THURSDAY, OCTOBER 26, 1916.

"METEORITICS."

Meteorites: their Structure, Composition, and Terrestrial Relations. By Dr. O. C. Farrington. Pp. x+233. (Chicago: Published by the Author, 1915.) Price 8*s.* 6*d.*

THE treatise on meteorites written by the well-known curator of geology at the Field Museum of Natural History, Chicago, will meet a difficulty that has long faced the student who, while desirous of studying this subject, has hitherto looked round in vain for a comprehensive text-book. Sir L. Fletcher's handbook and guide to the meteorite collection at South Kensington, which is now in its eleventh edition, is admirable so far as it goes; but its scope is naturally limited, since it is intended for the ordinary visitor to the museum. Meunier's "Météorites," which formed part of an "Encyclopédie Chimique," was published so far back as 1884, and is therefore out of date, and probably not now readily accessible. Cohen's "Meteoritenkunde" was excellently planned, but was unfortunately cut short at the end of the third of the five parts in which it was intended to be by the author's death in 1905; indeed, he did not live to see the third part appear.

At the outset Dr. Farrington attempts to solve the problem of finding a name for the subject, and suggests "Meteoritics," a word that seems to serve the purpose very satisfactorily, since "Meteoritology" is ruled out because of the inevitable confusion with that branch of science which is concerned with the weather. Previously "Astrolithology" had been proposed by Shepard, and "Aerolitics" by Story-Maskelyne, but neither word is suitable or suggestive.

The book consists of two parts, though it is not so divided, dealing the one with the mode in which meteorites have reached the earth's surface and their possible origin, and the other with their physical and chemical characters. But for the protection afforded by the atmosphere the fall of a meteorite would not be the comparatively rare phenomenon it is at present. Most of the erratic bodies which meet or overtake the earth are burnt up long before they reach the ground, and the velocity of those that do survive the passage through the air is so reduced by the friction that the rate of fall is only what would be due to gravity had they fallen from heights which have been variously estimated from 4 to 46 kilometres. The disruptive force generated by the heat resulting from the friction causes meteorites to burst into pieces which are often quite small. Nevertheless, some of the masses which must have fallen, though there is no recorded evidence of the fact, have been of considerable size and weight. The largest as yet known is the Ahnighito—one of those located at Cape York, West Greenland, by Admiral (then Lieut.) Peary in 1895, and now in the New York Museum; it weighs 36½ tons. The next in size is that of Bacubirito, Mexico, which, on account of its inaccessibility and the difficulty of transport, still remains where it originally fell; its estimated weight is 27 tons. Pathetic interest attaches to the photograph which is reproduced as a frontispiece. It represents the late Prof. H. A. Ward standing beside the Bacubirito meteorite. An indefatigable collector of meteorites, he was ready to start at a moment's notice to any part of the globe in search of one. He returned in safety from all his expeditions, only to be run over and killed in the street at Rochester, N.Y., where he had his home.

Meteorites are distinguished from terrestrial rocks both by their structure and by their mineral composition. All the elements present in the former are known terrestrially, but some of the common elements, such as barium, strontium, lead, and bismuth, have not been detected in meteorites, at least not in quantity or with certainty. Many of the minerals present in meteorites are peculiar to them, and have not been found terrestrially—for instance, oldhamite (calcium sulphide), schreibersite (iron-nickel-cobalt phosphide), lawrencite (iron-nickel chloride). Their presence is very significant, since they could not have been produced had solidification taken place in the presence of free oxygen. It is the last-named mineral that is largely responsible for the sweating and rusting which occur in certain irons. The metallic portion of a meteorite consists largely of an iron-nickel alloy, and is arranged in a definite manner, as is shown by the markings developed on etching a polished section. Dr. Farrington himself has established that the nature of the arrangement depends on the ratio of the iron to the nickel in the alloy; irons with about 6 per cent. of nickel have one type, which is characterised by the fine Neumann lines, those with from 7 to 15 per cent. have a second type, showing the broad Widmanstätten bands, and those still richer in nickel have a granular structure. Meteoritic stones are not unlike terrestrial rocks as regards their mineral constitution, but differ from them in their peculiar chondritic or granular structure.

One of the problems in the subject that call for solution is a satisfactory classification of meteorites. That at present in use, which is described in detail by Dr. Farrington, was devised by Gustav Rose, and amplified or modified by Tschermak and Brezina. It is cumbersome, consisting as it does of no fewer than seventy-six groups, and has no real scientific basis. The author refers the reader to a scheme on the lines of the American quantitative classification of rocks which he has himself put forward. This classification has, however, been by no means generally accepted in the case of rocks by petrologists. A promising scheme, which emphasises the relationship subsisting between meteorites, however apparently different their characters may be, was recently communicated to the Mineralogical Society by Dr. Prior. It consists of six groups, of which five may be considered as derived from the first

by chemical interaction between certain of the constituent minerals.

At the close the author appends a useful table for discriminating the metallic minerals occurring in meteorites, and has added two indices, one general, and the other giving the falls mentioned in the book.

ESCAPE OF ELECTRONS FROM HOT BODIES.

The Emission of Electricity from Hot Bodies. By Prof. O. H. Richardson. Pp. vii + 304. (London: Longmans, Green and Co., 1916.) Price 9*s.* net.

THIS work, which is one of the series of monographs in physics published under the editorship of Sir J. J. Thomson and Prof. Horton, deals with the emission of positive and negative electricity from hot bodies. The closely related subject of the conductivity of flames is not included. It will be remembered that a volume dealing with this part of the subject was published a few years ago by Prof. H. A. Wilson.

While it had long been known that hot bodies discharge both positive and negative electricity, the detailed investigation of this important subject was an immediate consequence of the development of the ionisation theory of gases. The author was one of the first workers in this new field of work begun at Cambridge, and with the help of numerous students he vigorously continued his investigations at Princeton University, and more recently at King's College, London. A large part of our knowledge of this subject is due to his investigations.

As a consequence, we have a first-hand account of this interesting subject, written by one who has a full appreciation of the experimental difficulties and the adequacy of the theories proposed. A large part of the volume is devoted to the study of the emission of negative electrons from heated filaments at low gas-pressures, its variation with temperature, the effect of residual gases, and the treatment of the metal surfaces. Although the electronic current is usually large and easily measured, there are in many cases wide discrepancies in the magnitude of the current obtained under similar conditions by different observers. This lack of definiteness in the data seems to result mainly from the part played in the electronic emission by the condition of the surface, and the presence of gaseous or other impurities. A general theory is advanced on the supposition that a metal contains free electrons which obey the gas laws. At high temperature some of the electrons acquire sufficient energy to escape from the metal surface. The theory of the escape of electrons from a hot metal is thus analogous to that of the evaporation of a liquid. This theory seems to explain satisfactorily the rapid variation of the electronic current with the temperature. The author has shown experimentally that energy is expended in the escape of electrons from the metal surface, and that heat is given up to the metal surface when electrons pass into it. The connection of these effects with the contact difference of potential has been carefully examined.

As is well known, there has been considerable difference of opinion in the past as to the origin of the large electronic emission from incandescent bodies. Its susceptibility to conditions, and especially to the presence of impurities, has led some to suppose that part, if not all, of the electronic emission is the result of chemical action between the heated metal and the gaseous or other impurities. The author evidently considers that there is a true electronic emission depending only on the metal, and his contention is certainly strongly supported by the observed fact that a tungsten filament in the highest possible vacuum continues its emission of electrons unchanged with time. On the other hand, the electron current from most metals is very markedly influenced by the previous history of the wire, and is extraordinarily susceptible to the presence of a minute amount of impurity. For example, Langmuir in a recent paper directs attention to the striking fact that the heating of a filament containing thorium in the neighbourhood of the tungsten wire increases the thermionic current of the latter by a million times. While great progress has been made in the last decade in extending our knowledge of this subject, there is no doubt that much work still remains to be done to clear up many outstanding difficulties.

In the last chapter the author discusses the experimental evidence of the emission of positive electricity from heated metals and salts, and describes the ingenious method developed by him to determine the mass of the carriers. The surprising fact is brought out that in the great majority of cases the carriers of positive electricity are atoms of potassium. The reason why potassium, which, even when present only in minute quantities, is an impurity, should be the active element in this emission is difficult of explanation.

In the preface the author mentions that he has not thought it desirable to include an account of the practical applications of thermionic emission, but mentions some of the more important papers in which this side has been discussed. It is to be hoped, however, that when a second edition is called for, the author will devote a chapter to the very interesting application of the thermionic emission to the rectification of alternating currents, and to the magnification of small currents in radio-telephony and radio-telegraphy. It is of great value that students should appreciate the striking way in which the pure science researches in this subject have proved of great technical value.

This book can be strongly recommended to all those who are interested in modern physics as a clear and up-to-date account of our knowledge of an important department of modern scientific research.

PHYSICS.

(1) *A Student's Heat.* By I. B. Hart. Pp. vii + 376. (London and Toronto: J. M. Dent and Sons, Ltd., 1916.) Price 4*s.* 6*d.*

(2) *Elementos de Física Descritiva para a 4ª e 5ª Classes dos Liceus.* Por Dr. F. J. Sousa Gomes e Alvaro R. Machado. 5ª edição, revista por Alvaro R. Machado. Pp. 528. (Braga: Livraria Escolar de Cruz y Ca., 1915.)

(1) MR. HART'S text-book of heat is intended for use in the higher forms of secondary schools, for advanced students in technical colleges, and for those taking a pass degree examination at the university. The author has included in his book descriptions of many modern methods of determining thermal constants and results of recent experimental investigations. Although the calculus is introduced in the section on thermodynamics, a knowledge of elementary algebra and geometry will suffice for the perusal of the greater part of the book. The text is furnished with a large number of clearly drawn diagrams, but the exposition in some parts is open to considerable criticism.

In the paragraphs dealing with electrical methods of measuring temperature the author assumes his reader to have no knowledge of electricity, and explains the chief points of the simple electric circuit with the aid of a diagram showing cell, ammeter, resistance, and voltmeter all connected in series. In connection with the platinum resistance thermometer, the compensating leads are not made of copper, nor is it usual to standardise the instrument in the way described by the author. The variation of resistance with temperature is represented by $R_t = R_0 (1 + \alpha t + \beta t^2)$. According to the author, β is neglected for approximate measurements, and $\alpha = 0{\cdot}00366$; while for more accurate work the constants α and β are determined by measuring the resistance at 0° C., 100° C., and −273° C. At the last-mentioned temperature the resistance of a pure metal is known to be zero. Again, when describing the thermocouple method of measuring temperature, on p. 23, we have "the difference in temperature at the junctions *induces* an electromotive force, and the galvanometer registers a *kick*." The formula derived for the expansion of a liquid by the weight thermometer method, on p. 49, is wrong. On p. 86, dealing with molecular velocity and temperature of a perfect gas, it should be made clear that it is the square root of the mean square velocity of the molecules which is proportional to the absolute temperature and not their mean velocity. It is difficult to see how Charles's law for unsaturated vapours is verified by the experiment described on p. 131, since the vapour will be subjected to varying pressures. On p. 182 we have the statement that Newton's law of cooling is an approximation to Stefan's law. This is wholly erroneous, since the law of Stefan refers to loss of heat by radiation alone. Each chapter is furnished with a large number of questions selected from the papers of various examining bodies.

(2) As its title implies, this text-book is purely descriptive in character. The subjects dealt with are mechanics of solids and fluids, light, heat, sound, electricity and magnetism. The ground covered is only elementary, and upwards of 200 pages are devoted to introductory mechanics and properties of matter. No mathematical proofs of the formulæ employed are given, the idea being that the statements are to be regarded as laws to be verified experimentally. While there is nothing novel in the treatment of the subject, the text is accurate, concise, and amply illustrated.

BIRDS AND THE POET.

The Birds of Shakespeare. By Sir Archibald Geikie. Pp. x + 121. (Glasgow: James Maclehose and Sons, 1916.) Price 3*s.* 6*d.* net.

THIS volume—one of the company of books which owe their existence to the tercentenary of Shakespeare—consists of an address delivered by the distinguished author to a country natural history society, and as such it must have served its purpose admirably. Beyond this it makes no pretensions, but it is all that it claims to be, and will fill a vacant place on the shelves of those who do not possess Mr. J. E. Harting's standard work.

In his opening pages the author lays stress on the development of man's feeling towards Nature from Chaucer to Shakespeare, from the simple, unreflective delight in the sights and sounds of the open air to the dawning of a sense of "the mystery of things" and its influence on the human mind; and again, at the close of the lecture, he passes to the further development of reflectivity manifest in the poems of Wordsworth, Keats, and Shelley, where the birds are not merely talked *about*, however poetically, but actually talked *to*, as being, like ourselves, "travellers between life and death." The main body of the volume is taken up with the passages in the plays and poems relating to the several birds, linked together by pertinent observations. Some half-dozen pages are deservedly devoted to that "pleasure for high-mounting spirits"—the sport of hawking, to which the birds of prey owed such consideration as they enjoyed; for, apart from this, Shakespeare shares the depreciatory attitude towards them current in his day and long after, including even the "mousing owl"; but then, as Waterton long ago remarked, from the time of Ovid downwards this useful bird has always been in ill odour with the poets. Passing on to the game birds, we get a too brief account of the various methods of taking them, and the sportsman to whom the "Diary of Master William Silence" is still an undiscovered treasure might have welcomed a footnote sending him to that invaluable work.

Here are one or two points which might receive attention when the book is reprinted. "The Passionate Pilgrim" and "The Phœnix and the Turtle" are drawn upon without any hint that these *réchauffés* are by no means wholly the work of Shakespeare. Loon, "a diver," and loon, "a

rogue," are words of distinct origin. With the very doubtful exception of the passage in "King Lear," Shakespeare's "chough" (as the present writer maintained many years ago in the *Zoologist*) is not the Cornish chough (*Pyrrhocorax graculus*), but the jackdaw (*Corvus monedula*), and, to be strictly accurate, Tereus was not the brother, but the brother-in-law, of Philomela.

The numerous illustrations require no recommendation. They are our old familiar friends from Yarrell and Howard Saunders.

OUR BOOKSHELF.

The Panjab, North-West Frontier Province, and Kashmir. By Sir James Douie. Pp. xiv+373. (Cambridge: At the University Press, 1916.) Price 6s. net.

THE editor of the Cambridge series of Provincial Geographies of India made a happy selection when he entrusted the Panjab to Sir James Douie, who during thirty-five years' work as a member of the Indian Civil Service has held the posts of Chief Secretary, Financial Commissioner, and Officiating Lieutenant-Governor; what he does not know of the Province in which he served is not worth knowing. In a series of chapters packed with information he discusses the physiography, ethnology, sociology, history, archæology, and administration of an area of one quarter of a million square miles, comparable in extent, as well as in other respects, with Austria-Hungary. To summarise this amount of information within a limited space naturally prevents the elaboration of detail. The book, in fact, is an epitome of the information contained in the Imperial and Provincial Gazetteers, and in numberless other official publications.

An excellent feature of the work is the large series of photographs, maps, and diagrams. In the illustrations it is pleasant to notice that the personal element is well represented in John Lawrence, Charles Aitchison, Denzil Ibbetson, and Michael O'Dwyer—some of the able administrators for which the Province has been noted—and in those of native celebrities. In a new edition we may suggest the inclusion of some great soldiers—Pollock, Nott, Gough, Nicholson, Edwardes, Roberts, and Donald Stewart. It would also be a help to students to provide a short list of the more useful books dealing with various aspects of history, social life, travel and sport. The mistake (p. 24) of fixing Lord Roberts's march to Kabul in 1898 should be corrected. Every young officer, military and civil, posted to India should possess a copy of this useful book, and it might with advantage be introduced into the geography course in British and Indian schools.

The Student's Handbook to the University and Colleges of Cambridge. Fifteenth edition, revised to June 30, 1916. Pp. 16+704. (Cambridge: At the University Press, 1916.) Price 3s. net.

THOUGH the statements contained in this handbook are not official, the information provided has been compiled from authentic sources and may be regarded as accurate. Parents sending sons to Cambridge will find the guide invaluable, especially the sections dealing with expenses and scholarships.

In view of the recent comparative inactivity of the University there are no additions to this issue of the handbook. Some temporary emergency regulations, occasioned by the war, affecting undergraduates are summarised conveniently, and altogether the general usefulness of the volume has been well maintained.

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.*]

Scarcity of Wasps.

THE scarcity of wasps in Cheshire during the passing autumn, noted in NATURE of October 12 by Mr. H. V. Davis, has been equally remarkable in this district (Wigtownshire). Observation extending over very many seasons has convinced me that the abundance of queen wasps in spring is no indication of the number of swarms in late summer and autumn. That appears to be regulated by the character of the weather in June and July, which this year was unusually cold and wet. In the autumn of 1915 there was an extraordinary number of the nests of social wasps, both of the species that build underground and those that found arboreal colonies. In consequence I do not remember ever to have seen so many queen wasps about as there were in May of this year. Presumably each of these started building cells and laying eggs, but even if these hatched out, the cold was fatal to the larvæ (for wasps are essentially lovers of sunshine); no workers were reared to assist in forming the colony, which consequently came to naught. Last year I would have undertaken to find fifty wasps' nests within a radius of half a mile of this house; this year I did not know of one. HERBERT MAXWELL.

Monreith.

THE past summer has been so remarkable as regards these insects that a few notes from an old observer may be acceptable. The principal fact to be noticed is the extraordinary disproportion between the immense number of queens in spring (I cannot remember so many in upwards of fifty years' observations) and the scarcity of workers in the summer. It is scarcely an exaggeration to say that there were more queens to be seen in the spring than workers when these were most numerous, in September. To go back to the beginning, an entry in my diary on October 18, 1915, states that on digging out a nest poisoned with cyanide two days previously, in which all the active workers had been killed, "a lot of quite lively ones, mostly queens," was found.

There can be little doubt that the cause of the scarcity of nests and workers was the cold and *wet* weather of mid-April. This supposition is supported by the fact that of the only four nests found and taken near this house, two were in fresh (and therefore warm) manure-heaps, one in the roof of the gardeners' bothy, and one in a sheltered hedge bottom. I have no recollection of having ever seen a nest in a dunghill before.

The discrepancy between the number of queens in

spring and of nests and workers in summer is so common that I am tempted to think that the more conspicuous, and therefore more often caught, queens are infertile, and the rewards for their destruction wasted. Perhaps some member of the Association of Economic Biologists will take the matter up?

ALFRED O. WALKER.

Ulcombe, Kent.

IN reference to the letter of Mr. H. V. Davis (NATURE, October 12, p. 109), I may say that in this district ordinary wasps have been decidedly scarce this year. Reports from several other localities are of the same character. Queens, however, were abudant in the spring (May and June), but I think that only a few survived the wet and cloudy weather.

I make a point of cultivating these insects, as they are extremely interesting to watch, and destroy myriads of flies every summer. There were six embryo nests in my garden in May last, but only one (*Vespa vulgaris*) managed to withstand the vicissitudes of the inclement weather. This nest was a weak one, for when I dug it out on September 20 it consisted of four layers of cells, the top one alone being for small working wasps (1000 cells), while the others were exclusively for queens and drones (1450 cells). This proportion is quite exceptional according to my own observation, for I have commonly found the smaller cells greatly in excess of the others. In a much stronger nest (*Vespa germanica*) which I took here on October 6, 1915, there were 12,900 cells, forming ten tiers, and less than a quarter of the former had been devoted to the rearing of queens and drones.

Very few persons will be inclined to attract wasps to reside in their own immediate neighbourhood, but anyone caring to study these insects should make a few little cavities in dry situations early in April. The queens begin selecting eligible positions in that month (average date, April 17). It is certain that wasps are not so aggressive and violent as commonly supposed. They display remarkable industry and activity, for at midsummer they may be observed streaming to and from their homes during a long working day of eighteen hours! In view of the justified agitation against the house-fly in recent years, it is questionable whether the usual spring campaigns against queen wasps should be encouraged. On a bright summer day in 1913 I carefully watched the entrance of a wasps' nest in my garden, and concluded that the insects brought home at least 2000 flies.

W. F. DENNING.

44 Egerton Road, Bristol, October 14.

REFERRING to Mr. H. V. Davis's letter in NATURE of October 12 on the scarcity of wasps, I have taken nests for some years over an area a little less than 1000 acres as follows:—1906, 95 nests; 1907, 61; 1908, 31; 1909, 113; 1910, one (*Vespa rufa*, Linn.); 1911, 85; 1912, 56; 1913, 189; 1914, 21; 1915, 56.

1916: I knew of three *Vespa vulgaris*, Linn., nests, and took one as it hindered ploughing, and in the early part of the season I hived three *Vespa sylvestris*, Scop., nests as there were a very large number of *V. sylvestris* queens about. My hived ones died out before hatching queens (this wasp is always earlier here, and gone before the fruit, and I have never caught it in my house), as did some unhandled nest I heard of. In 1910 the *V. rufa* nest had been scratched up before I got it, and I saw a few *V. vulgaris* workers about the Severn, indicating at least one nest, but actually saw no other nests that year. RICHARD F. BURTON.

Longner Hall, Salop, October 17.

THE Dartford Naturalists' Field Club this season also experienced a scarcity of wasps; local papers reported the same about Gravesend on the east, and Bexley on the west.

Their nests were very plentiful last year, and so queens were exceedingly plentiful in spring—abnormally so. But later a cold spell nipped those about at the time.

Observers here speak confidently of the persistent hunting of flies by these early queen wasps, out too soon for nectar from flowers, and say the early wasps put down the flies for this summer. Flies were far more numerous last year, and, other things being equal, a beekeeper predicts many flies next summer, because of this season's scarcity of wasps. He remembers such an experience at Green St. Green (Dartford).

On May 27 I saw a note about more wasps than usual at Dudley, a district fairly free compared with the south and west. It was during May when so many early queens were observed here.

S. PRIEST

(Hon. sec., Dartford Naturalists' Field Club).

REFERRING to Mr. Davis's letter, it would be interesting to know if the same dearth of wasps has been noted in the cider counties.

I have caught only two here this season (in jars of beer and sugar placed outside), while last year I trapped hundreds.

C. CARUS-WILSON.

Strawberry Hill, Middlesex, October 13.

Glacial Nomenclature and Scott's Antarctic Expedition.

IN the review of my book, "With Scott—The Silver Lining," in NATURE of June 1, the reviewer, among many kindly remarks, takes exception to my use of the word "riegel." He prefers the English word "bar." I have briefly explained my point of view in the *Geographical Journal* (p. 571, December, 1914), but may be allowed to elaborate it a little.

Webster gives fourteen paragraphs dealing with different meanings of the word "bar." One at least of these—the bar of a river—is a geographic term. Why should the reviewer use the Scotch word "corrie" or the French "cirque" (as I use the Welsh "cwm") if not because—as in my case—there is no English word which is not ambiguous? I believe that there was a movement in Oxford to standardise geographic nomenclature. I sent in a memorandum in 1913, but have heard nothing of it lately.

May I refer briefly to further Antarctic questions raised in the review? The "catenary curves" illustrated in my book are not "ordinary denudation curves" in my opinion. They are common in the Alps (*e.g.* above Hospenthal, on the St. Gothard Road), but not in regions of normal erosion. An ordinary water-cut valley only a few hundred yards across would certainly not exhibit the smooth catenary curve of the small empty Antarctic valleys.

The small scale of the photograph of the *Discovery* Hut (p. 189) has, I feel sure, led the reviewer into a natural error. My colleague, Debenham, is emerging *viâ* the window, since the door alongside was then blocked by ice. I am certain that Prof. J. W. Gregory's hut could not have been satisfactorily erected so that the "support" shown in the figure could have been sunk in the ice. Under the latter condition the door sill would have been 3 ft. below ground-level.

The problem of the "origin of the glacier valleys"

through the Royal Society Range is to a large degree answered by what I call the "palimpsest theory" (v., p. 175). In effect the outlet glaciers flow down notches cut by earlier headward (or cwm) erosion. I hope to publish shortly a mass of evidence and illustration in support of this sequence in glacial erosion.

GRIFFITH TAYLOR.

Meteorological Bureau, Melbourne, July 26.

Muret Sanders's "Encyclopädisches Wörterbuch" gives "riegel," in addition to the various ordinary meanings of the word "bar," including a bar of soap, eleven other meanings. What advantage is there in the use of a German term over an English term when both have equally varied meanings? The term "riegel" is especially overloaded, as in geography, according to Grimm's "Deutsches Wörterbuch," it is used in South Germany for a "kleine Anhöhe, steiler Absatz eines Berges," and he also quotes its use for a watershed.

Ordinary water erosion would certainly produce a slope with catenary curves if it is operating on suitable rock and under suitable conditions.

The conclusion that the *Discovery* Hut was not erected as designed was not based only on Dr. Taylor's photograph, and there could have been no difficulty in managing the supports on any surface of ice which had not so steep a slope as to be otherwise unsuitable.

The more detailed information regarding the origin of the glacier valleys which Dr. Taylor obviously collected may, as was remarked in the review, explain their origin. Dr. Taylor's further publication will be awaited with interest. THE REVIEWER.

ANNEALING GLASS.

EVERYONE who makes chemical apparatus by blowing glass practises annealing in a rude way by allowing the glass to cool slowly by gradual removal from the flame, or by the use of a smoky flame. In glass works more systematic annealing is effected by slow passage through a long chamber wherein the temperature falls from the incoming to the outgoing end. In the manufacture of optical glass of many different qualities the question of annealing is one of the first importance, as they differ so much in fusibility. Messrs. Hilger have after a careful investigation found the means of arriving at the maximum temperature necessary, and also the necessary rate of cooling, which may progressively become more rapid. Optical glasses may differ as much as 200° C. in the maximum necessary temperature, which temperature may be a long way below any visible softening point. It is desirable not to exceed the necessary temperature, as the very slow cooling at the higher temperature leads to great loss of time.

The method adopted by Messrs. Hilger for testing different specimens of glass is interesting as an example of a physical investigation made with a view to practically useful results. The principle of the method can be described very shortly. Fig. 1 shows a bar of glass supported as a cantilever, and carrying a load. Its edges are ground and polished in the form of two parallel planes. This is set up in an electrically heated muffle, with means for observing the temperature electrically. Polarised light broken up into interference bands by passage through a Babinet's compensator is passed through the glass, and when this is loaded the bands become inclined as shown in the figure, illustrating how perfectly the stress, whether of compression or extension, is proportional to the distance from the neutral axis. If the load is allowed to rest on a support in consequence of the slight yielding of the glass, the rate at which the bands change from the inclined to the straight position can be observed for any known tempera-

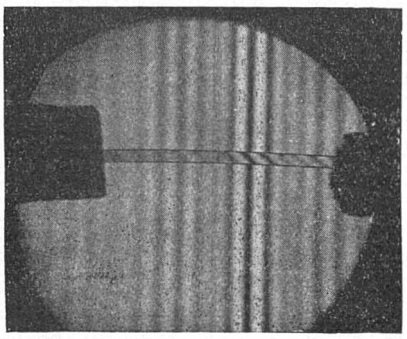

FIG. 1.

ture. Fig. 2 shows two specimens undergoing a change of temperature which sets up strains from the difference in temperature between the interior and the exterior. That the two specimens are very different is only too apparent.

By watching the bands in specimens of glass Messrs. Hilger are able to ascertain when the glass is hot enough to allow the internal strains to be relieved in a convenient time, and whether as the glass cools internal strains are avoided by

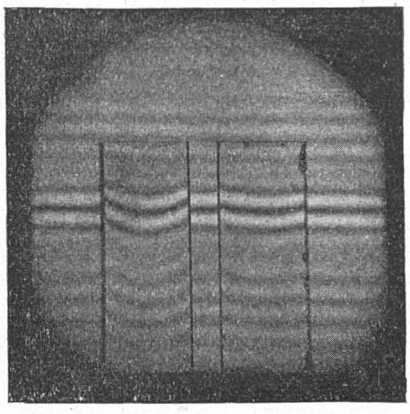

FIG. 2.

sufficiently slow cooling. After a point is reached at which the glass has lost all viscosity the cooling may be accelerated, and though the bands then become curved they straighten out again when ultimately the temperature is equalised. There is no hard-and-fast point at which the glass ceases to be viscous, and so there is a progressive permissible increase in the rate of cooling. Messrs. Hilger have thus shown how annealing may be effected perfectly in the minimum of time. Though

the research was carried out with the object of finding how best to anneal blocks of optical glass, the apparatus is available for testing any glass, chemical or otherwise, and Messrs. Hilger, having the apparatus set up in their laboratory, are prepared to test specimens of glass for the trade, and thus provide the valuable information which they are able so easily to obtain.

C. V. BOYS.

UNIVERSITY AND HIGHER TECHNICAL INSTRUCTION IN FRANCE.

ONE of the principal articles in the *Revue générale des Sciences* for June 30 is that by Prof. Paul Janet, of the Sorbonne, director of the Higher School of Electricity, concerning the *rôle* of the universities in higher technical instruction, especially in relation to the Bill before the French Senate, at the instance of M. le Goy, to sanction the establishment of faculties of applied science in the universities. The proposed measure is exciting considerable interest, not only amongst the learned bodies in France, but also amongst those engaged in scientific industries. The question has assumed a deeper interest in view of the problems raised by the war and of the position and means of development at its close of the national industries, especially those closely dependent upon chemical and electrical science.

Incidentally the question raised by M. le Goy in his project embraces other deep considerations relating to economic problems, including the right direction and utilisation of capital, the question of tariffs and raw materials, a closer union of capital and labour, and especially the creation of a better educated industrial *personnel* in the scientific control and administration of industry, together with measures for the amelioration of industrial conditions. It is urged with considerable force that there is need of a much closer understanding between men devoted to pure science and those engaged in the higher technical industries. The former are often ignorant of the difficulties which beset the engineer and manufacturer, despite the systematic methods he employs in the actual production of commodities; whilst the latter, resenting the accusation that they lack all scientific spirit, do not hesitate to apply derisively the epithet "Sorbonnique" to the science which is incontinently thrust upon them.

Only when this antagonism is entirely removed by a closer sympathy, understanding, and appreciation, on the one hand, of the potentialities of pure science, and on the other of the difficulties which beset its translation into terms of production, can there come that union of effort upon which the successful development of industry depends. In the case of the electrical industry it is freely admitted by all concerned that it finds its solid base in electrical science; nor is it now possible to pretend that any man can hope to become a competent engineer whose technical skill is not founded upon a sound training in science.

The article goes on to consider the existing resources for the training of the expert engineer, and passes in rapid review the faculties of science existing in the universities of France and their competence to train the future technologist; the technical institutes, such as the Chemical Institute at Nancy, founded in 1890, and the Electro-Technical Institute at Grenoble, founded in 1892; the Ecole Polytechnique and the Central School of Arts and Manufactures at Paris, and other special schools in France. An unfavourable view is taken, however, as to the competence of the faculties of science, which have never shown any appreciation of the needs of industry, adequately to train the men, who in fact do not really seek them, destined for industrial pursuits. A firm distinction is drawn between the ideals and aims of the university and the functions of the schools of practical science. The former need for their realisation absolute freedom and long leisure, since their purpose is the exploration and discovery of natural laws, the attainment of exact knowledge as the grand end of their existence, and the moral rather than the material progress of humanity. Research is with them the end, and teaching only the means. The latter, to achieve their purpose, require direct contact with industrial problems, and the due and serious employment of the time of their students, with strict discipline and method and supervised work.

In order to bring the universities into closer touch with industry, it is suggested that they should, with the collaboration of practical men, establish scientific institutes preparatory to industry. It is further proposed to found a very few higher technical schools for more advanced industrial training and research, established and controlled directly by men eminent in industry, yet aided by the State and directly linked with the Ministry of Public Instruction.

PUBLIC SCHOOLS AND OTHERS.

"PUNCH" of September 27, under the title of "Public Schools," prints a poem of which the last two verses are as follows:—

Spite of the anti-classicists' arraigning,
Spite of the ink so petulantly spilt,
Not by exact laboratory training,
Not by the test-tube character is built.

Only in fields of emulous endeavour,
Fired by the teaching of the famous dead,
Public-school boys, who play the game for ever,
Grow into leaders and inspire the led.

PUBLIC SCHOOLS: AN ANSWER.

Dear *Punch*, your poet praises public schools,
Not well, nor wisely, nor by half enough.
Their modern Army Classes, "mostly fools,"
Have shed his "grand old fortifying" stuff.
Their "labs," which he accentuates so oddly,
Seem just as formative, and just as godly.

Again, those test-tubes, which his words abhor,
And cheap thermometers with paper zeroes,
All made in Germany before the war,
Were not unknown to many of their heroes.
[Just now sweet girls in improvised pavilions
Are turning English test-tubes out by millions.]

Boys from our "public schools" (including those
Provided, non-provided, and the rest of it),
When once the opportunity arose,
Quitted themselves like men, and made the best of it.
The highest praise for such a band of brothers,
Would be: "Each did his duty like the others."

Then, as to leadership, I knew a lad,
By nature quite unqualified to grapple
With Greek and Latin verses. This was bad.
Worse still, a Jew, he never went to chapel.
And yet he learnt, in spite of missing sermons,
His duty to his men, and to the Germans.

Perhaps the Duke was right in his remark,
That old, apocryphal, and hackneyed saying;
And Eton Playing-fields, and Regent's Park,
And all fair fields where British boys are playing,
Have proved of higher value to the nation
Than classical, or modern, education.

W. D. E.

NOTES.

THERE have been much overlapping and unevenness of distribution in connection with the food parcels sent to British prisoners of war; and little scientific guidance has been sought or given as to the food-values of the things included in the parcels. The first of these defects will be remedied by a scheme which is to be brought into effect on December 1. It is announced that the Central Prisoners of War Committee, recently established by the British Red Cross Society and the Order of St. John, has, with the authority of the Government, now made the necessary arrangements for co-ordinating and controlling the work of the various associations and individuals at present sending parcels to British prisoners of war in Germany and other enemy and neutral countries. These arrangements have been made with the view of securing:—(1) That every prisoner shall receive an adequate supply of the comforts in the form of food, etc.; (2) that the excellent work being done at present by associations and individuals shall be disturbed as little as possible; (3) that overlapping and consequent waste shall be reduced to a minimum. In order to attain these objects the following arrangements have been made:—(1) All parcels must be sent through the Central Committee or an association authorised by it; (2) individual senders are requested not to send food parcels, but to arrange for this to be done by a recognised association. It is hoped that individuals and organisations now collecting funds for prisoners of war will continue their efforts, and will send the money collected either to the Central Committee or to such recognised association as they prefer. Subscriptions and donations should be sent to the Right Hon. Sir Starr Jameson, Bt., C.B., 4 Thurloe Place, London, S.W. All other communications should be addressed to the Secretary, Central Prisoners of War Committee, 4 Thurloe Place, London, S.W. We suggest to the committee that guidance is needed as to the most suitable things to send from the point of view of food-values. A prisoner of war doing moderate work requires a daily ration which has an energy value of 2500 calories, and may be made up of proteins, 100 grams; carbohydrates, 400 grams; and fats, 50 grams. It is possible to combine all these constituents in a single foodstuff, or to see that the ratios are roughly supplied by the combination of several things in a parcel. The British Science Guild has appointed a committee to make suggestions relating to food parcels, and the Central Prisoners of War Committee should enlist its aid or that of other food experts in order to advise associations as to the most suitable constituents of the parcels.

THE Board of Agriculture announces that an estate of 2363 acres near Patrington, in the East Riding of Yorkshire, about fifteen miles distant from Hull, has been acquired under the provisions of the Small Holding Colonies Act, 1916, for the purpose of a land-settlement colony of ex-service men. The soil is a rich alluvium capable of producing very heavy crops. This colony, when fully developed, will consist of a central farm of about 200 acres and sixty small holdings of "mixed farming" type, averaging about 35 acres in extent. The equipment of each of the latter will include a comfortable cottage and the necessary farm buildings for carrying on the holding. The central farm will be under the management of a director, and will be equipped with machinery, implements, horses, etc., which will be let out on hire to settlers requiring them. Selected applicants will, if necessary, receive preliminary training by working on the central farm under the supervision of the director, and be paid wages until such time as they are considered capable of working a holding independently. They will then be allotted, at a reasonable rental, land near their cottages which, if of less extent than the average-sized holding above indicated, may be afterwards increased by taking land from the central farm. Co-operative methods will be adopted for the purchase of requirements and the consignment and disposal of produce. This is, we believe, the first experiment of its kind in this country, and its development will be watched with great interest. For some years there has been a great controversy as to the merits of schemes of this kind, and now arises the opportunity for the large-scale test. The experience gained is likely to be of great value, deciding whether or not such colonies can be run on an economic basis.

PROF. A. S. DONNER, director of the observatory at Helsingfors, has presented to the University, of which he was formerly rector, the sum of 8000*l.*, to ensure the continuance, and indeed the completion, of the "Catalogue photographique du Ciel, Zone de Helsingfors," begun under his direction in 1890. Hitherto the work has been paid for, partly by the University, partly by Prof. Donner out of his private means. The sum now allotted by him is intended to cover all expenses for twelve years, when, at its present rate of progress, the task should be finished.

THE Sociedad Argentina de Ciencias Naturales, Buenos Aires, has elected as corresponding members Sir Ernest Shackleton and Mr. W. H. Hudson, author of "Argentine Ornithology" and other works. Mr. Hudson is an Argentine by birth.

THE opening meeting of the Institution of Electrical Engineers for the session 1916–17 will be held on Thursday, November 9, when the eighth Kelvin lecture will be delivered by Dr. Alexander Russell, who

will take as his subject "Some Aspects of Lord Kelvin's Life and Work."

THE address of the retiring president, Sir Joseph Larmor, at the anniversary meeting of the London Mathematical Society, to be held on Thursday, November 2, at 5.30, at Burlington House, will deal mainly with "The Fourier Harmonic Analysis: its Practical Scope and its Limitations."

THE Cardiff Naturalists' Society, the most influential body of its kind in Wales, attains its jubilee next year. It is hoped to signalise the event in a useful way by producing a complete fauna of Glamorgan.

A SINGULAR phenomenon excited extraordinary attention at and round Cardiff on the evening of October 16. About 6.25 a narrow bar of light appeared in the north-north-west, about 6° long and 1° broad, some 40° above the horizon, the sky being mostly overcast at the time. By 6.35 it had shifted to the north, and ten minutes later to its former situation, whilst a similar appearance was seen in the north-east, a good deal fainter than the other. The beam just mentioned was of an angry ruddy colour, and fitfully illuminated the surrounding haze. Along the northern horizon all this time there was a glow, probably of auroral origin, and the Rev. John Griffith informs the writer that the shaft of light was, in his opinion, possibly auroral also, he having witnessed a similar phenomenon some years ago.

WE notice with regret the announcement of the death on September 14, in his sixty-first year, of Prof. Josiah Royce, distinguished for his contributions to philosophy, logic, ethics, and psychology, and professor of the history of philosophy at Harvard University from 1892 until his recent retirement.

THE death is announced, in his fifty-third year, of Dr. J. H. Kastle, research professor of chemistry since 1911 at the agricultural experiment station in connection with the State University of Kentucky. He had previously been chief of the division of chemistry in the hygienic laboratory of the U.S. Health and Marine Service from 1905 to 1909, and professor of chemistry at the University of Virginia from 1909 to 1911. He was the author of treatises on the chemistry of metals and the chemistry of milk, as well as of articles in the *American Chemical Journal*.

AT a hearing before a New York official budget committee it was recently stated that the attendance at the American Museum of Natural History for the year ending June 30, 1916, was 870,000, as against 664,215 for the previous year. The increase was attributed to the larger number of visits to the museum by classes from the schools. During the same period the attendances at the Metropolitan Museum of Art, the New York Zoological Garden, and the Aquarium have considerably decreased.

THE death is announced of Dr. David Maron, a research chemist, whose work is referred to as follows in the *Times* of October 20:—"Dr. Maron was a Russian, aged fifty-two, who had been resident in England for many years. He claimed to have invented a new process by which the output of high-explosive shells could be accelerated, and he carried on his operations at a factory near London. On September 14 there was a serious explosion at the works. The Press Bureau announced that 'an explosion has occurred to-day at a factory where the manufacture of explosives on a small scale for the Government had recently been commenced. The casualties are not numerous, present reports recording five killed and fifteen injured.' Dr. Maron was seriously injured, and he died on September 17."

IN addition to the awards announced in April for papers read at the meetings, the council of the Institution of Civil Engineers has made the following awards for papers published in the Proceedings without discussion during the session 1915–16:—Telford premiums to Messrs. Hubert Mawson (Liverpool), T. W. Keele (Sydney), R. W. Holmes (Wellington, N.Z.), W. Fairley (London), J. M. Greathead (Johannesburg), T. C. Hood (Manmad, India), and J. B. Ball (London); the Manby premium to Mr. W. C. Cushing (Pittsburg, U.S.A.); and the Crampton prize to Major C. E. P. Sankey (London). The Indian premium for 1916 has been awarded to Sir John Benton (Eastbourne).

THE President of the Board of Trade has appointed a committee to consider the position after the war, especially in relation to international competition, of the lead, copper, tin, and such other of the non-ferrous metal trades as may be referred to the committee, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The members of the committee are:—Sir Gerard Albert Muntz, Bt. (chairman), Mr. C. L. Budd, Mr. C. Cookson, Mr. C. W. Fielding, Lieut.-Col. A. J. Foster, Mr. A. W. Tait, and Mr. A. H. Wiggin. The secretary is Mr. J. F. Ronca, to whom all communications relating to the committee should be addressed at 7 Whitehall Gardens, S.W.

AT the statutory meeting of the Royal Society of Edinburgh, held on October 23, the following office-bearers and council were elected:—*President*, Dr. J. Horne; *Vice-Presidents*, Dr. B. N. Peach, Sir E. A. Schäfer, the Right Hon. Sir J. H. A. Macdonald, Prof. R. A. Sampson, Prof. D'Arcy Thompson, Prof. J. Walker; *General Secretary*, Dr. C. G. Knott; *Secretaries to Ordinary Meetings*, Prof. A. Robinson, Prof. E. T. Whittaker; *Treasurer*, Mr. J. Currie; *Curator of Library and Museum*, Dr. A. Crichton Mitchell; *Councillors*, Dr. W. B. Blaikie, Principal O. C. Bradley, Dr. R. S. MacDougall, Dr. W. A. Tait, 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, and Prof. D. Waterston.

TYPHOID inoculation was the subject of a question by Mr. Chancellor, the member for Haggerston, in the House of Commons on October 18. Mr. Forster, replying, said that up to August 25, 1916, of the total cases finally diagnosed as typhoid fever amongst the British troops in France, 903 were amongst inoculated men and 508 amongst uninoculated men. There were 166 deaths, 47 of which were amongst the inoculated and 119 amongst uninoculated. To the same date there were 2118 cases of paratyphoid fever, 1968 amongst inoculated men, and 150 amongst men who had not been inoculated. There were 29 deaths, 22 of which were amongst the inoculated and 7 amongst the uninoculated. From these figures it will be seen that the case-mortality per cent. for typhoid fever is, among the inoculated 5·0, and among the uninoculated 23·4; for paratyphoid, among the inoculated 1·12, and among the uninoculated 4·66—a striking testimony in favour of inoculation.

THE exhibition of kinematograph films of Capt. R. F. Scott's Antarctic expedition has been revived after an interval of nearly two years, and is being shown twice daily at the Philharmonic Hall by Mr. H. G. Ponting. Mr. Ponting, during the year he

spent with the expedition, availed himself of every opportunity of making kinematograph records of the life and work in the Antarctic, and has a remarkable series of pictures to show. The pictures of Weddell seals and Adelie penguins are excellent records of Antarctic animal life, but cannot compare in the skill and patience required with the film of penguin chicks breaking out of their eggs or of skua gulls swooping down on a penguin rookery and stealing unguarded eggs. The film showing the bows of the *Terra Nova* breaking into the pack gives a good idea of how a polar ship forces her way among ice. The films of sledging and camping show Capt. Scott and his four companions in the first few days of their southward march. These have an interest that can never fade in any field of heroism. Mr. Ponting was happily inspired in reopening his exhibition at the present time, not only for the high educational value of the pictures themselves, but in recalling the devotion and self-sacrifice that men may show in peaceful endeavour.

WE learn from *Symons's Meteorological Magazine* that Mr. Edward Mawley died on September 15, at seventy-four years of age. The following particulars of his work in meteorology are from an obituary notice in our contemporary:—Mr. Mawley was elected a fellow of the Royal Meteorological Society in 1876, and served continuously on the council from 1881 to 1908. He was president in 1896–98, when he gave two addresses of great value. The first was on "Shade Temperature," giving the results of a lengthy series of experiments with different patterns of thermometer screen, which resulted in the adoption of the Royal Meteorological Society's modification of the Stevenson screen. The second was on "Weather Influence on Farm and Garden Crops," and may be said to have intertwined the two main branches of his life-work. After retiring from the presidency he acted as secretary at the meetings of the society from 1898 to 1901, and throughout the whole time his influence was always exercised in extending the usefulness of the society and increasing its dignity. Mr. Mawley commenced his meteorological observations at Richmond, Surrey, in 1870, and in 1873 he went to Addiscombe, near Croydon, where his meteorological observations were greatly extended. In 1883 he moved to Berkhamsted, where he soon created one of the finest private meteorological stations in the country.

THE meeting of the Gilbert Club, to which we referred in our issue of October 12, was held in the rooms of the Royal Society of Arts on Wednesday of last week. The Right Hon. Lord Moulton occupied the chair. Mr. Conrad Cooke, the hon. secretary, read his report recording the past history and present position of the club, and in it he paid a warm tribute to the memory of Prof. Silvanus Thompson, expressing the irreparable loss to the club, of which he was the life and soul, by his lamented death. Mr. Charles Benham, of Colchester, as representing the hon. treasurer, read the hon. treasurer's report. Both these reports were adopted. The members then devoted themselves to a discussion as to the disposal of the property of the club, including thirty-four copies of the translation of Gilbert's "De Magnete," issued by the Gilbert Club, and letters were read from Lord Rayleigh, Sir Joseph Larmor, Dr. Singer, of Oxford, Mr. W. M. Mordey, Mr. James Paxman, and others, in which various suggestions were made, and a general discussion followed. The general consensus of opinion, however, appeared to be that the proceeds should be devoted to forming the nucleus of a fund to establish a Gilbert scholarship for physical science in the Royal Grammar School at Colchester, in which in all probability William Gilbert was himself a scholar. Lord Moulton, in summing up the discussion, pointed out the legal aspect of the question, giving it as his opinion that the meeting was not competent to dispose of the property of the club outside its original constitution without giving notice to the members beforehand of the suggestion to be proposed. He considered it advisable that the meeting should be adjourned for three months in order that this should be done. Lord Moulton's recommendation was unanimously adopted.

IN the October issue of *Man* Mr. St. George Gray describes a remarkable chipped flint implement found in British Honduras. It is $19\frac{3}{4}$ in. in length, chipped throughout, with a straight, chopper-like edge on one side, and on the other two tapering projections. In general character it resembles other large and occasionally serrated implements found in Honduras and now in European museums. No suggestion is made about the possible use of such an implement; but the theory may be hazarded that it bears some ritualistic significance, and that it may have been used in sacrifice or for some similar religious purpose.

DR. A. C. HADDON contributes to the October issue of *Man* a useful article on "Kava Drinking in New Guinea," based partly on published materials and partly on information collected for the first time from friends who have visited the island. The question is important, because Kava drinking has been regarded as a criterion of a certain definite migration, or series of migrations, into Oceania. The root of the pepper plant (*Piper methysticum*) is chewed, not only by grown-up men, who take part in the feast, but also by boys, to whom the drink is still forbidden, and who, together with the women, are not allowed access to the feasting assembly. It is then filtered through grass in a coconut shell, and a traveller who drank it found that it possessed powerful intoxicating properties. It was apparently used to produce mental excitement during some form of tribal ritual. In British New Guinea the custom prevails among three cultures: those of the Kabiri, Mawata, and Maringara. Dr. Haddon supposes that it might readily spread from the Kabiri to the bush peoples behind the Fly delta, but we are in the dark as to the date of this possible drift. There seems to be no reason to believe that it was imported into the Fly estuary area on the south coast of Netherlands New Guinea by a migration or cultural drift by sea. His own opinion is that it has come overland, possibly from Astrolabe Bay. This must, however, remain doubtful until we know more of the races in the interior of New Guinea.

THE psychology of the organised group game is the subject of the fourth Monograph Supplement to the *British Journal of Psychology*. The author, M. J. Reaney, in her introduction, considers the problem of play in general, and summarises the various theories, both physiological and biological, which have been put forward to account for the phenomena of play. She then reviews the types of play leading up to the organised group game, which occupies such a prominent position in the life of modern England. The relation between the type of game played and the degree of racial development is brought out, showing that the organised group game appears only in races which have reached a stage of development in which co-operation is combined with division of labour and loyalty to a leader. She suggests, too, that this form of play gives an outlet to instinctive tendencies for which civilised life affords little scope. In an investigation worked on the principle of correlation she found a direct correspondence between general ability and success at games. The paper will be of particular

interest at the present time, when the place of games in education is so much discussed, and when the English habit of "playing the game" is showing its value. Apart from the scientific value, antiquarians and historians will find much that is interesting.

DR. HAMLYN-HARRIS and Mr. Frank Smith contribute some valuable notes to the Memoirs of the Queensland Museum, vol. v., on "Fish Poisoning and Poisons Employed among the Aborigines of Queensland." Considering the widespread practice of fish poisoning, the authors hold that it is not unjustifiable to assume an independent origin among the Australian aborigines, and the evolution of an empirical knowledge of efficient piscicides. Having regard to the very considerable number of plants used for this purpose, the varied properties of the poisons obtained from them, and the skill and knowledge displayed in their preparation, the intelligence and reasoning powers of the preparers would seem to be of a higher standard than that generally attributed to them.

THE Rev. S. Graham Birks contributes a lengthy paper on Megalichthys to the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, vol. iv., part 2. The fossils described belong in part to the Hancock Museum, Newcastle-upon-Tyne, and in part to the Manchester Museum, some of which have not been previously described. The result of this investigation, it is contended, seems to show that the position of Megalichthys in the family Osteolepidæ is by no means secure. There are, indeed, indications that the classification of the Rhipidistia is in an unsatisfactory state. According to the author, although Megalichthys is not itself the ancestral type of the Stegocephalian Amphibia, there can be little doubt that the study of this genus leads inevitably towards the conclusion that its affinities are with the ancestral type, and that the Stegocephalia were evolved from a similar fish, and probably from a nearly related form. A number of very beautiful photographs add much to the value of this work.

MESSRS. HERON-ALLEN AND EARLAND have issued a report (Trans. Linn. Soc., London, Zool., vol. xi., part 13, 1916), illustrated with five excellent plates, on the Foraminifera collected during the cruise of Prof. Herdman's steam-yacht *Runa* off the west of Scotland in 1913. The material examined consisted of shore-sand and dredgings from comparatively shallow waters—sixty fathoms being the greatest depth. A list is given of the twenty-five stations at which the material was obtained, the more noteworthy species from each being indicated, and following this is a systematic account of the 324 species and varieties identified in the gatherings. A new species, *Halophragmium runianum*, and a new variety of *Lagena pulchella* are described; twenty-seven species are recorded for the first time from British waters, and a considerable number make their appearance for the second time only in a British list. The richest material was a lump of mud of about 3½ lb. weight, dredged from twelve fathoms in Loch Sunart, which yielded 203 species and varieties of Foraminifera. The memoir forms an important contribution to our knowledge of the Foraminifera of the British area.

THE report on the survey operations in New Zealand for the year 1915-16 has been received. Despite the difficulties it had to contend with in shortage of surveyors and of funds, the department records that the acreage of the settlement survey is considerably in excess of the previous year, while the cost per acre has been decreased. On the other hand, little triangulation was done, and shortage of paper seems to have delayed the publication of several maps. A feature of the report is the inclusion of a map of Anzac and the Suvla Bay area on a scale of one inch to a mile, with the heights and trenches shown. Some notes on the operations accompany the map. It is fitting that the Survey Department should make this record of the gallant endeavours of the New Zealanders and Australians in Gallipoli.

IN connection with the navigability of Hudson Bay and its value as an outlet for Canadian grain, a useful list of arrivals and departures of ships at and from Moose Factory has been compiled by Mr. J. B. Tyrrell (Papers and Records of the Ontario Historical Society, vol. xiv.). The record shows that from 1751 to 1880 not a single year passed without at least one ship arriving at Moose Factory, generally in August or September, but occasionally in July or October. The ships left again in August or September. Furthermore, Mr. Tyrrell points out that for eighty years previous to 1751, and for thirty-five years after 1880, ships sailed from Britain to Moose Factory bringing supplies, and returned with furs. When it is remembered that these ships were generally old sailing vessels, and that as a rule no attempt was made to send more than the one ship a year, the record is evidence that Hudson Strait and Bay could easily be navigated by steamers for some three months at least every summer.

TWO papers by Dr. L. V. King on the "Linear Hot Wire Anemometer" have been reprinted from the Journal of the Franklin Institute, January, 1916. In these papers the mathematical theory of the instrument and the uses to which it may be put are discussed by the author. The instrument consists essentially of a fine platinum wire carrying an electric current. The temperature of the wire depends on its resistance and the strength of the current, and also on the rate at which it is cooling, since the wire, being very fine, has little capacity for heat, and the energy supplied by the current must just balance the loss by radiation and convection. The loss by convection is naturally dependent on the velocity of the air current in which the wire is placed, and it is claimed that by suitable measurements of the current and the resistance the velocity of the air to which the wire is exposed can be measured with an accuracy of less than 1 per cent. There are obviously many cases where such an instrument can be usefully employed, notably in mapping out the stream lines in two-dimensional motion, where the wire can be placed perpendicularly to the plane of motion. Wires of about 1/400 in. diameter are used, so that very little interference with the flow of air is caused.

MR. MURRAY'S new list of announcements includes the following forthcoming books of science in addition to those to which attention has been directed already in our columns:—"The War and the Nation: a Study in Constructive Politics," by W. C. D. Whetham—the book will deal with such topics as land, coal and railways, science and industry, and with those fundamental racial problems made acute by the great loss of life caused by the present war; "Volcanic Studies in Many Lands," by the late Dr. Tempest Anderson, second series—the volume is intended as a memorial to the author by the Yorkshire Philosophical Society, and will contain the results of further visits to the Lipari Islands, Vesuvius (after the outburst in 1906), and to Etna, together with photographs taken after the great eruptions of the Soufrière and Mont Pelée; "Horses," by R. Pocock, with a preface by Prof. J. Cossar Ewart; and "British Agriculture: The Nation's Opportunity, being the Minority Report of the Departmental Committee on the Employment of

Sailors and Soldiers on the Land, together with some Considerations by a Free Trader in Favour of the Policy therein Advocated."

THE following volumes are in preparation for appearance in the "University of Michigan Studies" (*New York: The Macmillan Company*):—Contributions to the History of Science, part ii., "The Prodromus of Nicholas Steno's Latin Dissertation on a Solid Body Enclosed by Natural Process within a Solid," translated into English by Prof. J. G. Winter, with a foreword by Prof. W. H. Hobbs, illustrated; part iii., "Vesuvius in Antiquity," passages of ancient authors, with a translation and elucidations, by F. W. Kelsey, illustrated; Scientific Series, vol. ii., "Studies on Divergent Series and Summability," by Prof. W. B. Ford.

OUR ASTRONOMICAL COLUMN.

TWO LARGE FIREBALLS.—On October 20 at 8h. 14m. and 10h. 34m. p.m. large fireballs were observed. The first was seen by Mr. J. E. Clark, of Purley, Surrey, and it was estimated as twice as bright as Venus. The path was 82°+62° to 79°+35°, and its duration four to five seconds. The second was seen by Mrs. Fiammetta Wilson at Totteridge, Herts, and by Mr. Denning at Bristol. It appeared as a ball of fire streaming slowly along in a level course about 8° above the northern horizon. This fireball was at a great distance from the observers, and probably over the southern region of Scotland. It probably emanated, like Mr. Clark's fireball, seen earlier on the same night, from a radiant near Zeta Herculis low in the N.W. sky.

ENCKE'S COMET.—Further particulars of Dr. Max Wolf's recent observation of Encke's comet are given in *Astronomische Nachrichten*, No. 4861. The search for the comet was undertaken at the instigation of Dr. Kritzinger, and eight plates were taken at different times during August and September, with exposures amounting altogether to about thirteen hours. The last two exposures were made on September 22, in a very clear sky, and though the plates were on the point of being regarded as failures, the use of lower magnifying power easily revealed the comet, at a point about 20′ from the position given by the ephemeris. The comet appeared on both plates as a faint nebulous patch, with an extremely small condensation, and the displacement of the images in the interval between the exposures corresponded precisely with the ephemeris. The photographs were taken with the 71-cm. reflector, which was guided to follow the probable motion of the comet. The observation is of special interest from the fact that the comet was not far from the aphelion point of its orbit.

INTERNAL MOTION IN SPIRAL NEBULÆ.—An investigation of internal motions in the spiral nebula Messier 101 has been undertaken by A. van Maanen (Proc. Nat. Acad. Sci., vol ii., p. 386). In the first instance measures were made with the stereocomparator on two photographs taken by Ritchey in 1910 and 1915, and strong evidence of motion, even in this short interval, was obtained. Other plates, taken with the Crossley reflector of the Lick Observatory in 1899, 1908, and 1914, were afterwards included in the discussion. The resulting data depend upon measures of eighty-seven nebulous points and thirty-two comparison stars. Relatively to the mean of the comparison stars, the annual motion of translation of the nebula was found to be +0·005″ in R.A. and −0·013″ in declination. The mean rotational motion is 0·022″ left-handed, and the mean radial motion 0·007″ outward. The measures further indicate a small, but scarcely trustworthy, decrease of rotational motion with increasing distance from the centre. At the mean distance of 5′ from the centre, the rotational motion of 0·022″ corresponds to a period of about 85,000 years. If the parallax were known, and if it could be assumed that the movements were in elliptical orbits, the central mass could be calculated. A comparison with the average translation of spiral nebulæ determined by Curtis suggests a parallax of 0·005″, while a comparison of the cross-motions with the known radial velocities of some of the spiral nebulæ leads to 0·0003″. The corresponding central masses are 30,000 and 140,000,000 times that of the sun, and the corresponding orbital motions 21 and 345 km./sec. Evidence of rotation has also been found in Messier 81.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

A LARGELY attended general meeting of the members of the Association of Technical Institutions was held on October 20-21 at the Imperial College of Technology and Science, under the presidency of Sir Alfred Keogh, K.C.B., the president of the association, with the view of discussing educational questions bearing upon the work of technical schools and colleges. The Right Hon. A. H. Dyke-Acland, the chairman of the executive of the governors of the Imperial College, extended a welcome to the members and referred to the splendid service which Sir Alfred Keogh, the rector of the college, in his capacity of director of the Army Medical Service, was rendering to the nation.

The conference was addressed in the first instance by Lord Haldane, Chancellor of the University of Bristol, who took for his subject "Education after the War, with special reference to Technical Instruction." He made clear in his address that unless technical education was based upon large ideas and was penetrated by sound knowledge it must surely fail. He deprecated most strongly the current controversies which sought to place the teaching of the humanities and natural science in unfriendly relation. Knowledge was one and indivisible. The study of fine literature and of the thought it embodies was just as needful to the complete training of the human being as the study of mathematics or of the phenomena of Nature, since the object of all true education was a wider, a more penetrating and stimulating vision. The teaching of the higher mathematics could, if taught in the right way, be made as stimulating as the classics. There was a great awakening in the nation, induced by the events of the war, to the paramount necessity for knowledge. Education and business were not really in two compartments. Rightly considered, the successful pursuit of manufacture and commerce depended for its permanence and value upon sound methods of education and the acquisition of accurate knowledge. Many apt and clear illustrations in support of this contention were adduced from the sphere of chemical, physical, and electrical science and practice. In the domain of applied science attention was directed to the fact that London was the great centre of the world's trade in furs, but that in order to make the furs marketable to the consumer we exported them to foreign countries, notably to Saxony, where alone they could be dyed and treated with suitable effect. The aloofness between the man of business and the man of science must cease, and all classes from the workers upwards, amongst whom there was splendid raw material, must receive the benefits of scientific training. We must have a higher standard of knowledge not only for managers, but for workmen also, if the position of

the nation industrially and commercially is to be maintained in face of the fierce competition of the advanced nations of the world. The nation is really entering upon the most critical period of its history. The old spirit was splendid, but it will not avail against modern science any more than we could make progress on the Somme without modern science in furnishing us with the great artillery and high explosives required for battering down the trenches before us. Undue specialisation in secondary schools was undesirable in the best interests of education.

Lord Haldane's address was followed by a valuable paper by Sir A. Trevor Dawson, of Vickers, Ltd., on "Education after the War, with special reference to Engineering Instruction," in which he strongly urged the desirability of apprenticeship beginning at an earlier age than at present, and that the most capable boys should devote a portion of each day to the workshop and the rest to the school, and that every encouragement should be given to capable and talented boys, with a view to their being sent on to the technical college or university to complete their theoretical training, serving their vacations in the works so that they may have the advantage of special courses of advanced work on experimental research. The council of the association was instructed to prepare a public statement dealing with the immediate necessity for the further development of the means of scientific and technical education, and a resolution was passed calling upon Parliament to abolish all forms of exemption from school attendance below the age of fourteen, and to require compulsory facilities for continued education up to seventeen years of age, extending to at least six hours per week within working hours, for all persons employed who have left school. A further resolution was passed to invite the governing bodies of the various agricultural schools and colleges to join the association. On Saturday, October 21, a valuable and suggestive paper was read by Major Robert Mitchell, director of the Regent Street Polytechnic on "What Can Be Done to Train Disabled Sailors and Soldiers in Technical Institutions?" The facilities existing in London for the training of such disabled men in various occupations, and the success which had followed the work, together with the necessity for its further extension throughout the country, were fully set forth.

RECENT WORK ON TSETSE-FLIES.

THE tsetse-flies (Glossina) continue to occupy the attention of entomologists working in tropical Africa. Dr. W. A. Lamborn has now published (*Bull. Entom. Research*, vii., part 1) a third report of his investigations into the habits of these flies in Nyasaland (see NATURE, vol. xcvii., p. 90). He believes that an abundance of the flies usually indicates the presence of "big game" in the neighbourhood; yet he doubts whether the destruction of game would be effective in reducing the numbers of the fly, because "the game, if severely harassed, will retire [to surrounding areas] during the dry season, when only it is possible to hunt, returning in the wet and probably bringing more flies with it." In the same number of the bulletin there is also a paper by Ll. Lloyd on *Glossina morsitans* in northern Rhodesia. His observations show that in districts where game is scarce tsetses are often more numerous and troublesome than where game is plentiful; he suggests that this is because the flies, in the absence or scarcity of other mammalian prey, must attack man in larger numbers and with a more violent hunger. Mr. Lloyd, like Dr. Lamborn, finds males much more abundant than females in ordinary collections of Glossina, but Dr. Lamborn points out that the proportion of females is largely increased when flies are caught beneath an umbrella or resting on trees, approaching the equality with the males which is seen in flies reared from puparia. Both writers have interesting notes on species of Mutilla (described by R. E. Turner in the same number of the bulletin), the larvæ of which are parasitic in the pupæ of the tsetses, while Dr. Lamborn has shown that a small chalcid (*Syntomosphyrum glossinae*), believed also to be a parasite of the Glossina, is really a hyperparasite on the Mutilla.

A convenient and useful summary of our knowledge of the tsetse-flies ("Notice sur les Glossines ou Tsétsés") by E. Hegh has been published in London under the auspices of the Belgian Colonial Ministry. It serves as an introduction to the structure, life-history, and classification of the insects in tropical Africa generally, but with special reference to the Belgian Congo. M. Hegh begins his historical introduction with the work of Bruce in 1895–6, and seems to ascribe to that distinguished surgeon the discovery that tsetse-flies carry disease. The deadly action of Glossina on European domestic beasts was well known to Livingstone during his early African journeys, and in his "Missionary Travels and Researches" (1857) he described the effect of the tsetse's bite on cattle and horses. With a seeming prevision of modern discoveries, he wrote of the "germ" of a poison "which enters when the proboscis is inserted to draw blood," and which "seems capable, although very minute in quantity, of reproducing itself." Bruce's contribution to the subject was the demonstration of this "germ" as a flagellate blood-parasite or Trypanosoma.

G. H. C.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THE papers read in Section D were devoted chiefly to the consideration of problems arising out of the war. An account has already appeared in NATURE for October 19 of the papers on fisheries.

Flies.

Mr. F. M. Howlett gave a lecture dealing with the occurrence, habits, life-history, and means of prevention and destruction of the principal insects which have been troublesome during the campaign in France and Flanders. In another communication he surveyed briefly the known facts regarding the senses of insects, and gave an account of his observations, made in India, on the extraordinary attractiveness for the males of certain species of flies of *iso*valeric aldehyde, *iso*eugenol, and methyleugenol.

Miss O. C. Lodge gave an account of studies on the habits of flies in relation to means employed for their destruction. The best bait for blow-flies was found to be liver, brain, and fish which had been already attacked by maggots, and thus rendered more attractive. Baits were found to be much more attractive in the sun than in the shade. The best bait for house-flies is a mixture of casein, banana, any sweet substance, and water. Formalin in water (about 1 : 13) is apparently the best poison (excluding scheduled poisons) to use against house-flies.

Bilharzia Disease in Egypt.

Dr. R. T. Leiper gave an account of the later results obtained by the War Office Bilharzia Commission in Egypt. After sketching the conditions in a village where 91 per cent. of the schoolboys were found to be infected with Bilharzia, Dr. Leiper stated that the Commission had proved the occurrence of two species of Bilharzia, the chief characters of which he pointed out with the help of lantern illustrations. The egg of

Bilharzia haematobium is terminal-spined, and the cercariæ are found in the fresh-water molluscs, *Bullinus contortus* and *B. dybowski*. The egg of *Bilharzia mansoni* is lateral-spined, and the cercariæ occur in *Planorbis boissyi*. From these molluscs the cercariæ escape, and were proved to enter experimental animals through the skin as well as through the mucous membrane of the mouth.

Protozoa and Disease.

Dr. Helen Pixell-Goodrich gave an account of the amœbæ parasitic in man, namely, *Entamoeba histolytica*, the specific cause of amœbic dysentery, from the large intestine; *E. gingivalis*, from the mouth; and *E. coli*, a harmless species, feeding on the contents of its host's intestine. Dr. Pixell-Goodrich devoted special attention to *E. gingivalis* in relation to pyorrhœa, but although this amœba occurs so commonly in these lesions, it was not considered to be the cause of the disease. The morphological similarity of the trophozoites of *E. gingivalis* and *E. histolytica* was pointed out, and the large characteristic inclusions of the former were held to be the nuclei of lymphocytes.

Dr. T. Goodey's paper dealt with the results of observations by Mr. Wellings and himself on *E. gingivalis*, which they found in the mouths of both young and old persons wherever there was accumulation of food débris. They concluded that there is nothing to show that the organism is in any way causally connected with pyorrhœa, the food bodies being nuclear fragments of decomposed salivary corpuscles.

Dr. Annie Porter gave an account of observations by Dr. H. B. Fantham and herself on the flagellate protozoa associated with dysentery, with special reference to cases from Gallipoli. *Trichomonas hominis* has been found in cases of severe diarrhœa at Salonica; prophylaxis is directed to the prevention of contamination of food or water by infected material and by possible insect carriers and rodents (similar Trichomonads occur in rats, mice, and rabbits), and to the isolation of human "carriers." Cases of Tetramitus diarrhœa have been found among patients from Egypt, Gallipoli, and Salonica. *Giardia* (*Lamblia*) *intestinalis* was found to be the commonest flagellate in the stools (3800) of the soldiers examined, and in some cases occurred in enormous numbers; one stool was estimated to contain 14,400,000,000. Giardia derived from man is pathogenic to kittens and mice, producing erosion of the intestinal cells. Rats, mice, and cats can act as "reservoirs," and by contaminating the food and drink of man may spread the organism.

War and Eugenics.

Mr. Hugh Richardson stated the case for the institution of an inquiry into the after-effects of war on population. He pointed out the nature of the evidence available or to be sought, the statistical methods to be employed, and, after referring to the various and dubious theories held in the past, indicated some of the problems which seemed capable of solution. Subsequent speakers—Dr. Chalmers Mitchell, Dr. Doncaster, Dr. Tocher, and Prof. MacBride—were emphatic in supporting the case for an impartial inquiry and for the collection and preservation of statistical information by the Registrar-General, the Army recruiting staff, school medical services, and other agencies.

Dr. F. A. Dixey exhibited and commented upon a series of insects collected on the way to and from and in Australia in 1914. Mr. Heron-Allen exhibited lantern-slides illustrating the mussel fishery and the life of Alcide d'Orbigny at Esnandes.

The Friday afternoon was devoted to a visit to the Dove Marine Laboratory at Cullercoats, the members being taken over the laboratory and aquarium by the director, Prof. Meek. J. H. ASHWORTH.

ENGINEERING AT THE BRITISH ASSOCIATION.

MR. GERALD STONEY devoted his presidential address to a review of some of the errors committed in the past by masters and men in the engineering industry. An abridgment of the address appears elsewhere in this issue of NATURE.

After the address a paper on "Limit Gauges" was read by Dr. R. T. Glazebrook, director of the National Physical Laboratory. This subject has been forced upon the attention of the whole engineering world by its importance in the manufacture of munitions. The greatly increased scale of manufacture necessitated the production of an enormous number of gauges, both for workshop use and for testing. The National Physical Laboratory has acted as the checking authority for the correctness of the gauges employed by the Government inspectors. Dr. Glazebrook first described the principles of limit gauging and then the various methods and apparatus evolved for dealing with the problem at the National Physical Laboratory.

A paper on "The Principle of Similitude in Engineering Design" was read by Dr. T. E. Stanton, who discussed the possibilities and difficulties of obtaining accurate information for the design of structures, ships, aeroplanes, propellers, etc., from tests made on small models.

The late Mr. Leslie Robertson, who was lost on the *Hampshire*, had promised to read a paper on the work of the International Standards Committee. Mr. le Maistre, who has succeeded him as secretary of the committee, took over the task, and read an interesting paper on "Standardisation and its Influence on the Engineering Industries."

Mr. H. T. Newbigin described the *raison d'être* of the Michell type of bearing. Already in common use for thrust bearings, it is now being experimentally applied to journal bearings.

Prof. W. M. Thornton discussed "The Influence of Pressure on the Electrical Ignition of Methane," and described experiments showing that, as the pressure is gradually increased, the energy in the spark necessary to cause ignition increases in a stepped, discontinuous manner.

Prof. W. H. Watkinson described some tests showing that Diesel engines could be worked satisfactorily with compression pressures considerably lower than those usually employed.

Prof. G. W. O. Howe read a paper on "The Calculation of the Capacity of Aerials, including the Effects of Masts and Buildings." Papers on this subject were read by the author at the Sydney and Manchester meetings; in the present paper the subject is carried further, and a number of numerical examples and experimental results are given which fully confirm the method of calculation.

Mr. McLachlan described the results of some experiments on a Poulsen arc, to determine the best magnetic field strength to employ for maximum output and for maximum efficiency.

The only research committee that reported at length was that on "Complex Stress Distribution," in connection with which Dr. Stanton exhibited a model of a new machine in use at the National Physical Laboratory for subjecting a specimen to a rapidly reversing combination of bending and twisting.

The last day of the meeting was devoted to a joint discussion with the Chemical Section of the report of the Committee on Fuel Economy.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION G.

ENGINEERING.

OPENING ADDRESS (ABRIDGED) BY GERALD STONEY, B.A.I. (DUB.), F.R.S., M.INST.C.E., PRESIDENT OF THE SECTION.

AT times such as these the mind naturally turns to problems to be considered both at the present time and after the war, and in considering such problems a review of some of the errors committed in the past is most necessary. Such a review enables methods which should be adopted both now and in the future to be considered. As this is an address to the Engineering Section of the British Association for the Advancement of Science, only such problems will be considered as affect engineering and its allied industries.

One thing which has handicapped our industries is the reluctance of firms to utilise highly educated labour or to adopt scientific methods. In looking round the industries of the district one is struck by the small number of men who have undergone a thorough scientific training at one of the universities or at one of the leading technical colleges, and who occupy a prominent place in the firms in this district.

The general complaint is that university and college men are too theoretical and not practical. It is the usual thing for a bad workman to blame his tools, and is it not because employers do not know how to make use of such labour that they utilise it to such a small and imperfect extent?

Things are very different in some other countries with which we have competed in the past, and with which there will be in all probability still fiercer competition in the future. There we find the fullest use made of highly educated scientific labour.

How many engineering firms in this district have a skilled chemist on their staff, and what percentage of these pay him a decent salary? And how many heads of firms have sufficient chemical knowledge to appreciate the work and utilise the services of such a man? because unless there is appreciation of the work done by such a man his services are useless and he becomes discouraged, generally finding himself up against the blank stone wall of there being no appreciation of his services, and yet chemical problems are continually cropping up in engineering work. There is the question of the supply of materials; as a rule the manufacturer trusts to the name of the contractor and assumes that he gets materials of the composition and purity he ordered. Every now and then something goes wrong and the question arises, Why? Without a chemist to analyse the material it is often most difficult to say. Apart from this question of the analysis of raw or partly manufactured materials received, there is the chronic question as to the mixtures of the metals in both the metal and brass foundry, and large economies can be effected by systematic analyses.

Another direction in which scientific labour is invaluable is in seeing that instruments are in proper order, and that tests are accurately carried out. Tests carried out with inaccurate instruments and without proper scientific precautions to see that they are accurate and trustworthy are worse than useless, and, in fact, most misleading and dangerous, as entirely untrustworthy inferences may be drawn from them and far-reaching troubles caused in the future. Under scientific supervision arrangements are made to avoid such troubles and get trustworthy results which can be depended on for future designs.

What is the case with pressure gauges and the measurement of pressure applies, of course, to all other instruments and measurements. In most works it may be said with sorrow that the only moderately accurate measurements that can be made are those of dimensions and weight. It is only by accurate testing of existing plant that trustworthy deductions can be drawn enabling safe progress to be made in future designs.

One of the great things which helped forward the steam turbine in the early days was accurate and full testing of each plant as soon as it was completed and before it left the works. The late Mr. Willans was probably the first, or one of the first, to recognise the importance of accurate testing of steam plant, and the success his well-known engine had was largely due to this. From the earliest days of the steam turbine Sir Charles Parsons recognised the necessity of such testing, and the test-house has always been a prominent feature of Heaton Works. And then in the higher ranks of an engineering works it requires a scientific mind to draw safe conclusions from tests carried out and to see in what directions progress can safely be made. Such methods have enabled the steam turbine during the writer's acquaintance with it, now extending over some twenty-eight years, to grow from 50 horse-power to some 45,000 or more in each unit, and the steam consumption to be reduced from 40 lb. per h.p.-hour to about 7½ lb., or less than one-fifth.

And closely allied to such work in engineering works is the general question of scientific research, and here a trained scientific mind is of the utmost importance to see that trustworthy results are obtained and to make true logical deductions from those results. Without suitable training a man is liable to be unable to grasp all the conditions of an experiment and to make deductions from the data obtained which are totally unjustified and often lead to most disastrous results in the future.

Such research is generally carried out in four places —engineering works, private laboratories, engineering colleges, and national laboratories. The first has already been dealt with. The second is of comparatively small importance in practice.

As regards the third, a great deal of good work has been done in engineering colleges, often under great difficulties for want of plant and money, and it is greatly to the credit of our professors and others that they have succeeded in doing so much with the very inadequate appliances at their disposal, and handicapped for want of funds. How inadequate their income is can be understood when it is remembered that Leipzig University alone has an annual income from the German Government of 100,000*l.*, as against a total Government grant to *all* the universities here of about 45,000*l.*, or less than half.

Of national laboratories we have only one, the National Physical Laboratory at Teddington, and here again the support given to it is totally inadequate. The total income from all sources last year was only 40,000*l.*, and of this 23,000*l.* was charges for work done, such as testing meters and other instruments and similar commercial work; the Government grant is only 7000*l.* a year, and besides this 7500*l.* was received for experiments in connection with aeronautics, which is really war work. The balance was made up of subscriptions, grants from technical societies, and miscellaneous receipts. Compare this with the German equivalent, the Reichsanstalt of Berlin, which has an income of 70,000*l.* a year from the Government, or ten times that given to our N.P.L. The Bureau of Standards, the similar institution in the U.S.A., has a Government grant of 140,000*l.*, or twenty times ours. In the Civil Service Estimates there is an allowance of 40,000*l.* for research, an increase of 15,000*l.* over that allotted last year. The total estimates are more

than 20,000,000*l.*, so that less than one-fifth per cent. is allotted to research.

It is difficult to realise what benefits might be gained by investigations which could be carried on by the N.P.L. if only sufficient funds were available, and of what importance they might be to industry at large. One example may suffice. Some time ago the Reichsanstalt carried out a most complete set of tests on a certain class of machine, an investigation which must have cost several thousands of pounds sterling, apart from the time it occupied. The results of this investigation are available to German manufacturers of this machine, and just before the war preparations were being made to take advantage of this, and from figures stated a large extra economy was expected. This, of course, would enable them, provided the cost of manufacture was not too high, to have an enormous advantage over such machines manufactured without this special knowledge. The Institution of Mechanical Engineers saw the importance of this problem and appointed a Research Committee to deal with the matter, but the first question met with is that of finance. Should this be the case in a wealthy country such as this that depends on its manufactures for its very existence? And that such an investigation is required is obvious from the fact that the designs of no two independent manufacturers of this machine in this country agree among themselves. Of course, each claims his is the best, but this cannot be so.

Investigations in engineering shops do not meet such a case. The question of finance has to be carefully watched, and as soon as results sufficiently good are obtained they are generally accepted, and in any case the problem is rarely thrashed out to the bottom, an almost universal defect in commercial research work. Without the help of the National Physical Laboratory the position of the aeroplane in this country would be very different from what it is, and what has been done for the aeroplane requires to be done in many other directions.

But what firm here would do what has been done in the commercial synthesis of indigo, on which it is said that seventeen years' work and more than 1,000,000*l.* have been spent by one firm alone abroad? Here in chemical investigations and manufactures the Government refuses even to give the help of allowing cheap alcohol to be obtainable, and much of such work is impossible in this country on that account, as in many cases methylated and denatured alcohol are not suitable. Recently under pressure the restrictions have been somewhat relaxed by the Government, but many manufacturers have found that the privileges granted are so tied up with red tape that the concessions are practically useless.

I am sorry to say the employer does not look after the welfare of his workmen as he might. In a small factory the head of the firm, as a rule, knows all the leading men among the workmen, many of them having been with him for years. As the place grows he loses touch with his men, and as an actual fact knows fewer of those under him when he has 1000 or more employees than he did when he had 400 or under. This state of things gets worse when the place is turned into a limited liability company, as nearly all large places are at present. The result is that a most deplorable state of things has come to pass. The workman says, "Put not your trust in employers"; the master says, "Put not your trust in workmen"; and the official who is between the master and the workman says, "Put not your trust in either."

It is difficult to say what is to be done to remedy this state of things, but one cannot help feeling much might have been done in the past to have prevented such a regrettable state of affairs as there is at present. Much of this trouble might have been avoided if employers had shown more consideration for the welfare of their workmen.

With the growth in strength of the Trades Unions, which at first were for the legitimate object of seeing that the workman got fair play, and providing out-of-work and old-age benefits, etc., has grown up a system of Trades Union officials who live by agitation, and whose jobs would be gone if there were no supposed grievances to agitate about. These men keep the labour world in a constant state of agitation, and make the employers' and officials' existence a burden to them by constant demands of all sorts, many of them utterly impracticable and unfair. When they cannot agitate against the employer they agitate against another Trades Union, and thus endless disputes spring up on the demarcation of work. Some of the worst strikes in the past have been due to disputes between two Trades Unions.

Unless something can be done to bring master and man together and make both work for the common good, English trade must inevitably go down, and the supremacy that England has in the engineering of the world will come to an end.

Nothing ever was a truer statement than that recently made by Lord Joicey that this country, unless it produces as cheap as, or cheaper than, other countries, cannot in the long run keep her trade, and this is true in spite of any tariff walls which may be set up. And if the present state of affairs is maintained of unscientific management and obsolete machinery, combined with limitation of output and high wages, or, in other words, high cost of production, we must, sooner or later, go to the wall.

What is really wanted is common honesty and common sense on both sides, for one side is as bad as the other at present.

Apart from the considerations set out above, combinations among the firms employed in any one trade are most essential for the well-being of that trade. It is by such combination that much of the progress made of late years by our competitors has been effected. Some of these combinations have been international, and at least two such in the engineering trade were so before the war. These now, of course, are, and it is expected will be after the war, confined to the Allied and possibly to neutral countries, but such combinations, whether among all the engineering firms in one district or among firms employed in one particular trade, to be successful must be worked fairly to all members, and the larger firms must not override the smaller, as, it is regrettable to say, has been done in combinations of employers in some districts. For example, in a district where there is one firm very much larger than any of the others, it is not unknown for it to act the bully and insist on everything being done as would suit its requirements, regardless of the rights of others. And, further, such combinations are, unless directed by men with broad minds and able to take a wide view of things, liable, especially in case of emergency, to do much harm.

If the armament ring in this country had taken such a view when it was found what an enormous supply of munitions was required, it is doubtful if there would have been such a shortage as there has been. Hundreds of firms were willing and anxious to help in the production of munitions, but when they offered their services they were met in many cases with a blank refusal, and in all cases with little encouragement. And when, under pressure from the Government, the ring accepted outside help, in many cases the conditions imposed on the sub-contractors were unfair in the extreme, apparently the whole idea of the ring being to make all the profit they could out of the troubles of the Empire. It has been just as difficult to persuade the armament ring to give up

what they thought was their monopoly and to bring in outside works to help in the production of munitions as it has been to persuade the Trades Unions to forgo trade customs and to enable outside sources of labour to be employed, such as women and other unskilled labour. But both have had to do it. In other words, "dilution of works" has been as difficult to effect as "dilution of labour," and the position both of the armament ring and of the workman would have been very different if they had consented freely to it when it became obviously necessary for the safety of the Empire.

The necessities of research work have already been dealt with, and by the pooling of such research work enormous advantages in any one trade could be obtained. Such pooling of information has been effected with most beneficial results, especially in the chemical trade abroad. Any workable scheme which would enable this to be done and get over the jealousies between one firm and another would be of enormous benefit to the trade in general.

Another thing that must not be lost sight of is the urgent need of improving our educational system. It is little short of a disgrace that the older universities are closed to those without a knowledge of Latin and Greek.

Languages are of the greatest importance to an engineer—not dead languages, but living ones. And these should be properly taught, so that the student should be able not only to read and write them, but also to speak and understand them when spoken. It is quite a different knowledge of a language to be able to read, write, speak, or understand it. Many people can read a language without being able to write, speak, or understand it when spoken, and conversely it is not uncommon to meet people who can speak and understand a language without being able to any large extent to read or write it. And it is only in living languages that a man is trained to speak and understand a language.

Why is it that we are so wedded to the dead languages? There is, of course, the tradition that such are necessary for a liberal education, and there is the argument that modern languages are not so good a training for the mind. Granted that they are not quite so good from the point of view of learning to read and write them, does not the fact that they can also be taught as a living language to be spoken and understood make them on the whole the best educationally for a man? This is entirely apart from the fact that modern languages are useful and ancient useless to the man in commercial work. There is, of course, bitter opposition from that most conservative man, the schoolmaster, and one great reason is that it is much easier and cheaper to get a man to teach Latin and Greek than modern languages which have to be taught orally. The teaching of Latin and Greek as they are usually taught has been standardised to the last degree, and as a result they can be taught by the "semi-skilled" man, and a "skilled" man is not necessary, to use engineers' phraseology. In fact, the teaching of Latin and Greek is a pure "repetition job." At the same time, no education is complete unless science is combined with languages, and also literature, and here lies one great danger of modern technical education.

After the boy has left school and enters the shops more facilities should be given to enable him not only to keep up but to continue his education. In the shops and drawing office too often the boy is left to pick up a knowledge of his trade as best he can. The apprentice who asks questions is often looked on as a nuisance, and requests for information are generally met by a blank refusal or worse. Often the foreman or chief draughtsman is afraid to answer questions for fear of being charged with giving away so-called "trade secrets," but an immense deal of information can be given to an apprentice without doing so.

Evening classes are all very well in their way, but more facilities should be given for the diligent apprentice to attend day classes, and this can be arranged in various ways if the employer has a will to do it. A thing that at present often prevents boys desirous of educating themselves getting on is the fact that overtime is allowed as soon as a boy is eighteen, and often he is compelled to work overtime regardless of classes that he ought to be attending.

It is important to remember that the boy of to-day is the man of to-morrow.

One complaint is that after a lot of trouble is taken about a boy he leaves after a few years and goes to another employer. The good of the trade in general must be considered, and a man who has had experience of various classes of work is generally a much more valuable man than one whose knowledge is confined to one class only. In any case, the other employer gets the benefit of what has been done by the first, and thus the trade in general benefits.

It is realised that this is a very imperfect review of things as they are at present, but if this address induces all classes engaged in engineering to consider how things can be bettered the author feels that a part, at all events, of his object has been attained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Notice is given of the forthcoming appointment to the George Henry Lewes studentship in physiology. The object of the studentship, the annual value of which is 200*l.* and is tenable for three years, is to enable promising students to devote their whole time to physiological research. Candidates are requested to send a short statement of their qualifications to Prof. J. N. Langley, the Physiology School, Cambridge, by November 18.

LONDON.—At a meeting of the Senate held on October 18, the Vice-Chancellor (Sir Alfred Pearce Gould) being in the chair, the following doctorates were conferred:—*D.Sc.* (*Engineering*), Mr. E. H. Salmon, an internal student, of the East London College, for a thesis entitled "Columns." *D.Sc.* (*Economics*), Mr. P. Bandyopadhyay, an internal student, of the London School of Economics, for a thesis entitled "Public Administration in Ancient India." *D.Sc.* (*Physiology*), Miss D. J. Lloyd, an external student, for a thesis entitled (*a*) "The Osmotic Balance of Skeletal Muscle," (*b*) "The Relation of Excised Muscle to Acids, Salts, and Bases."

OXFORD.—The reports for the year 1915 of the curators of the Botanic Garden and of the Department of Botany have just been published. They contain long lists of contributors, both public and private, of specimens and other material for study to both institutions. To most of those who have sent donations to the garden a return has been made in kind. Many interesting plants have flowered in the garden during the past year. In the Department of Botany lectures have been given by the Sherardian professor and Messrs. A. H. Church and W. E. Hiley. Practical work in physiology has been conducted by Mr. Kempin. Considerable progress has been made with work on the herbarium. The accounts show that great economy has been practised in the matter of expenditure.

THE University of Lund is founding a personal professorship in the theory of heredity for Dr. N. H. Nilsson-Ehle.

MISS G. J. SANDERS, formerly principal of the Lowthorpe (Massachusetts) School of Horticulture and Landscape Architecture for Women, has been appointed principal of the Swanley Horticultural College.

A PAMPHLET issued by the Bradford Education Committee describing the courses in chemistry and dyeing held at the Technical College in that town is symptomatic of the altered outlook towards the various branches of the chemical profession brought about by the world-war. These college courses are, in the first place, arranged to meet the growing requirements of the local dyeing industry. Together with the study of colouring matters, practical instruction is given in the art of dyeing in a dye-house with full-sized machinery combined with a finishing plant for completing the commercial treatment of cloth. As in many other technical colleges, there is an entrance examination, in which English and mathematics are compulsory. Special stress is laid on the fact that a sound secondary education up to the age of sixteen or seventeen is a preliminary asset of the greatest importance. The combined course in chemistry, dyeing, and the allied subjects extends over a period of four years. A similar course has been devised for those taking up chemical work in other industries, such as in oil and soap works, or in metallurgy or gas engineering. Both these courses include a certain proportion of mechanics and engineering bearing specially on chemical industries. Students passing satisfactorily through either of these courses receive the college diploma, but the associateship of the college is reserved for those who have had one year's practical experience subsequent to the award of the diploma, and who have submitted a thesis on some previously approved subject. The ultimate object of the curricula of this college is to turn out practical chemists, dyers, and pharmacists, and that these qualifications are appreciated by manufacturers is seen from the encouraging list of appointments secured by the alumni.

AN appeal on behalf of the Endowment Fund of the School of Oriental Studies at the London Institution has been issued by an influential committee of which Lord Curzon is chairman. The objects of this new institution are three in number:—(1) To provide a place where the Englishmen who will presently be engaged in governing or garrisoning the Oriental and African parts of the Empire may learn the languages and study the literature, the religions, and the customs of the peoples with whom they will be brought into contact; (2) to offer a training to those who are about to proceed to the same countries to take part in commercial enterprise or avocations; (3) to furnish in the capital of the Empire a meeting-ground and focus for the scholars of the East of all nationalities on their visits to this country. Evidence has been accumulating in recent years that the training of our Civil Servants and officers in the languages and modes of thought of Oriental peoples falls short of the ideal which we ought to have in view. In the new relations that will develop when the war is over there must be a higher standard of efficiency in these respects if our rule is to continue to commend itself to those with whom we are brought into relations. Information has been received that important steps are already being taken in Germany to give a higher education to Germans about to proceed to the East. Provision will be made in the new London school for all the more important languages of the Near, Middle, and Far East, and of Africa. The committee desires to raise an endowment fund of 150,000*l*., towards which they have now as a result of a preliminary appeal about 10,000*l*. Donations and subscriptions may be paid to the head office or to any branch of the London County and Westminster Bank, or to the secretary of the executive of the appeal committee at the School of Oriental Studies, Finsbury Circus, E.C. The governing body of the school has appointed Dr. E. Denison Ross, C.I.E., to be its director, and he will take up his work almost immediately. Dr Ross has travelled extensively in the East. Among his numerous works is the "Tarikh-i-Rashidi," a history of the Moguls of Central Asia.

A SERIES of resolutions referring to the claims of humanistic studies to scientific attention was adopted a couple of months ago by a conference representing the Classical, English, Geographical, Historical, and Modern Language Associations (see NATURE, September 7, p. 23). The committee of the Association of Public School Science Masters has just expressed agreement with the principles of education stated in the resolutions; and in answer to an invitation to make a statement with regard to education in the natural sciences, it has sent the following to the chairman of the conference:—"Natural science in education should not displace the 'humanistic' studies, but should be complementary to them. In this capacity natural science meets two needs in particular:—(1) *Search for Truth*: Imaginative power indicates new fields in which further knowledge of truth may be revealed; its subsequent establishment depends on accurate observation, with constant recourse to nature for confirmation. The one aim of natural science is, in fact, the search for truth based on evidence rather than on authority. Hence the study of the subject implies accurate observation and description and fosters a love of truth. The special value of Natural Science in the training of Mind and Character lies in the fact that the history of the subject is a plain record of the search for Truth for its own sake. (2) *Utility*: There are certain facts and ideas in the world of natural science with which it is essential that every educated man should be familiar. A knowledge of these facts assists men (*a*) to understand how the forces of nature may be employed for the benefit of mankind; (*b*) to appreciate the sequence of cause and effect in governing their own lives; and (*c*) to see things as they really are, and not to distort them into what they may wish them to be. It is the business of Natural Science in education to bring this knowledge within the range of all." The statement is signed by Prof. H. H. Turner, president of the Association of Public School Science Masters, and by Mr. A. Vassall, chairman of committee. Probably arising out of the conference referred to above, a Council of Humanistic Studies has been constituted, comprising representatives of the British Academy, in addition to the five associations mentioned above. Its object is to watch educational developments in the interests of the studies represented by these bodies and to co-operate, if possible, with the representatives of natural science. The president is Lord Bryce, and the chairman Sir Frederic Kenyon, to whom communications may be sent at the British Museum.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 28.—Dr. Alfred Harker, president, in the chair.—Dr. A. Smith **Woodward**: A new species of Edestus from the Upper Carboniferous of Yorkshire; with a geological appendix by J. Pringle. The fossil confirms the interpretation of Edestus as a row of symphysial teeth of an Elasmobranch fish. The row of eight bilaterally symmetrical teeth, fused

together, occurs at the tapering end of a pair of calcified cartilages, which evidently represent a jaw. An imperfect detached tooth probably belongs to an opposing row. The teeth are large compared with their base, and the serrated edges have been worn during life. Small Orodont teeth of the form named Campodus are scattered in the shale near the jaw. Markings on the Edestus teeth themselves suggest that they have been derived from the Campodus type of tooth. The specimen was obtained from shale below the Rough Rock, in the upper part of the Millstone Grit, at Brockholes, near Huddersfield.—A. **Holmes**: The Tertiary volcanic rocks of Mozambique. With the exception of a coastal belt of Cretaceous and Tertiary sediments, flanked on the west by later Tertiary volcanic rocks, the territory consists of a complex of gneisses and other foliated rocks, intruded upon by granites belonging to at least two different periods. From Fernão Vellosa Harbour to Mokambo Bay the junction of the sedimentary formations with the crystalline complex is faulted, and the volcanic rocks are distributed on each side of the fault. The lavas are of post-Oligocene age, and are the result of fissure-eruptions, the feeding channels being exposed as small dykes that penetrate the underlying rocks. The prevailing lavas are amygdaloidal basalts. An andesite dyke of later date occurs near the Monapo River. In the north, near the Sanhuti River, picrite-basalt, basalt, phonolite, and sölvsbergite have been found, and related lavas occurring elsewhere in the area are tephritic pumice and ægirine-trachyte. The "alkali" series can be closely matched by the lavas of Abyssinia, British East Africa, Réunion, and Teneriffe. The amygdaloidal basalts of the "calc-alkali" series are similar to those of the Deccan, Arabia, and East Africa, and also to those (of late Karroo age) occurring in South Africa and Central Africa. Each of the series was probably evolved by a process of differentiation acting on a parent magma. From the composition of the amygdale minerals it is deduced that the parent magma of the "alkali" series was rich in carbon dioxide and under-saturated in silica; whereas that of the "calc-alkali" series was rich in water and over-saturated in silica. The radio-activity of the lavas indicates that the depth from which the parent magma came was probably between thirty-three and forty-four miles from the earth's surface.

Royal Microscopical Society, October 18.—Mr. E. Heron-Allen, president, in the chair.—Dr. Helen Pixell **Goodrich** and M. **Moseley**: Certain parasites of the mouth in cases of pyorrhœa. After a general description of the pathological changes in gum tissues resulting from pyorrhœa, illustrated by sections of normal and infected jaws, a detailed account of *Entamoeba gingivalis*, Gros, was given, followed by notes on Trichomonas and the interesting complex Leptothrix colonies, which give rise to the tartar. Of these parasitic organisms only the Leptothrix colonies were considered by the authors as likely to be the cause of the disease.

PARIS.

Academy of Sciences, October 2.—M. Camille Jordan in the chair.—E. **Picard**: Functions of two complex variables remaining invariable by substitutions of a discontinuous group.—G. **Bigourdan**: The declaration of Louis XIII. relating to the first meridian. The text of the declaration, dated July 1, 1634, is given in full. The position chosen had no scientific basis.—G. **Bigourdan**: The propagation of the sound of the cannonade at the front to great distances. There is evidence that the sounds heard are not propagated through the air, but through the soil.—H. **Douvillé**: The Cretaceous and the Tertiary in the neighbourhood of Thones (Haute Savoie).—J. **Meunier**: The detection of small quantities of selenium; distinction from arsenic. Selenium may cause error in the Marsh test for arsenic when present in minute traces only. A scheme for examining the deposit is given, by means of which selenium can be detected in the presence of arsenic.—P. **Garrigou-Lagrange**: Luni-solar action and temperature.—J. **Amar**: The technique of the sense education of men without limbs or sight. Details of the methods and apparatus used in the education of the sensibility of mutilated limbs, and of the sense of touch in the blind.—L. **Camus**: Vaccinal immunity resulting from intravascular injections of vaccine.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 9, vol. ii., September 15).—J. **Loeb**: The mechanism of diffusion of electrolytes through animal membranes. For the diffusion of certain electrolytes through animal membranes there is required, besides the osmotic pressure, a second effect, called the "salt effect," upon the membrane. This consists probably in an ionisation of the protein molecules of the membrane.—F. G. **Pease**: The rotation and radial velocity of the spiral nebula N.G.C. 4594. The radial velocity is +1180 km., in good agreement with the values found by Slipher. The linear velocity of rotation at a point two minutes of arc from the nucleus is more than 330 km.—F. H. **Seares**: A simple method for determining the colours of the stars. The method suggested consists in determining the ratio of exposure-times which is necessary to produce photographic and photovisual, or, more briefly, blue and yellow, images of the same size.—H. **Shapley**: Studies of magnitudes in star clusters. III. The colours of the brighter stars in four globular systems. It is concluded that in all the clusters examined, and probably in all globular clusters, the volumes of the bright red stars are very great in comparison with the stars that are fainter and relatively blue.—Janet T. **Howell**: The effect of an electric field on the lines of lithium and calcium. Lithium and calcium were examined, both for longitudinal and transverse effects.—A. B. **Coble**: A proof of White's porism.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of the Philippine Islands. Six detailed analyses are given of rocks from Luzon, P.I.—W. O. **Fenn**: Salt antagonism in gelatine. The experiments on gelatine support the hypothesis that anions antagonise kations in their effects upon organisms. The hypothesis here developed resembles that of Clowes except that it requires that NaCl should antagonise any electrolyte which has either a strong anion or a strong kation. The point of maximum antagonism is an isoelectric point at which the amount of alcohol needed for precipitation is at a minimum, and the aggregation or amount of precipitation is at a maximum.—W. O. **Fenn**: Similarity in the behaviour of protoplasm and gelatine. A close analogy to Osterhout's experiments on the electrical resistance of Laminaria is found in gelatine (plus NaOH), if we assume that the effect of time in the Laminaria experiments is to increase the concentrations of the salts in the cells of the tissue.—W. E. **Milne**: Certain asymptotic expressions in the theory of linear differential equations. Formulas more precise than those previously obtained by Birkhoff are given.—H. B. **Fine**: Newton's method of approximation. A condition is given under which Newton's method of approximation for computing a real root of an equation, and the extension of this method used in computing a root of a system of equations, will with certainty lead to such a root or solution.

BOOKS RECEIVED.

Studies of Inheritance in Guinea-Pigs and Rats. By W. E. Castle and S. Wright. Pp. iv+192+plates 7. (Washington: Carnegie Institution.)

Plant Succession. By Prof. F. E. Clements. Pp. xiii+512. (Washington: Carnegie Institution.)

The Jukes in 1915. By A. H. Easabrook. Pp. vii+85. (Washington: Carnegie Institution.)

American Fossil Cycads. By G. R. Wieland. Vol. ii., Taxonomy. Pp. vii+277. (Washington: Carnegie Institution.)

The Vulgate Version of the Arthurian Romances. Edited from Manuscripts in the British Museum. By H. O. Sommer. Index of Names and Places to vols. i.–vii. Pp. 85. (Washington: Carnegie Institution.)

Fecundity versus Civilization. By A. More. Pp. 52. (London: G. Allen and Unwin, Ltd.) 6*d*. net.

Air-Screws. By M. A. S. Riach. Pp. viii+128. (London: Crosby Lockwood and Son.) 10*s*. 6*d*. net.

Eclipse or Empire? By H. B. Gray and S. Turner. Pp. x+316. (London: Nisbet and Co., Ltd.) 2*s*. net.

Economics in the Light of War. By Prof. R. A. Lehfeldt. Pp. 56. (Johannesburg: South African School of Mines and Technology; London: W. Wesley and Son.) 1*s*.

Annals of the South African Museum. Vol. v., part iv. (London: Adlard and Son.) 25*s*.

Form and Function: a Contribution to the History of Animal Morphology. By E. S. Russell. Pp. ix+383. (London: J. Murray.) 10*s*. 6*d*. net.

Annual Report of the Board of Regents of the Smithsonian Institution for the Year ending June 30, 1915. Pp. xii+544. (Washington: Government Printing Office.)

The Indo-Aryan Races: a Study of the Origin of Indo-Aryan People and Institutions. By Ramāprasād Chanda. Part i. Pp. xiii+274. (Rajshahi, Bengal: The Varendra Research Society.)

The Cambridge Pocket Diary, 1916–17. Pp. xv+265. (Cambridge: At the University Press.) 1*s*. net.

Robert of Chester's Latin Translation of the Algebra of Al-Khowarizma. With an Introduction, Critical Notes, and an English Version, by L. C. Karpinski. Pp. vii+164. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 2 dollars.

Memoirs of the Boston Society of Natural History. Vol. viii., No. 2. Monographs on the Natural History of New England:—The Whalebone Whales of New England. By G. M. Allen. Pp. 107–322. (Boston, Mass: The Society.)

The Origin of Finger-Printing. By Sir W. J. Herschel. Pp. 41. (Oxford: At the University Press, H. Milford.) Paper covers, 1*s*. net.

A Portfolio of Reproductions of Finger Prints. (Oxford: At the University Press, H. Milford.) Not sold.

William Oughtred: a Great Seventeenth-century Teacher of Mathematics. By Prof. F. Cajori. Pp. vi+100. (Chicago and London: Open Court Company.) 4*s*. net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 27.

PHYSICAL SOCIETY, at 5.—The Determination of the Saturation Values for Magnetism of Ferromagnetic Metals, Compounds, and Alloys by means of the Kerr Effect: Dr. S. G. Barker.—The Influence of the Time Element on the Resistance of a Solid Rectifying Contact: D. Owen.—Diffusion in Liquids: B. W. Clack.

TUESDAY, OCTOBER 31.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Gurkhas and their Country: Aubyn Trevor-Battye.

WEDNESDAY, NOVEMBER 1.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Quantitative Microscopy: T. E. Wallis.—Formula for Converting Zeiss Butyro-Refractometer Readings into Refractive Indices: C. C. Roberts.—Criticism of Vaubel's Bromine Values: Cecil Revis and H. R. Burnett.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Waves in an Elastic Plate: Prof. H. Lamb.—(1) Multiple Integrals; (2) The Order of Magnitude of the Coefficients of a Fourier Series: Prof. W. H. Young.—A Determination of the Heat of Vaporisation of Water at 100° C. and 1 Atmosphere Pressure in Terms of the Mean Calorie: T. C. Sutton.—The Mechanical Relations of the Energy of Magnetisation: G. H. Livens.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Address of Retiring President: The Fourier Harmonic Analysis; its Practical Scope and its Limitations: Sir Joseph Larmor.

CHEMICAL SOCIETY, at 8.—Overvoltage Tables. Part IV. The Theories of Overvoltage and Passivity: E. Newbery.—Studies of the Carbonates. Part II. Hydrolysis of Sodium Carbonate and Bicarbonate, and the Ionisation Constants of Carbonic Acid: C. A. Seyler and P. V. Lloyd.—The Synthesis of Hydroxyquercetin: M. Nierenstein.—(1) The Reaction between Methyl Iodide and some Metallic Cyanides; (2) Some Reactions produced by Mercuric Iodide: E. G. J. Hartley.—The Dual Theory of Acid Catalysis. A Comparison of the Activities of Certain Strong Acids: H. M. Dawson and T. W. Crann.

FRIDAY, NOVEMBER 3.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Thomas Hawksley Lecture: The Gas Engineer of the Last Century: H. E. Jones.

SATURDAY, NOVEMBER 4.

GEOLOGISTS' ASSOCIATION, at 3.—Followed by Annual Conversazione.

MONDAY, NOVEMBER 6.

SOCIETY OF ENGINEERS, at 5.30.—Heating and Ventilating Private Dwelling-Houses: C. T. A. Hanssen.

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