number of fundamental differential equations. Until recently time was explicitly or implicitly treated as the independent variable, in terms of which the other variables had to be found; and all phenomena were supposed to take place in a three-dimensional Euclidian space, where we can use the formula $ds^2=dx^2+dy^2+dz^2$ for the distance between two very near points. In the theory expounded by Minkowski and others we have a different formula, $ds^2=c^2dt^2-(dx^2+dy^2+dz^2)$, where we may regard dt as an element of time, and speak of a "world-point" (x, y, z, t) determined not only by its position, but also by its age. Einstein has developed his gravitation-theory from the general expression, $\Sigma g_{ij}dx_idx_j$ $(i, j=0, 1, 2, 3)$, assumed for ds^2, where ds is an element of distance in a four-dimensional space. (It may be remarked that in the previous theory, as Minkowski pointed out, we might take dt as a variation of a co-ordinate distance; then phenomenal processes in our space might be regarded as "sections," so to speak, of a four-dimensional system.)

With Einstein's form of ds^2 we can at once use all the known geometrical theory of infinitesimal geometry in four dimensions, and, in fact, the well-known symbols of Riemann and Christoffel directly enter into Einstein's gravitation formulæ. This is a matter of mathematics merely; the most striking fact, from the physical point of view, is that Einstein has used his formulæ successfully to account for the secular motion of the perihelion of Mercury. This does not show that Einstein has said the last word on the theory of gravitation, but it does show that these post-Newtonian theories provide a calculus which gives a better image of actual facts than the purely Newtonian theory seems able to do. The more predictions the new theory can give us, which are verified by experiment, the more we shall be inclined to trust it; and this is quite independent of what we call the "real meaning" of the symbols involved. For instance, Prof. Levi-Civita's paper No. 2 seems to show that if we could produce a sufficiently strong magnetic field, we should find it inducing upon the three-dimensional space to which, so far, our intuition appears to be confined, a corresponding "curvature" measured by $1/R^2$, where R is a length. Assuming that the field is one of 25,000 gauss, the author deduces that $R=\frac{3}{2}.10^{20}$ cm., or about ten million times the mean distance of the earth from the sun. As he points out, there is little hope of testing this by experiment, but he obtains a formula for the velocity of light, $V=c_1\exp(x/R)+c_2\exp(-x/R)$, with a damping coefficient in the second term, which he suggests might come within the range of observation.

Philosophically, the trouble still seems to be about *time*, in the philosophical sense. If we could look at the universe *sub specie aeternitatis*, we might perhaps find our greatest delight in its unchangeable perfection; but so long as we are constrained by processes (even processes of thought), time, *in some sense or other*, is apparently indispensable, and if we evict it from one habitation, we may expect it forthwith to be in occupation of another. G. B. M.

[1] (1) "Statica Einsteiniana"; (2) "Realtà fisica di alcuni spazî . . ."; (3) "Sulla espressione analitica spettante al tensore gravitazionale . . ."; (4) "Nozione di parallelismo in una varietà qualunque . . ."; (5) "Sulle linee d'azione degli ingranaggi." (1), (2), and (3) are reprints from *Rendic. della R. Accademia dei Lincei* (Rome, 1917); (4) from *Rendic. del Circ. Mat. di Palermo* (Palermo, 1917); (5) from *Attie Memorie della R. Accad. di Padova* (Padua, 1917).

METEOR ORBITS.

A PAMPHLET on "The Determination of Meteor Orbits in the Solar System," by G. von Niessl, has just been published in Smithsonian Miscellaneous Collections (vol. lxvi., No. 16, Washington, 1917). The pamphlet is a translation by the late Cleveland Abbe of a paper published in the "Encyclopädie der mathematischen Wissenschaften," dated Vienna, 1907. The author, who has had considerable experience in computing meteor paths and orbits, gives his views as to the mathematical treatment of the subject. He indicates the best method to be followed in determining the radiant and geocentric velocity of meteors and fireballs of which multiple observations have been obtained. Not the least interesting part of his discussion is that in which he deduces the mean errors in the results:—

Mean error of azimuth $=5{\cdot}8^\circ$, 351 observations.

Mean error of apparent altitude $=4{\cdot}1^\circ$, 235 observations.

Mean error of radiants $=3{\cdot}3^\circ$, 43 cases, 537 observations.

Mean error of inclination $=6{\cdot}5^\circ$, 250 observations.

The radiant positions of the chief periodical showers he gives to within 1° of probable error.

Tables are furnished of the average terminal velocity and altitude of meteors, from which he concludes that they "can penetrate deeper into the atmosphere in proportion as they move with a low velocity"—a fact previously well ascertained. With regard to atmospheric resistance, von Niessl's opinion is that direct observations make it probable that the velocity of meteors in the upper atmospheric regions is slighter, while in the lower strata of the air it is greater, than theoretical views.

The masses of fireballs and shooting-stars are discussed from various data. Prof. A. S. Herschel dealt with this part of the subject many years ago, and held the view that a first magnitude meteor is usually a few grams in weight, while the very small meteors are only the fraction of a gram. V. F. Sands found from the Leonids of 1867 that the average mass, or weight, of a meteor equal to Jupiter in brightness was 0·67 gram, while a fourth magnitude object was only 0·006 gram.

Von Niessl finds it necessary to assume decidedly hyperbolic orbits for the majority of meteors, for their "observed geocentric velocity far exceeds the limits for parabolic orbits. Therefore the large meteors in general are undoubtedly of interstellar origin." Schiaparelli arrived at similar conclusions half a century ago.

The paper is an instructive contribution to the literature of a branch of astronomy which has been somewhat neglected in recent years. But some of the data on which von Niessl's conclusions are based are old and inaccurate. There is no doubt whatever that for the trustworthy investigation of various difficult questions affecting the subject more exact, modern, and abundant observations are necessary.

GEOLOGY OF THE WITWATERSRAND GOLD FIELD.

THE Rand mining field is geologically one of the most interesting areas in South Africa, as well as the most important economically. Its general structure has been gradually unravelled by the work of the geologists and miners of the Transvaal, and it has now been investigated in detail by the Geological Survey of South Africa. The results of this survey are shown on an excellent map (Geological Map of the Witwatersrand Gold Field, 3 sheets, 1917) on the scale of 1 to 5000, or almost an inch to the mile. It has not been contoured owing to the inadequacy of the topographic surveys, but as the mining fields are on an area of high plains this deficiency is of little practical inconvenience. The map is mainly the work of Mr. E. T. Mellor, who has prepared also a short explanation of 46 pages summarising the geology of the mining field and including a bibliography of the chief literature. The report classifies the rocks and gold reefs of the Rand. The age of the rocks is so uncertain that no precise correlation with those of Europe is attempted. They are divided into three systems with South African names. The youngest, the Karroo, which includes the famous Dwyka glacial deposits and the coal seams, has yielded many fossils, so that its correlation is at least approximately known. The Transvaal system includes the quartzites to the north of the goldfield, a thick series of dolomites and cherts, and the Black Reef series. The oldest of the three, the Witwatersrand system, includes the quartzites, shales, and conglomerates of the goldfield. These two older systems are unfossiliferous, and whether they are Lower Palæozoic or pre-Palæozoic is uncertain. The author accepts the view that the gold of the Rand is of alluvial origin, and abandons the long popular theory that it was introduced by infiltration as in ordinary lodes. The alluvial or placer theory has been advocated by several geologists, while the majority of the mining engineers have supported the infiltration theory. Probably the most striking feature displayed by the map is that strike-faulting is far more important than had been suspected. The author concludes that the unworked parts of the goldfield are so extensive that the gold-mining industry has elements of "comparative permanency not found in many other goldfields and more akin to those of a base metal district or a manufacturing centre."

ORGANISED KNOWLEDGE AND NATIONAL WELFARE.[1]

THE future of any nation is secure if it lives up to its possibilities. The nation which does this is bound to be a leader among nations and to command world-wide respect. Its national problems will be solved, and solved intelligently and thoroughly. The greatness of a man is in part born in him and in part the product of his environment. According to eminent biologists, he is about two-fifths born and three-fifths made. Similarly, a nation is great according to its resources and according to its development of these resources. And the development of those resources may be accomplished only through organised knowledge.

(1) *The Function of Organised Knowledge.*—Consider for a moment two manufacturing concerns on an equal footing as regards output, but of which one is continually making progress through improvements in manufacturing processes, developing new and valuable products and investigating the fundamental principles underlying all these processes. This firm will in time outstrip the other in every way; the balance, in fact, is a very delicate one, since the results are cumulative. In quite a similar manner, that nation will advance to leadership in which the increase in organised knowledge and the application of that knowledge are greatest. For this reason, interest in research should be as wide as the nation and should cover the whole gamut of problems from administration to agriculture, from medicine to manufacture. For it is only through the solution of individual problems that general principles can be arrived at and the sum total of useful organised knowledge increased.

It is essential that the wide field to be covered be kept in mind, extending over not only physics, chemistry, engineering, and all their branches, but all the biological and mental sciences as well. In the last analysis an increase in knowledge in the field of the *biological sciences* means more and better food, improved racial stock, and improved public health, as well as increased material welfare in all having to do with plants and animals. Increased knowledge of the fundamental principles of the *mental sciences* means increased efficiency in administration, legislation, education, operation, and research. I do not mean mere book learning in psychology, but such a command of the fundamental principles as will assist in the solution of all practical problems. Increased knowledge of *chemistry* means increased ability to utilise raw materials and an improvement in general health and living conditions. One may almost say that the generalised problem of chemistry is to convert the less expensive raw materials, such as cellulose, petroleum, glucose, various minerals and oils, starch, nitrogen of the air and the like, into food, clothing, tools for our use, and means for national defence. An application of the fundamental principles of *physics* in the way of various engineering problems leads to a fuller utilisation of resources and of new products useful to man, makes inventions possible and effective, and adds to the general increase in operating efficiency in every way.

The utilisation of organised knowledge in national welfare comes about both through knowledge itself and the incentive to apply that knowledge. Both ability and incentive are essential to utilisation. So far as knowledge went, we might have made dyes and optical glass many years ago in the United States, but since they could be bought so cheaply there was no incentive to develop the manufacture of such articles. These are cases of ability without incentive. On the other hand, there has long been an incentive for the fixation of nitrogen and for various mechanical devices, but these have not been forthcoming for lack of sufficient knowledge.

In general, in normal times it is perhaps no exaggeration to say that neither the average individual nor the average nation approaches within 50 per cent. of their possibilities. Nothing short of a war threatening the national existence can shake a nation out of its lethargy. Similarly, the average individual cannot be induced to put forth his best efforts without the strongest of incentives. It is unfortunate that this is the case. However, with sufficient attention given to the problem by trained experts in mental science, it is

[1] Abstract of an address given on April 9 to the Associated Engineering Societies of Worcester, Mass., by Dr. P. G. Nutting. Reprinted from *Science* of September 14.

quite possible that at some future date as high as 60 or 80 per cent. of the possibilities may be realised without any appeal to arms for the nation or any unusual incentive for the individual.

(2) *The Increase of Organised Knowledge.*—The research by which organised knowledge is increased will doubtless always be carried on chiefly by three distinct types of research organisations: research by the Government in national laboratories, research by the universities in connection with the work of instruction, and research by industrial laboratories in connection with the interests of manufacturing concerns. Apart from these three main classes of laboratories there will always be large, privately endowed research organisations, dealing with neglected fields of remote commercial interest, private industrial laboratories supported by consulting fees, and co-operative testing laboratories, also self-sustaining.

National, university, and industrial research follow three essentially different lines. There is considerable overlap in field, it is true, but each is centred on a different kind of research. The proper function of *national* research is the solution of such problems as concern the nation as a whole, affecting the general interests of all classes of individuals; it is the custodian of standards, it develops methods of precise measurements and investigation, it is trouble engineer for the solution of very difficult problems or the problems of producing units so small as not to be able to have their own research laboratories. It is the proper guardian of the public health. It solves problems connected with contagious and vocational diseases. It develops methods of making good roads, increasing the fertility of the soil, and stocking waters with fish. National research is of all grades, from that dealing with fundamental principles up to that relating merely to lessening the costs of production.

University research must always, in the very nature of things, be concerned chiefly with the advancement of the various sciences as such, and with the development of the fundamental principles of each science. The best university instruction is along these lines, and investigators and students in close touch with them will naturally have most new ideas in close connection with fundamental principles. University research is necessarily one of small jobs and the best minds, and is without very much continuity. The advanced student is interested in a research just long enough to make it acceptable as a doctor's thesis. The instructor is too burdened with teaching to give more than a margin of time to research. But a very small part of the university research is extended year after year, covering a wide field. This is quite as it should be, the university looking after those fields of research of little commercial value on one hand, and not directly affecting the interests of the nation as a whole on the other, but of fundamental and far-reaching importance to all.

Industrial research takes the middle ground and has already become a distinct profession. It is in close touch with practical commercial application on one hand, and with fundamental principles on the other. Its proper field is anything between elimination of works troubles and the investigation of fundamental principles. The staff of the ideal industrial research laboratory is composed of experts of wide experience who can serve the manufacturing departments in a consulting capacity without sacrifice of time. We may perhaps best summarise the preceding statements by describing the ideal research man and the ideal research laboratory.

Some writers have spoken of the investigator as a rare individual to be sifted out from educational institutions with great care for a particular line of work. My personal opinion is that a large percentage of the men students are fitted for research work if properly started along the right line. The investigator should have a mind at once fertile and well-trained. His mind should be teeming with new ideas, but he should possess unerring judgment to reject those which are not logical or promising. We are often asked what sort of preparation in physics would be best for men intending to take up research as a life work. It has even been proposed to give courses in "applied physics" for the benefit of those intending to take up industrial research. Our invariable reply is that the best preparation for a research man is a thorough grounding in the fundamental principles of his science: physics, chemistry, or whatever it may be. If he has this thorough knowledge of fundamental principles it is safe to say that in any properly organised research laboratory with the proper leadership and companions, such a student will have many times as many useful ideas as he can himself possibly follow up with research. Scarcely anyone who has completed advanced work in a science can read, say, a journal of abstracts without thinking of many problems which he would like to investigate. Fertility of mind is not so much an inborn quality of the mind itself as of the training and association which that mind has had.

The ideal industrial research organisation may perhaps be outlined with a knowledge of its development during the last fifteen years. I shall give, frankly, my personal views on the matter, based on an intimate knowledge of four universities, three professional research laboratories, and a visiting acquaintance, so to speak, with quite a number of others. The ideal industrial laboratory, to my mind, consists of two quite distinct divisions: one taking the brunt of works troubles and testing or making analyses of the material used. The other wing is complementary to this, and deals with the larger fundamental problems encountered, problems requiring skilled specialists and considerable time for their solution. The alternative organisation with a single research laboratory covering both works troubles and fundamental problems is not so successful. The plan in this case is to have considerable research in progress of very little interest to the company, but engaging a staff much larger than required to take care of ordinary works troubles. In this case, when works troubles are many and insistent, as they are wont to be at times, the staff engaged upon fundamental research forms a reserve to be called out occasionally to deal with works troubles. The chief disadvantage of this is that the fundamental work is subject to more or less frequent interruption and cannot be so efficiently carried on. On the other hand, when the research is in two quite distinct divisions, fundamental work is not subject to interruption by works troubles.

Industrial research is pre-eminently fitted to be carried on by team work. This we have developed to a high degree in Pittsburg, and consider very much more efficient than the alternative cell system, where each leading man has a room or suite of rooms to himself and keeps his work to himself. In the ideal organisation two or three men work together on the same large problem or group of problems, the aim being to have a good theoretical man and a good experimentalist working together as much as possible, or even a physicist and chemist in some cases. The characteristic of the team-work plan, however, is the conference system. The five or six men most interested in each line of research meet for an hour each week to discuss the problem in its various aspects, to plan new work, and to consider various interpretations and applications of the results obtained. The ideal conference is not fewer than four and not more than eight men, and includes an efficient stenographer. To one experienced in such team work the results of getting together are surprising. A good suggestion is no sooner made than capped by a better, and the saving in time and effort is almost incalculable.

The conference system also aids in putting useful results before the other wing of the research division and before the patent department. At each of our conferences are representatives of the other wing of the research division, charged with taking up any results immediately applicable, and a member of the legal department who takes care of any ideas worth patenting. This plan of conferences relieves the scientific men from responsibility for directing the attention of the works or of the patent department to useful patentable results.

So far as national welfare is concerned, in order to increase our stock of organised knowledge we need more teaching by professors and instructors in closer touch with industrial problems. So far as developing research men goes, the ideal instructor is probably an ex-professional research man, and, in many cases, one who has made a reputation or a fortune by his work along industrial lines. Another need is, of course, more research laboratories all along the line. The increase would naturally be among industrial organisations and the expense borne largely by manufacturing concerns, since it is they who reap the chief direct financial benefit.

Another great need is co-operation among the various branches of research: national, university, and industrial. There should be a free interchange of men between such laboratories, and each should be thoroughly familiar with the needs and problems of the other. One great benefit from this war, if it lasts sufficiently long, will be to force co-operation between different branches of research.

(3) *The Application of Organised Knowledge.*—The present national crisis brings home to us the crying needs of the nation in availing itself of the knowledge and ability at its command. Fifty thousand specialists, in applying scientific knowledge to practical problems, as well as scores of research laboratories, have offered their services to the nation. But problems requiring investigation are slow in being developed. Once they are formulated and given to the engineers of the country, few will remain unsolved very long.

It is for the engineer to apply the results of research to practical problems and to carry practical problems demanding general research back to the research laboratories. To the engineer every special problem requires a special application of fundamental principles. Is it too much to hope that the day is rapidly approaching when all great problems, particularly those of our national and State Governments, will be automatically placed in the hands of trained specialists? Not self-seeking politicians, or yet men with mere theories, but engineers with a real command of fundamental principles, men with an unbroken record of big achievements and no failures, men ever ready to stake their all on their ability to handle problems in their specialty.

Prof. Joseph Le Conte, in an address years ago, remarked that each of the great professions first attained high standing when it was taught as such in universities. When so taught, the professional men turned out are no longer quacks, but each has a real command of the fundamental principles in his chosen field of action. The basic relation is that any profession has standing in so far as its fundamental principles have been developed and applied. To retain standing, a profession must be continually increasing its stock of knowledge of fundamental principles through research. The engineer of standing in his profession must not be content with a mere working knowledge of rules of thumb, but must have a real command of basic principles in his chosen field and in related fields. The illuminating engineer, for example, should not only know lighting, but also possess a working knowledge of the laws of vision and of geometrical and physical optics. So the great physician or constructional engineer has a command of his own field and an intimate acquaintance with related fields.

So also with research as a profession, the leaders have not only a taste for research and logical minds clearly to analyse and attack problems with thorough scientific knowledge, but also a knowledge of the principles of research; getting the most out of their own minds, avoiding side-issues, co-operating with their colleagues, and putting their most valuable results in permanent, readily available form. Research is one of the youngest of the professions, and one with a promising future, but let no one enter it without thorough knowledge or a full understanding of its aims and methods. With sufficient attention given to research and to its application, this nation with its great national resources should at once attain and retain a permanent lead among the nations of the earth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR WILLIAM TATEM has given 25,000*l.* for a laboratory at the University College of South Wales, Cardiff.

WE notice with regret that Mr. Bonar Law announced in the House of Commons on October 19 that he feared it would be possible neither to pass the Education Bill this session, nor to give a day for the second reading, unless there was a prospect of passing the Bill. There is little substantial opposition to the essential clauses of Mr. Fisher's Bill, and all the provisions covered by them are "urgently demanded by, and connected with, the circumstances of the war," as Mr. Fisher has said. We trust that even yet the Government may be able to proceed with the Bill.

THE University of Bristol has again benefited from the generosity of the Bristol family of Wills and their interest in higher education. Mr. Henry H. Wills lately purchased the Royal Fort House and grounds, which immediately adjoin the University buildings. This historical house was built and decorated in the eighteenth century by a member of the Tyndale family, descendants of William Tyndale, translator of the Bible. The greater part of this property, as well as some adjoining land, has been conveyed by Mr. Wills to the University for future extensions. The property conveyed covers nine acres, which will give the University a total building area of about thirteen acres. Part of the new site has been marked out for the purpose of the department of physics, and another part for that of a residential college. It is proposed to retain the existing house as part of the group of buildings which will eventually occupy the site. It will be remembered that shortly before the war Mr. H. H. Wills, jointly with his brother, Mr. George A. Wills, placed a sum of more than 200,000*l.* in the hands of the University for the construction and endowment of buildings on another part of its site.

THE governors of the Huddersfield Technical College are appealing for public support to enable them to carry out a large extension of the existing buildings. For many years the college has been seriously overcrowded, whilst in some important branches of local industries, such as woollen carding and spinning, no provision whatever has been made for technical instruction. The chemical and engineering industries of the district are developing so quickly that the need for better accommodation at the Technical College has become very urgent. The scheme contemplates the building and equipment of new departments for coal-tar colour chemistry and for dyeing; the addition to the textile department of new sections for (1) carding and spinning, and (2) cloth finishing, providing at the same time improved facilities for weaving and testing, along with a textile museum; the extension of the departments of mechanical and electrical engineering, especially as regards facilities for practical and experimental work. Space would thus become available for necessary extensions in other departments. To carry through these proposals it is estimated that a sum of 85,000*l.* will be required. The Technical College should then be in a position to deal adequately with the varied educational needs of the leading industries of the district, both for advanced teaching and for research. The principal donations promised to date are:—British Dyes, Ltd., 5000*l.*; Sir J. F. Ramsden, Bart., 3000*l.*; Mr. J. A. Brooke, 1000*l.*; Mr. J. E. Crowther, 1000*l.*; Messrs. Simon-Carves, Ltd., 1000*l.*; Messrs. Walter Sykes, Ltd., 1000*l.* Furthermore, the Huddersfield engineers have undertaken to provide the complete equipment of the new engineering section.

LAST February, by the passing of the Smith-Hughes Act, the United States embarked on a national scheme of State-aided vocational education. We learn from the *Scientific American* of August 25 that the Act is similar in its features to the Agricultural Extension Act of 1914. There is the same provision for increasing grants, beginning with 340,000*l.* in 1917, and rising to 1,440,000*l.* in 1925. The available money will be distributed among all States which agree to contribute sums equal to their share of the grants and to conform to the terms of the Act. The grant provides for the creation of three distinct funds, viz. for paying salaries of teachers, supervisors, or directors of agricultural subjects; for paying the salaries of teachers of trade, home economics, and industrial subjects; and for training the teachers and other educational workers concerned. The Act creates a Federal Board for Vocational Education, consisting of the Secretaries of Agriculture, Commerce, and Labour, the U.S. Commissioner of Education, and three other members, to be appointed by the President, of whom one is to represent manufacturing and commercial interests, one agricultural interests, and one labour interests. The board, besides administering the Act, will carry out investigations relating to vocational education, co-operating with the Departments of Agriculture and Commerce and the Bureau of Education. There has been some fear in the United States that the spread of vocational training may disturb the principle of compulsory general education But every boy and girl will be required to get the same minimum amount of "book learning" as at present, and those who, under conditions now prevailing, would enter the trades and industries as unskilled labourers will, for the future, receive specialised training that will enable them to command higher wages and make them more useful members of society.

THE address delivered to the members of the United Tanners' Federation at the Leather Sellers' Hall, London, on July 17 last by Dr. Sadler, the Vice-Chancellor of the University of Leeds, deserves the serious consideration not only of the protagonists on classical *versus* scientific education, but also of all who are engaged in industries in which science is a prime factor. It puts with force and precision the necessity of an all-round general education in which science, broadly conceived, shall take its due place in the education of all classes of the people, and especially that it shall be made "a stimulating and energetic force in the education of every boy and girl in our secondary schools," and that whilst not claiming that science, as ordinarily understood, should have the last word in settling our view of life, yet that it should be a powerful ingredient in the intellectual ferment which determines the final judgment. It insists that technical education must be preceded by a good general education, and that it "should include three elements—scientific discipline, a study of processes of manufacture, and the study of the relationships, moral and economic, which should be established between the employer and his subordinates and between the industry and the community as a whole." In short, the address conceives the possibility of such a training being itself the core of a liberal education. The importance of scientific research and of a much closer relationship between the industries and the scientific resources of the universities is strongly stressed. "The gulf between the practical man and the scientific investigator is not yet bridged. To span it will be a costly business." In no country is there need for a more intimate union, for the solution of the grave industrial and social problems which beset us, between those practically engaged therein and the patient, scientific investigator. We are "rich in shrewd experience, but almost barbarous," says Dr. Sadler, in our "conception of the service that science can render to practice."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 8.—M. Camille Jordan in the chair.—E. **Branly**: The electrical conductivity of mica. A detailed account of experiments proving the conductivity of mica in thin sheets (0·003 mm.) when under the electromotive force of a single thermo-element (0·004 volt). A special method of testing the mica sheets for holes is described.—G. A. **Boulenger**: Considerations on the Permo-Triassic reptiles of the order of the Cotylosaurians.—W. H. **Young**: The theory of trigonometrical series.—M. **Guilleminot**: Dosimetry and X-radio-therapy in the services of the Army.—G. **Sizes**: The Pythagorean scale from the point of view of musical acoustics.—M. **Guillery**: The Brinell hardness test of metals. For this test it is necessary that the conditions, size of ball, total pressure, and duration of the pressure should be rigorously defined. The last condition, not fewer than five minutes, is practically impossible under works conditions where some 10,000 tests a day have to be carried out. The author has worked out a method by means of which the time is reduced from five minutes to two seconds, the imprint being the same as if working under the standard conditions. This is secured by working with an excess pressure above the standard 3000 kg., and a machine is figured and described by means of which the desired pressure is automatically realised; 600 tests per hour can be made with one machine, and data are given proving the accuracy of the results to be within one per cent. of the Brinell standard.—L. F. **Navarro**: The Flyde peak and Cañadas cirque of Teneriffe.—R. **Anthony**: The primitive embryonic circulation of the Teleostean fishes; study of the embryo of *Gasterosteus gymnurus*.—E. **Bordage**: The transformation phenomena of larval tissues in reserve tissues observed during the metamorphoses of insects.—MM. **Baudisson** and A. **Marie**: The spondylotherapy of asthenic and post-traumatic vasomotor or commotional troubles.

CAPE TOWN.

Royal Society of South Africa, August 15.—Dr. L. Crawford in the chair.—Sir Thomas **Muir**: Note on the resolvability of the minors of a compound determinant.—J. **Moir**: Colour and chemical constitution (part ii.): the spectra of the mixed phthaleins and of the sulphonephthaleins.

Mixed phthaleins, containing two different phenol residues, one of which is $C_6H_4 \cdot OH$, are made with extraordinary ease by boiling *para*oxybenzophenone-*o*-carboxylic acid with any phenol or amine, whether free or substituted. The spectra of eighteen new phthaleins of this class are described, and the laws governing the colour elucidated. The method is an excellent analytical one for identifying phenols and amines and their ethers and derivatives. The spectrum of phenolthymolphthalein is not exactly half-way between those of phenolphthalein and thymolphthalein. The spectra of five sulphonephthaleins made from "saccharin" are also described, also six more new derivatives of ordinary phenolphthalein. A new general formula for the coloured substances is put forward.—J. R. **Sutton**: Kimberley diamonds, especially cleavage diamonds. This paper is a general and statistical account of the diamonds produced in the mines under the control of the De Beers Company at Kimberley. It describes the outstanding differences in size, colour, and type between the yields of the different mines; speaks of coloured diamonds, bort, and, especially, cleavage diamonds; and advances the view that many diamonds have been naturally broken by the unequal expansion of themselves and mineral inclusions. It appears that brown diamonds have shown a particular disposition to come up broken from the deeper levels of the Wesselton mine (though the ratio of colourless cleavage to colourless stones also increases with depth of mining), but the author doubts the common assertion that brown or smoky diamonds are markedly liable to spontaneous fracture.—S. **Schönland**: The phanerogamic flora of the divisions of Uitenhage and Port Elizabeth. This paper is meant to be a companion to the papers published by the late Dr. Bolus and Major Wolley Dod on the flora of the Cape Peninsula, and by the late Dr. J. Medley Wood on the flora of Natal. There are 2290 species recorded, of which ninety-eight are considered by the author not to be native. They are distributed over 128 natural orders and 712 genera. There are, however, still large tracts of this area unexplored. Most of the localities quoted are contained in about 600 sq. miles, while the total area is about 2500 sq. miles; much of the remaining tract is, however, covered by fairly uniform karroid succulent vegetation.—J. R. **Sutton**: A lunar period in the rates of evaporation and rainfall. This paper directs attention to the possibility of a lunar influence governing the evaporation from a water surface, and a lunar period in the incidence of rainfall. Tables are given showing that as the result of hourly observations of evaporation and rainfall during the 120 lunar months from August, 1899, to April, 1909, rainfall has its maximum frequency about the time of moonrise, and its minimum just after moonset; also that the rate of evaporation has a maximum and minimum, respectively, shortly after the moon passes the meridian above and below the horizon.

BOOKS RECEIVED.

Two Summers in the Ice-Wilds of Eastern Karakoram. By F. B. and W. H. Workman. Pp. 296+3 maps+illustrations. (London: T. Fisher Unwin, Ltd.) 25*s*. net.

University of London. University College. Abridged Calendar. Session 1917–18. (London: Taylor and Francis.)

The Pasteurization of Milk from the Practical Viewpoint. By C. H. Kilbourne. Pp. iv+248. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Modern Propagation of Tree Fruits. By Prof. B. S. Brown. Pp. xi+174. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Elliptic Integrals. By Prof. H. Hancock. Pp. 104. (Mathematical Monographs, No. 18.) (New York: J. Wiley and Sons, Inc.; London, Chapman and Hall, Ltd.) 6*s*. net.

A Text-Book of Inorganic Chemistry. By Prof. A. F. Holleman. Issued in English in co-operation with H. C. Cooper. New edition. Pp. viii+507. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Dairy Cattle Feeding and Management. By Profs. C. W. Larson and F. S. Putney. Pp. xx+471. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11*s*. 6*d*. net.

Rustic Sounds and other Studies in Literature and Natural History. By Sir F. Darwin. Pp. 231. (London: J. Murray.) 6*s*. net.

The Faith of a Farmer: Extracts from the Diary of William Dannatt, of Great Waltham. Edited, with an Introduction, by J. E. G. de Montmorency. Pp. xliii+249. (London: J. Murray.) 5*s*. net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 26.

PHYSICAL SOCIETY, at 5.—A Class of Multiple Thin Objectives: T. Smith.—The Radius of the Electron, and the Nuclear Structure of Atoms: Prof. J. W. Nicholson.

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Reflexion of Light from a Regularly Stratified Medium: Lord Rayleigh.—Two Cases of Congenital Night-blindness: Sir William Abney.—Duration of Luminosity of Electric Discharge in Gases and Vapours. Further Studies: Hon. R. J. Strutt.—Surface Reflexion of Earthquake Waves: G. W. Walker.—Characteristic Frequency and Atomic Number: Dr. H. S. Allen.

CONTENTS.

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

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

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