THURSDAY, APRIL 19, 1917.

EDUCATION AND RESEARCH.

Science and the Nation. Essays by Cambridge Graduates, with an Introduction by the Rt. Hon. Lord Moulton. Edited by Prof. A. C. Seward. (Cambridge: At the University Press, 1917.) Price 5*s.* net.

IT is the fate of many symposia to fail as a whole by the very excellence of the parts; relationship and proximity as well as stars are needed to form a constellation; and this unsatisfactoriness of *ensemble* is all too manifest in this well-intentioned volume that the Master of Downing has gathered together rather than edited, to which Lord Moulton contributes an introduction. Individually the chapters are of the utmost interest to the general reader; they give him compactly and authoritatively a sound idea of the scope and value of contemporary work in chemistry, physics, botany, geology, medicine, mathematics, and anthropology by such eminent Cambridge hands as Profs. Pope, Bragg, Hobson, Biffen, Wood, Nuttall, and Gowland Hopkins; and it is only when his heart, glowing responsively, demands, "And in return for all these benefits, in a lively hope of more to come, in the desire for more to come, what do you want the general public to do for you?" that the book becomes ineffective. This is not for want of a common intention. There are clear indications of a common intention to cry up "pure" science and to insist upon the importance of scientific studies and scientific research, but the cry never becomes more than a vague cry, and the need of the present time is for definite proposals. The present reviewer, who is a journalist very anxious for the advancement of science and very eager to serve it if he can, turns from this book with an uncomfortable sense that scientific men have still to develop a definite policy with regard to schools and colleges and higher education. They do not seem to realise how far science progress is bound up with these matters.

Here, for example, is a passage from Prof. Keeble's contribution. It shows an extraordinary blindness to the difficulties of the educational conflict at the present time. To the keen parent of promising boys, or to the keen patriot in these urgent times, its easy, ill-informed carelessness will be almost maddening.

In our own sphere we might well make a beginning by calling a friendly truce between the big-endians and little-endians of Classics and Science. For if the protagonists were to confer instead of to contend, they would discover that in the ample years of leisure which our youth enjoy there is room in plenty for both classical and scientific education. In such a spirit of sweet reasonableness the scientific and the classico-clerical might proceed together to a reform of our system of education—from top to bottom. There is room for it. It is essential that our statesmen and administrators, our teachers and our poets, know something of the work and method and beauty of science. It is no less essential that the men of science of the coming generation should be cultivated citizens as well as competent specialists.

The Master of Downing failed in his editorial duty when he let that passage stand. No parent, no schoolmaster of any intelligence will endorse Prof. Keeble's delusion that the swift years of youth are "ample years of leisure." From first to last through the whole curriculum the educationist knows that he is up against an inexorable limitation of time. The contemporary dispute in education turns wholly upon the compulsory imposition of the Greek language upon those who go on to a higher education and upon its use as a medium of philosophical instruction. The case of the moderns is that *there is no time for Greek,* and that the Greek shibboleth cuts off philosophical studies from the general intelligence. No one anywhere is attempting to turn education into a manufacture of "competent specialists," and the idea Prof. Keeble favours, that to be cultivated and to be scientific are antagonistic states, is a suggestion of the enemy that has no real foundation in experience. A man may be a Greek scholar and a boor. A man may be unable to construe half a dozen words in Greek and have a beautifully trained and subtly refined intelligence. The case for the defence of the Greek obstacle consists largely in ignoring these facts.

If scientific men who have not had the time to follow up this educational controversy closely wish to grasp its essential values, they cannot do better than weigh over the implications of this passage that follows, from an article by Lord Bryce in the current *Fortnightly Review*:—

I do not contend that the study of the ancients is to be imposed on all, or even on the bulk, of those who remain at school till eighteen, or on most of those who enter a university. It is generally admitted that at the universities the present system cannot be maintained. Even of those who enter Oxford or Cambridge, many have not the capacity or the taste to make it worth while for them to devote much time there to Greek and Latin. The real practical problem for all our universities is this: How are we to find means by which the study, while dropped for those who will never make much of it, may be retained, and for ever securely maintained, for that percentage of our youth, be it 20 or 30 per cent. or be it more, who will draw sufficient mental nourishment and stimulus from the study to make it an effective factor in their intellectual growth and an unceasing spring of enjoyment through the rest of life? This part of our youth has an importance for the nation not to be measured by its numbers. It is on the best minds that the strength of a nation depends, and more than half of these will find their proper province in letters and history. It is by the best minds that nations win and retain leadership. No pains can be too great that are spent on developing such minds to the finest point of efficiency.

We shall effect a saving if we drop that study of the ancient languages in the case of those who, after a trial, show no aptitude for them.

Let the scientific man read that over carefully, and, if need be, re-read it. Let him note first the invincible conceit of the classical scholar in

the superiority of his particular education to any other, and his firm determination *to secure the pick of the available boys and the pick of the administrative posts* for the classical training. Science and research are to have those rejected as unfit in this sublime progress of the elect. Instead of our boys—I mean the boys destined for real philosophy, living literatures, science, and the study of actual social and political questions—having a straightforward, well-planned school course, they are to be *tried over* at Greek for just the most precious years educationally, and our modern world is to have the broken fragments. This claim is pressed even more impudently by Mr. Livingstone in his recent "Defence of Classical Education." He insists that all our sons are to be muddled about with by the teachers of Greek up to at least the opening of the university stage, entirely in the interests of Greek scholarship. Prof. Keeble's dream of "sweet reasonableness" is a mere dream. These classical people are absolutely ignorant of their own limitations; they can imagine no compromise; they mean to ram compulsory Greek down the throat of every able English boy they can catch, and they mean to load the scales in favour of Greek at any cost to science, philosophy, and national well-being.

Against this strangle-grip of the classic-worshipping mandarins on our higher English education such a book as "Science and the Nation" scarcely fights at all. Is it too much to suggest that scientific men should take a little more trouble collectively than they have hitherto done to master the essentials of this question, and to understand better what it is that really sustains the general contempt and distrust of modern knowledge in Great Britain and blocks the way to a widespread national support of research? H. G. WELLS.

THE WORLD CRISIS AND AFTER.

Janus and Vesta: a Study of the World Crisis and After. By Benchara Branford. Pp. xviii + 316. (London: Chatto and Windus, 1916.) Price 6*s.* net.

THIS is not a "war book," but it makes a well-timed appearance, for in an England unillumined and unchastened by these last terrible years it might have found few readers capable of perceiving its value. The author should now, however, be assured of a large company who will accept his invitation to read his work "backwards and forwards in the belief that it will repay careful study." To one at least who has done so it seems a noble book, full of a wise and strong humanity, worthy to be classed with writings to which all men pay homage. Any scientific reader who will start with the chapter on "Science and Occupation" and follow whither the clue leads will probably reach much the same opinion.

Mr. Branford is well known in the educational world as a divisional inspector of the London County Council. He was once a lecturer on mathematics in the Victoria University, and was afterwards principal of the Technical College and Director of Education in the Borough of Sunderland. In 1908 he published an admirable "Study of Mathematical Education," which has been translated into German. In 1902, in conjunction with Prof. W. A. Bone, he issued proposals for a school of metallurgy, which recent unhappy experiences have shown to be as necessary as they were far-sighted. The statement of these facts will suffice to commend to scientific readers the views on educational reform that constitute a vital part of the present work; it should, nevertheless, be added that the author deals with all aspects of the problem of education with quite remarkable insight and breadth of sympathy. His zeal for universal vocational training is the expression of no narrow ideal of "national efficiency," but springs from a profound study of the conditions of development of the human spirit. It is, therefore, in complete harmony with his passionate conviction that a revival of university life (including a renaissance of the "wandering scholar") is one of the most urgent needs of the time, being necessary in order that the nations, old and young, may not only rise to the full height of their spiritual possibilities, but also learn, through the intercourse and mutual understanding of their best minds, to compose their historical discords.

In this connection Mr. Branford argues with much force that universities have, during the modern epoch, largely forgotten their catholic mission, and have become, in many insidious ways, organs for the cultivation of national separatism and egotism. As a remedy for this state of things he presses the suggestion of a "world university," neutral, as the Papacy is neutral, to be the guardian of the common spiritual interests of mankind, both Western and Eastern, as the Papacy was formerly the guardian of the common spiritual interests of the western European nations.

It is not possible in a short notice to follow in detail Mr. Branford's diagnosis of the diseases of our age, or to indicate the remedies he proposes. It must be enough to say that whether he speaks of things temporal or things spiritual, his voice has the authentic accent of the prophet. Like all true prophets, he shows not only the eager desire to know the things that belong to the peace of his own people, but also the depth of vision that reveals them *sub specie aeternitatis*. For this reason, though his ideas are often at first provocative, they are generally seen, on candid consideration, to be widely and solidly based. No one concerned with the problems of our State, internal or external, can afford to neglect them.

SCIENTIFIC OBSERVATION AND REASONING.

Comptes Rendus of Observation and Reasoning. By J. Y. Buchanan. Pp. xl + 452. (Cambridge: At the University Press, 1917.) Price 7*s.* 6*d.* net.

MR. BUCHANAN is a believer in original research in the full significance of the words, including originality in methods and point

of view, as well as in the subject dealt with. Unlike his former volume of collected oceanographical papers, this collection consists of a selection on many subjects, scientific and popular, several reproduced from the pages of NATURE. The strictly scientific memoirs deal with the relation of ice and brine, steam and brine, calorimetry, and the occurrence of ice in Nature, mainly in the form of glaciers. These researches grew out of Mr. Buchanan's observations of melting sea-ice during the cruise of the *Challenger* in the Antarctic regions, and, as regards calorimetry, in part out of observations on solar radiation during a solar eclipse in Egypt. The memoirs themselves form solid and informing reading for students; but they are rendered entertaining by the extraordinarily copious analytical Table of Contents, which occupies thirty pages. In this each paper is not only analysed and epitomised by the author, but also annotated, and sometimes criticised. For example, the discussion (reprinted from NATURE, vol. lxix., p. 293) of the system of the Royal Society (and, for that matter, of all scientific societies) of referring the papers of fellows to unnamed referees, who may suggest or insert alterations, is illustrated by a delightful reminiscence. In explaining how they manage these things better in France, Mr. Buchanan gives this pleasing picture of an episode of his student days:—

"In the summer of 1867, while working in the laboratory of Wurtz in the Ecole de Médecine in Paris, I made some investigations on the products of the reaction of perchloride of phosphorus on salts of isethionic acid. I collected the results in a short paper, and, with Wurtz's approval, I proposed to offer it to the Academy. At that date Wurtz himself was not yet 'of the Institute,' but there was a standing custom that papers by his *élèves* were presented by Balard, the veteran discoverer of bromine. Accordingly, I took my paper with me and made a formal call on M. Balard, who received me with the greatest kindness and courtesy in his study, wearing, as had been the fashion in his younger days, a black frock-coat, and a white neckcloth taken twice round his neck. When I had expressed my desire that he would do me the honour to present my paper to the Academy, he replied at once that he would have the greatest pleasure in doing so. I handed him the paper, he presented it the following Monday, and it was published in the *Comptes rendus* of the next week."

Reference may be made to another annotated paper, the "Chemical and Physical Notes" which appeared originally in the "Antarctic Manual," prepared for Captain Scott's first expedition. These notes proved less useful than they should have been, as there was no trained chemist on the expedition, and the physicist who was appointed did not sail with the *Discovery*, and only joined her in Australia. Had there been a chemist of Mr. Buchanan's manipulative skill and keen insight the notes would have been most helpful, for he now tells us that he prepared them as memoranda for a worker by imagining that the worker was himself. In fact, we gather that they are the instructions which thirty years of experience had shown would have profited him most had he himself received them when he sailed on the *Challenger* in 1872. They will stand, we trust, as inspiration for the chemist of some future expedition. An interesting point about this paper is mentioned in the preface: "It was conveyed to me through an old friend and former colleague that this contribution to the 'Antarctic Manual' had done much to retard the standardisation of research. I took it as a compliment. To standardise research is to limit its freedom and to impede discovery. Originality and independence are the characteristics of genuine research, and it is stultified by the acceptance of standards and by the recognition of authority."

This expression of opinion is really a confession of faith, and Mr. Buchanan's consistent acceptance of it as a guide in his own work is apparent in every paper and article which he has written. It is one of the curious instances of history repeating itself, that in every age the really original thinker is treated as a heretic by organised bodies and conventional men, unless, or until, he can hold his own against all attempts at suppression, passive and active; then he becomes a prophet, whose disciples, in turn, exercise a like intolerance of the forerunners of the next advance.

H. R. M.

OUR BOOKSHELF.

A Practical Manual of Autogenous Welding (Oxy-Acetylene), with a Chapter on the Cutting of Metals with the Blowpipe. By R. Granjon and P. Rosemberg. Translated by D. Richardson. Fourth edition. Pp. xxii+244. (London: Charles Griffin and Co., Ltd., 1916.) Price 5*s.* net.

THE fact that three large editions of this English translation have been exhausted in less than three years is evidence of the value it has been to those interested in the special technical methods described. Owing to the special nature of the subjects dealt with, the chief demands for the book must have arisen from workshops and factories where the processes so fully described are in actual use.

Although autogenous welding by means of the oxy-acetylene blowpipe has been largely used in this country, it has not received the same amount of attention as it has in other countries, such as France, for instance, where the Union de la Soudure Autogène has done valuable work in the encouragement of research and in the improvement of the methods of application.

The book deals with the properties and manufacture of oxygen and acetylene, and with the erection, testing, and working of welding installations; practical information is given on the composition of the metal welding rods and cleaning fluxes used, and on the preparation and execution of welds; and the autogenous welding of iron, steel, copper, brass, bronze, aluminium, and other metals and alloys is considered in detail.

A chapter is devoted to the important operation of cutting iron and steel by means of the blowpipe, in which illustrations of different types of cutting blowpipes are given, and the application of the process to new work, repairs, and demolitions is considered.

The book contains a large number of illustrations of practical value and can be very strongly recommended to all interested in the subject, especially as it contains a large amount of information not otherwise obtainable in the English language. C. O. BANNISTER.

Hawaiian Legends of Volcanoes (*Mythology*). Collected and translated from the Hawaiian by W. D. Westervelt. Pp. xv+205. (Boston, Mass.: Ellis Press; London: Constable and Co., Ltd., 1916.) Price 6*s*. net.

MANY of us became first acquainted with Pele, the goddess of Kilauea, in the fascinating description of the Sandwich Islands by Miss Isabella Bird (Mrs. Bishop). The filaments of glassy lava, spun out by the wind from blobs thrown up into the air, have since become familiar to generations of students under the name of "Pele's hair." Mr. Westervelt now reveals Pele to us as a beautiful and wayward princess, warmly passionate, yet ready to consume her lovers, and dominating the long volcanic slopes with sheets and whirls of flame. The main interest of the legends lies in the evidence they provide of the constant and terrible menace under which the Hawaiians drew up their system of natural theology. The insistence on Pele's arrival from a distance suggests that the first settlers knew volcanoes elsewhere, but found Hawaii peaceful during their earliest years of occupation.

The author has illustrated his charmingly produced book by photographs of notable volcanoes, which greatly increase its attraction for the geologist, and include such rare scenes as the ideally shaped and snow-covered cone of Mount Shishaldin, in Alaska. Mont Pelée of Martinique (p. 160) recalls, by an odd coincidence, the name of the impulsive and beautiful devil of Hawaii. Humane anthropologists will take some comfort from Hii-aka-i-ka-poli-o-Pele, the youngest sister, who was literally incubated "in the bosom of Pele." G. A. J. C.

Fungoid and Insect Pests of the Farm. By F. R. Petherbridge. Pp. vi+174. (Cambridge: At the University Press, 1916.) Price 4*s*. net.

THE author tells us this book has been written for those who wish to acquire some practical knowledge of farm and garden pests. It naturally does not aim at dealing with all the numerous enemies which affect crops, but rather at giving an accurate account of some of the commoner forms. It is a pity a great many more of the common pests were not included, especially amongst the Arthropods, for then it would have been of very considerably greater value. The accounts also of many of the pests treated in the book are far too short to be really helpful.

Part i. deals with fungoid diseases, including the potato disease, damping off, onion mildew, etc. Chap. iii. (pp. 35-47) describes the well-known finger-and-toe disease and the important wart disease of potatoes. In other chapters the author deals with mildews, ergot and clover sickness, rusts and smuts. Altogether nearly half the book is taken up with fungoid pests. A chapter is given on moths and butterflies, which deals almost entirely with the surface caterpillars. To the diamond-back moth five lines are devoted, in which one is told how to try to destroy it, without the slightest hint as to how to identify it. Wireworms and turnip-flea beetles (chap. x.) are better dealt with, and also the chafers; errors occur in the references to the figure here. The chief flies mentioned are the frit and gout flies, the Hessian fly, the cabbage-root flies, daddy-long-legs—the parents of leather-jackets—and the warble-flies. The last chapter deals with the eelworms, the accounts of which are far too short and vague to serve any useful purpose. There are fifty-four figures, most of which are good, but not nearly enough of the Arthropods for the book to be of much help to "those who wish to acquire some practical knowledge."

FRED. V. THEOBALD.

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.*]

Adjustable Clock-dials.

To gain daylight by adjustment of the clock is a brilliant practical idea, but the present method of realising it by moving the hands of the clock is grossly unscientific, and should, I think, be changed for the alternative one.

Let the circular disc of the clock-dial be put in place by screws in curved slots. In spring and autumn, when changing time, we should rotate the dial backwards and forwards respectively, leaving the hands untouched. The advantages of this procedure are many:—

(1) The zenith and nadir of the sun are the natural turning-points in the day. These would still occur, as they should, at the *top* of the dial, though the time would then be one o'clock (for summer time).

(2) The times of rising and setting of the sun at the equinoxes are other natural points of time. These would occur, as they should, at the *bottom* of the dial.

One's concepts of time in the day are conditioned by the sun's movements, and the adjustment of the clock as here suggested would at least give pride of place to Nature's time signals; all the other points of time in the day could be varied without disturbance to one's instincts. As we are doing at present, the top and bottom of the clock are losing their special significance, and they mean one thing for several months and something different for the rest of the year.

(3) Some clock hands—*e.g.* in strikers—cannot be moved back. Hence in autumn we should avoid the painful necessity of standing by the clock during the

weary business of putting on the hands eleven hours and waiting for seventy or more strikes.

(4) When the clock is thus adjusted, one would see at a glance whether "summer" or normal time is being registered on his clock. At present we have no means of knowing from the clock itself which time is indicated.

Clock-makers might be well advised to initiate this simple change. I, for one, would certainly choose a clock of the type suggested, which, used as I urge, would obviously be less liable than on the present plan to injury at the bi-yearly adjustment.

P. E. SHAW.

AEROPLANES AND PROPELLERS.[1]

(1) CONTRARY to its title, the first quarter of Lieut. Turner's book is devoted to the aircraft of yesterday. The early mythical attempted or pretended flights attributed to such historical characters as Leonardo da Vinci, Dante of Perugia, Besnier, Barthelémy Lourenco, and others have always afforded entertaining reading. A book which starts with these exploits and traces the development of the airship and aeroplane past Montgolfier's discovery of the balloon and the aeroplane experiments of Lilienthal, Pilcher, Chanute, and Wright down to the present war cannot fail to be of interest.

It may safely be said that the author has been very successful in an attempt to concentrate the maximum amount of information in the minimum amount of space. Every page is full of facts, yet the book is quite readable and interesting. Much of the subject-matter will probably be new even to the great majority of experts; for instance, the altitude charts of the first historic balloon journeys from London to Russia and Sweden. The chapter on meteorology, too, contains a number of interesting tables of statistics relating to atmospheric conditions at different altitudes.

Modern aeronautical theory and practice may be said to occupy about 130 pages of the whole book, and this section contains interesting chapters on "Learning to Fly," "Sensations during Flying," and "Sensations during Ballooning." The remainder of the book is mainly taken up with aircraft in war, and undoubtedly will do much to enlighten the British public on matters which everyone ought to know. For example, on p. 242 :—

"In anti-aircraft weapons Germany led the way and had done so for many years. The French were, however, in a strong position when the war broke out. Great Britain had done little save feed on illusion until a few months before the war, and for many months after deficiency in this respect was only too conspicuous."

But the most notable feature of this section is the chronicle of thrilling feats and adventures in the great war. Bomb-dropping on railways and on submarines, duels in the air, and seaplane adventures give some idea of the more exciting contents of the book, while, on the other hand, the possibilities and limitations of aircraft in war are subjects on which the author expresses well-considered opinions.

An intelligent reader would not, naturally, turn to a book of such a character for information on the more theoretical aspects of aeronautics. It is, however, to be regretted that the few references to the principles of mechanical flight are so fragmentary and one-sided that it would have been far better to leave them out altogether.

The constantly recurring references to stability cause that subject to assume an exaggerated degree of importance for which there is no historical justification, since inherent stability has played no part whatever in the practical evolution of the aeroplane except in its most recent improvements. Moreover, the definition of stability (p. 299) is incorrect, and on p. 139 Mr. Turner confuses the centre of pressure with the area of maximum pressure. On the other hand, the author fails to appreciate the fundamental importance of Langley's work in showing that for small angles of attack the air-pressure on an oblique lamina is far in excess of what it would be according to Newton's hypothesis. Had it not been for "Langley's law" modern feats of aviation would have been impossible. The next step was the improvement of light motors and propellers, on both of which subjects fuller statistical information would be of much more use than these scrappy attempts to discuss a highly technical question like stability. Moreover, we greatly doubt whether the systems figured as illustrating "inherent stability" have ever been proved to satisfy the requisite conditions. Many of them were certainly designed long before the experiments at the National Physical Laboratory rendered any such test possible.

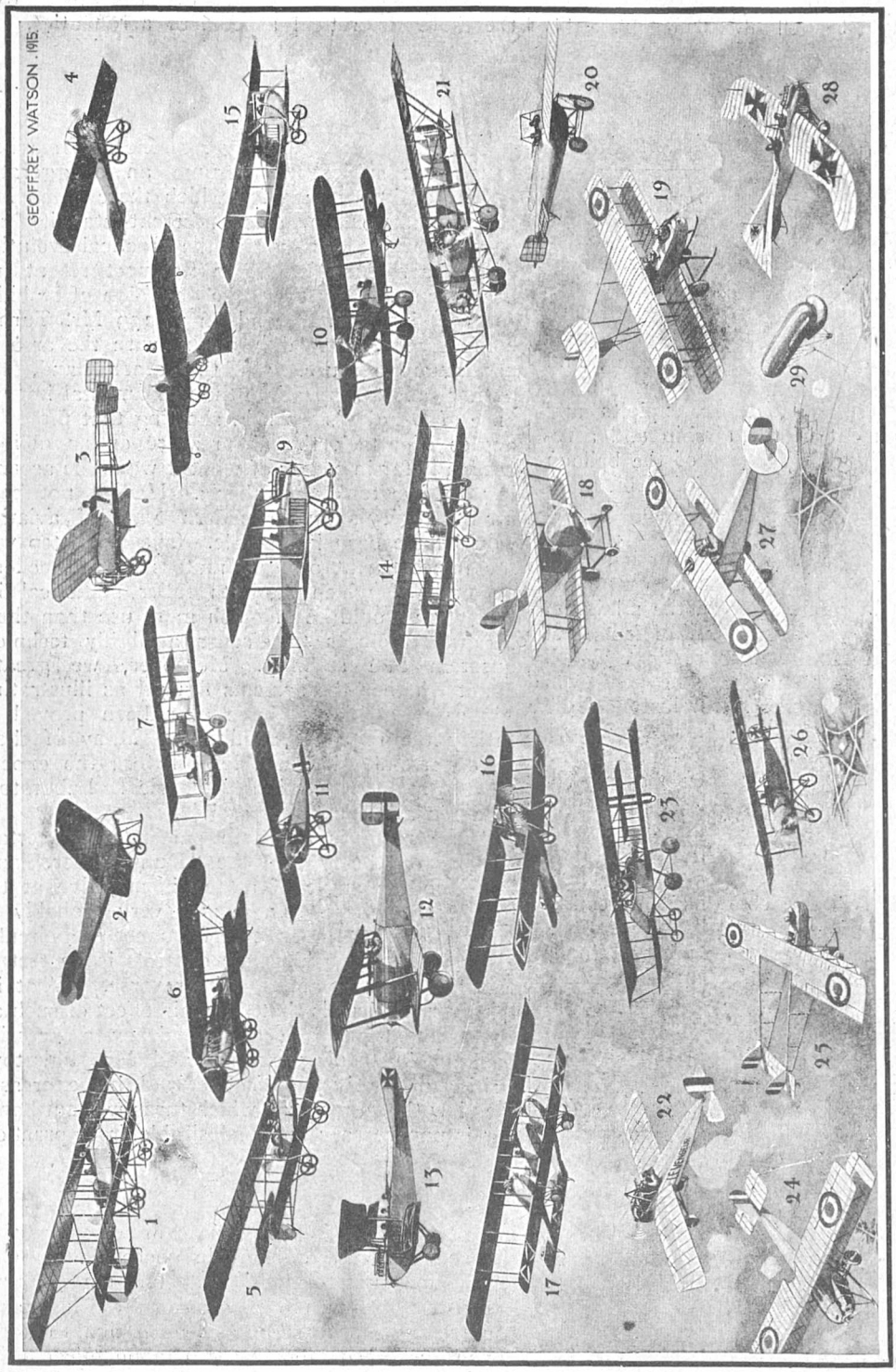
These remarks apply in particular to certain systems on the type of the "Dunne" aeroplane, in which the angle of attack is negative at the tips of the wings. These *may* very probably be inherently stable, but the performance of a circular flight without touching the controls is no test of this property; sometimes the reverse. What is, however, evident is that the main effect of such an arrangement is to reduce the tendency to excessive banking in turning curves, and Mr. Bairstow, writing in the *Aeronautical Journal,* has expressed the view that a machine which turns without banking is unnecessary and undesirable from practical considerations.

A very short concluding chapter deals with "Flying Developments in Sight." It is interesting that no opportunity has yet arisen for testing the uses of the aeroplane in peace times. One application suggested by Mr. Turner is certainly promising, namely, exploration of unknown countries, and, in addition to the list of places which he mentions, we may not improbably live to see frequent air excursions to an hotel at the North Pole!

(2) M. Paul Popovatz's paper on "Reaction Apparatus" deals only with considerations of the

[1] (1) "Aircraft of To-day: a Popular Account of the Conquest of the Air." By Lieut. C. C. Turner. Pp. 315. (London: Seeley, Service and Co., Ltd., 1917.) Price 5s. net.
(2) "Notions générales sur les Appareils à Réaction." Par Paul Popovatz. Pp. 36. (Paris: Gauthier-Villars, n.d.)

most elementary character relating to propulsion by recoil, and in particular to the action of screw or other propellers when kept fixed relative to the surrounding medium. It is thus based entirely on the principles of momentum and energy, and the formulæ given are all immediately intelligible to any beginner who has mastered the somewhat illogical notation, according to which, when a mathematician speaks of *ab*, he means *a multiplied* by *b*. Of course, the amount of information thus obtainable regarding the behaviour of such a complex mechanism as an air-screw is comparatively small. The author makes his formulæ depend, amongst other things, on the mean velocity of the issuing-jet, its mass per unit time, and the area or diameter of the final



1. A Maurice Farman biplane with 70 h.p. Renault engine. 2. The Nieuport two-seater monoplane, generally fitted with an 80 h.p. Gnome. 3. The 80 h.p. Blériot "tandem" two-seater. 4. A Deperdussin monoplane. 5. The Henri Farman biplane, 80 h.p. Gnome. 6. A D.F.W. biplane, usually driven by 100 h.p. Mercédès engines. 7. An Ago biplane. 8. A Rumpler-Etrich Taube, 120 h.p. Austrian-Daimler engine. 9. An early L.V.G. biplane, 100 h.p. Mercédès engine. 10. A B.E. 2b biplane, a product of the Royal Aircraft Factory, resembling the B.E. 2, and preceding the B.E. 2c. 11. A Morane "Parasol" monoplane. This machine is usually fitted with an 80 h.p. Le Rhone motor. 12. A Bristol "Scout" biplane, fitted with a 100 h.p. monosoupape Gnome. 13. A German three-seater "battle-aeroplane." 14. A Henri Farman version of the Voisin, a steel biplane. 15. A standard straight-winged Aviatik biplane. 16. A modern Albatross biplane. 17. A German two-fuselage, double-engined biplane. 18. The Martinsyde single-seater scout biplane. 19. Vickers gun-carrier, driven by 100 h.p. Gnome. 20. Blériot armoured monoplane. 21. A two-engined Caudron biplane. 22. Morane monoplane, with Hotchkiss gun firing through the propeller. 23. Voisin gun-carrier. 24. Eighty h.p. Avro biplane. 25. A Maurice Farman of the "short-horn" type. 26. A Fokker biplane scout. 27. A Nieuport biplane scout with gun firing upward through the top plane. 28. A Taube. 29. A kite-balloon. From "Aircraft of To-day."

section. These are all quantities of which the assumed values have to be found experimentally, and one assumption, according to Renard's results, is that the final diameter of the section is equal to the diameter of an air-screw. The method certainly leads to one class of conclusions, namely, those deducible by means of the principle of similitude. For the rest, the most useful feature appears to be that the paper can be read by a mechanic having no knowledge of mathematics and very little knowledge of dynamics.

RESEARCHES ON CEREBRO-SPINAL FEVER.

IN January, 1915, the Medical Research Committee was consulted by the Director-General, Army Medical Service, with regard to an outbreak of cerebro-spinal fever which had occurred among the troops at home. Steps were at once taken to provide for the application of preventive measures, and also for organised research work to improve our knowledge by which further administrative action should be guided. Dr. Mervyn Gordon was appointed by the committee as bacteriologist to advise and superintend the scientific work; with him several other observers collaborated. A special advisory committee analysed the various studies then completed, and their report was published in January, 1916. The present publication[1] contains the reports received from Lieut.-Col. Gordon and his co-workers, and two other reports upon closely related work.

Cerebro-spinal fever is a disease which varies greatly in its clinical aspect in different cases. A minute spherical bacterium, the meningococcus, attacks the membranes of the brain and spinal cord, causing inflammation, and the definite recognition of the disease is finally based upon the finding of this organism in the cerebro-spinal fluid. The meningococcus also occurs in the naso-pharynx of a certain proportion of contacts and well persons, constituting "carriers," by whom the disease may be spread, and an important branch of all preventive measures is the searching out and segregation of such carriers, the identification of whom is similarly based upon the finding of the meningococcus in the naso-pharynx.

In the first paper of the present report Lieut.-Col. Gordon outlines the bacteriological measures taken to deal with the military outbreak of 1915. In the second paper, by the same observer, the discrimination of the meningococcus by means of agglutination is described. If an emulsion of a microbe be mixed with blood-serum derived from an animal, *e.g.* a rabbit, which has received three or four injections of the microbe in question, the microbial cells in the emulsion generally aggregate into masses; this is known as "agglutination." The reaction is very specific, the serum of an untreated rabbit or of a rabbit injected with other species of microbes failing to agglutinate, so that an agglutinating serum is employed for discriminating species of micro-organisms. By means of this test the meningococci of the

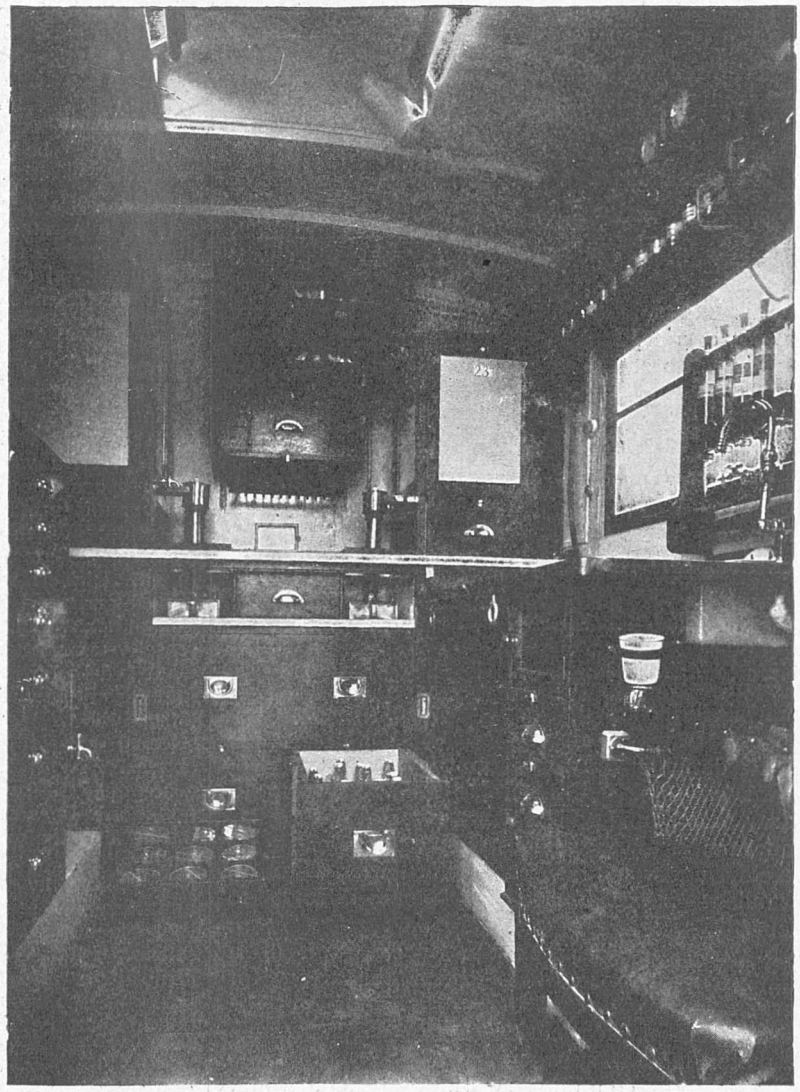


FIG. 1.—Interior of the Motor Laboratory.

[1] National Health Insurance. Medical Research Committee. Special Report Series, No. 3. Bacteriological Studies in the Pathology and Preventive Control of Cerebro-spinal Fever among the Forces during 1915 and 1916.

epidemic can be divided into four types (? varieties or species). The procedure was as follows: A series of meningococci from thirty-two cases of cerebro-spinal fever was collected, a rabbit was immunised with the first of them, and the agglutinating power of its serum tested upon all of them, with the result that nineteen of the strains showed good agglutination and the remaining thirteen slight agglutination or none at all. A second rabbit was then immunised with the first of these thirteen meningococci negative to the first serum, and agglutination tests made with all the thirty-two strains; eight of the cocci agglutinised well. A third rabbit was similarly prepared with one of the remaining five cocci, and four of the strains reacted, leaving one strain which had failed to react with the three serums. A fourth rabbit was prepared with this strain, and the serum tested on all the thirty-two strains; the homologous coccus alone was agglutinated, but none of the others. By the use of this test it has been found that only one type of meningococcus exists in a particular case of the disease or in a carrier, and the types have been found to remain quite stable and unaltered for a year.

FIG. 2.—The fine dots represent colonies of salivary bacteria; the heavy dots represent colonies of meningococcus.

Capt. Flack contributes an exhaustive analysis on cases of cerebro-spinal fever in the London district. Lieut.-Col. Gordon and Capt. Flack detail experiments on the attempt to disinfect carriers. Chloramine-T in the form of spray was found to be the most efficient agent, and carriers with a scanty infection clear up quickly under its influence, but cases with an abundant infection are far more difficult to "cure."

Major Hine describes the organisation of a supply department of the Central Laboratory for furnishing media and other requisites for the bacteriological examination of cases and contacts. A motor laboratory was used in this connection (Fig. 1); it contained working bench, water supply, incubators, etc., all the equipment necessary for investigating cases on the spot.

In a final paper Lieut.-Col. Gordon describes the inhibitory action of saliva upon the growth of the meningococcus. It was found that meningococci mixed with saliva fail to grow on appropriate media. If the saliva be diluted more and more, a stage is reached when the meningococci begin to grow, and as dilution proceeds the meningococci are finally unaffected (Fig. 2).

This action of saliva in inhibiting the growth of the meningococcus was found to depend upon the presence of the salivary micro-organisms, for if the saliva be centrifuged so as to get rid of these it no longer inhibits.

From this brief and incomplete summary it will be seen that the report contains matter of considerable interest to the bacteriologist and epidemiologist which should be of much value in the control of cerebro-spinal fever in the future.

R. T. HEWLETT.

NOTES.

THE annual meeting of the British Science Guild will be held at the Mansion House on Monday, April 30, at four p.m. The Lord Mayor will preside, and an address on "National Reconstruction" will be given by Lord Sydenham. Other speakers will be Sir William Mather, Mr. H. A. L. Fisher, President of the Board of Education, and Mr. H. G. Wells. Admission will be by ticket, to be obtained from the secretary, British Science Guild, 199 Piccadilly, London, W.1.

IT is a common conceit among representatives of literary studies that attention to the natural sciences in educational courses is detrimental to the development of the noblest attributes of civilised life, and tends to produce a non-moral condition of mind. With complete disregard of the historical meaning of the "humanities," they use this term to signify such subjects as languages, literature, and history, in contradistinction to a dehumanised study which they classify as "science." Writers in the public Press may perhaps be forgiven a want of understanding in this matter, but responsible leaders of thought should enlighten the popular mind instead of deluding it by misrepresentation. When, however, we read a communication from Prof. Ramsay Muir, professor of modern history in the University of Manchester, to a recent conference arranged by the Workers' Educational Association at Liverpool, we begin to wonder whether representatives of letters and history will ever understand what are the true aims and motives of science teaching. Prof. Muir is reported to have written: "I am mortally afraid of an over-emphasis upon natural science, especially in the teaching of children under sixteen. . . . What is likely to be the effect of concentrating all their attention upon the ruthless and non-moral laws of Nature? Something of the moral effects of this we have seen, I think, in Germany. The philosophy which has poisoned the national mind is a philosophy which tries to transfer the concepts and ideas of science to human life." It is untrue that teaching children the elements of the natural sciences leads to ruthlessness and is dangerous to civilisation, and the suggestion that German barbarity is the result of such teaching has its origin, not in fact, but in prejudice. The historians, moral philosophers, statesmen, and diplomatists responsible for the war were not educated in scientific schools, but in the Gymnasien, where even less attention is given to science than in many of our public schools. The fact is that in our own schools there is already more science teaching than in any corresponding schools in Germany, and that if it leads to national degeneration, we should exhibit this character rather than the Germans. The attempt to father upon science the diabolical conduct of the war by our enemies is unworthy of literary learning, and a perversion of historical truth. Only an unscientific mind could lend itself to the expression of conclusions so little supported by evidence.

THE food problem is one of those matters in which everyone may help the State by action, and by bringing influence to bear on others. A most important

fact is the shortage of wheat in this country. Putting it very shortly, at our present rate of consumption of wheat we cannot get through until next harvest. It is everyone's duty to try to realise, and get others to realise, what it means to have this country without bread and potatoes for a month or six weeks. The result would be starvation, and the remedy is to eat one pound less of bread per week per person than we at present consume. Compulsory rationing is a thing to be avoided if possible; voluntary rationing may, when weighed in the balances, be found wanting. There is an intermediate course, which may be called "persuasive rationing." The distributors of flour are comparatively few in number. These might well be instructed to reduce in every way possible the flour sold by the amount required in the above-mentioned scheme. The baker in turn should be advised and encouraged to persuade each individual customer to cut down his weekly bread allowance by the pound a week suggested. In order to make this easy, the supplies of oatmeal, barley meal, maize meal, rice, etc., should be made readily accessible to the baker through millers and flour factors; the baker should be advised to prepare from these a cooked substitute for bread. Even if this had to be a biscuit, like the old-fashioned ship's biscuit, it would be eatable, and an efficient bread substitute. The average person does not like a helping of stewed rice when he wants a slice of bread, but a plain biscuit should be quite acceptable. The "persuasive" baker could then, while docking the bread allowance, offer instead the equivalent in the form of biscuits (or similar articles), other than of wheat, as an alternative. It is believed that this course would render it materially easier for the average individual to lessen his bread consumption.

AT a meeting of the Aeronautical Institute on March 22, a paper by Col. B. R. Ward was presented, dealing with the means of securing the best supply of officers for the scientific services of the Army. The author urges that for the highest efficiency the Services must maintain contact with the civil professional organisations and a practical connection with the varied national work in engineering. The present war has demanded the utmost knowledge, experience, and energy from engineers in all branches of the profession. Engineers of all ranks have rendered invaluable services attached to the Army in the field, in workshops at the base, in constructing railways, in organising transport at home and abroad, and in advising Government departments. What the author most definitely suggests is that there should be a permanent corps of Mechanical Engineers, organised similarly to, and attached to, the Royal Engineers, capable of performing such functions and ready for any future emergency. The difficulty is that in peace-time there is not scope for the acquirement of the necessary varied experience within the range of military requirements. Col. Ward appears to think that the corps he proposes should in peace-time largely engage in civilian employment. There is something to be said for such a view. The earlier irrigation works in India were executed by Royal Engineer officers with great zeal and efficiency. But now public works there are carried out by a civilian department, it is believed with advantage to India. Engineering has become complex, and is best in the hands of men who devote their lives to it or to a special branch of it, and who are not hampered by military duties or regulations. Still, no doubt the war has shown defects of preparation, and something in the direction of Col. Ward's suggestions may be desirable.

BY the death of Mr. Walter Baily, London, and in particular the University of London, has lost one who has played an important part in connection with education. From a report in the *Times* of April 3 we learn that after a brilliant academic career at Cambridge (Second Wrangler, Smith's prizeman, and fellow of St. John's College) he was appointed inspector of schools in the West Riding of Yorkshire. From 1893 to 1915 he was a member of the council (which, on the incorporation of the college in the University, became the committee) of University College, London, and from 1902 to 1906 the chairman of its committee of management. His scientific work reflected his early mathematical training, though it was combined with a keen interest in experimentation. The record of it is to be found mainly in the early volumes of the Proceedings of the Physical Society, of which he was for many years secretary, and afterwards a vice-president. One of the most interesting of his experimental researches consisted in a new mode of producing Arago's rotation. This is, in principle, an anticipation of the two-phase motor: two electromagnets with their poles beneath the Arago disc, and in planes at right angles to one another, having their polarity inverted by a commutator so that the fields have a phase difference of 90°. His other papers describe an integrating anemometer of his own design, the vibrations of a film in reference to the phoneidoscope, an illustration of the crossing of rays, a map of the world on Flamsteed's projection, a theorem relating to curved diffraction gratings, the construction of a colour map (in which he advocated the use of rectangular instead of trilinear co-ordinates), and a mathematical explanation of the appearances presented by starch and unannealed glass under the polariscope.

WE regret to record the death at Washington, D.C., U.S.A., of Dr. Hamilton Wright at the age of forty-nine. While at Cambridge University and at the Pathological Laboratory of the L.C.C. Asylum, Claybury, Dr. Wright made investigations upon the nervous system, notably a number of experiments upon animals, with the view of demonstrating chromatolytic and dendritic changes in the neurones of the brain as a result of prolonged chloroform narcosis. He was next appointed by the Colonial Office to investigate beri-beri in the Straits Settlements, where he supervised the building and equipment of an excellent pathological laboratory at Kuala Lumpur. Here he conducted his researches on the causation of beri-beri. He came to the conclusion, both by experiments on animals and observations upon prisoners in the gaol, that the theory of rice being the source of the transmission of an organism to the human system was incorrect. In his report he states that "beri-beri is due to a specific organism which remains dormant in certain localities, but, having gained entrance to the body by the mouth, it multiplies locally (in the stomach or duodenum chiefly) and gives rise to a local lesion, and produces a toxin which, gaining the general circulation, acts on the peripheral terminations of both afferent and efferent neurones to cause bilateral symmetrical atrophy; and that finally the organism escapes in the fæces, to lie dormant again in places." Although the absence of the vitamine in polished rice is now the generally accepted theory of the causation of beri-beri, it does not exclude the possibility of a secondary microbial toxæmia acting as a coefficient. Dr. Hamilton Wright married the daughter of Senator Washburn, and took up work for the United States Government. He was appointed a member of the International Opium Commission, and prepared a Bill for the suppression of the opium trade, known as the Harrison Bill, which was passed by Congress.

DURING the Easter vacation the Port Erin Biological Station has been occupied by about twenty senior

women students and post-graduate researchers—most of them present or future science schoolmistresses taking a course of practical marine biology, under the direction of Prof. Herdman, Mr. Douglas Laurie, and Miss R. C. Bamber, and supported by a grant from the Liverpool Council of Education. The wintry conditions have been unfavourable for much work in the open, but plankton observations in the bay have been made almost daily, and the vernal maximum of the Phyto-plankton (mainly Coscinodiscus and Chætoceras spp. at present), which is probably affected more by the increasing sunlight than by temperature, is now (April 12) well marked. The fish-hatching is going on as usual, and several millions of young plaice have already been set free to the west of the Isle of Man. A point of considerable interest is that the second generation of young plaice reared in captivity is now passing through the hatching-boxes. There are about eighteen adult plaice reared from eggs produced and hatched in the tanks in the season of 1914, and therefore just three years old, which are now spawning. One of these fish, which has been isolated in an aquarium tank and is now producing spawn, measures 27 cm in length (about 10½ in.). The average size of spawning female plaice in the Irish Sea is about 15 in., and the smallest previous record is about 13 in. The eggs produced from these three-year-old plaice are slightly smaller than those from older fish, but otherwise seem normal, and are developing into embryos and larvæ. A large shoal of grey mullet visited Port Erin Bay on April 11 and 12—a very unusual occurrence at this time of year—and swarmed close in to the rocks and beach at high tide. More than 400 large fish, some of them weighing up to 7 lb., were caught in a seine net and sent to the Liverpool market.

A COPY of an address by Prof. Murray Butler, delivered at the annual dinner of the Pittsburgh (Pa.) Chamber of Commerce on February 10 last, has been received. Prof. Butler asks, and attempts to answer, the question: "Is America Drifting?" The general tone of the address would probably have been modified had it been delivered after the entry of the United States into the war, but its appeal to thinking Americans to do all in their power to assist the adjustment of American national institutions to modern-day needs and demands could scarcely have been more insistent. "I do not recall," says Prof. Butler towards the end of his address, "that any great administrator has ever been chosen to be President of the United States, and few governors or mayors seem to take any interest in the improvement of ordinary administration, such as every manager of an industrial or business undertaking concerns himself with every day and every hour." Americans, he states, are so concerned with their own personal affairs and immediate interests that they are letting America drift, and until every American feels his personal responsibility for the formulation of definite public policy at home and abroad, and for the businesslike administration of public affairs, the drifting will continue. There is, he insists, a call to Americans for national service and a preparation for it which, so far from sharing the spirit of militarism, are only the voice of democracy conscious of its obligations and its duties, as well as of its rights and opportunities.

THE Societa Italiana delle Scienze has awarded the gold medal of the physical section to Prof. W. H. Bragg and Mr. W. L. Bragg in recognition of their distinguished work in physics.

MR. T. SHEPPARD, curator of the Hull Municipal Museums, has been elected honorary life member of the Selby Scientific Society, in recognition of his services since the society was founded.

RECENT enterprises in connection with the preparation of food and the development of its concessions in West Africa and elsewhere have led to the establishment of a research department by the Co-operative Wholesale Society, and Dr. Geoffrey Martin has just been appointed to direct its work. This appointment marks a new departure in connection with the co-operative movement, and has been rendered necessary by the concessions acquired by the Co-operative Wholesale Society in West Africa, Nigeria, and elsewhere, as well as by the development of fresh undertakings at home.

THE National Canners' Association has offered Harvard University, says *Science*, the sum of 4000*l.* annually for a period of three years to carry on an investigation of ptomaine poisoning, with special reference to canned goods. The offer has been accepted by the University, with the understanding that the investigation shall be conducted and the results published with entire academic freedom. The study will be made at the medical school, under the direction of Dr. M. J. Rosenau, professor of preventive medicine and hygiene. The National Research Council of the National Academy of Sciences is supervising the investigations on this subject.

THE *British Medical Journal* announces the death, on February 27, of Prof. J. J. Dejerine, of the University, Paris, one of the leaders of contemporary neurology. He was born at Geneva in 1849, and studied medicine in Paris, where he took his doctor's degree in 1879. In 1901 he was appointed professor of the history of medicine, and afterwards transferred to the chair of internal pathology. Finally, in 1911, he became professor of nervous diseases and head of the clinic at the Salpêtrière. He was a member of the Académie de Médecine, and an honorary fellow of the Royal Society of Medicine, which awarded him the Moxon medal. From the first he devoted himself to the study of neuro-pathology, and his published papers cover the whole field of nervous disease. His chief work is the "Anatomie des Centres Nerveux," written in collaboration with his wife, herself a doctor of medicine.

AT the fourth annual general meeting of the Institution of Petroleum Technologists, the elections were announced of Mr. C. Greenway as president, Prof. J. Cadman as a vice-president, and Sir Frederick Black and Major A. Cooper-Key as honorary members. The vice-presidents and council for the ensuing year are:—*Vice-Presidents:* The Rt. Hon. Viscount Cowdray of Cowdray, Sir Thomas H. Holland, and Sir Boverton Redwood, Bart.; *Council:* A. C. Adams, H. Allen, Sir Robert Balfour, Bart., Capt. R. W. Barnett, H. Barringer, Sir George Beilby, E. R. Blundstone, A. Campbell, J. T. Cargill, E. H. Cunningham Craig, A. W. Eastlake, T. C. Palmer, Dr. F. Mollwo Perkin, and R. Redwood.

IN Southern Nigeria the wholesale destruction of interesting cult-objects by the fanatical adherents of the prophet who called himself "Elijah II." has robbed ethnologists of a vast amount of valuable material which can never be replaced. It is fortunate that Mr. P. Amaury Talbot, while engaged in official work in these districts, has been able to form a splendid collection of ethnological specimens, and both the British Museum and the Oxford Museum have acquired by his generosity a number of valuable accessions. Among them Mr. Henry Balfour, in the April issue of *Man*, describes a remarkable carved and painted ceremonial paddle used by the Kalabari tribe.

This formed part of the paraphernalia of the amaningiu, or serpent, Juju, the serpent and the hippopotamus spirit being represented on Janus-like carvings on the back and front. A similar rendering appears on a Kalabari wooden mask from Abonnema, which is also described in this article by Mr. Henry Balfour.

IN the Journal of the Royal Anthropological Institute (vol. xlvii., July–December, 1916) Dr. Bronislaw Malinowski contributes a paper on "Baloma: The Spirits of the Dead in the Trobriand Islands," which lie off the eastern coast of British New Guinea. Incidentally, he discusses the question, brought into prominence by Spencer and Gillen in the case of the Australian Arunta, that the belief in reincarnation, a spirit child believed to enter the womb of the mother, excludes any knowledge of the physiological law of the process of impregnation. That this ignorance exists is certain. The writer deals with this difficult subject in a scientific and tactful way, and he arrives at the general conclusion that its prevalence among the Melanesians of New Guinea is a condition extending into much higher stages of development than it would have seemed possible to assume only on the basis of the Australian material.

THE *rôle* of the flagellated protozoa in infective processes of the intestines and liver (of animals) is the subject of Bulletin 166, Agricultural Experiment Station of the Rhode Island State College, U.S.A., by Dr. P. B. Hadley. Evidence is presented that a Trichomonas is the causative organism of an almost invariably fatal cecal and hepatic infection in birds. The pathological findings are described and the course of infection and development of the parasite is studied. The paper is illustrated by three excellent plates. In a further Bulletin (No. 168) the avenue and the development of tissue infection in intestinal trichomoniasis are discussed. The stages are, first, multiplication of the parasite in the cecal contents, then the flagellates penetrate the goblet cells of the intestinal mucous membrane, break through the basement membrane of the mucosa, and enter the sub-mucous connective tissue. Simultaneously, a marked invasion of the base of the crypts occurs, and the crypt space becomes consolidated. As a result of this, the deep-lying cecal epithelium becomes to a large extent destroyed. Eleven plates illustrate this part of the investigation.

THE *Quarterly Journal of Experimental Physiology* for March (vol. x., Nos. 3 and 4) contains a series of papers by Prof. Noel Paton and Messrs. Findlay, Watson, Burns, Sharpe, and Wishart on the functions of the parathyroid glands and their relation to the disease known as tetany. It is shown that removal of the parathyroids induces a condition resembling tetany. This effect is brought about by the influence of the parathyroids on guanidin and methylguanidin metabolism; these substances are increased in amount by removal of the parathyroids, and their artificial administration induces a condition resembling tetany. Tetany may therefore be regarded as being caused by an increase in the amount of guanidin and methylguanidin in the body, due to disease or disordered function of the parathyroids.

IN *California Fish and Game* for January a long and valuable history is given of the introduction of food and game fishes into the waters of California. The author, Mr. W. H. Shebley, who is in charge of the fish-culture department of the California Fish and Game Commission, carries his survey from the initiation of this work in 1871 to the present day. While he has many failures to record, as must always be the case in acclimatisation work, he has a long list of very striking successes. Among these are to be reckoned the introduction of the common shad. Between 1871 and 1880 as many as 619,000 shad fry were imported from the Castleton hatchery in New York and turned down in the Sacramento River. As a result, this fish is now one of the commonest in Californian waters. The introduction of carp, "which will probably become one of the State's most valuable food fishes," has been equally successful, though it has brought about the destruction of the Californian perch. As a set-off against this, however, it is pointed out, it forms the chief food of the black and striped bass. The introduction of the black bass into California is regarded as "one of the greatest feats of acclimatisation of new species of fish in the history of fish-culture." Loch Leven trout have also thriven. The introduction of the carp, we note, has given cause for repentance in one case, at any rate. Their rapid increase in the Chautauqua Lake so fouled the water as to make it almost unfit for use. In consequence, pike and muskelunge were introduced to exterminate the carp, but the latter still remain in possession, the fish introduced to effect the work of extermination having themselves been exterminated. An excellent coloured plate of the eastern brook-trout forms the frontispiece of this number.

As a result of the shortage of cotton owing to the war, we learn from "Am Haüslichen Herd" (Zürich, Pestalozzigesellschaft, xx., 6) that an old industry is being revived in the cultivation of stinging nettles for textile purposes, both in Switzerland and Germany. In order to obtain fibres of the best quality, the nettles should be grown on rich soil and thinned out when necessary. In the spring, when they are about a foot high, they are to be cut down and the young tops may be eaten like spinach. The second growth produces much better fibres than the first, and the stems are cut down in June or July, when they have reached a height of about 4 ft. Another crop is obtainable in September. In October the shoots can be used as fodder, and for this purpose they may be dried, when they will lose their stinging properties. They may also be chopped up for feeding poultry. It is much to be hoped that in our country a similar use will be made of the stinging nettles, which at present constitute such a pest in gardens and plantations.

ON the basis of Bohr's theory, taking account of the magnetic and electrical fields of the atom, a general formula for spectral series has been deduced by Mr. J. Ishiwara (Proc. Tokyo Math. Phys. Soc., series 2, vol. ix., No. 2). The formula may be written:—

$$\nu = A - \frac{\alpha}{(m+\mu)^2[1+a(A-\nu)+b(A-\nu)^{\frac{3}{2}}]} - \frac{\sigma\alpha}{(m+\mu)^4}$$

where ν gives the wave numbers of lines corresponding to successive integral values of m, A is the limit of the series, and α is the Rydberg constant, slightly varied according to the atomic weight of the element; μ, a, and b are constants special to each series. The last term is a relativity correction, and σ has the numerical value 0·00015908. As a test of the formula, the author has employed it in a re-calculation of the numerous series of enhanced lines of magnesium discovered by Fowler, for which the Rydberg constant has four times the value appropriate to the arc lines. The formula appears to be well adapted to the series in question, and there are some curious relations between the values of μ for six of the series.

ON behalf of the Bureau of Standards, Dr. G. K. Burgess, the head of the metallurgical department of

the bureau, has recently made a series of observations at steel works in the United States with the object of determining the best methods to use in the measurement of the temperatures in Bessemer and open-hearth practice. He finds that the present methods involve differences of temperature between consecutive Bessemer teems and between successive melts in the open-hearth furnace which may exceed 50° C., and strongly advises the use of some form of optical pyrometer using monochromatic light, in order to introduce greater certainty in the conditions which determine the properties of the steel produced. In the complete paper, which is to be issued by the bureau, details of the methods adopted are to be given. At present information is available in abstract only in the Transactions of the American Institute of Mining Engineers, before whom Dr. Burgess gave an account of his work at the New York meeting in February.

PROF. MCADIE, the director of Blue Hill Observatory, proposes a new temperature scale in which the freezing point of water is to be taken as 1000, and the absolute zero −273° C., as 0. He points out the objections to the present scales; and the suggested scale, if we could make a new start, would certainly have some advantages. For meteorological purposes the Centigrade degree is too large, since it is possible to express mean values of temperature with accuracy to within a few tenths of a degree, and a difference of 1° C. in the mean summer temperature of a place, for example, makes quite an appreciable difference in the climate; but a quarter of this, about 1 on the suggested scale, would not be appreciable, so that it would suffice on it to express values to the nearest whole degree. The advantage of starting from the absolute zero is very great, especially to those who have to deal with radiation and to artillerists or airmen, who are concerned with the density of the upper strata, but the suggested scale would involve the printing of four figures, which is one too many.

FROM an article contributed by M. Renouard to *La Nature* of March 31 it appears that in France the metric system has not yet ousted all the old customary denominations of measure in many trades, especially those connected with the textile industry. For example, in the hosiery trade, sizes of stockings for children are indicated in terms of the old Paris inch, while the numbers denoting the lengths of ready-made articles for grown-up people relate to the same ancient measure: thus, size "36" signifies a length of 36 in. Again, in the north of France the widths of cloths and linens are denoted by such fractions as 2/3, 4/4, 7/8, the widths being the corresponding fractions of the "aune" of 120 centimetres. It is true that traders are not always aware of the origin of the symbols they employ, and there is an amusing instance of this in the case of certain silk stuffs invoiced "15/16," which some shopkeepers from ignorance have represented to their customers as "fifteenth- and sixteenth-century taffetas." Gold and silver fringes and ribbons are sold according to numbers which correspond to their widths in terms of the old Paris "line." Numerous examples of the persistence of ancient or foreign systems of measure occur also in the lace trade and in the numeration of silk and cotton yarns. Although so many anomalies still exist as regards measures, the old customary weights, on the other hand, appear to have been completely superseded in France by metric denominations.

THE appearance of the decennial index of the *Biochemical Journal* induces us to make a mental review of the biological chemistry of recent years. Although first issued in 1907, it was not until five years later that this journal was taken over by the newly formed Biochemical Society, for which it has since been edited by Profs. W. M. Bayliss and A. Harden. According to the original idea, opportunities for chemists and biologists to forgather were to be provided by establishing a biochemical club. But the club, shortly after its foundation, was transformed, to the regret, perhaps, of many of its members, into the present Biochemical Society. This society was instituted for the purpose of facilitating intercourse between those biologists and chemists who are interested in the investigation of problems common to both. The title "Chemistry of the Living Organism," used in its widest sense, might perhaps be suggested to include all such problems. It will be acknowledged that the society has attained its object to a marked degree, and the index of the *Biochemical Journal* is a witness to the valuable work which has been accomplished by the society through its members. The names of nearly all the well-known workers in biological chemistry are to be found in this index, and the subjects of their labours range from the distribution of maltase in plants to the treatment of trypanosomiasis. Those who ever have occasion to refer to the literature of biological chemistry will certainly find this index a valuable adjunct to their libraries.

OUR ASTRONOMICAL COLUMN.

THE PLANET MERCURY.—This object will be favourably visible to the naked eye on clear evenings during the remainder of the present month. Its light varies considerably owing to change of phase, but with good conditions the planet shines more strongly than a star of the first magnitude. About an hour after sunset it should be readily discerned above the W.N.W. horizon when the sky is clear. It will set as under:—

	h. m.		h. m.
April 19 ...	9 1 p.m.	April 25 ...	9 19 p.m
20 ...	9 6	26 ...	9 19
21 ...	9 10	27 ...	9 20
22 ...	9 13	28 ...	9 20
23 ...	9 16	29 ...	9 19
24 ...	9 18	30 ...	9 18

The planet will arrive at its greatest elongation on April 24, when it will set about 2h. 10m. after the sun. The above are Greenwich mean times; for summer time one hour must be added.

COMET 1917*a* (MELLISH).—Prof. Strömgren has circulated the following revised elements and ephemeris, calculated by J. Braae and J. Fischer-Petersen from observations on March 21 (Lick), March 25 (Königstuhl), and March 30 (Copenhagen):—

T = 1917, April 10·6285 G.M.T.
ω = 120° 36·73′
☊ = 87° 23·77′ } 1917·0
i = 32° 23·57′
log *q* = 9·28448

Ephemeris: Greenwich Midnight.

1917	R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ	Mag.
April 19	0 41 7	−1 26·9	9·5732	0·0132	5·2
21	44 32	3 7·8	9·6331	0·0340	5·6
23	48 31	4 28·9	9·6852	0·0529	6·0
25	52 47	5 35·5	9·7309	0·0701	6·3
27	0 57 9	6 31·3	9·7713	0·0858	6·6
29	1 1 31	7 19·1	9·8076	0·1002	6·8

LABORATORY WORK IN ASTROPHYSICS.—An instructive account of the relation of laboratory investigations to astrophysical research has been given by Dr. A. S. King (Pub. Ast. Soc. Pacific, February). Apparatus

for physical investigations formed a large part of the equipment of observatories in which the earlier work in astrophysics was carried on, such as those of Lockyer and Huggins, and Dr. King points out that there is a constantly increasing demand for this close co-operation between the laboratory and the observatory. Though much work of great value has been done in university laboratories, greater continuity in the prosecution of extensive pieces of research is possible in a laboratory which is specially equipped, and provided with a staff having full time to devote to these problems. Typical examples of the experimental work carried on at Mount Wilson are described and illustrated; the photographs showing the effect of the magnetic field on the sun-spot spectrum are particularly striking.

PARALLAX OF A PLANETARY NEBULA.—In view of the doubtful value of most of the parallaxes previously deduced for nebulæ, a result recently obtained by Mr. A. van Maanen with the 60-in. reflector at Mount Wilson is of considerable interest and importance (Proc. Nat. Acad. Sci. Washington, vol. iii., p. 133). The nebula in question is N.G.C. 7662, having a sharp stellar nucleus which gave measurable images with exposures of twenty-five minutes. The absolute parallax is given as 0·023″, which would place the nebula at a distance of about 140 light-years. As the angular diameter of this nebula is 26″, its linear diameter would thus be of the order of nineteen times that of the orbit of Neptune.

THE RECENT COLD WEATHER.

AFTER a more than usually severe winter, the spring has opened with exceptional cold over the whole of Great Britain, and the wintry conditions have also embraced a large part of western Europe.

Dr. Mill, the director of the Rainfall Organisation, in a letter to the *Times* of April 11, mentions that "the first ten days of April have been colder this year than in any other," according to the Camden Square record of temperature, which has been kept for sixty years. Frost is said to have occurred on every night but two. In the Camden Town records for 1888 frost occurred every night but one, although the mean temperature for the period was slightly higher than in the present month. The Greenwich records for the past seventy-five years show that prior to the present year the greatest cold for the first ten days of April occurred in 1888, when the highest night temperature for the period was 32·1° on April 1. At South Kensington, the recording station of the Meteorological Office, frost occurred in the open on thirteen nights during the first fortnight of April this year.

The cold has been even more severe over the northern portions of the kingdom; and in the official reports from the health resorts, Southport is shown to have had a minimum shade temperature of 13° on April 3.

In the winter six months, from October to March inclusive, there was frost on seventy-three nights at Greenwich. During the last seventy-five years frost has only occurred more frequently in the six winter months six times, whilst the winter which has just closed has had a greater number of frosts than any winter since that of 1890–91, when there were seventy-six frosts. The highest number is eighty frosts, in the winter of 1887–88.

The frequency of snow in London is dealt with in the *Times* of April 11, and records by a meteorologist at Wandsworth Common for the last quarter of a century are referred to. Snow is said to have fallen on as many as thirty days this year prior to April 11, and since that date snow has fallen on four more days to April 17, so that snow has fallen on thirty-four days since the commencement of January. This is three times the average for the first four months of the year, and is eleven more than in any corresponding period since 1892. The average number of days with snow in an entire year at Wandsworth Common for the past twenty-five years is thirteen. Mr. Mossman, in a communication made to the Royal Meteorological Society some years ago, showed that the average number of days with snow was fifteen in the course of the year, deduced from the observation of 100 years, and twelve of these snowy days occurred in the first four months of the year.

Snow has fallen in larger quantities during the last few months over the northern portion of the kingdom than in the south, although the occurrence of the snow may not have been more frequent.

In 1908 railway traffic was much hampered in the south of England by a heavy fall of snow on April 25, and ordinary traffic by road was completely stopped for a time.

Rainfall for the past winter was less than in many recent winters, and the total for the six months in London was 14·4 in., which is about 110 per cent. of the average. January and February were dry, little more than one-half of the average rain falling in the latter month. Sunshine has been deficient for months past over England, and in London there has been an unusual number of overcast and sunless days.

CHAS. HARDING.

MEMORIAL TO SIR WILLIAM AND LADY HUGGINS.

ADDRESS BY SIR J. J. THOMSON, O.M., P.R.S.

WE gave on April 5 (p. 109) an account of the unveiling of a memorial to Sir William and Lady Huggins in St. Paul's Cathedral. The address delivered by Sir Joseph Thomson on that occasion has since reached us, and we are glad to be able to print it below.

I have been asked, as president of the Royal Society, to commit this memorial of Sir William and Lady Huggins to the care of the Dean and Chapter of St. Paul's, and also to say a few words as to the inception of the memorial. Shortly after the death of Sir William Huggins some of his friends were anxious to set on foot a proposal to obtain a memorial of him; this came to the knowledge of Lady Huggins, and she expressed the wish that she might be allowed to defray all the expenses, so that no one except herself should be put to any expense in the matter. Before any arrangements had been arrived at Lady Huggins died, and it was found that in her will she had left a sum of money to provide for a memorial to Sir William. It seemed to those responsible for carrying out her wishes that in view of the long and active part she had taken in her husband's work, and that some of the most important papers were published in their joint names, no memorial to Sir William would be satisfactory unless it testified in some way to the part Lady Huggins had played in his work; to effect this a small medallion of Lady Huggins had been added as a pendant to the one of Sir William.

There can be no question as to the claim of Sir William Huggins, the founder of astrophysics, as he has been called, to such a memorial, nor any doubt as to where it could most appropriately be placed. For no man of equal scientific eminence was ever more closely connected with this city. He was born in London, he was educated entirely in London, he was in business in London, and when he retired from business to devote himself to astronomy he built his observatory in London; and in spite of the fact

that the atmosphere of London is far from being an astronomer's ideal, all the observations which led to the discoveries on which his fame rests were made in London. This great Cathedral seems the appropriate resting-place of a memorial to one whose life and work were so linked up with this city.

Sir William Huggins was a prominent example of a type of man to whom English science owes much, the non-official worker. Like his contemporaries, Darwin and Joule, he never held any professorship or scientific appointment. When in 1858 he retired from business at an unusually early age, he seems to have been undecided as to whether he should devote himself to the microscope or the telescope. The telescope gained the day, and he built an observatory at Tulse Hill; he began by making drawings of the planets, but seemed to be losing interest and to be rather despondent, when Kirchhoff's determination of the chemical elements in the sun by the aid of spectrum analysis came to his knowledge. This was to him, he said, like water in a thirsty land, and he determined to attempt to find out the constitution of the stars by the same method. At the beginning of 1862 he persuaded Prof. Miller to join with him in the work, and in spite of the formidable difficulties due to the feebleness of the light, the mechanical difficulties of keeping the image of the star on the slit of the spectroscope, and the caprice of the London atmosphere, they were able to present to the Royal Society in 1863 a preliminary statement as to the spectra of some of the brighter stars, while in 1864 they published in the Philosophical Transactions of the Royal Society a general account of the spectra of about fifty stars, with a detailed study of some of the more important ones. They showed that the stars are made up of elements which, with few exceptions, are found in the earth. In 1864 Huggins made a discovery of capital importance in connection with the evolution of the stars, for he discovered a nebula the spectrum of which showed that it consisted of glowing gas, and was therefore in quite a different state of development from the stars he had examined, the spectra of which showed that their physical condition was analogous to that of the sun. Huggins threw himself with characteristic energy into the study of the spectra of the nebulæ, and found that the nebulæ were not all of one kind; some were stellar aggregates, while others were continuous masses of incandescent gases.

The importance of these results and the interest they excited were recognised by scientific societies with a promptitude almost without parallel. Three years after beginning serious scientific work he was elected a fellow of the Royal Society, the next year he was awarded a Royal medal, and after ten years he seems to have been elected to almost every scientific society in Europe. The work which commenced with such brilliance was carried on with undiminished ardour for nearly fifty years; since 1875 with the active co-operation of his wife. It showed throughout the characteristics so noticeable in the earlier work: the power to select the right problem to attack, the ability to devise the best way to attack it, and the industry to take boundless pains in overcoming the difficulties which sprang up at every turn.

On behalf of the Royal Society, I record with gratitude the help he gave to the work of that society, and especially to the distinction and dignity with which he for five years discharged the office of president. For the medallion we are indebted especially to Mr. Pegram, the artist whose skill has produced it, and to Miss Montefiore, who has borne the burden of the heavy work necessary to bring such a scheme to completion.

THE DEVELOPMENT OF VEGETATION.[1]

CONSIDERABLE scepticism is not infrequently expressed by botanists who are not ecologists as to the possibility of formulating a satisfactory natural classification of vegetation, *i.e.* of plant communities; and this scepticism is natural enough when we consider the numerous attempts, largely inconsistent and contradictory, that have been made in this direction, especially in recent years. It is obvious that the ultimate test of validity will be general acceptance, and certainly we cannot claim that there is anything like agreement among ecologists as to a natural scheme or as to the principles upon which such a scheme should be based. At the same time, it must be remembered that it took a very long time and constant efforts from many quarters to arrive at a natural system of classification of species which commanded anything like general acceptance. The task of the classifier of plant communities is much more difficult for many reasons, the chief of which is that the outlines of the classificatory units—the plant communities—are frequently vague and shifting, owing to the multiplicity of causes and combinations of causes which determine their nature and limits. Some would doubtless go so far as to say that the units themselves are illusory, but it is significant that this is not the view of those who have seriously studied vegetation in the field.

The natural system of species has been ultimately established on a phylogenetic—*i.e.* a developmental—basis, and any other was impossible once the principle of evolution had been accepted. Prof. Clements's fundamental contention in the volume under review is that the natural system of plant communities must also be established on a developmental basis, and he includes in his purview not only present vegetation, but all the past vegetations that have come into existence since plant-life first appeared on the earth. As the basis of this contention Prof. Clements claims that the *plant formation*—his basic unit—is an organism.

Whether that claim can be admitted or not depends, of course, upon our conception of an organism. Starting with individual animals and plants, which are the typical, or, as some might say, the only, organisms, it is clear that we can, if we so choose, extend the conception to human societies, for instance, which certainly have very many of the same characteristics, though they have not the close-knit spatial unity of structure and function of the individual plant or animal. If we extend the conception further to include plant formations in Clements's sense, we drop from our concept one of the characteristics of the higher animal organisms and of human communities—the conscious co-operation of parts in pursuit of the ends of the whole. But neither is this a character found in the lower animals or in plants. Unless, therefore, we definitely restrict our conception of organism to individual animals and plants, we must concede Clements's contention that plant formations are organisms, and if we do so restrict it we have perforce to admit that the plant formation has many of the characters of organisms, a fact which we may perhaps express by calling the vegetation unit a *quasi-organism*.

Prof. Clements's plant formation is the plant community in equilibrium with its climatic habitat, *i.e.* determined and kept constant by the control of a distinct climate. The type of such a formation is the forest of definite floristic composition which maintains itself indefinitely so long as the climate maintains its general character. Prof. Clements points out that such a community has a definite organisation, *i.e.* a fixed spatial and functional relation between the plants

[1] "Plant Succession: an Analysis of the Development of Vegetation." By Prof. F. E. Clements. Pp. xiii+512+61 photographic plates and 51 figures in the text. (Carnegie Institution of Washington, 1916.)

composing it and with the substratum: it regenerates destroyed parts, and can reproduce itself in new situations; and, finally, it has a definite development or ontogeny.

It is this last feature with which the present volume is concerned. On bare ground or in water, within the climatic limits which determine the particular forest formation, there develops a succession of plant communities which ultimately gives rise to the forest. The causes of succession are the reactions of the successive plant populations on the habitat, which render it favourable to particular new invaders and less favourable to the existing occupants. The final stage, or climax, is reached when equilibrium is established and invasion no longer possible. The earlier course of development differs according to the nature of the substratum on which succession occurs, but the later phases correspond whatever the origin of the succession. This has been amply established in the case of several of the great forest climax formations of North America. As a particular instance W. S. Cooper has worked out in strikingly complete detail the successions culminating in the climax forest of *Abies balsamea, Betula alba,* var. *papyrifera,* and *Picea canadensis* on Isle Royale, Lake Superior. The primary successions in this case start from the bare rock shore or beach (xerarch successions), or from bogs and delta swamps (hydrarch successions), and through distinct series of definite and constant plant communities converge to the climax forest. Secondary successions are initiated by forest burns. If the humus is burned the resulting secondary succession is like the beach succession. When the humus is not burned the regeneration of the climax forest is much shorter.

In regions the climate of which does not permit of the establishment of forest the climax formations are of other vegetation types, such as desert or grassland; and here the successions from bare soil or water to the climax are shorter because woody plants are not involved.

Prof. Clements recognises the existence within the formation of *associations* which are "climax communities associated regionally to constitute the formation," and "are recognised chiefly by floristic differences." He thus maintains the practice almost universally agreed upon among ecologists of making the association a subordinate unit to the formation. Successively subordinate units of the association are designated as consociation (dominance of a single species), society, and clan. Parallel units are distinguished in the development series—*i.e.* those leading up to the formation in succession.

The author's foible is undoubtedly the multiplication of terms, a great number of which are proposed in this memoir. This is the concomitant of the compelling necessity he feels to establish complete systems of concepts logically worked out in every detail. Without entering upon a criticism of the validity of the conceptual systems themselves, which would occupy far more space than is at our disposal, it may be pointed out that the normal human mind invariably refuses to accept new concepts and terms until the progress of our knowledge of the relations of phenomena compels their adoption. It can scarcely be said that all Prof. Clements's terms are essential to clearness of thought and description. Some of them will no doubt come into general use, as some of the terms proposed in the author's "Research Methods in Ecology" (1905) have done.

The present work shows a great advance in maturity as the result of a wider experience, and is notable as the first systematic account of a fundamental phenomenon in vegetation. Its outstanding merit is logical thoroughness and completeness. It is impossible even to indicate the ground covered within the space of a short article.

The numerous photographs deserve quite special praise. They are not only of uniformly high standard and excellently reproduced, but they are admirably chosen to illustrate the text. A. G. T.

THE ZOOLOGY OF THE "TERRA NOVA" EXPEDITION.

FOUR further reports on the zoological material collected during the British Antarctic (*Terra Nova*) Expedition, 1910, have recently been issued by the British Museum (Natural History). Miss Massy (*Zool.*, vol. ii., No. 7, pp. 141–176, 43 figs.) describes sixty-eight specimens of Cephalopoda, which belong to seventeen species and twelve genera. Forty of the specimens belong to the Octopoda, the abundance of the genus Moschites being noteworthy.

The Decapod Crustacea, described by Mr. Borradaile (vol. iii., No. 2, pp. 75–110, 16 figs.), comprise forty-six species, but only three of these—all taken in the Ross Sea—are antarctic. In his account of *Crangon antarcticus,* Mr. Borradaile points out that the affinities of this antarctic shrimp lend some support to the hypothesis of bipolarity. One of the most interesting of the Decapods, a species of Porcellanopagurus taken off the northern end of New Zealand, forms the subject of a separate report (No. 3, pp. 111–126, 13 figs.). Mr. Borradaile points out that Porcellanopagurus is one of the many attempts of Nature to evolve a crab. This crab seems to have been evolved from an ordinary hermit-crab, and the method followed was not only, as in other such cases, a broadening and depressing of the cephalothorax together with a reduction of the abdomen, but also a drawing out horizontally of the edges of the hard plate which roofs the fore part of the body of a hermit-crab. Mr. Borradaile traces the relations between the various external features of Porcellanopagurus and those of a hermit-crab. He surveys other routes by which evolution in the direction of "carcinisation" has proceeded throughout the Anomura, and reaches the conclusion that there is in the constitution of the Anomura a disposition or tendency to achieve that special formation of body which constitutes a crab. Whether the tendency be primarily one of morphology or of habits is another question, but, seeing that a similar form of body has been reached independently in circumstances which must have needed very different changes in the habits of the animals, it would appear that a morphogenetic tendency is the primary factor, but that it can only be realised in the event of the development of suitable habits. Mr. Borradaile remarks that there are few better instances than those afforded by "carcinisation" of the fact that the organism is, after all, the dominant factor in evolution.

In No. 4 (pp. 127–136, 7 figs.) Mr. Borradaile gives an account of the fourteen species of barnacles brought back by the expedition. The most interesting specimens described are some valves, referred to a new species of Hexelasma, collected in a glacier, 30 ft. above sea-level, in Evans Cove, Terra Nova Bay. It is not possible to state from their appearance whether these valves are recent or fossil, but it seems scarcely probable that they are recent, for no trace of such a barnacle has been found in any collection from either the Ross Sea or elsewhere, nor can any satisfactory suggestion be made as to the way in which recent shells could have reached the position in which these were found. If they be fossil, it seems highly probable that they are, if not of Miocene age (their nearest known relation is *H. aucklandicum*

from the Miocene of New Zealand), at least Tertiary, for they are quite unlike any Cretaceous barnacle. But there is the difficulty that no Tertiary rocks are known from the neighbourhood of the glacier, nothing later than Carboniferous having been reported in this region, though it may be that the glacier is in contact somewhere in its course with Tertiary rocks.

EDUCATIONAL REFORM.

MR. T. H. J. UNDERDOWN, in his presidential address to the National Union of Teachers on April 11, revealed some deplorable facts as to the pay of teachers. It appears that more than forty-two thousand certificated teachers are paid less than 100*l.* per annum, and that the pay in many other cases is little short of scandalous. It is not surprising in the face of these facts to know that the supply of teachers has been failing seriously in recent years, and that the provision of a sufficient number of qualified men and women to carry out the educational developments contemplated in the programmes recently put forward is one of the most important practical problems to be solved. The precedent to reform, as Mr. Underdown pointed out, must be a fundamental change in the attitude of the nation as a whole towards its schools, colleges, and universities, and towards those who labour in them, both teachers and taught.

The recent Departmental Committee, as well as bodies like the Association of Directors and Secretaries for Education, the Association of Technical Institutions, the Workers' Educational Association, the British Science Guild, the Education Reform Council, and, lastly, the National Union of Teachers, whose programme of educational progress is now before us, are all practically at one in the demand for a reorganisation, to come into force as soon as possible, of the means and methods of national education, especially in their application to the domain of elementary instruction, and for the proper equipment of the schools in respect of practical training, the provision of playgrounds, and other means of physical education, together with proper measures for medical treatment for all children requiring it. There is, moreover, a strong agreement amongst all these bodies that measures shall be taken for the due and effective training of all the teachers engaged in the schools and the payment to them of adequate salaries. There is some hope that this consensus of opinion may induce Parliament to take into serious consideration, despite the exigencies and demands of the war upon the energies of the nation, the measures of educational reform proposed with a view to their early adoption. We cannot too soon, having regard to the dreadful wastage of our young, virile life, set about instituting provisions whereby we may effectively train the youth of the present generation for the responsibilities which surely await them. To neglect such measures will be fatal to the nation's best interests.

All the bodies above named are agreed that all exemptions interfering with full-time attendance up to fourteen years of age, including half-time, shall be abolished; that due provision shall be made whereby all young persons entering into employment between fourteen and eighteen years of age shall continue their education on general and specialised lines, in their working hours, which shall not exceed forty-eight per week, during about forty weeks of the year; and that it shall be the duty of the employer to give facilities, according to the circumstances of the locality, for the due observance of these conditions. The foregoing authorities further agree that the fullest facilities shall be given for all duly qualified young persons to proceed to institutions for higher education on such conditions as shall ensure their adequate maintenance in such institutions. Suggestions are also made for the simplification of the payment of public grants in aid of education, so as to ensure that local authorities shall give adequate encouragement to all forms of education essential to the well-being of their respective areas.

The subjoined extracts from Mr. Underdown's address show that there can be little hope of any of these educational reforms being carried out until the pay and prospects of teachers are improved.

The most urgent and pressing reforms awaiting enactment by Parliament are: (*a*) The abolition of half-time, and other forms of wage-earning, child labour. (*b*) The prohibition of street trading by persons under the age of sixteen or eighteen. (*c*) The raising of the statutory minimum leaving age from twelve to fourteen, accompanied by powers under local by-laws to enforce attendance to fifteen or sixteen. It is little use to attempt to extend the superstructure of higher education provided by secondary, technical, and continuation schools, urgent though these extensions be, until the foundations in the primary schools are truly and firmly laid.

The reforms I have indicated are of supreme importance, yet every attempt to set them afoot is foredoomed to failure unless accompanied by immediate steps to secure an adequate supply of qualified teachers. Every single project carries with it an added demand for further teachers. For example, the raising of the leaving age to fourteen would retain an additional 250,000 children for at least a year, which on a basis of forty children per teacher—not by any means a liberal standard of staffing—would require an additional 6000 fully qualified teachers. But the supply is failing, apart from the fact that of the 20,000 teachers on war service many will either remain in the Army or Navy, or find other posts with brighter prospects. The number of intending teachers in 1906 was 11,901, and this fell to 5679 in 1912, and although a slight increase to 6938 is shown in 1916, the improvement is quite inadequate to warrant any confidence for the future. From these numbers must be deducted a large percentage who fail to qualify. Figures given by the Board of Education in 1915 show that in a recent year only 63 per cent. of the bursars and 53 per cent. of the pupil teachers afterwards proceeded to a training college to complete their qualifications. Thus only a few more than half the 6030 entrants, the average number for the last six years, are likely to become fully qualified teachers. This supply of 3000 per annum is totally inadequate, as the wastage amongst teachers has been estimated at 7000 yearly, due to loss by death, superannuation, breakdown in health, transfer to other more lucrative walks of life, and to marriage, which was found over a period of twenty years to account for 75 per cent. of the removals of women teachers from the profession.

Here are the facts relating to the salaries of full-time certificated teachers as shown by the latest information published by the Board of Education in 1915. In England and Wales, out of nearly 106,000 certificated teachers, two headmasters, one headmistress, one certificated assistant-master, and 218 certificated assistant-mistresses received less than 50*l.* per annum—that is, less than 19*s.* 3*d.* per week. The facts are:

Certificated masters		Certificated mistresses		Less than £		Less than s.	
3	...	219	...	50 =	19¼	per	week
42	...	1,135	...	60 =	23	,,	,,
315	...	4,568	...	70 =	27	,,	,,
758	...	13,020	...	80 =	30	,,	,,

Viewed in another way:—

468 headmasters 4,783 certificated assistant-masters 4,847 headmistresses 32,013 certificated assistant-mistresses	Received less than 100*l.* a year = less than 38*s.* 6*d.* per week.

Total 42,111 certificated teachers

From these meagre sums, 3*l.* 12*s.* for men and 2*l.* 8*s.* for women are deducted every year towards an equally meagre superannuation allowance. These thousands of professional, educated men and women, selected by the State, medically examined at more than one stage of their academic preparation and professional training, tested by his Majesty's inspectors of schools as to fitness over and over again—these men and women are disgracefully and shamefully paid. These are strong words, but not too strong in face of the facts, whether viewed in their individual incidence or in bulk—*i.e.* 42,111 out of 105,930 fully certificated teachers employed in 1915, or about 40 per cent., received less than 38*s.* per week. Further, these figures take no account of the salaries of 41,000 uncertificated teachers and 13,000 supplementary teachers, in which classes the salaries are probably not more than 50 per cent. of those for the certificated teachers above mentioned.

It may be argued by some that these low salaries are limited to the inexperienced members of the profession. It is not so, as will be shown. The 42,000 certificated teachers receiving less than 100*l.* per annum are, as a body, not inexperienced, for they represent at least a ten-years' supply. This line which I have drawn at 100*l.* a year should be, in my opinion, the minimum salary permitted by the Board of Education. It should be the basis of the teachers' contract clause. Below that standard, no man or woman, having passed through the full training course, and commencing a professional career at twenty or twenty-one years of age, should be engaged. Any product not worth 100*l.* a year ought not to be entrusted with the vital work of teaching children. With 250*l.* as a minimum wage for a medical practitioner upon the body, surely even 150*l.* is not an ambitious or unreasonable starting salary for a newly trained teacher, a fully qualified practitioner upon the child's mental, moral, and physical development. That ripe experience and long service do not always carry a fuller reward is shown by the following cases collected a few months ago by the National Union of Teachers:—

(*a*) *Headmaster* in eastern county, appointed thirty years ago at 87*l.* per annum, present salary 96*l.* During these thirty years he must have satisfied the Board of Education, or he would not have held his post. His reward for thirty years' service is an increase of 9*l.* per annum.

(*b*) *Headmaster* in eastern county, appointed more than forty years ago at 70*l.*, now receives 95*l.*, with no increase during the past seven years.

(*c*) *Headmistress,* county near metropolis, commenced service in present post thirty years ago at 48*l.*, and now receives 70*l.*

(*d*) *Headmistress,* neighbouring county, appointed at 23*s.* per week thirty-five years ago, has never received a farthing increase during the whole time.

(*e*) *Headmistress,* a Welsh county, salary was 90*l.* for twenty-six years without revision.

(*f*) *Headmistress,* a Welsh county, has held post for thirty-three years, and advanced in salary from 90*l.* to 97*l.* 10*s.*

(*g*) *Headmistress* in East Anglia receives 70*l.* after eighteen years of service.

(*h*) *Headmistress* in the broad-acred county receives salary of 80*l.* after service of seventeen years.

These are but typical cases. They throw a searching light upon the conditions of rural teachers. Small wonder is it that some county authorities advertise scores of vacancies for teachers, posts they can never hope to fill again at the wretched salaries offered.

Another aspect of the problem is the opening up to young educated people of other avenues and walks of life which are more attractive in prospects, less costly in training, less exacting in the daily task, and more substantially remunerative. The bank successfully competes with the classroom for the services of the educated woman. The counting-house, the insurance office, the engineering works, to say nothing of the other professions, provide far brighter prospects for the youth than he can hope to realise as a teacher. Thus the teaching profession stands to lose its fair proportion of the supply of the best brains the nation produces. The only sources of supply likely to remain permanently are the few vocationally called to the labour, and those who find themselves eliminated from other more coveted positions by the sieve of competition.

Those already in the service find themselves cramped, barred, and chained by small prospect of promotion to higher posts, both professional and administrative, and by the narrow limits of the scale of salaries. The class-master of to-day has in most large towns only a 1 in 100 chance of promotion to a headmastership, and this for the fortunate few rarely takes place before they are forty-five years of age. His position is therefore practically permanent, and his salary stationary until the end—his retirement at sixty-five years of age. If the fully qualified class teacher is to survive as a professionally living force in the schools, the outlook must be made brighter and the position such as will provide for an educated man or woman a satisfactory career in itself and within its own confines. The present salaries fall far short of such prospects.

Inadequate retiring allowances further accentuate the check upon the supply of teachers. The maximum pension for a master retiring now at sixty-five years of age, after forty-five years of service, is 69*l.*, and for a mistress 60*l.* Further, the Teachers' Superannuation Act of 1898 applies only to service in State-aided primary schools. Service in a secondary, technical, or other school does not count. This places an obstacle in the way of that free intercourse from one type of school to another which is so essential for the life and vigour of our educational system from the kindergarten to the university. A pension scheme embracing all sections of the profession is long overdue. The retiring age of sixty-five is far too high, and retirement should be optional at sixty. The fact that the premiums paid (3*l.* 12*s.* per annum for men and 2*l.* 8*s.* for women for possibly forty-five years) are non-returnable in the case of death before pension age is unsatisfactory. This basis may have been justified in the early years of the scheme, when fewer premiums were paid in by those reaching pension age, but as time goes on this system becomes more and more speculative, and indeed approaches the nature of a gamble. Scotland has granted to the whole of the teaching profession a pension scheme without these defects, and what Scotland did yesterday England can do to-day. If the same careful forethought, the same skilful plans and designs, and the same generous consideration which are used to cajole young persons into the profession were applied to schemes for the improvement of the teacher's prospects in his riper years and old age, a permanent and ample supply of excellent material for the teaching staff of the nation's schools would follow as the dawn follows the night.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Duke of Richmond and Gordon has been elected Chancellor of Aberdeen University in succession to the late Lord Elgin.

IT is announced that Mr. Henry Musgrave proposes to contribute a sum of 10,000*l.* to Queen's University, Belfast, to endow a chair in connection with Russian language and literature.

NEW buildings for the arts faculty, the library, and the general museum of the University College of North Wales were put up on a particularly fine site in the city of Bangor a few years ago, and were opened by his Majesty the King on July 14, 1911. The funds, a large proportion of which had been contributed by the rural districts of North Wales, did not suffice for the re-housing of the science departments. These, including agriculture and forestry, which are of the first importance in the neighbourhood, have remained in buildings of a purely temporary character, which were adapted for the purpose some thirty years ago. A movement has now been initiated by Mr. R. J. Thomas, of Holyhead, to erect buildings for the science departments on the new site, as a "memorial to the men of North Wales who have fallen in the war." Mr. Thomas has started the fund with a gift of 20,000*l.*, and it is hoped to raise at least 150,000*l.* In the new buildings especial prominence will be given to agriculture and forestry, which are, or will be, the main industries of the northern counties of Wales. Other branches of science —physics, chemistry, geology, botany, zoology, and so forth—are provided for in the scheme. It is the intention of the authorities to erect laboratories on what may be termed a modern university scale. The high ability for science, as well as for literature, which so often appears in the remote rural districts of North Wales will in the new laboratories find fuller opportunity than heretofore. It is a pleasure to record that his Majesty the King (the Chancellor of the University), H.R.H. the Prince of Wales, and the Prime Minister have each expressed their approval of, and their sympathy with, the scheme.

WITH the growing advances in technical education it is very desirable that teaching connected with the building trade—one of the largest trades in this country—should be properly organised. The "Memorandum on the Teaching of Building in Evening Technical Schools," recently issued by the Board of Education (Circular 978), is intended to convey suggestions as to organisation, accommodation, equipment, and methods of instruction to teachers and those responsible for arranging building classes. At the same time, we are glad to see it stated that these suggestions are not designed to stereotype methods of procedure, which must vary with the needs of different localities. Most technical institutions possess some classes suitable for students interested in building, but in many cases these are inadequately correlated with other courses which it is desirable a student should take in addition, and the memorandum urges the desirability of "grouped" courses which shall give the worker a sustained interest and provide him with an adequate time-table. Further, it is pointed out that such courses should be arranged to form a continuous scheme from quite junior to advanced work, and that for those whose field of operations or whose intelligence is too limited to render a full course suitable a parallel restricted scheme of work should be arranged. It is impossible here to enter into the detailed suggestions given in the fifty pages of this publication, which cover not only the ordinary building trades proper, but also surveying and office work; it may be noted, however, that a laudable effort has been made to show in what manner mathematics and pure science can be brought to bear upon the direct needs of the builder. In conclusion, some comments on the material requirements of these subjects, in the way of lecture-rooms and laboratories, are given, which include plans of a combined lecture- and drawing-room found to be satisfactory, and of a building laboratory showing the arrangement of the various fittings.

SOCIETIES AND ACADEMIES.

LONDON.

Aristotelian Society, March 5.—Dr. H. Wildon Carr, president, in the chair.—Prof. C. **Lloyd Morgan**: Fact and truth. We may start with facts of appearance, as a convenient point of departure. A fact of appearance is always relational in structure, and it is this relational structure which is of the very essence of fact. All facts of appearance are facts *for* knowledge, but we need to distinguish facts *for* knowledge and facts *of* knowledge. We may winnow out from the multiplicity of facts *for* knowledge certain facts *of* knowledge which have a privileged status, and we may speak of a fact of knowledge as accordant with a privileged fact of appearance without denying that accordance may merge in identity. We may then further distinguish between "the sphere of knowledge" and "the sphere of the knowable"—a fact of knowledge as an item of content on the sphere of knowledge may be said to be correspondent to a knowable fact, when the radii of the two spheres in contact are in the same right line. And here again correspondence may merge in identity—the difference between knowable fact and fact of knowledge being a difference in context. The relation between any knowable fact on a non-contact radius of the sphere of the knowable, and any imagined fact on a non-contact radius of the sphere of knowledge, is given in practical determination by the nature and amount of rolling of the spheres requisite to establish right-line contact. Right-line contact is that of direct acquaintance when the knowable and that which is then and there factually known are one. Fact is always particular, always a "this" or "that" dateable and placeable. But owing to the enormous amount of repetition in the total fact-structure of the knowable world, truths as well as facts of knowledge enter into the structure of the sphere of knowledge. There is (*a*) truth in the structure of the knowable world, (*b*) truth in the structure of knowledge, and (*c*) truth as correspondence of these two structures.

Royal Anthropological Institute, March 27.—Sir Hercules Read, president, in the chair.—Miss M. Edith **Durham**: South Slav customs as seen in Serbian ballads and tales by Serb authors. Until quite recent times justice, in South Slav lands, was administered by the headmen of the district, who sat before the church and considered the evidence and judged accordingly. The number of headmen summoned depended upon the gravity of the case. In the case of a blood-feud twenty-four was the usual number. They made an account, balancing one dead man against one dead on the other side, and reckoning the value of the wounds at so many "bloods" apiece—each blood to be paid for. Peace was made by members of the opposing families or clans swearing blood-brotherhood, and by a member of the injured family standing godfather to an infant of the other family. Godfatherhood was reckoned as blood-relationship, and the two families were thus united. Vuk Vrchevitch, who collected and

noted local customs between 1835 and 1889, has recorded many curious verdicts given by the "Council of Good Men," as it was called. Much information about local customs is obtained from the ballads of the land. In the poems of Voyvoda Mirko, the father of the present King of Montenegro, we get much detail about the practice of head-hunting. The Montenegrins were great head-hunters. He describes the setting of heads on stakes around a village as lately as 1857; also the plundering and stripping of the dead and the sharing of the booty. It was all pooled and distributed by the chieftain.

Geological Society, March 28.—Dr. Alfred Harker, president, in the chair.—F. **Dixey** and Dr. T. F. **Sibly**: The Carboniferous Limestone Series on the south-eastern margin of the South Wales coalfield. The outcrop dealt with extends from the valley of the Ewenny river near Bridgend (Glamorgan) to that of the Ebbw river at Risca (Monmouth), a distance of about nineteen miles from west-south-west to east-north-east. It is traversed by the rivers Ely, Taff, and Rhymney. Traced north-eastwards along this outcrop, the Carboniferous Limestone Series suffers much attenuation and becomes mainly dolomitic, as shown by the officers of H.M. Geological Survey during the recent re-survey of the coalfield. The outcrop now described supplies a key to the remarkably attenuated development of the Carboniferous Limestone Series which is known to prevail on the eastern and north-eastern borders of the coalfield. Overstep and actual thinning are both operating in a north-easterly direction to produce great attenuation. A detailed description of the lithological and faunal succession is given. The physical features of the outcrop are described, and attention is directed to the remarkably perfect adjustment of minor drainage-lines to geological structure. The paper is illustrated by maps on which the zonal divisions are indicated, by horizontal and vertical sections, and by photographs which depict some of the most interesting features of the scenery.

Royal Astronomical Society, April 13.—Major P. A. MacMahon, president, in the chair.—Rev. J. G. **Hagen**: Missing B.D. stars. Some stars, recorded in the Bonn Catalogue, are now not found in the sky. In a few cases it appeared that, through bad focus, faint stars close together had been observed as one star, and in six cases the R.A. of one star had been accidentally combined with the declination of another. —Prof. S. D. **Tscherny**: Observations made during the partial eclipse of the sun of January 22, made at Rostow-on-Don, Russia.—Dr. L. **Silberstein**: The motion of the perihelion of Mercury, deduced from the classical theory of relativity. It was well known that the motion of the perihelion of Mercury was greater than could be caused by the perturbations of the other planets, the excess being now found to be nearly 43″ per century. Einstein's most recent "generalised theory of relativity" had yielded for this excess its full value. It therefore appeared worth while to investigate if the excess would not also be accounted for by the old theory of relativity, retaining the constancy of the velocity of light, and its independence of the gravitational field.—Prof. H. H. **Turner**: Note on possible attraction between photographic images. Cases occurred in which the image of a bright star appeared to distort a réseau line near it, and he had found a similar effect produced when réseau lines, twice copied on the same plate, crossed each other at small angles. Mr. Bellamy had examined the measures of double stars in the Oxford Astrographic Catalogue, and found the same order of error for distances less than 7″, though nothing sensible beyond this.—Prof. A. **Fowler** and J. **Brooksbank**: The third line spectrum of oxygen. Spectra had been obtained with feeble, moderate, and strong discharges, and slides from the photographs were shown. The stellar lines, which can be identified with the third line spectrum of oxygen, are not numerous, but it is of interest to find in oxygen another example of the occurrence in the earliest type of stars of lines which we can only obtain by employing the strongest discharges. This may indicate that in stars of early type we are presented with phenomena resulting either from powerful electric action or from extremely high temperatures.

PARIS.

Academy of Sciences, March 26.—M. A. d'Arsonval in the chair.—P. **Appell**: Short report of the Committee on Ballistics.—E. **Bompiani**: Deformable hypersurfaces in a real Euclidean space of $n>3$ dimensions. —E. **Kogbetliantz**: The summation of ultraspherical series.—E. **Belot**: The possible origin of star clusters. The vortex theory in cosmogony, which has already explained the laws of the solar system and the formation of spiral nebulæ, can also define the very special conditions under which a star cluster can arise, and gives an exterior distribution very nearly exponential. —M. **Fayet**: Observation of Mellish's comet made at the Observatory of Nice.—J. **Pellissier**: Some geometrical properties of a bundle of X-ray tubes. Applications to the localisation of foreign bodies in the organism. An application of the principles of anharmonic ratios and of homography to X-ray problems. —J. **Fromentin**: A rapid radioscopic method for the localisation of projectiles.—Em. **Bourquelot** and A. **Aubry**: The biochemical synthesis, with the aid of emulsin, of a second galactobiose. On working up the residues from the preparation of the galactobiose described in an earlier paper, with the view of obtaining an increased yield, a new sugar, isomeric with the first, has been obtained. Its physical and chemical properties are given.—P. **Bonnier**: Incontinence of urine. An account of the application to sixty-two cases of the method of cauterisation of the branches of the trigeminal nerve in the nose previously described. Thirty-eight cases were cured and nine improved.—A. **Paillot**: New parasitic micro-organisms of the caterpillars of *Lymantria dispar*.—J. **Danysz**: The treatment of some dermatoses by bacteriotherapy.—Ed. **Delorme**: The operative methods applicable to wounds of nerves by projectiles.

WASHINGTON, D.C.

National Academy of Sciences (vol. iii., No. 1, January). —E. **Thomson**: Inferences concerning auroras. Auroras consist of vertical streamers which, seen from different points of perspective, give the various optical effects observed.—H. F. **Osborn**: Application of the laws of action, reaction, and interaction in life evolution. In each organism the phenomena of life represent the action, reaction, and interaction of four complexes of physico-chemical energy.—P. W. **Bridgman**: The resistance of metals under pressure. Twenty-two metals are examined up to 12,000 kg.—A. **Forbes**: The rate of discharge of central neurones. The normal frequency of nerve impulses discharged from the ganglion cells in voluntary contraction must lie between 300 and 5000 per second.—Ethel B. **Harvey**: A physiological study of Noctiluca, with special reference to light production, anæsthesia, and specific gravity. These animals are able to regulate their specific gravity. Anæsthetics seem to attack the mechanism of the utilisation of oxygen, in the absence of which light is not produced. —N. M. **Fenneman**: Physiographic subdivision of the United States. The basis of division shown on the map is physiographic or morphologic. There are twenty-four major divisions, some with six to ten sub-

divisions.—S. **Hatai**: The composition of the Medusa, *Cassiopea xamachana*, and the changes in it after starvation.—H. **Shapley**: Studies of the magnitudes in star clusters, iv. On the colour of stars in the galactic clouds surrounding Messier 11. The frequency-curve for colours shows great diversity of colour index and general resemblance to the curve for the brighter stars in the neighbourhood of the sun. A striking progression of colour with decreasing brightness is shown.—F. H. **Seares**: The colour of the standard polar stars determined by the method of exposure-ratios. The colours of the polar standards, brighter than the 13th magnitude, have been determined to about the same precision as was reached in the investigation of the magnitude scale, with an expenditure of time and labour perhaps a tenth of that in an earlier investigation.—C. **Keyes**: Terracing of bajada belts. The feature of desert bajada-terracing, when explained upon a strictly aqueous basis, cannot but lead to complete misinterpretation. It is far more largely the result of wind-action.—C. D. **Perrine**: Relation of the apex of solar motion to proper motion, and on the cause of the differences of its position from radial velocities and proper motions.—Brig.-Gen. H. L. **Abbot**: Hydrology of the Isthmus of Panama. Extensive tables for rainfall, outflow, evaporation, etc., are given and discussed.—C. P. **Olivier**: The meteor system of Pons-Winnecke's comet. The elements of the meteor's orbit are determined from more than 1000 observations.—T. W. **Richards** and H. S. **Davis**: Improvements in calorimetric combustion, and the heat of combustion. The improvements are: means of effectively closing the bomb with less risk to the lining and cover; means of burning volatile liquids without loss; a method of automatically controlling the temperature of the environment; means of evaluating the incompleteness of combustion. The heat of combustion of toluene is determined as 10·155 calories (18°) per gram.—R. C. **Tolman** and T. Dale **Stewart**: The mass of the electric carrier in copper, silver, and aluminium. A continuation of experiments on currents produced by acceleration in metals.—E. B. **Rosa** and G. W. **Vinal**: The silver voltameter as an international standard for the measurement of electric current. A summary of eight years' experimental work which has shown how the voltameter can be used as a trustworthy current standard and as a means of checking the constancy of the value of the Weston normal cell.

BOOKS RECEIVED.

Guide to Materials for American History in Russian Archives. By Prof. F. A. Golder. Pp. 185. (Washington: Carnegie Institution.) 1 dollar.

Théorie de la Contre-Evolution ou Dégénérescence par l'Hérédité Pathologique. By Dr. R. Larger. Pp. xiv+405. (Paris: F. Alcan.) 7 francs.

Dairy Farming. By Prof. C. H. Eckles and Prof. G. F. Warren. Pp. xv+309. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s.* net.

Air Power: Naval, Military, Commercial. By C. Grahame-White and H. Harper. Pp. 262+20 illustrations. (London: Chapman and Hall, Ltd.) 7*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 19.

ROYAL INSTITUTION, at 3.—Industrial Finance after the War; The Character of the Industrial Struggle of To-day: Prof. H. S. Foxwell.

MATHEMATICAL SOCIETY, at 5.30.—A Liquid Gyrostat: Prof. W. Burnside.—The Integral Formula for Generalised Legendre Functions: G. N. Watson.—A Substitution Permutable with the Transposed Substitution: Prof. H. Hilton.

LINNEAN SOCIETY, at 5.—The Heteranziums of the British Coal Measures: Dr. D. H. Scott.—Hypophysis and Premandibular Cavities; a Suggestion: E. S. Goodrich.—Wooden Scratching Tools made by an African Parrot: Miss N. Layard.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.—Stope Measurement at Messina: W. Whyte.—Platinum in Spain: F. Gillman.

CHEMICAL SOCIETY, at 8.—The Hydration of Ions and Metal Overvoltage: E. Newbery.—The Pungent Principles of Ginger. Part i. A New Ketone, Zingeribone, occurring in Ginger: H. Nomura.—Velocity of Decomposition and the Dissociation Constant of Nitrous Acid: P. C. Rây, M. L. Dey, and J. C. Ghosh.—The Alkaloids of Ipecacuanha. Part ii: F. L. Pyman.—Studies in Catalysis. Part vi. The Mutual Influence of Two Reactions proceeding in the same Medium: R. O. Griffith, A. Lamble, and W. C. McC. Lewis.—Studies in Catalysis. Part vii. Heat of Reaction, Equilibrium Constant, and Allied Quantities from the Point of View of the Radiation Hypothesis: W. C. McC. Lewis.—Note on the Isolation of Methylnonylketone from Palm Kernel Oil: A. H. Salway.—Metallic Derivatives of Alkaloids: J. N. Rakshit.

ROYAL SOCIETY OF ARTS, at 4.30.—The Industrial and Economic Development of Indian Forest Products: R. S. Pearson.

FRIDAY, APRIL 20.

ROYAL INSTITUTION, at 5.30.—The Future of Wheat-growing in England: Prof. R. H. Biffen.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Presidential Address: M. Longridge.

SATURDAY, APRIL 21.

ROYAL INSTITUTION, at 3.—Principles of Aerial Navigation: Prof. G. H. Bryan.

MONDAY, APRIL 23.

ARISTOTELIAN SOCIETY, at 8.—Symposium: Ethical Principles of Social Reconstruction: Principal L. P. Jacks, G. Bernard Shaw, C. Delisle Burns, and Miss H. D. Oakeley.

TUESDAY, APRIL 24.

ROYAL INSTITUTION, at 3.—Russian Development—The Rise of Moscow: Prof. C. R. Beazley.

WEDNESDAY, APRIL 25.

ROYAL SOCIETY OF ARTS, at 4.30.—Flour and Bread: Sir Francis Fox.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—Industrial Finance after the War: Prof. H. S. Foxwell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—High-tension Overhead Transmission Lines: G. V. Twiss.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 5.30.—The Organs of Hearing in relation to the War: Dr. Dundas Grant.

SATURDAY, APRIL 28.

ROYAL INSTITUTION, at 3.—Principles of Aerial Navigation: Prof. G. H. Bryan.

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