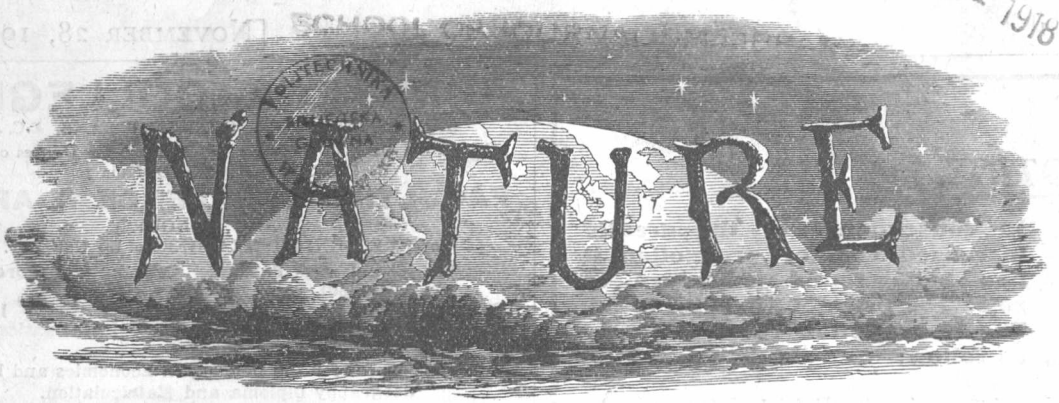

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

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Under the direction of the TRUSTEES of the BRITISH MUSEUM.

A course of Twelve Lectures on "MAN AND HIS ANCESTRY" will be delivered by DR. THOMAS J. JEHU, F.R.S.E., at the Royal Society of Arts, 18 & 19 John Street, Adelphi, at 5.30 p.m., on December 10, 12, 13, 19, 20, 30, 31, and January 2, 3, 7, 9, 10.

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(COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.)

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D. J. A. BROWN,
Registrar.

University College,
Cathays Park, Cardiff.

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C. F. MOTT,
Acting Director of Higher Education.

County Education Offices, Stafford, November, 1918.

THURSDAY, NOVEMBER 28, 1918.

ABSORPTION SPECTRA AND CHEMICAL CONSTITUTION.

Colour in Relation to Chemical Constitution. By Prof. E. R. Watson. Pp. xii + 197. (London: Longmans, Green, and Co., 1918.) Price 12*s.* 6*d.* net.

IT is justifiable to ask whether this book has been written to help those engaged in research on synthetic dyestuffs or as a text-book for those investigating the problems of absorption spectra. On one hand it contains scarcely anything of sufficient definiteness for the colour chemist to pin his faith to, and, on the other, the information is not complete enough to justify its use as a text-book on absorption spectra. The author, however, can scarcely be blamed for the lack of definiteness in establishing even one article of faith for the colour chemist to accept, because it is progressively becoming more evident that there is no definite relation between colour and chemical constitution in the generally accepted sense. Every one of the theories connecting the two that from time to time have been proposed is shown by the author to fail in one way or another. Even his own theory of oscillation within a conjugated system of double bonds is of limited application, for it entirely fails to explain his own test case of the blue nitroso-derivatives of the paraffins, not to mention the numerous examples of colour changes shown by the same compound in different solvents. The time has surely come when it were wiser frankly to let the colour chemist into the secret and tell him that the usual conception of correlation between colour and constitution has been found to be unsound. Let us be brave and state that the real connection between them is far deeper than any of the theories of Witt, Nietzki, Armstrong, von Baeyer, or Hantzsch would lead us to believe.

Criticism must be made of some statements in this book, statements which cannot be allowed to pass unchallenged. For example, Beer's law cannot be said to be true within a wide range. The substances which conform to this law are relatively few, and, indeed, the law is more honoured in the breach than in the observance. Then, again, it would seem that the author has confused the number of absorption bands shown by substances. Many absorption bands exhibit a number of sub-groups, and great care must be taken to guard against looking upon these sub-groups as separate absorption bands. Some of the author's criticisms are based on this error and lose their point when it is remembered that different sub-groups of one band and not different absorption bands are under discussion.

Then, again, the persistence of a band is wrongly defined as the ordinate passing through the head of an absorption band; this ordinate is, of course, a measure of the absorptive power, while the persistence is the difference between the extreme ordinates over which the band persists. Although this is a minor point, it directs attention to the fact mentioned by the author of the remarkable differences shown by substances in the persistence of their absorption bands. The reason for this is that in the case of those compounds which exhibit relatively shallow bands very few molecules exist in the absorbing condition, the remainder not exerting any selective absorption in the spectral region under examination. It will at once be seen how dangerous it becomes to dogmatise or even postulate any theory as to the constitutional origin of a band when such is due to a very small fraction of the molecules present.

The book is well put together and excellently illustrated with absorption curves of a variety of compounds. The chapters dealing with the earlier theories on colour and constitution are well written, and although the discussion of each of these is necessarily restricted, the author has succeeded in presenting their salient points well. Chapters are devoted to infra-red absorption and to fluorescence, and finally there is a good account of the work on the colour of inorganic compounds. In some ways this book may be recommended, but the impression will remain that the author loses conviction by reason of having stepped too delicately. E. C. C. B.

SYNTHETIC AND ANALYTIC PHYSICS.

(1) *Cours de Physique Générale.* By H. Ollivier. Tome Troisième. Pp. 632. (Paris: A. Hermann et Fils, 1918.) Price 30 francs.

(2) *Electrical Experiments.* By A. Risdon Palmer. Pp. xii + 115. (London: Thomas Murby and Co., 1918.) Price 1*s.* 6*d.* net.

(3) *Magnetic Measurements and Experiments (with Answers).* By A. Risdon Palmer. Pp. 124. (London: Thomas Murby and Co., 1918.) Price 1*s.* 6*d.* net.

IN the discussion on the teaching of physics in schools which took place recently at a meeting of the Physical Society two methods of teaching physics were contrasted. The first, which may be called the synthetic method, starts from certain general principles and develops the consequences of those principles. The second, or analytic method, dissects out the principles from some more or less complicated piece of mechanism. Thus the first method starts with Boyle's law and ends with the steam-engine, whilst in the second method the order is reversed. Each method has its advantages and its drawbacks, and makes its appeal to a particular type of mind or at a particular stage of development. The volumes under discussion may be regarded as examples of the two methods of presentation.

(1) The subject of vibrations and their transmission forms the groundwork of the third part of M. Ollivier's text-book, and it is developed from first principles with the lucidity which seems to be innate in French scientific writers. The first six chapters may be regarded as introductory; they contain a concise and interesting summary of the main features of periodic functions, of

vibratory movements, and of wave motion. Chap. vii. deals briefly with the subject of acoustics, and includes a detailed description of the anatomy of the ear, with excellent diagrams after A. Pizon. Then follows a lengthy section devoted to physical optics, in which the subjects of interference, diffraction, and polarisation are discussed in a masterly manner, one of the valuable features of this portion of the work being the number of problems worked out in detail with numerical illustrations. In dealing with the passage of polarised light through crystalline plates extensive use is made of the geometrical construction devised by Poincaré, in which the characteristics of the elliptically polarised light are represented by the position of a point on the surface of a sphere.

The damped oscillations of certain material systems, such as moving-coil galvanometers, are considered in chap. xv. At first sight the chapter on thermionic apparatus seems somewhat out of place, but this impression is removed when it is realised how important a part thermionic valves and amplifiers play in connection with electric oscillations and wireless telegraphy and telephony. Recent improvements in these departments of applied electricity are described in most interesting fashion. The remaining chapters deal with electro-optics and optical effects due to motion, the volume closing with a brief review of the principle of relativity.

Special interest attaches to this volume through the circumstances in which it has been produced. In an introductory statement M. Ollivier says: "Ce n'est pas sans une profonde émotion que nous publions ces leçons professées à Lille avant la guerre. Car aux souvenirs heureux qu'elles évoquent pour nous, au rappel d'un temps où notre Université était grande et florissante, s'ajoute en un contraste déchirant la longue et cruelle vision des malheurs qui sont venus. Ce n'est pas à nous qu'il appartient de décrire les souffrances infinies de la ville martyrisée. Mais nous ne voulons pas signer ce livre sans adresser un hommage à nos collègues et à nos élèves morts."

(2 and 3) Two useful books for beginners are provided by Mr. Risdon Palmer, who is familiar with the difficulties of both student and teacher. In the study of electricity the analytic method is employed. The first experiments to be performed involve the use of accumulators, glow-lamps, adjustable resistances, voltmeters and ammeters. Even if the treatment is not strictly logical, the student at once acquires some familiarity with the notions of electromotive force, resistance, and current. In magnetism the idea of pole strength is based on the use of a simple form of magnetic balance, and the experiments are supplemented by illustrative examples and arithmetical questions. Considerable emphasis is rightly laid on the expression of results in the appropriate units, the realisation of the magnitude of the quantities involved, and graphical representations.

H. S. ALLEN.

PRACTICAL FORESTRY.

Forestry Work. By W. H. Whellens. Pp. 236. (London: T. Fisher Unwin, Ltd., 1918.) Price 8*s.* 6*d.* net.

THE author of this book is a working forester, who has had much experience while in charge of large wooded estates in England and Scotland. He tries to explain in simple language the actual operations which are usually carried out on such estates, and in this is fairly successful. The book can be recommended as a useful one for the forestry apprentice, and will be found serviceable in giving instruction to disbanded soldiers and to women who are now taking short courses in nursery work, measuring timber, etc., at various centres. There is nothing novel in the book, which is simply a straightforward account of ordinary British forestry practice. Whether this practice requires amendment or improvement is another matter. Hitherto, on private woodland estates, methods have been in vogue which are not strictly economical. In the future money will be scarce, and efforts must be made either to invent cheaper methods or to import such from foreign countries, like the United States, where of late ingenious inventions have been devised, which save labour materially in the planting and in the felling of trees.

Mr. Whellens's first chapter deals mainly with nursery work, and contains much that is valuable and well put; but no mention is made of the transplanting lath or of the method employed at Brocklesby and Abbeyleix, by which young trees are ploughed out of the nursery lines instead of being lifted; yet these are excellent labour-saving devices. The chapter on the preparation of the ground for planting, on draining, and on fencing is well done. Sowing and planting are next dealt with. The chapter on tending plantations is unsatisfactory, the difficult subject of thinning being too briefly treated, while much space is given to pruning, an unnecessary and expensive operation in most cases. Felling timber is rather summarily disposed of, and nothing is said about clearing the area after felling. The space devoted to the measurement of timber is quite inadequate, and requires considerable enlargement to make the subject intelligible to workmen. The chapter on insect and fungoid enemies is without illustrations, and the descriptions are too short. The appendix is a collection of useful tables.

DEVELOPMENTS OF THE THEORY OF RELATIVITY.

The Theory of the Relativity of Motion. By R. C. Tolman. Pp. ix+225. (Berkeley: University of California Press, 1917.)

THE author of this book takes much for granted. The main source of interest in the principle of relativity is the revolution which it demands in the concepts of space and time. It is not easy for most people to accommodate themselves to the changes which they are asked to make in these fundamental elements of their

thought. But until this has been done the postulate "that the velocity of light in free space appears the same to all observers regardless of the relative motion of the source and the observer" is one that remains a stumbling-block, and the detailed mathematical discussion of the consequences of such a postulate must remain a matter of minor interest.

In the development of any branch of scientific thought it generally happens that in the form finally assumed the historic order of thought is reversed. The process of analysis of the complex into its constituent elements is replaced by a formal synthesis of those elements to reproduce the original complex. To the student seeking to get a living grasp of the meaning of science, and not a mere formal and abstract parallel to it, it is necessary to go through in his own experience the stages by which the perfected final form of the science has been reached. The teacher and the writer of text-books should therefore seek first of all to give the benefit of his knowledge and matured thought to enable the reader to pass painlessly and naturally through those various phases. When this has been done, the demonstration of unforeseen consequences is legitimate.

The present author places quite late in the book those transformation equations for the electric and magnetic intensities which played an absolutely vital part in making the enunciation of the principle possible. One may be permitted to wonder if in so doing he is not writing with his eye too close to his subject, so that the reader does not come sufficiently into his field of view.

But, this being a matter of common occurrence, it may pass, and the book may be recommended as an account of the later developments of the theory of relativity, which dwell particularly on those quantities which seem to have a significance that is not relative. In particular the "action" of a dynamical system is one that has some such absolute meaning if it be true that the motion of a system is to satisfy the principle of least action regardless of the velocity which the observer chooses to assign to himself. The invariance of the action seems to be the most comprehensive summing up of the consequences of the principle of relativity, and at the same time opens out the possibility of the generalisation of it in the way that Einstein has recently achieved. This extension of the principle does not come within the scope of the book, which concludes with a presentation of the four-dimensional vector analysis in the form developed by Wilson and Lewis.

OUR BOOKSHELF.

Die Vegetation des Val Onsernone (Kanton Tessin). By J. Bär. 80 pp., with coloured phytogeographical map. (Zurich: Rascher and Co., 1918.) Price 3 francs.

THIS is a very compact description of the vegetation of a mountain valley-basin south of the Alps, a little to the north-west of Lago Maggiore. The rainfall is high (80 in. to 100 in.), and is nearly all received during the summer. At the same time, the number of rainy days is low and of clear days high, so that a great deal of sunshine is received, and the winter temperatures are relatively high. Thus we have a combination of some of the favourable conditions for vegetation characteristic of an "oceanic" climate with some of those characteristic of a continental one, a combination which, together with the great range of altitude (250 m. to 2500 m.) within the area, leads to the occurrence of a very wide range of vegetation and a very large number of species. The vastly greater proportion of the whole area of 113 sq. km. is covered with trees and shrubs. The general altitudinal forest zonation on the northern exposures is chestnut, beech, silver fir, spruce, and larch, with the addition of extensive birch woods and more local lime and grey alder woods according to the soil conditions. Besides these there are extensive scrub associations of hazel, chestnut, birch, beech, and oak, which play an important part in the economy of the valley as pasture for goats, besides unpastured scrub of willow, alpine alder, alpine rose, juniper, etc., "heaths" of heather, broom, and bilberry, and numerous types of grassland. Many of the associations are almost identical with common British types. Above these there is a wide selection of alpine types, and at the other end of the scale an association of the Mediterranean *Cistus salviifolius*. The memoir is accompanied by an excellent vegetation map, in which the distribution of the dominant trees and shrubs is depicted by means of coloured symbols.

Food Gardening: For Beginners and Experts. By H. Valentine Davis. Second edition, revised and enlarged. Pp. viii + 133. (London: G. Bell and Sons, Ltd., 1918.) Price 1*s*. net.

THIS handbook will prove useful to the allotment-holder, as it sets forth clearly and fully the details of cultivation of the commoner vegetables. The first part of the book, however, contains several instructions that are misleading and may cause difficulty. It is contrary to all accepted usage to grow root crops and onions on soil which has not been dug or even forked over since the removal of the previous crop. The plan may succeed on light land, but on heavy, sticky soil such a procedure would probably court failure. For many districts June is very late for planting maincrop potatoes, and parsnip-sowing should not be deferred until April. It is also beside the mark to recommend that green peas should be eaten raw, and to suggest that discarded woollen garments and leather articles should be used for manurial purposes. On the other hand, the details of working are usually well explained, and the calendar of operations affords a useful guide to the approximate times for carrying out the more important pieces of work. The second part, dealing with such crops as tomatoes and celery, is very lucid, and the hints on the winter storing of vegetables and on the destruction of diseases and pests are valuable and practical.

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.]*

Zeiss Abbe Refractometer.

IN reply to Mr. Simeon's communication published in NATURE of November 21, we would state that of the many different types of Zeiss Abbe refractometer, including a late pre-war instrument, that have passed through our hands for repair, all have been fitted with an illuminating prism of low refractive index glass (N_D about 1·515). In every case, by substituting an extra dense prism of suitable angle, we have rendered the instrument serviceable for the examination of liquids above 1·52. We discovered this defect some time ago, and later directed the attention of Prof. Cheshire to it, communicating it to NATURE of June 21, 1917 (vol. xcix., p. 331). We have a number of these low-refractive index prisms which have been removed from Zeiss refractometers, and also a complete Zeiss instrument showing the defect mentioned. It would, perhaps, be possible to arrange to bring this instrument and the prisms to the next meeting of the Optical Society, and if Mr. Simeon would bring a Zeiss instrument having a pair of extra dense prisms, a comparison would be interesting. It is just possible that the Zeiss instrument to which Mr. Simeon refers is one in which a dense lower prism has been substituted.

As we have already pointed out, in theory any glass would make a suitable illuminating prism so long as the roughened surface remains unimpaired, but in practice the cleaning of the prism surface tends to polish it, and as a result the illumination quickly falls almost to vanishing-point. L. BELLINGHAM.

Bellingham and Stanley, Ltd.,
71 Hornsey Rise, N.19, November 22.

BRITISH IRON-ORE RESOURCES.

ONE of the most marked effects of the war has been the stimulus that it has given to the development of the mineral resources of the British Empire, and particularly of those of Great Britain. For many reasons the more active exploitation of our home iron ores has been one of the most prominent features of this movement. Up to the invention of the Bessemer process the iron industry of this country depended practically exclusively upon domestic ores, the bulk of the ores smelted being the claybands and blackbands of the Coal Measures; in addition to these the red hæmatites of the Mountain Limestone of the West Coast and some of the Jurassic ironstones were also worked, but up to about 1870 the iron-ore deposits of the Palæozoic rocks formed the mainstay of our British iron industry. When the Bessemer process introduced mild steel as an important factor in the industry, the relatively small production of West Coast hæmatite no longer sufficed for our needs, and as many of our centres of iron-smelting are situated within easy access of the coast, Bessemer ores were naturally looked for abroad, and an energetic importation of foreign ores ensued. Bilbao ore was first imported about 1870, and by 1878, after the Carlist War, this importation had reached 850,000 tons; in 1913 the importation from Spain, to which Almeria and other parts of Spain contributed as well as Bilbao, was 4½ million tons, whilst our total imports from abroad, by far the greater part of which was Bessemer ore, amounted to about 7½ million tons. The domestic ore production was 16 million tons, of which about 12 million tons came from the Jurassic ironstones. The growth in the output of these last-named ores was due in large measure to the increasing adoption of the basic process of steel-making. When the war rendered the importation of foreign ores difficult and expensive, our iron and steel industry had to rely more and more upon basic steel produced from the latter class of ore. This development has been favoured by the grudging recognition that for most purposes basic steel properly made is as good as acid, and furthermore by the abandonment by the Board of Agriculture of the so-called citric acid test for basic slag in favour of its valuation by the total phosphoric acid present; this means that whereas under the former "made in Germany" test thousands of tons of British basic slag had to be dumped out at sea as unsaleable, such slag can now be utilised and its phosphoric acid contents rendered available for the British agriculturist. At the same time, the British steel trade now has a market opened up for what was before a waste product.

One of the signs of the increasing interest taken in domestic ores is the attention that is being devoted to the study of our iron-ore resources. Apart from some earlier descriptions of British iron ores, which have to-day at most only an historical interest, the first attempt at a real estimate of our iron-ore resources was that published by the present writer in the important treatise issued by the Eleventh International Geological Congress at Stockholm in 1910. This showed for the first time the magnitude of Britain's iron-ore reserves, and attracted much attention on the Continent; it would be interesting to speculate how far it may have contributed towards Germany's intention to bring about the war, one of the main motives of which was Germany's desire to obtain possession of the French iron-ore fields and thus to outstrip all competition by commanding far the largest iron-ore supplies of Europe. The principal value of the above-named estimate to-day lies in the fact that it has formed the basis of newer and more accurate estimates. Since the beginning of the war three important contributions to our knowledge of our own iron-ore resources have appeared, each under the auspices of a Government department—it need scarcely be added, having regard to our characteristic British methods, a different department in each case, working independently of the others. Nothing could be more eloquent of the need for a central administration, co-ordinating such efforts and avoiding useless duplication of work. The first was the now well-

known report on the resources and production of iron ores, etc., by Mr. G. C. Lloyd, issued by the Department of Scientific and Industrial Research, which appeared in May, 1917, a second, revised and enlarged edition being issued towards the end of the same year.

In the spring of this year an important paper was read by Dr. F. H. Hatch before the Iron and Steel Institute by permission of the Controller of Iron and Steel Production, Ministry of Munitions, the data for this having been collected by Dr. Hatch working for that Ministry. It deals with the Jurassic ironstones of the United Kingdom, and, as has already been shown, these constitute by far the most important of the British iron resources from the economic point of view. The deposits dealt with comprise the Northamptonshire, Cleveland, Leicestershire, Oxfordshire, Lincolnshire, and Raasay ironstones, and full descriptions are given of their geology, mode of occurrence, and chemical composition, the numerous tables of analyses being particularly valuable. Finally, Dr. A. Strahan, Director of the Geological Survey, has recently issued his annual report, in which he presents very interesting estimates of the quantity of iron ore that may fairly be assumed to exist in the various deposits. This is a summary of an extensive series of investigations upon British iron-ore deposits which the Geological Survey has been recently conducting, the detailed reports upon which are being awaited with much interest. It constitutes a portion of the very valuable "Special Reports on the Mineral Resources of Great Britain," the first volume of which was issued in November, 1915; in the introduction to this volume Dr. Strahan has set out clearly the object of these reports and their economic significance.

The present report summarises as follows the iron-ore resources of Great Britain under two heads: (*a*) reserves more or less developed, and (*b*) probable additional reserves. The figures are:—

	(*a*)	(*b*)
Hæmatites, etc. ...	42,500,000 tons	75,000,000 tons
Mesozoic ores ...	1,775,052,160 ,,	2,104,886,000 ,,
Clay-ironstones and blackbands ...	1,065,637,000 ,,	6,248,475,600 ,,

Dr. Strahan says that the estimates are "framed in a cautious spirit," and this statement may readily be accepted. Indeed, as regards the last class, the figures are palpably underestimated; thus the probable additional reserves are given as about 6250 million tons, of which four-fifths are credited to South Wales and Monmouthshire, the coalfield which Dr. Strahan probably knows best. There is no reason to suppose that the other British coalfields fall so far short of South Wales in iron contents as collectively to contribute only one-fifth of the whole, and in some cases the figures are clearly wrong. For instance, for the whole of the great northern coalfield he gives only 1·5 million tons, apparently taking the Redesdale area alone, whilst Durham is not even mentioned. Yet such ironstones were worked extensively at Shotley Bridge and other places in the Derwent Valley, as well as at Waldridge Fell, Urpeth, Birtley, Tow Law, and other points in the county of Durham, whilst in Northumberland they were worked at Wylam and Lemington in the extreme south of the county, and at places so far apart as Haltwhistle, Hareshaw, Redesdale, and Brinkburn. There is no evidence whatever that the ironstone was worked out at any of these places, but quite the contrary, and there is at least a probability that it underlies the entire coalfield, though whether it will ever prove to be workable is another question; Dr. Strahan, however, points out that he is "concerned only with the quantities that exist," quite apart from their workability. It must indeed be admitted that this part of the question is one of scientific rather than of economic interest, and in any case the full reports are not yet available, though it is to be hoped that they soon will be. All contributions to our knowledge of our own mineral resources are of the greatest value to the nation at the present time. H. LOUIS.

TROPICAL QUEENSLAND.[1]

THE author does well to remind us that much of Queensland is tropical, and that it possesses the largest barrier reef in the world, enclosing a lagoon of immense size and possibly of great potential wealth in pearls, pearl-shell, bêche-de-mer (trepang), fish, and perhaps some day sponges as well. Here, on Hinchinbrook, a coastal island made known to us by his "Confessions of a Beachcomber," the author ruminates on the birds, beasts, and plants around him, a true beachcomber far from and almost uninterested in the world's affairs, content to bask in the suns of his Arcady. All is delightful; the greatest men of the past are those born in the lands of the sun; the planter tills not, but "permits Nature to have her own wayward will with his dutiful trees"; "vegetation does not tolerate any period of rest," and here are "many lusty, fat, sleek, good-humoured, straight-backed, frolicsome calves." It is impossible to criticise from the point of view of science, since the author's writing partakes of the Arcadian nature of his pursuits. The power of observation of, and a feeling for, the important facts of life in all living Nature the author certainly has, but we have the uneasy feeling that he has set out to write a book, whereas in his "Confessions" he poured out his soul and gave us a book of permanent value. "Tropic Days" is, however, thoroughly pleasant chat, well fitted for one's lighter hours, and as such likely to appeal to a wide circle of readers.

Descriptions of trees and plants are always excellent, and a charming individuality is given to certain trees of the domain. A chapter on beach plants reveals in this environment practically the same types of growths and plants as are found in

[1] "Tropic Days." By E. J. Banfield. Pp. 313. (London: T. Fisher Unwin, Ltd., 1918.) Price 16*s.* net.

the most distant coral islands of the Indo-Pacific with but few additions from neighbouring continental shores. The same is true also of sea and shore birds, but neighbouring lands give many visitors, which quickly learn to eat what man cultivates. A photograph of a baby nightjar in dead leaves is excellent, and, indeed, requires its explanatory diagram to point out the bird. We like the idea of a conchological (not floral) almanac, for we have ourselves noticed in the tropics the regularity of the approach to the shores, the coming up from the deep, of many Trochi, etc., almost as regular as the "balolo" worm obeys the call of an especial phase of the moon at the same season of every year. In "Snake and Frog Prattle" the author as naturalist is at his best. His true character as a man is perhaps shown in "Time's Finger," a simple, eloquent account of a solitary climb into the "debil-debil" land where his "boy" dare not come; it is a story of adventure in which the author nearly lost his life, and it gives also a remarkable picture of how tropical jungle manages to conquer even perpendicular granite slopes. The domination of multi-rooted trees, banyans (fig trees), mangroves, and screw-pines (Pandani) is typical of tropical moist jungles. For the ethnologist there are a few stories of natives, and we particularly commend to those who dwell at home the psychology of "Cassowary" and "Soosie" as typical, the produce "of the very land on which they were born." "Blacks as Fishermen" is interesting rather as a study of facts. J. S. G.

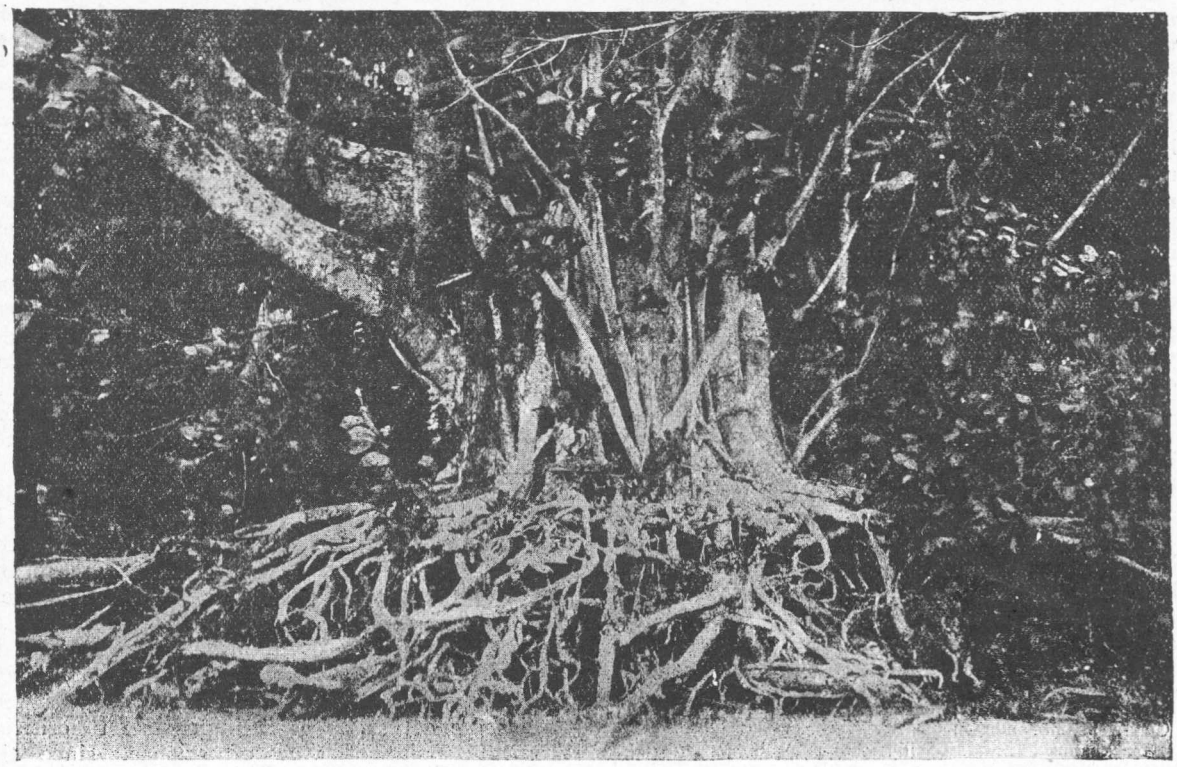

FIG. 1.—A banyan tree: stilt and buttress roots. From "Tropic Days."

AGRICULTURAL RESEARCH IN AUSTRALIA.

WITH the growing demand for intensified agricultural production occasioned by the war has come the realisation of the inadequacy of the existing provision for agricultural research in all parts of the world. The movement towards more generous and systematic provision is by no means confined to the older, more highly cultivated countries, but is perhaps even more active in those more distant parts of the globe where increased production on a large scale by extensive methods is still possible. Few countries, indeed, have set about this particular task of reconstruction more systematically and energetically than the Commonwealth of Australia, the prosperity of which is so closely bound up with the fortunes of her great agricultural industry.

For three decades or more Australian agriculture has had the advantage of liberal provision for agricultural education and research under the ægis of the various State Departments of Agriculture. These Departments have not only established agricultural colleges with associated experimental farms, but other farms and laboratories for general experimental work have also been developed, as well as centres for the specialised investigation of different branches of agriculture, such as viticulture, dairying, sugar production, and irrigation.

Most of the experimental farms are of great size, and admirably equipped for field experimental

work. The Roseworthy Agricultural College Experimental Farm in South Australia covers about 1600 acres, with 100 acres in permanent experiments; the Hawkesbury College Farm in New South Wales extends to 3500 acres, with more than 200 acres of experimental plots; whilst the Victorian State College Farm at Dookie has an area of about 4500 acres, with some 400 acres devoted to experimental work with cereal and fodder plants. In all there are in the various States about thirty experimental stations, with a total farm area of nearly 50,000 acres, in addition to numerous experimental orchards, vineyards, and other areas.

Armed with this extensive equipment, the Australian State and college workers have achieved very substantial advances in agricultural production, of which the development of new varieties of wheat deserves special mention. Since the federation of the States into the Commonwealth in 1901, however, there has been a growing feeling in favour of a central Federal organisation to secure greater co-ordination of effort and reduce the overlapping inevitable under the existing State systems. Many important problems that are receiving or require attention are common to the greater part of Australia, and could obviously be dealt with more effectively and with greater economy of means and men by a central organisation than by independent investigation in the different States.

A similar need has also been felt in connection with other industries, and the whole movement has culminated in the recommendation by the Commonwealth Advisory Council of Science and Industry for the immediate creation of a permanent Commonwealth Institute of Science and Industry, organised purely for research, and entirely dissociated from routine administrative work. The executive committee, under Prof. D. Orme Masson, and including other prominent agricultural investigators, has devoted a large share of its attention to agricultural research, and in the final report has formulated a definite programme of agricultural research for the initial years of operation of the institute, which includes studies in soil fertility, plant pathology and insect pests, plant breeding, animal breeding and feeding, animal diseases, cotton and flax growing, forestry, and other subjects. The Advisory Council has pressed for immediate action, and the general features of the organisation and lines of work have already received the provisional approval of the Commonwealth Government, and doubtless formal adoption will not long be delayed.

Among the many activities of the executive committee of the Council, special interest attaches to the week's conference of agricultural men of science held under its auspices in Melbourne in November, 1917, and reported in full in Bulletin No. 7 of the Advisory Council. Limitations of space prevent more than the briefest reference to the varied programme dealt with by the conference, the topics discussed including cereal breeding, the acclimatisation of plants, the utilisation of Australian phosphate deposits, the tobacco and sugar industries, fibre-plants, native grasses and fodder plants, and crops for the production of power alcohol.

One session was devoted entirely to a general discussion on the endowment and co-ordination of agricultural research in the Commonwealth, papers on the subject being read by Prof. A. J. Perkins, Director of Agriculture in South Australia, and Prof. R. D. Watt, professor of agriculture in the University of Sydney.

Prof. Perkins urged that the research worker should be free from State control, and advocated the development of agricultural research at the universities rather than in the State agricultural colleges. For this purpose central research institutions, financed by the central Government, should be located at the different universities. The University of Adelaide has already secured land for the purpose, but financial assistance is required to develop the scheme.

Prof. Watt also emphasised the importance of developing agricultural research at the universities, but pointed out that the rate of increase in the number of trained research workers must be slow, owing to the small numbers of agricultural students at the universities and the consequent limitations of staff. He hoped for better conditions in this respect after the war, especially if provision could be made for research scholarships and fellowships.

The shortage of adequately trained research workers was generally agreed to be one of the chief difficulties in the way of the necessary expansion of research activities, and a resolution was adopted requesting the Advisory Council to bring the need for training more research workers to the attention of the universities. The difficulty is by no means peculiar to Australia, and all concerned with the promotion of agricultural research will await with interest the steps taken in Australia to solve this particular problem.

REGINALD PHILIP GREGORY.

BY the death on Sunday, November 24, of Mr. Reginald Philip Gregory, from pneumonia following influenza, the University of Cambridge has lost an able botanist, a man for whom young and old felt a warm affection. Mr. Gregory was born on June 7, 1879, at Trowbridge, Wilts; he received practically the whole of his early education in a preparatory school established in 1887 by his mother at Weston-super-Mare, where special attention was paid to natural history. At the suggestion of Prof. Reynolds, of University College, Bristol, from whom he received some additional training, he successfully competed for an entrance scholarship at St. John's College, Cambridge, in 1897. He came into residence in October, 1898, and in 1900 obtained a first class in the first part of the Natural Sciences Tripos; in

1902 he gained a first class in botany in the second part of the Tripos.

In 1904 Mr. Gregory shared the Walsingham medal with the late Dr. Keith Lucas, and in the same year he was elected a fellow of his college. In 1907, after serving five years as a demonstrator in the botanical department, he was elected to a University lectureship. In 1912 he became tutor of St. John's, an appointment which he was able to hold with the University lectureship; and in the same year he married Joan, the second daughter of Mr. T. E. Bisdee, of Hutton Court, Somerset, by whom he had three children. From July, 1915, to July, 1917, he held a captain's commission in an officer cadet battalion at Cambridge, which he relinquished to join the 1st/6th Battalion of the Gloucestershire Regiment as a second-lieutenant. After about a fortnight in the front line he was gassed, and from the effects of this he never completely recovered; he was discharged from the Army in October of this year, and, though still far from well, resumed his college and university duties.

Mr. Gregory was one of a group of students who were stimulated by the teaching and enthusiasm of Prof. Bateson to take up different branches of genetics; it was mainly with cytological problems that his researches were concerned. He was the author of several papers, some of which were published in the Proceedings of the Royal Society in collaboration with Prof. Bateson. His most important contributions were those dealing with the genetics and cytology of giant races of Primula, published in the *Journal of Genetics* (1911) and in the Proceedings of the Royal Society (1914). His work demonstrated the striking fact that some forms of Primula exhibit the giant character not only in the plant-body as a whole, but also in the constituent cells. The results obtained constituted a definite advance in our knowledge of phenomena connected with the reduplication of certain terms in a series of gametes. His researches also included the investigation of heterostylism, habit, leaf-form, and flower colour in *Primula sinensis*, the seed characters of Pisum, reduction-division in ferns, forms of flowers in Valeriana, and other subjects.

Mr. Gregory was a good all-round botanist, who inherited from his mother (whose work on the genus Viola is well known to systematists) a love of natural history. He had already established for himself an honourable position as an original investigator, and those who knew him best looked forward with confidence to still greater achievements in the future. He was a man who would never grow old; he enjoyed life in the best sense, and endeared himself to undergraduates and older associates by his unselfishness and joyous, open-hearted character. His place will be hard to fill, particularly in these days when there is an exceptional need for virile teachers and men of wide and strong human sympathies.

A. C. SEWARD.

NOTES.

IN his speech at Wolverhampton on Saturday last the Prime Minister made a noteworthy declaration in regard to the application of science to agriculture—a declaration which would appear to adumbrate something more than a passive policy of commendation. "Scientific farming *must* be promoted," he said; and in another passage he spoke of utilising the capacity of the soil to a greater extent by the application of scientific principles. There is a certain vagueness in these statements, and until concrete proposals are put forward it is difficult to appraise their meaning and value. One obvious way of adding to the capacity of the soil would be to promote the use of artificial fertilisers, and, seeing that Mr. Lloyd George also spoke of the need for a "national supply of fertilisers," it seems probable that what he had in mind in speaking of scientific farming was the extended use of artificial manures. The suggestion—or is it a decision?—to have a national supply of fertilisers foreshadows a new departure in State policy of great import. It is to be hoped that in applying science to farming the Prime Minister will bear in mind the need for encouraging research in the sciences bearing on agriculture.

A DEPUTATION from the National Sea Fisheries Protection Association is to wait upon the Right Hon. R. E. Prothero, President of the Board of Agriculture and Fisheries, as we go to press, to urge that the evolution and general direction of a fisheries policy for the whole nation should be entrusted to a Minister of the Crown who will be able to give to the subject his undivided interest. The industry is of prime importance, and a strong case can be made out for the constitution of a separate Ministry to be concerned with its interests and development. Mr. Hoover, the United States Food Administrator, whom we welcome among us, has warned us time and again of the fact that for many years to come the world must go short of beef. The impending meat famine, he tells us, started in 1907. In meat-eating countries the population increased. The demand for meat rose; prices rose; stockmen yielded to the temptation, and slaughtered cows, heifers, and calves which should have been kept as *reproducteurs*. The herds have further been diminished by periods of drought in Argentina, Australia, and North America, and by internecine strife in Mexico and Europe. Whatever happens, we shall be short of meat for years to come. That is one ground on which the National Sea Fisheries Protection Association bases its claim for reform of the fisheries administration of this country. The other considerations are: that fishermen will not undertake the catching of fish—a herculean labour of unending toil—unless there is a good living to be made out of fishing; that their industry has been so disorganised during the war that nothing short of national assistance can save it; and (a self-evident proposition) that these islands must maintain their fishermen communities or "go under." Such, in brief, is the case which the association presents to the Government. It has been worked out in detail in a printed memorandum which we commend to the study of our readers. Copies can be obtained from the secretary of the association at Fishmongers' Hall, E.C.4. We wish well to the deputation and to Mr. Prothero. Meanwhile, we note that there is a great degree of unanimity in the demand of the industry for a central Ministry to supervise the work of the English and Scottish fisheries services, and that the fishermen of Canada,

France, and Germany are demanding similar consolidation of effort from their respective Governments. Fishermen know their business, and there is a strong presumption that their demands are reasonable.

THE *Times* for November 25 gives an interesting forecast of the report of the Civil Aerial Transport Committee, which has now been presented to Parliament, but will not be published until the New Year. It will be remembered that this Committee was appointed in May, 1917, to consider the regulation of commercial air traffic and the possibility of employing existing machines and *personnel* for commercial purposes after the war. The Committee has divided itself into various sub-committees, dealing with various issues, and the main conclusions reached, as foreshadowed in the *Times*, are here summarised. With regard to the sovereignty of the air, it has been recommended that any country must exercise sovereign rights over the superincumbent air if commercial aviation is to be properly regulated and controlled. Such points as the qualifications for using aircraft, registration, and the problems arising in connection with damage caused by aircraft have been thoroughly discussed. In dealing with the possibilities of existing machines, four types have been considered, represented by the Handley-Page, the de Haviland, the R.E.8, and the Sopwith "Pup." The first two types are naturally the most interesting, being both capable of carrying considerable loads. The lighter machines may, however, be of much assistance to commercial activities in connection with the rapid transport of passengers and small quantities of goods.

THE Committee referred to above expresses the opinion that speed of aircraft is probably the chief factor for commercial success, especially for inland routes, where an express train service is available as an alternative. For isolated spots and sea passages speed will not be so important. A speed of 100 miles per hour is suggested, and this is sufficiently difficult to attain with heavy machines on account of the high landing speed involved, especially if the wing-loading is high. The Committee directs attention to this point, stating definitely that a high loading is a necessity for commercial success, and suggesting that a development of air-brakes or arresting devices may meet the difficulty. Night-flying is considered essential, particularly in relation to mail services, and the development of existing facilities should be encouraged. Those interested in commercial aeronautics will await with interest the publication of the full report, but the above brief remarks will suffice to show that the difficulties to be surmounted are considerable, and will tax the powers of designers to the utmost. The wonderful progress that has been made with military aircraft should prove a great stimulus, and if similar facilities for experimental research can be applied to the commercial problem, we may well look forward to a period of rapid development and success.

RAPID strides have been made by the Meteorological Office in weather knowledge during the progress of the war, and the information available for the newspaper Press is vastly superior now to that of four years ago. The rapid development of the Air Service has entailed a more minute study of the upper air, and facts of really scientific value are being secured. It is now suggested that the changes in atmospheric pressure at the earth's surface are controlled by the atmospheric pressure at the elevation of about five or six miles. Pilot-balloon observations are now made daily in many different parts of the British Isles, and these are charted for the several elevations up to 10,000 ft. or 15,000 ft. Since the weather has again become public information, the pilot-balloon observations have shown many points of interest. During the progress of a storm area on its north-easterly course to the westward of Ireland on November 20 the surface-wind at Valencia was travelling at twenty-nine miles an hour, whilst at 2000-ft. elevation it was travelling seventy miles an hour. On November 22, with a surface-wind of thirteen miles an hour, the rate per hour at 4000 ft. was fifty-three miles, the direction in both cases being south-easterly.

THE Registrar-General's return for the week ending November 16 shows a very decided decrease in the deaths in London from influenza, the number being 1665, while for November 9 it was 2433, a decrease of 768. At many places in the English provinces the complaint is still virulent, and the deaths show no abatement. The death incidence at the several ages is well maintained, the deaths between the ages of twenty and forty-five being 46 per cent. of the total, and the deaths below forty-five years being 77 per cent., whilst above forty-five years the percentage is only 23. Influenza was responsible for 49 per cent. of the deaths from all causes during the week, pneumonia for 14 per cent., and bronchitis for 7 per cent. For the whole six weeks of the epidemic influenza has caused 48 per cent. of the deaths from all causes, pneumonia 12 per cent., and bronchitis 6 per cent. Chicago, with nearly two-thirds of the population of London, had 571 deaths from influenza in the week ending October 12, when London had eighty deaths only, showing that the disease was rampant earlier in Chicago.

AN appeal has been issued by the president of the Royal Society of Antiquaries of Ireland, supported by representatives of other associations interested in Irish antiquities, on the subject of an inventory of the local archæological remains. The writers point out that the antiquities of Ireland possess more than local interest, and that in comparison with those of Great Britain they are more numerous. In recent years, owing to the changing conditions of land tenure, the abandonment of old superstitions, the imperfection of the system of local education, the extension of tillage, and other causes, much damage has been done to these monuments. It is pointed out that in 1908 three Royal Commissions were appointed for the purpose of making detailed inventories of the ancient monuments of England, Scotland, and Wales, as a result of which a large mass of important information has been collected and published. But, so far, no steps have been taken to institute a similar survey in Ireland, and an appeal by the Royal Society of Antiquaries and the Royal Irish Academy has been rejected. The request of this important body of antiquaries is clearly reasonable, and will, we have little doubt, receive hearty support from antiquaries in Great Britain.

IT has long been recognised that whilst the open fire is at once attractive, and furnishes practically the only means of ventilation of ordinary dwellings, its heat efficiency is remarkably low. The shortage of coal and its high price—the latter a legacy which will probably remain to the householder—furnish ample incentive to improve the efficiency of the domestic grate, but the replacement of even a small part of the number by more scientifically constructed appliances is obviously out of the question. Landlords will not go to the expense to save tenants' pockets, and tenants are equally averse to incurring expense which in most cases would benefit others. Means may, however, be found to improve the efficiency of existing grates, and Prof. C. V. Boys has invented an economiser in which the flue-gases are diverted on their way to the

chimney through two upright cylinders, standing one on each side of the fireplace, each cylinder surrounding a concentric pipe which is open above and below. The flue-gases pass through the annular space thus formed on their way to the chimney, heating the inner tube and causing a current of warm air to be discharged into the room; also the surrounding air is warmed by contact with the exterior of the flue-gas chambers. The fire remains visible and radiates as usual. It is admitted that such a device is not altogether ornamental, but people may be willing to accept this disadvantage in view of the advantage of added warmth for a given consumption of fuel.

THE death is recorded in *Science* of Prof. W. L. Hooper, head of the department of electrical engineering at Tufts College, Mass. Prof. Hooper had been a member of the faculty at Tufts for thirty-five years, and was acting president in 1912 and 1913.

THE death is announced, in his seventy-fourth year, of Prof. William Main, formerly professor of chemistry in the University of North Carolina. Prof. Main was one of the pioneers in copper and lead mining in the United States. He invented the lead-zinc storage battery, and is said to have been the first to apply the storage battery commercially to the propulsion of street-cars. In recent years he had been chiefly employed as an expert in technical cases before the courts.

LT.-COL. LLEWELLYN LONGSTAFF, whose death at the age of seventy-seven is announced by the *Times*, was known to geographers chiefly for his generous support of Antarctic exploration. The funds for the projected national expedition were growing so slowly that there seemed little hope of enough being collected to equip even a modest expedition when in March, 1899, Col. Longstaff sent a contribution of 25,000*l*., which, with contributions already in hand, guaranteed the sailing of the ship. Two years later the expedition sailed in the *Discovery* under Capt. Scott. Col. Longstaff also contributed to Capt. Scott's last expedition. Most of his life he devoted to business, and he was keenly interested in volunteering. For more than forty years he had been a fellow of the Royal Geographical Society, and served for some time on its council. His eldest son, Capt. T. G. Longstaff, is well known for his travels and explorations in the Caucasus, Himalayas, and Tibet.

THE success of the British Scientific Products Exhibition, held at King's College, London, during the past summer, has led the British Science Guild to decide to organise another exhibition next year. The main object of the new exhibition will be to stimulate national enterprise by a display of the year's progress in British science, invention, and industry. Further particulars will be available in due course. A large part of the recent exhibition has been transferred to Manchester, where it will be on view at the Municipal College of Technology in a few weeks' time.

THE Cecil medal and prize of 10*l*. of the Dorset Field Club will be awarded in May next for the best essay on "explosives used in warfare from the time of the Crusades to the present war, giving details (unobjectionable from a military point of view) of each invention, and the chemical proportions of the substances used in each case, commencing with gunpowder and Greek fire." The competition is open to persons between the ages of seventeen and thirty-five on May 1, 1919, either born in Dorset or resident not less than a year between May 1, 1917, and May 1, 1919. Particulars are obtainable from Mr. H. Pouncy, Midland Bank Chambers, Dorchester.

THE *Museum Journal*, published by the University of Pennsylvania (vol. ix., part 2, June, 1918), is largely devoted to a study of works of art from the Far and Nearer East. In primitive Chinese ritual bronze vessels were used to hold the food and drink offered to the spirits of the earth and air and the manes of departed ancestors. Two valuable specimens of this class of vessel, one belonging in all probability to a period well back in the first millennium before our era, the other dated during the twelfth or eleventh century B.C., are described. Of these the ornamentation, though bizarre, is singularly effective in conforming to the exigencies of the space to be covered. The Bronze age in China is believed to have drawn to a close about the middle of the first millennium before our era. For religious purposes, however, bronze continued to hold its own, and it was not for another millennium, or until the sixth or seventh century A.D., that the art of the bronze-worker may be said to have attained its apogee with the casting of those wonderful gigantic statues which characterised the religious enthusiasm prevailing in China of the Northern Wei (A.D. 386–535) and T'ang (A.D. 618–907) dynasties, of which the sole remaining example in the world to-day is the great Daibutsu at Nara, the ancient capital of Japan.

FURTHER light on the respiration of larval dragonflies is afforded by Mr. Joseph H. Bodine in the Proceedings of the Academy of Natural Sciences of Philadelphia (vol. lxx., part 1). The author shows that these larvæ breathe by means of the rectum from the time of hatching until transformation. The so-called tracheal "gills" serve but as rudders during locomotion, and take no part in respiration, as is shown by the fact that they may be removed with impunity. That respiration takes place through the skin of the larva he regards as improbable, since any oxygen thus absorbed would be quite insufficient for respiratory purposes.

THE significance of specific structural characters as between nearly related species is variously interpreted by evolutionists, who are prone, in discussing this theme, to neglect the work of the systematists who are providing an immense store of material for analysis. Larval characters are especially interesting in this regard, as will be manifest on a careful examination of the enlarged figures of the mouth-parts of tadpoles given by Dr. N. Annandale in his papers on "Some Undescribed Tadpoles from the Hills of Southern India" and on "The Tadpoles of the Families Randidæ and Bufonidæ Found in the Plains of India" in the Records of the Indian Museum (vol. xv., part 1).

AS is well known, surgeons insert grafts of living bone to supply defects caused by destructive injuries, but there is a difference of opinion as to the fate of such bone grafts. The opinion most usually held is that they always die, and that they merely help recovery by supplying a framework which is invaded by neighbouring living-bone cells. The view that grafts are purely passive in their action is supported by experiments reported by MM. J. Nageotte and L. Sencert (*Comptes rendus*, October 21). So far as all forms of connective tissue are concerned, the authors find that grafts which have been preserved in formalin or alcohol for a month or more serve all the purposes of a living graft. The dead fibre of the graft unites with the living fibre of the host, so that the point of union cannot be detected. The authors excised from the common extensor tendon of a dog's foot a piece 2·5 cm. long, and stitched in its place a corresponding piece of tendon which had been kept in alcohol for

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a month. When the dog was killed three months later it was found that the dead graft had become so perfectly united with the original tendon that its position could be detected only by the marks of the stitches. It is unnecessary to emphasise the importance of these observations to military surgeons.

THE Eskimo of Greenland have a term, "savssat," to denote the crowding of animals in large numbers into a small space. This phenomenon has been referred to by several writers on Greenland. Mr. M. P. Porsild, director of the Danish Arctic Station at Disko, has some notes on the subject from personal observations in Disko Bay in the *Geographical Review* for September, 1918 (vol. vi., No. 3). In the winter of 1914–15 the ice-covering began to form at the outer end of Disko Bay, and the inner parts were closed later. This resulted in many narwhals being caught at the head of the bay and in Waygat Sound. The Eskimo discovered belts of thin ice in which the narwhals had broken breathing-holes. Around these holes the Eskimo collected and slaughtered the animals as they appeared. Allowing for carcasses lost, Mr. Porsild calculates the total number of narwhals killed at two "savssats" at more than a thousand. It is interesting to note that Mr. Porsild, who has had good opportunities to judge, denies that the male narwhal uses his tusk to make breathing-holes in the ice. These, he insists, are made by the top of the head. Eskimo confirm this view.

THE October issue of the *Journal of the Board of Agriculture* is essentially a women's work number, and gives an interesting survey of the great contribution made by women to the national food production effort of the past two years. Separate articles descriptive of various phases of the work of the Women's Branch of the Food Production Department are contributed by Miss Meriel M. Talbot, the Hon. Mrs. Alfred Lyttelton, and Miss M. M. McQueen, the principal officers of the branch. The work of the women of Wales is described by Mrs. M. S. Roberts; the work of women's institutes by Miss G. Hadow, vice-chairman of the National Federation of Women's Institutes; whilst Miss S. C. Hamlyn contributes an interesting account of a successful Devon experiment in the running of a farm entirely by women. The series is prefaced by a very suggestive article by Sir Daniel Hall on the position of women in agriculture. The problem of providing suitable openings for the many trained women who are now determined to remain upon the land and take up farming as a career he believes can best be solved by large farms worked entirely by women upon co-partnership lines. The small holding he regards as too speculative for the woman with little capital, and demands, moreover, an expenditure of physical energy which is beyond the powers of the average woman. The return to the small-holder is probably no greater than can be secured for the individual woman worker on the large co-partnership farm, provided it is carefully selected and well managed. He suggests that a trial should be made with a farm of about five hundred acres, devoted mainly to fruit-growing and market-gardening. Estimates are given which indicate that with reasonable success, after making due provision for interest on capital, management, wages, and reserve, a surplus should be available for distribution which would raise the weekly wage from 25*s*. to 40*s*. The provision of living accommodation and social amenities for the women workers is considered, and suggestions are given for the establishment and organisation of a community system, including communal buildings and cottages.

WE have received a copy of the first issue of the *South African Geographical Journal*, which is the publication of the South African Geographical Society formed last year at Johannesburg. The journal is edited by Mr. J. Hutcheon, of the School of Mines and Technology, who contributes an introductory article on the aims of the society. It is hoped "to raise the standard and to safeguard the interests of the subject and those teaching it, to encourage geographical research," and to arouse interest in geography in South Africa. The society has in view the institution of travelling scholarships and the organisation of long-vacation excursions to India, Australia, Europe, etc. The journal is mainly occupied with reports of lectures delivered before the society, but contains an important article by Prof. J. W. Bews on "South African Phytogeography." The author gives the characteristics and distribution of fifteen types of vegetation, which he suggests as the basis of a botanical map of South Africa.

IN the *Scientific American* for October 12 Mr. E. C. Horst describes a new industry which has sprung up in California with the support of the American Government. This is the drying of vegetables for export. It is done by placing slices of cleaned fresh vegetables, grown in the vicinity, on perforated trays packed in a room through which a current of warm, dry air is driven by fans. This slowly extracts the 65 to 85 per cent. of moisture the vegetables contain without, it appears, destroying their flavour when water is afterwards added to them. The dried vegetables are packed in cartons and tins of about 10 lb. weight. Millions of these tins have been sent to France, and one of the establishments on the Pacific coast now employs several thousand persons.

THE Board of Science and Art, New Zealand, has decided on the bi-monthly publication of a *New Zealand Journal of Science and Technology*, together with additional bulletins in which papers too long for the ordinary journal will appear. This is an extension of the scheme authorised by the Government for the co-ordination of all papers and reports of a scientific nature. Already the official issues include the *Journal of Agriculture*, and bulletins and palæontological bulletins of the Geological Survey Department, and the bulletins of the Dominion Museum. The first of the new series of bulletins records the investigations of H. Rands and W. O. R. Gilling, national research scholars of the Canterbury University College, Christchurch, on the use of New Zealand brown coals, of which Prof. Park estimated the reserves at 521,000,000 tons, and of which only about 13,000,000 tons had been mined to the end of 1913. The two sections of Bulletin I. deal with the use of these brown coals in gas producers and the products yielded by low-temperature distillation.

A PAMPHLET describing the Fahy permeameter has been received from Mr. E. H. Alexander, of Coleshill Street, Birmingham, who is the agent for their sale in this country. The great commercial importance of a knowledge of the magnetic qualities of samples of iron and the time and labour involved in testing them by the standard ring method has led to the invention of numerous permeameters. Searle's magnetic square was one of the earliest types, and modifications of Ewing's yoke method have been extensively used. The Burrows permeameter has been officially adopted by the American Society for Testing Materials. In the Fahy permeameter we have an **H**-shaped piece of iron, the magnetising coil surrounding the horizontal bar, and the magnetic flux

returning by the two gaps at the top and bottom of the vertical lines. One of these gaps is spanned by the sample steel bar to be tested, and the magnetising forces across this sample and across the remaining air-gap are adjusted by means of compensating and test coils until they have the same value. Hence the magnetising force on the bar—which is always the difficult thing to measure—can be found. The magnetic induction is measured in the ordinary way by reversing the current in the magnetising coil and noting the deflection produced on a ballistic galvanometer in series with a search coil. It would appear from the tests made by the U.S. Bureau of Standards that the accuracy of the permeameter is of the order of 5 per cent. Since the magnetic properties of a strip of transformer steel usually vary by this amount at different parts along its length, the accuracy obtained is satisfactory. So far as we know, however, the Drysdale permeameter is the only one that professes to test the magnetic properties at different parts of a large block of iron. In this a special tool is used to bore into the iron, so that parts of it can be tested *in situ*.

THE line of the New Zealand Government railways between Christchurch and Timaru is the easiest stretch in New Zealand; it is straight and almost level for nearly the whole distance, but express trains frequently involve loads of more than 400 tons behind the tender, and the prevalent north-west gales make flange resistance heavy. The gauge is 3 ft. 6 in., and the trains were formerly worked by four-cylinder balanced, compound locomotives of the Pacific type. *Engineering* for November 22 contains an illustrated account of some new non-compound engines for this service, designed by Mr. H. H. Jackson, chief mechanical engineer. Superheated steam of 180 lb. per sq. in. pressure is used, with 54-in. coupled wheels and 17 in. by 26 in. cylinders. The valve gear is of the Walschaert type, with piston valves. The new engines have been tested against the best compound engines available, and show a saving of 20 per cent. in water and 33 per cent. in coal, including coal used in making up the fire each morning and during the two hours' stand over at Timaru. Part of the saving is undoubtedly due to the boiler, which is easily the best steaming boiler seen on a locomotive in New Zealand, and of this saving part again is directly due to superheating. The records of the hauling performances are also very good.

THE current issue of Mr. C. Baker's quarterly list of second-hand instruments for sale or hire will repay careful examination by scientific workers. The catalogue contains descriptions of more than 1500 pieces of scientific apparatus, nearly all of which can be examined at 244 High Holborn, W.C.1. Great prominence is given in the list to microscopes and accessories, astronomical and terrestrial telescopes, theodolites, spectroscopes, projection and photographic apparatus, as well as to general physical apparatus.

OUR ASTRONOMICAL COLUMN.

COMETS: WOLF'S AND BORRELLY'S.—Ephemeris of Wolf's comet for Greenwich midnight:—

		R.A.	S. Decl.	Log r	Log Δ
		h. m. s.	° ′		
Dec.	2	22 19 27	2 53	0·2003	0·1204
	6	22 30 22	3 17	0·1996	0·1294
	10	22 41 26	3 36	0·1994	0·1367
	14	22 52 34	3 51	0·1992	0·1480
	18	23 3 47	4 1	0·1995	0·1576
	22	23 15 2	4 6	0·2000	0·1672
	26	23 26 19	4 8	0·2008	0·1769
	30	23 37 34	4 5	0·2019	0·1867

The comet reaches perihelion on December 13, but, owing to its increasing distance from the earth, it is not likely to be brighter than the 12th or 13th magnitude.

The following is an approximate ephemeris of Borrelly's comet for Greenwich midnight:—

		R.A.	N. Decl.	Log r	Log Δ
		h. m. s.	° ′		
Dec.	4	7 3 13	31 46	0·1497	9·6795
	8	7 3 2	36 20		
	12	7 2 12	40 45	0·1545	9·6832
	16	7 0 35	44 59		
	20	6 58 5	48 55	0·1610	9·7043
	24	6 54 11	52 25		
	28	6 49 50	55 29	0·1687	9·7382

The comet is less than half an astronomical unit from the earth during the first half of December. It should be an easy object in small telescopes. The high north declination renders the comet observable throughout the night.

THE ORBIT OF 83 AQUARII.—For the second time Dr. R. G. Aitken has deduced the orbit of a visual binary star, all the work on which, including the discovery and measurers, has been carried out by himself (Lick Observatory Bulletin No. 317). The star in question is 83 Aquarii (=A 417), and was noted as a close pair with components of equal brightness in 1902. Until 1912 the angular motion was nearly uniform, but in the last few years the motion has been extremely rapid, and the apparent distance so small as to make the pair difficult to measure even in the 36-in. telescope. The provisional elements of the orbit, with their computed probable errors, are as follows:—

$P = 23{\cdot}82 \pm 1{\cdot}37$ years	$\omega = 261{\cdot}3° \pm 5{\cdot}4°$
$T = 1917{\cdot}68 \pm 0{\cdot}20$ year	$i = \pm 56{\cdot}35° \pm 4{\cdot}1°$
$e = 0{\cdot}404 \pm 0{\cdot}016$	$\Omega = 21{\cdot}6° \pm 2{\cdot}4°$
$a = 0{\cdot}245'' \pm 0{\cdot}005''$	

THE SPECTRUM OF NOVA AQUILÆ.—An important contribution to the spectroscopic study of Nova Aquilæ has been made by Dr. J. S. Plaskett, who has obtained a large number of photographs with a single-prism spectrograph attached to the new 6-ft. reflecting telescope of the Dominion Astrophysical Observatory at Victoria, B.C. (Journ. R.A.S. Canada, vol. xii., p. 350). Some of the photographs are remarkable for their great extension into the ultra-violet, as many as nineteen lines of the hydrogen series having been measured on June 19. The description of the changes recorded agrees closely with the accounts given by other observers. A change towards the nebular stage was noted on June 20, when the lines 5007, 4685, and 4363 began to show, and on July 11 the nebular stage was strongly marked. The displacement of the first set of hydrogen absorption lines increased at Hγ from 20·5 A on June 10 to 25·4 A on June 24, and from June 10 to June 15 there was a second set having a displacement of 33 A to the violet at Hγ. The measured positions of these lines agree with the positions computed by Balmer's formula when the constant is changed from 3646·13 to 3625·78 for the first and to 3618·4 for the second component on June 15. The positions of some sixty-five metallic lines, identified chiefly as enhanced lines of Ti, Fe, Cr, Sr, Sc, and V, were measured on the spectra from June 10 to June 15, and it has been shown that the displacements of these were also proportional to the wave-length, and were exactly the same as those of the hydrogen absorption lines. Dr. Plaskett considers it more likely that the displacements are due to some physical cause acting in the same manner on the molecules of all the elements involved than to velocity.

ORBITAL DISTRIBUTION OF THE ASTEROIDS.

PROF. K. HIRAYAMA has published further papers on this subject (*Annales de l'Observatoire Astronomique de Tokyo*, Appendices 2, 4, 5, and 6), which was referred to in a note in NATURE for March 21 last (vol. ci., p. 53). These papers may be divided into two parts: (1) an examination of the various kinds of libration that may take place; (2) a study of the effect of a resisting medium on the asteroid motions.

The first portion is based on Prof. E. W. Brown's paper in Monthly Notices, R.A.S. (vol. lxxii., p. 609). Taking l, n, ϖ, e as the mean longitude, mean motion, mean longitude of perihelion, and eccentricity of an asteroid nearly commensurable with Jupiter, and denoting by accented letters the corresponding elements of Jupiter, n_0 is a quantity nearly equal to n, such that $n_0/n' = s/s'$, where s, s' are small integers. Then $n/n_0 - l$ is denoted by x, and $s'l - sl' + (s-s')\varpi$ is denoted by θ. In the cases of the first order $s-s'=l$, it is shown that the angle θ may either revolve through the whole circle or librate over a limited arc, according to the values of the constants; there are three types for either revolution or libration, viz. they may be on the negative side of x, on both sides of x, or on the positive side of x.

These rules are applied to a large number of orbits, and the following general results are given:—(1) All the asteroids with n less than 500″ librate, forming groups near the commensurable points 1/1 (the Trojan group), 3/2, and 4/3. The last case is that of Saturn's satellites Hyperion and Titan, the conjunctions of which always take place near Hyperion's aposaturnium, thus avoiding near approaches. (2) The asteroids with n above 500″ generally avoid the libration, and thus the gaps at 2/1, 3/1, 5/2, etc., are produced.

The author then proceeds to consider the effect of cosmic dust revolving in circular orbits about the sun on the asteroids. He points out that such dust is likely to be pretty dense in the sun's neighbourhood, and less dense with increasing distance. It is probably eliminated from the regions near the orbits of the planets, but may be present in the asteroid zones. Assuming the resistance to an asteroid to vary as the square of the relative velocity, it is shown that the perturbation of a varies as e^3, that of e as e^2, those of the other elements being insensible. A difficulty arises that if these perturbations are sensible for the asteroids, they should be far more so for comets, the eccentricities of which are so large; it is suggested that, owing to the loose constitution of comets, the result might be partial disintegration instead of a bodily shift. The general effect on asteroid motion is shown to be that the first two types both of libration and revolution are not permanent, but tend to degenerate to the third type. The different cases are discussed in a manner that cannot be reproduced in a brief summary.

In Appendix 6 Prof. Hirayama announces the interesting discovery that there are three families of planets the orbits of which are inter-related in such a manner as strongly to suggest a common origin for each family. He calls them the Koronis, Eos, and Themis families, using in each case the name of the earliest-known member of the family. The Koronis family consists of sixteen asteroids, the mean motion of which lies between 720″ and 740″, and inclination between 0° and 4°, ϕ being also between 0° and 4°. The corresponding limits in the Eos family, which has nineteen members, are 671″ to 682″, 8° to 11°, 2° to 7°. Those in the Themis family, which has twenty-two members, are 622″ to 653″, 0° to 3°, 7° to 12°. Plotting the poles of the orbit-planes of each family, they are found to lie nearly on the circumference of a circle the centre of which is the pole of Jupiter's orbit-plane. Further, taking longitude of perihelion and eccentricity as polar co-ordinates, and plotting a further series of points, these also lie approximately on the circumference of a circle the centre of which lies in the same direction from the origin as the corresponding point for Jupiter's orbit, but its distance from the origin is less than that of the latter point in the ratio of (about) 2 to 3. The author shows that these features would be explained by the perturbations produced by Jupiter, on the assumption that each family once formed a single body or swarm, which afterwards broke up. The discovery sheds new light on the history of the asteroids.

OFFICERS' UNIVERSITY AND TECHNICAL CLASSES.

THE Ministry of Labour some months ago arranged for officers not fit for service to be allowed to spend their time in training for Government posts or for the work they will undertake when released from service. The armistice will cause a great development of this work, which will now include discharged officers as well.

The training already given has been very varied; most of it has been given in universities or technical colleges, but where it has seemed desirable officers have been placed with commercial or industrial firms. While training they receive full pay and allowances, but have to find the fees for the courses they are taking. In most of the universities members of the O.U.T.C. are studying; a large number are taking up engineering, while some are pursuing curricula in the faculties of arts and science. Lately, training for business has been included; this has been developed in Birmingham, and further courses are in process of arrangement at London, Edinburgh, and Bristol.

The courses are "intensive" in most cases, though a proportion of the officers are aiming at a degree. Most of the universities have, very rightly, decided that where their preliminary education is very good they may be admitted to matriculation without examination, and, where possible, excused one year of study and the first examination for a degree, so that they may qualify for graduation after two years of study.

The complete courses are likely—at least, in science and technology—to yield more satisfactory results than the "intensive" ones, which usually last for about ten weeks, and can, therefore, only give satisfactory training to those who merely need to refresh the knowledge they had already gained or to occupy their minds during convalescence.

The Ministry of Labour has assisted universities and colleges to undertake this work by lending them, free of charge, qualified invalided officers to act as temporary lecturers and demonstrators; otherwise much of the work done would have been impossible with the depleted staffs available. Often the officers lent have been graduates who were former students of the institutions which borrowed them.

The Ministry of Pensions will give aid to discharged officers and men who wish to benefit by this scheme and whose means are insufficient to enable them to complete their studies, if these were interrupted by the war.

The Controller of the Department to which this work is entrusted is Mr. G. Home McCall, to whose initiative and energy the success it has already attained is largely due. J. WERTHEIMER.

A SCIENTIFIC RESEARCH ASSOCIATION.

IN the spring of this year steps were taken at Cambridge to form a scientific research association, and a provisional executive committee was appointed to bring the matter before a limited number of selected representatives of the various branches of science throughout the country. The aims of the association were defined as follows:—

(1) To be prepared to offer advice and information to those who wish to devote themselves to scientific research.

(2) To be prepared to give advice to bodies administering public funds for research as to the most useful ways in which such funds could be applied.

(3) To impress upon the attention of the public the importance of scientific research, and thus to promote a wider understanding of the fundamental value of scientific method.

(4) To consider the possibility of organising a scheme of permanent national endowment so as to afford opportunities for young and promising students to establish themselves in research work, and to secure to the ablest of these the possibility of a career devoted mainly to the continued pursuit of scientific investigation.

Widespread and representative support was obtained for the project, seventy fellows of the Royal Society being among those who signified their adhesion to these aims, and this has encouraged the provisional committee to proceed with the work of drafting an outline of the proposed constitution and organisation of the association. This draft, with an explanatory statement of the aims of the association and a first list of supporters, has now been issued in a circular which is abridged below. Though the association had its origin in Cambridge, its activities are, of course, not intended to be limited to Cambridge, but to be national in scope, membership being open to all who have published research or are engaged in research for publication, and associate-membership to all who, without being engaged in research, have its interests at heart. A general meeting will be called in London as soon as possible, to which rules and constitution will be submitted, and at which a governing body and officers will be appointed who will fix the details of organisation. The acting secretary is Mr. A. G. Tansley, F.R.S., Grantchester, Cambridge, to which address applications for membership or for further particulars of the association should be sent.

It is believed that the time is ripe for the formation of a scientific research association to watch over and promote the interests of research in pure science in this country. While applied sceince has recently received a notable stimulus owing to the urgent demands of the war, there is a real danger that the interests of pure science, in spite of recent and very explicit public recognition, may remain neglected. In view of the large projects of reconstruction now occupying the best minds, it seems particularly opportune for men of science to make a concerted effort both to improve the efficiency of their own contribution to national life and to bring home to the mind of the nation the vital importance of science and the scientific method in all departments of national life.

In the first place, it is believed that science requires not only larger endowments, but also more co-ordinated and informed allocation of those endowments than is provided by any existing machinery. It is thought that the best way to construct really adequate machinery is to provide a comprehensive internal system of intelligence as to the research that is actually being done in the various branches of science and of new research as it is projected. Such a system would serve a double function. It would increase the use of existing facilities by putting qualified workers into touch with institutions where the most satisfactory conditions for carrying out their researches already exist, and reciprocally by suggesting to institutions and departments the names of suitable workers. It would also quickly bring to light the deficiencies in existing facilities and enable suggestions to be made for their improvement and increase. Work of this kind is, of course, already done privately and by various bodies, but it is more or less sporadic, casual, and uncoordinated. It is believed that systematic organisation of such intelligence work would be of great value in facilitating and stimulating the carrying out of research.

It is also believed that the best—indeed, the only completely efficient—method of creating the machinery required is to associate together the whole body of men of science on a democratic basis. It is only by such association that really full information can be obtained and impartially sifted.

The governing body of the association would serve as a link between the proposed intelligence organisation and the Government Departments and other public bodies controlling funds available for the endowment of research, acting as an organ of intelligence as to the funds required. There have already been created, under the auspices of the Department of Scientific and Industrial Research, a number of industrial research associations which will keep the Department informed of the needs and progress of industrial research, as well as themselves carrying on research. Making allowance for the difference of conditions, the Scientific Research Association would aim at performing a somewhat similar function in regard to research in pure science, though it would not, of course, itself undertake research.

The association would necessarily acquire a unique body of information as to the existing situation in regard to research, and would thus be in an exceptionally favourable position for suggesting new and promising lines of development. A conspicuous feature of much recent research has been the development of co-operation, not only between different workers in the same branch of science who undertake joint work on problems beyond the power of single workers to cope with, but also between workers in different departments who co-operate in an attack upon border-line problems which require for their solution the contributions of men trained in more than one branch of science. The comprehensive organisation of the association should render it specially capable of facilitating or even of initiating this kind of fruitful co-operation.

No interference with the work of any existing body is contemplated. The association would act as a co-ordinating agency, and would endeavour to co-operate intimately with existing scientific bodies and to assist all efforts of a similar kind that are at present being made. Thus the Medical Research Committee at present attached to the National Health Insurance Department, in addition to initiating and carrying out research on its own account, also performs similar work in regard to medical research. The Scientific Research Association would hope to co-operate with that Committee in regard to research having a direct or indirect bearing on medical problems, rendering the Committee any assistance that might be possible. It has been suggested that

specialist societies representing practically the whole of the research workers in their respective subjects might in some cases be able and willing to carry out the functions contemplated for the subject committees of the association. In such cases, to avoid duplication of organisation, it might perhaps be arranged for the corresponding subject committees to be dispensed with and for the societies in question to have the necessary representation on the association.

But it is felt that the aims of the association should go beyond the better co-ordination of existing work and endowments. There is no doubt that if the national life is to be increasingly vitalised by scientific research and the development of the scientific habit of mind, the ranks of scientific workers must be much more amply reinforced from the best human material. In order to secure such a result it is essential that an assured career should be open to the competent research worker. It is therefore proposed to formulate an extensive scheme of State endowment of research which would afford opportunities for young and promising students to establish themselves in research work and to secure to the ablest of these the opportunity of a career devoted mainly to the continued pursuit of scientific investigation. It is not intended to advocate action which would lead to the separation of research and teaching functions, which are often fruitfully combined in existing circumstances, but rather to secure conditions in which those who are best fitted for research may devote themselves mainly or wholly to research without anxiety.

Finally, it is thought that the association might usefully play a leading part in impressing upon the attention of the public by carefully organised propaganda along definite lines the importance of scientific research in all its aspects, and especially the fundamental value of scientific method in every department of national life and the special claims of pure science to national support.

The proposed organisation and functions include :—

(i) *Information, Intelligence, and Advice.*—(*a*) *Special*, dealing with the needs of and facilities for research in the different branches of science. Organ : *Subject committees* and *secretaries*, intermediary between individuals and institutions. These subject committees and their secretaries would be the most important part of the organisation so far as detailed intelligence work was concerned. They would form a sort of internal nervous system of research in the different subjects, and the threads would be gathered up by the council when it was a question of the need for fresh endowments. The subject committees would not be limited in membership, most of their work being done by correspondence, and would be made really representative of the whole of the research in each subject.

(*b*) *General* intelligence and advisory functions. Organ : *Council, General Purposes Committee, General Secretary*, intermediary between Government and other bodies controlling funds available for research on one hand, and institutions and individuals carrying on research on the other, partly through the agency of the subject committees.

(ii) (*c*) *Propaganda.*—Impressing upon public attention the value and importance of scientific method and scientific research in every department of life. Organ : *Propaganda Committee* and *Propaganda Secretary*.

(iii) (*d*) *Formulation of Scheme of State Endowment of Research.* Organ : *General Purposes Committee* and *Council*.

The proposed working of the organisation here outlined is described in the circular referred to.

SCIENCE AND THE FUTURE.[1]

A MATTER which we now see constantly referred to, in every newspaper and by many public speakers, is what is known as reconstruction—that is to say, the putting of our affairs in order after the finish of the war. Now, undoubtedly the war has been responsible for an enormous amount of destruction of capital; but when estimates are given, as they constantly are given, of the percentage of loss in Belgium, France, Italy, Serbia, and other countries, it is not usually borne in mind that capital does not merely consist of gold and silver, of bricks and mortar, of furniture and fitments, or even of railways, steamships, and machinery—mostly things that in process of time fall into decay—that the main capital of the modern world does not consist of the concrete constructions of labour or of material things at all, but of scientific knowledge. If we could imagine such a catastrophe as destruction on the scale that has recently taken place in the fighting zones spread over the whole civilised world, so that nothing was left anywhere at all of the material handiwork of the past few hundreds of years, this would not necessarily mean the relapse of mankind in general to the savage state of our prehistoric ancestors, who lived before the accumulation of our present priceless scientific knowledge had even begun. That this is so we see clearly from the lessons of the past. For thousands of years the manual labourer has been at work, and untold have been the products of his toil. How many of these products, however, have come down to the present day? Where are now the splendid constructions, the magnificent buildings, the costly and varied manufactures of ancient Babylon, Egypt, Greece, and Rome? A few scattered fragments of a purely antiquarian interest, but of no utilitarian value, are all that are left. The greater portion have entirely disappeared. But not so the products of the ancient mind. These, to a large extent, still endure. For all our industries, all our arts and crafts, and all our sciences have their roots in the distant past. Some knowledge of importance may, in the crash of empires and the great social convulsions that have taken place, have been lost or forgotten, but comparatively not much; while, owing to the invention of printing, and the consequent easy multiplication of records, this is never likely to happen again—at any rate, on a considerable scale.

Thus to reconstruct the material things now temporarily destroyed will take only a very small fraction of the labour that had to be expended, or of the centuries of time that had to pass, while, by slow degrees and arduous effort, man learnt how to bring all these things about. For the mere construction of the material paraphernalia of civilisation is in value as nothing to the knowledge of how to construct them. Taking this into consideration, we recognise the fallacy of the doctrine that all wealth is due to manual labour, and we see how little of the capital of the world is really due to mere handiwork, however skilled, and how much to the mental efforts of exceptional men, who through countless generations, by their investigations, discoveries, and inventions, have rendered possible all our wonderful possessions. When, therefore, we compile estimates of the losses due to the war, let us not forget that our greatest asset, the vast store of knowledge that Science has gathered together for us the heirs of all the ages, is still intact. It is a store that has slowly been accumulating ever since the beginning of the

[1] Abridged from the inaugural address delivered before the Royal Society of Arts on November 20 by the chairman of the council, A. A. Campbell Swinton, F.R.S.

world—a store which enables man more and more to triumph over Nature, and one that for ever remains practically indestructible as the real permanent capital of the race, and by far its most precious heritage.

Now, though the devastation due to the war will in time be readily enough repaired, and this without any call for new scientific invention or discovery, it is otherwise with the general future. Though the doctrine of Malthus—that whilst the population increases in geometrical ratio, the supply of food only increases in arithmetical ratio—is now discredited, the war, in fact, has shown us how nearly the world lives up to its supply of food and other necessaries, and how disturbances, such as those that the war has occasioned, may lead to the disappearance of the little margin there is. Were it not for the aid that Science already affords to agriculture—in mechanical means of cultivation, and in methods of irrigation, fertilisation, and the like, together with facilities as regards transport and countless other matters—neither a country like this nor the whole earth could even now support its present population; whilst in the future, as human beings increase still further, the stress will be accentuated. Whether we are dealing with present-time requirements or with those that are more remote, the shortage of the necessaries of life and of civilisation that is bound to grow in extent, *vis-à-vis* of the increase of the population of the world, can be met only by new achievements in the way of scientific discovery and invention, and by improved and more scientific organisation.

Just as John Stuart Mill feared that the limited number of notes in the audible musical scale would in time lead to the exhaustion of all possible melodies, so there have been those who have thought that scientific discovery would before long come to a stop owing to the dearth of subject-matter and to the limitations of the human intellect. Whatever may be the fact in regard to music, nothing could be more erroneous than this idea in respect to Science, for the reason that every new discovery and invention opens up the path for others, and thus the scientific horizon surely widens year by year. Indeed, so far from discovery and invention being likely to come to a stop, both are sure to extend at a rapidly increasing rate, particularly if we have more science taught to young people and greater encouragement given to scientific workers, with consequent additions to their numbers.

In the comparatively new fields of radio-activity, electro-magnetic radiation, synthetic chemistry, chemical catalysis, electrical osmosis, photo-electricity, and corpuscular matter, to mention at random only a few of those that readily occur to one, the prospect seems practically illimitable. Moreover, new materials with new properties, whether elementary substances such as the new gases—argon, helium, krypton, neon, and others; the so-called rare earths—thorium, cerium, yttrium, scandium, and the rest; or new alloys and compounds which chemists and metallurgists keep providing for particular purposes, afford fresh means for pursuing research. We have also new mechanical appliances of all sorts, and new methods which enable us to obtain, on one hand, in the electric furnace, temperatures approaching in degree to that of the sun, and, on the other, in special refrigerators, to cold quite near to that of space and of the absolute zero—temperatures both high and low, quite beyond reach only a few years ago. Again, we have learnt how to apply prodigious mechanical pressures and how to obtain gaseous vacua on unprecedented scales. We can produce and employ electric currents and pressures, and both electric and magnetic fields, of intensities previously unknown, and measurements of all kinds can be made with a delicacy and an accuracy almost beyond belief.

The number of these things is much greater than there is time to record here, and their importance is intensified by the fact that each reacts on the others with the production of more, so that the tools and agents at the disposal of research are continually being added to. Nor, if we turn from pure science and its possibilities and means for discovery to inventions and the science that is applied to utilitarian uses, is the case in any wise different. Here, again, the effects are cumulative, both discovery and invention assisting to bring still further invention within our reach. The petrol engine, originally invented for propelling boats, and later adapted to driving land vehicles, has rendered possible the conquest of the air by the aeroplane, as also the depths of the sea by the deadly submarine. Bell's telephone, that instrument of almost sublime simplicity, which, as originally produced, was intended for transmitting speech, is now used for receiving the inarticulate signals of wireless telegraphy, which could scarcely have reached its present development without it.

Photography and its sensitive plates and papers are now applied in radiography and in other directions of which the original photographic inventors never dreamed. The metal cerium, first brought into notice by its being a necessary constituent of incandescent gas mantles, now in pocket-lighters helps the smoker in these difficult times to dispense with matches. The vacuum jacket, invented by Sir James Dewar for keeping liquid air cold, is used to-day for keeping things hot. Radium, which when discovered by Mme. Curie was only a scientific curiosity, has many applications in medicine, and is now used to illuminate watches and instrument dials so that they can be read in the dark. The gyrostat, which is a development of the child's spinning-top, and used to be merely a scientific toy, is now the foundation of a description of ship's compass which points to the true, and not to the magnetic, north pole of the earth, and without which the navigation of submarines would be almost impossible. Tungsten, which a few years ago was unknown in true metallic form, now constitutes the filaments of all our incandescent electric lamps; while the discoveries of Crookes, J. J. Thomson, and others in connection with rarefied gases have rendered possible the so-called half-watt lamp of surprising efficiency. By an electric process as old as the time of Cavendish, who discovered it, nitrogen from the air is now being extracted to make nitrates so necessary for agricultural fertilisers and for explosives, which latter have their uses apart from their application to warfare. The kinematograph of the modern picture palace has been developed out of the old Wheel of Life of the days of our childhood. Indeed, the list that could be compiled is almost endless.

One of the most interesting of modern inventions is that of wireless telegraphy, and it is also one which appears to present great scope for improvement and extension. There is a mysterious fascination that captivates the imagination about these wireless signals, which come over hundreds and thousands of miles of space without any visible or tangible means of connection. Yet, as a matter of fact, they are in nowise more wonderful than telegraphy by wire. Indeed, had, as might quite have been possible, the wireless method been the first to be discovered, then our wonder would have been excited at the ease with which, by means of a wire of minute section, the signals could so easily be conveyed over prodigious distances in any direction to any required point. For the wireless system is really analogous to the uproarious fog-horn, the signals of which are sent out far and wide in all directions, for all who have ears,

and are within range of the sound, to hear; while wire telegraphy more resembles the speaking-tube, whereby much smaller sounds are conveyed from the speaker to a particular listener at the other end.

Now during the past five years the improvements made in wireless telegraphy, and also in wireless telephony, have been very important, but as yet it is not admissible to discuss them; besides, my subject is rather the future than the past. One matter, however, is within public knowledge, and that is the increased and still increasing amount of news that we get in the papers that appears under the heading of "Per Wireless Press." Indeed, wireless telegraphy appears to be developing at last in what has always appeared to me to be its proper field, which is not so much to communicate between one individual and another as for the communication of intelligence broadcast over the earth, *urbi et orbi*—to the city and to the world—to borrow from the famous wording of the Papal benediction from the Loggia of St. Peter's in Rome of bygone times. No doubt maritime wireless communication between ships, and between ship and shore, hitherto its most useful application, is another case altogether, and supplies a want that telegraphy by wire cannot meet at all. With this we are already familiar, while the use of wireless as a voice that can speak simultaneously to points on every portion of the earth is in some ways a more novel proposition.

No doubt some persons who had private wireless stations of their own before the war used to get time-signals from Paris from the Eiffel Tower, and from Nauen in Germany; while a few of those who had mastered the difficulties of reading the Morse alphabet by ear were able to decipher weather reports from these places, as well as from our own Admiralty, in addition to general news from Poldhu, in Cornwall, and from one or two other large stations.

What I have in my mind, however, goes much farther than this. In London tape- and column-printing telegraph instruments operated by wire, that record sporting, Parliamentary, and general news, have long been familiar objects in clubs and hotels, and become a portion of our daily life. Now there is no reason at all why similar printing instruments, which he who runs may read, should not be operated by wireless means, not only in London and other large cities, but also throughout the country, or even throughout the world. Special transmitting stations using different wave-lengths could send out the messages, while separate printing machines, tuned each to respond to the wave-length of a particular transmitter, at each required point, would receive and record them. No connecting wires, costly as regards both first expense and upkeep, would be required, but only suitable aerials at each transmitting and receiving station.

Some regulations would be necessary to prevent interference, and as wireless waves, travelling as they do through the ether of space at the enormous speed of 186,000 miles per second, recognise no international boundaries, they would have to be universal. Thus arises a fitting opportunity for the League of Nations. For the distribution of news to the Press nothing could be better or more economical, while there is no reason why clubs, hotels, and private houses everywhere should not also be thus supplied with the latest intelligence. For in wireless telegraphy it costs no more to send signals to a thousand receiving stations than to a single one, and there is practically no limit to the number of the stations that can simultaneously receive signals from a single transmitting station. To some this sketch of the universal distribution of news to all and sundry may appear fantastic, but it is not really so at all; for, at any rate as concerns an area no larger than Western Europe and the British Isles, it is well within the range of practicability at the present time, and only requires a little working out to arrive at the best arrangements. Nor is this all; spoken words of the human voice have already been intelligibly transmitted by wireless across the Atlantic between the United States and Paris—a feat that has never been accomplished by cable; and there is no reason that I am aware of why, in the near future, we should not have a public speaker, say in London, in New York, or anywhere, addressing by word of mouth and articulate wireless telephony an audience of thousands scattered, maybe, over half the globe.

Great things are at present being foretold as to the marvels that we are to see in the way of the electric distribution of energy throughout the whole country from a small number of giant generating stations. Indeed, the subject is considered of sufficient importance to be mentioned in the Prime Minister's election address, which in itself is surely a sign of the times. The hope is held out that electric energy is thus to be so cheap that it will supersede every other kind of energy, not only for driving our mills, our machinery, and our railway trains, but also universally for cooking, heating, and other domestic purposes. Great improvement over our present parochial methods—according to which Parliament, in its wisdom, has divided up the country into an enormous number of absurdly small municipal electrical areas, which are far too limited in consumption for any reasonable economy to be obtained—is no doubt possible, but let us not be too sanguine. Some of the highest and most experienced authorities are of the opinion that the limits of economical generation and distribution are already being reached in the case of some of our larger systems, and that when we get above tens of thousands of horse-power the step to hundreds of thousands does not effect more than a small percentage of saving, either in first cost or in cost of working.

There is also the question of material for the distribution conductors. Excepting silver, which, of course, is out of the question, pure copper, which is almost as good as silver, is the best electrical conductor we know of, and the amount of copper in the world is, of course, limited. No doubt by raising the electrical pressure, the amount of energy conveyed through a given conductor with a given loss can be largely increased. But, again, there are limits to the endurance of insulating materials that can be obtained at a reasonable cost, though perhaps there is more obvious scope in regard to this than as regards increasing the conductivity of conductors. In a recent speculative article of American origin by Dr. J. A. L. Woddell, I notice that the writer prophesies the discovery of an alloy of ten times the conductivity of copper, but, so far as we at present know, all alloys have a worse, and not a better, conductivity than their elementary constituents; and though, so far as I am aware, no special investigation has ever proved that this is a natural law that cannot be overcome, still, conversely, there are no data to show that improvement can be looked for in this direction. True, Dr. H. Kamerlingh Onnes, of Leyden, not long ago showed that, by reducing the temperature of metals to the temperature of liquid helium, or to within less than 4° of the absolute zero of temperature, or more than 450° below zero Fahrenheit, these lose practically all resistance, and become nearly perfect conductors. Under these conditions an electric current, once started by an electromotive force applied to a cooled mercury ring, was found to persist for hours after the electromotive force had been removed

—truly a startling effect, and one calling to mind Ampère's theory of permanent magnetism, according to which the magnetism is supposed to be due to molecular electric currents that persist indefinitely.

Still, even to those most anxious to do their best to believe in the wonders of the future, the cooling of electrical conductors by passing through them streams of liquid helium, in the case of the thousands of miles of such conductors that are requisite for electrical distribution, does not appear to be a very practicable proposition. However, results like those obtained by Onnes give one furiously to think, and there are other solutions that are possible, though at present far from within our grasp. For instance, no one knows what improvement is yet to be obtained in the conductivity of metals by further purification, and especially by freeing them entirely from occluded gases. Electrolytic copper, which is specially pure, has already a conductivity measurably in excess of what was obtainable by the older methods of refining, while it has been found that in the case of palladium the extraction of the occluded hydrogen materially improves the conductivity. Possibly similar treatment might lead to important results with other metals. The subject is still largely unexplored, but if any practical method could be devised for diminishing the resistance of conductors, it would be a most important matter, as the enormous amount of copper at present required for any very large and widespread scheme of electrical distribution presents a very real difficulty.

It would also be rash to deny too positively the possibility of the wireless transmission of electric energy in bulk. The fact that enormous quantities of energy come to us in this way from the sun, with a transmission density that near the sun's surface is immense, shows what the ether is capable of doing. The production of plane waves would help the solution of the problem, but there is the difficulty of so concentrating and directing the waves that they may all be received on a limited area. Perhaps, however, it may be found that though electromagnetic waves cannot be driven to go exactly and only where wished, they can possibly be led there. It is a problem at present beyond our ken, but so many marvels come to pass that one can never be sure of what may be brought about, provided always that no natural law stands in the way.

When coal is exhausted it would seem that in the main recourse will have to be had to the enormous flood of solar radiant energy that is continually falling on the earth, and the problem is how this can best be utilised. The most obvious method is, of course, to grow plants, stimulating them in every way that science can devise, and cultivating especially those which grow most rapidly and are specially suitable for the production of fuel. Such fuel need not, however, take the crude form of mere firewood, but more likely it will be best to cultivate plants that store the solar energy in the form of starch and sugar which can be converted into alcohol, as is already being done on some scale in order to supplement petrol for motive purposes.

As, however, vegetation is an exceedingly inefficient accumulator for the storage of solar energy, and as there is the further inefficiency of the heat engine to be taken into account before mechanical power can be realised, there arises the question whether science cannot devise some more efficient and different method of converting solar radiation into work, leaving altogether on one side the organic world and the means that plant-life affords. Solar engines, in which the heat of the sun's concentrated rays in tropical climates is employed to boil water or other more volatile liquids, and thus operate steam-engines, are by no means new, but owing to their considerable first cost per horse-power and their great cost of upkeep, they have never so far proved commercially practicable, even where coal is exceedingly dear. They also suffer in an extreme degree from the limitations of all heat-engines, inasmuch as they cannot take proper advantage of the extremely high temperature of the sun, but have to work at a much lower temperature, which implies degradation of the energy and loss.

Happily, solar-heat engines do not exhaust the possibilities of the case, as there remain other methods which, though still in the womb of the future as regards development, can yet be indicated, and with regard to the success of which there is no inherent improbability. Photo-chemistry is usually associated with the art of photography, but really embraces a much wider field, the potentialities of which have as yet been but very imperfectly explored. The direct transformation of radiant energy into chemical, or even into electrical, energy is by no means impossible; indeed, the former transformation is already effected, inefficiently it is true, by plants; while it also takes place on a small scale in all photographic processes where light causes chemical reduction. Becquerel, in France, showed some fifty years ago how radiant energy could be transformed into electrical energy; and Minchin, in England, and others have also done the same by different methods. There do not appear to be any theoretical objections to success, nor to much higher efficiencies being obtained in this way than by organic means. No doubt the laws of thermodynamics apply to all photo-chemical action, but as the temperature of solar radiation is so very great this is of no large importance. Here, then, in photo-chemistry, perhaps in photo-electric chemistry, we have probably the most important problem that the science of the future has yet to solve.

Of late, in the world-war, on many a stricken field, our own and our Allies' armies have been overcoming our adversaries and subjugating the power of evil. In the future may we hope for conquest in even a wider realm? From now let us look forward to the further triumph of Science over the forces of Nature, and to the bringing of these forces still more into subjection for the common service of mankind, for—

> Peace hath her victories
> No less renowned than war.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Academic Council reported to the Senate of the University on November 20 the resignation by Sir Herbert Jackson, in view of his appointment as director of the British Scientific Instrument Research Association, of the Daniell professorship of chemistry attached to King's College. Sir Herbert Jackson has held this office since 1914, having been first appointed to the staff of the college in 1887, and having occupied the chair of organic chemistry since 1905. The Senate has conferred upon him the title of emeritus professor of chemistry in the University of London, and appointed as his successor in the Daniell chair Lt.-Col. A. W. Crossley, who has since 1914 held another professorship of chemistry in the college.

The University has recently revised the regulations for the admission of graduates of other universities as candidates for its higher degrees except in medicine and surgery. Since its reorganisation in 1900 about 350 graduates of other universities in all

parts of the world have been so admitted. In the course of last year an appeal was addressed to the universities of the United Kingdom on behalf of the Canadian universities asking (1) for the establishment of a doctoral degree the qualifications for which take account of preliminary work done in Canada for lower degrees, the standard of the degree to be such as to bring it within the reach of the best Canadian students who hold the preliminary Canadian degree; (2) for the time to be spent in the United Kingdom not to exceed three years; and (3) for the provision by the British universities of a certain number of scholarships open particularly to students from the Overseas Dominions. With respect to the first request, the University of London has always regarded the work done by a graduate of another university as the foundation of his claim for admission. A candidate so admitted stands on the same footing as an English candidate, and should have an equal chance of obtaining a doctoral degree. Arrangements have been made for informing Overseas students before leaving their homes whether they can be admitted. The second request is met by the regulations under which, out of the four or five years which must elapse between the date of the examination which forms the basis of admission and that of the examination for the doctoral degree, only two need be spent in London. The third request can be complied with if sufficient financial support is provided by the Parliaments of the Empire and the Overseas Dominions.

OXFORD.—Sir Basil Zaharoff has intimated to the Vice-Chancellor his desire to offer to the University the sum of 25,000*l.* "for the establishment of a chair of French, to be called the Marshal Foch professorship of French literature, and for other purposes connected with the promotion of French studies."

THE sum of 20,000*l.* has been offered to the George Watson's College, Edinburgh, by Mr. James Glass, of London, in aid of the establishment of a school of chemistry at that institution.

THE title of emeritus professor of experimental philosophy has been conferred upon Dr. E. H. Griffiths, F.R.S., on his retirement from the principalship of the University College of South Wales and Monmouthshire.

THE course of twelve Swiney lectures on geology for 1918–19 will be delivered at the Royal Society of Arts, beginning on December 10, by Dr. T. J. Jehu, who will take as his subject "Man and his Ancestry." The lectures will be given at 5.30 o'clock, and admission will be free.

THE Elgar scholarship in naval architecture, which is of the annual value of 100*l.* and tenable for three years, will be offered for competition in 1919 among students of the Institution of Naval Architects. Communications respecting the scholarship should be sent to the Secretary of the institution, 5 Adelphi Terrace, W.C.2.

APPLICATIONS are invited by the Salters' Institute of Industrial Chemistry for a limited number of fellowships, value from 250*l.* to 300*l.* per annum, to be awarded for post-graduate study in the methods of chemical research, or in any branch of chemistry bearing on industry, including chemical engineering, to young chemists who have completed a degree course at a recognised college or university, and whose training has been interrupted by naval, military, or national service. Applications, with references and full particulars of training and experience, should be sent to the Director of the Salters' Institute, Salters' Hall, St. Swithin's Lane, E.C.4.

ON Saturday last, November 23, the Chancellor of the Exchequer, the President of the Board of Education, and the Secretary for Scotland received a deputation of representatives of all the universities of the United Kingdom and of certain other institutions doing work of university standard. The Irish Chief Secretary was, at the last moment, prevented from being present. Oxford and Cambridge took part in the deputation, not as suppliants, but for the sake of showing the solidarity of the universities in their plea that higher education does not at present receive the degree of support from the State which is essential if the educational fabric is to be complete and the brains of the nation are to be adequately trained for the service of the State. The deputation was introduced by Sir Donald MacAlister, K.C.B., Vice-Chancellor and Principal of the University of Glasgow. The case for the universities of England and Wales was presented by Sir Oliver Lodge, that for the Scottish universities by Sir Donald MacAlister, and that for the Irish universities by Sir Bertram Windle. Sir Alfred Ewing spoke of the need for a capital fund available for buildings and equipment. The claims of the "humanities" were advocated by Sir George Adam Smith, those of science by Prof. W. H. Bragg, those of medicine by Sir Bertrand Dawson, and those of commerce and economics by Sir William Ashley. Sir Alfred Dale, Sir Gregory Foster, and Prof. Gillespie also spoke. The Chancellor of the Exchequer and the President of the Board of Education made sympathetic replies.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, November 20.—Sir Napier Shaw, president, in the chair.—Prof. R. DeC. **Ward**: The larger relations of climate and crops in the United States. For the purpose of his inquiry Prof. Ward divides the States into two major divisions separated by the mean annual rainfall line of 20 in., which forms the eastern boundary of the Great Plains. These are again divided into agricultural districts or belts as a framework into which the larger facts of climate and crop distribution and of types of farming are fitted. The eastern half of the country has sufficient rain in normal years, and ordinary farming methods are followed. The western half, with generally inadequate rainfall, is a region of irrigation, of dry farming, and of grazing. Here there are no great belts distinguished by certain dominant crops as in the east; the crops are very varied, often extremely localised. The crops in both divisions are discussed with much detail as to the influence of climatic factors. A comprehensive bibliography is appended.—Capt. C. J. P. **Cave** and J. S. **Dines**: Soundings with pilot balloons in the Isles of Scilly, November and December, 1911. The ascents were made to ascertain the wind structure in a place where the effect of land masses may be regarded as at a minimum. The Scilly Isles consist of a small group of islands twenty-five miles south-west of Land's End. The greatest height above sea-level does not much exceed 150 ft. The period covered by the observations (November 22 to December 8) marked the setting in of a south-westerly type of pressure distribution, with low pressure over Iceland. This type became well developed by November 30, and during the rest of the period several pronounced secondaries passed across the British Isles from the Atlantic. The ascents show that the changes in wind associated with the passage of these secondaries were more marked near the surface than at greater heights. Taking the mean of the ascents, the layer in which surface friction made itself felt on the wind velocity was decidedly shallower than at inland stations. The

majority of the balloons were followed with two theodolites and the vertical motion computed. The average rate of ascent is found to agree closely with the value given by the formula now generally adopted in this country. There was little change in the mean rate between the ground and 4 km. height. In this particular the results differ from those obtained at inland stations, where the rate of rising has been found generally to be greater in the first half-kilometre than at greater heights.

PARIS.

Academy of Sciences, October 28.—M. P. Painlevé in the chair.—The permanent secretary read a letter signed by MM. H. Parenty, Laguesse, Duret, Witz, and A. Calmette, members and correspondants of the Institute, of the Academy of Medicine, and of the Academy of Agriculture, retained at Lille during the German occupation, giving an account of some of the outrages and indignities inflicted by the German authorities upon the population.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: Injections of blood plasma (plasmo-therapy) for replacing blood. It has been shown in previous communications that dogs after heavy loss of blood (54 grams of blood per kilogram of body-weight) only survive if a transfusion of blood or blood plasma is made. In the present paper experiments are given showing that the blood corpuscles play only a secondary part, the efficacity of the transfusion being mainly due to the plasma.—G. **Giraud**: The connection with the theory of hyperabelian functions of a certain partial differential equation of the second order, with a generalisation to any number of variables.—A. **Angelesco**: The simultaneous approximation of several definite integrals.—M. **Riquier**: A property of analytical functions with any number of imaginary variables.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the first quarter of 1918. Details of observations made on seventy-six days during the quarter.—A. **Véronnet**: The limit and composition of the terrestrial atmosphere. Aurora borealis, meteorites, shooting stars. The percentage of nitrogen increases regularly at altitudes up to 100 kilometres. Between 100 and 150 kilometres the nitrogen forms 96 per cent. of the atmosphere at a pressure below 10^{-6} atmosphere, a pressure of the same order as that in a Crookes tube. This is the region of the aurora borealis.—J. **Renaud**: The deep ports on our Mediterranean coast and on those of our colonies and protectorates.—E. **Carvallo**: The correction of faults in lenses.—Albert and Alexandre **Mary**: The inversion of cane-sugar by colloidal silica. Colloidal silica effects an appreciable inversion of cane-sugar, and its inverting power is a function of its state of dispersion.—H. **Hubert**: Limit of the horizontal siliceous grit in western Africa.—J. **Chaine**: Contribution to the phylogeny of muscles.—M. **Baudouin**: The discovery of a trustworthy method for recognising sex in human vertebræ of any age.—M. **Folley**: The action of sodium citrate on the blood.—Ch. J. **Gravier**: The Actinia from great Atlantic depths obtained during the cruises of the *Princesse-Alice*, and some biological characteristics of these animals.

BOOKS RECEIVED.

Cast Iron in the Light of Recent Research. By Dr. W. H. Hatfield. Second edition. Pp. xvii+292. (London: C. Griffin and Co., Ltd.) 12*s.* 6*d.* net.

The Principal Species of Birds Protected by Law in Egypt. By Capt. S. S. Flower and M. J. Nicoll. Pp. iv+8+viii plates. (Cairo: Government Press.) P.T.5.

A Modern Pilgrim in Mecca. By A. J. B. Wavell. New cheaper impression. Pp. xv+232. (London: Constable and Co., Ltd.) 2*s.* 6*d.* net.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. vii., part 1: England and Wales. By Dr. A. Strahan and J. Pringle. (London: H.M.S.O.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 4.30.—Bhupendranath Basu: Some Aspects of Hindu Life.

MONDAY, DECEMBER 2.

ARISTOTELIAN SOCIETY, at 8.—Principal F. B. Jevons: Rabindranath Tagore's Personality.

ROYAL SOCIETY OF ARTS, at 5.—Prof. J. C. Philip: Physical Chemistry and its Bearing on the Chemical and Allied Industries.

SOCIETY OF ENGINEERS, at 5.30.—H. Kelway-Bamber: Notes on Railway High Capacity Wagons' Wheel Axles.

TUESDAY, DECEMBER 3.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Continued Discussion*: R. B. Joyner: The Tata Hydro-electric Power-supply Works, Bombay.—*Followed by* E. L. Leeming: Road-corrugation.—F. Wood: Investigations in the Structure of Road-surfaces.—T. B. Bower: Notes on Road Construction and Maintenance.

RÖNTGEN SOCIETY (at King's College Hospital, Denmark Hill, S.E.), at 7.30.—Visit to the Radiographic and Electro-therapeutic Department. Demonstrations of Apparatus.

WEDNESDAY, DECEMBER 4.

ENTOMOLOGICAL SOCIETY, at 8.—Dr. H. Eltringham: Butterfly Vision.

GEOLOGICAL SOCIETY, at 5.30.—Wheelton Hind and A. Wilmore: The Carboniferous Succession of the Clitheroe Province.

ROYAL SOCIETY OF ARTS, at 4.30.—B. Seebohm Rowntree: Housing after the War.

SOCIETY OF PUBLIC ANALYSTS, at 5.—Dr. Eric K. Rideal and Dr. H. S. Taylor: Recorder for Estimating Carbon Monoxide in Inflammable Gases.—A. D. Powell: The Estimation of Phenacetin and other Para-aminophenol Derivatives by Hypochlorous Acid.—H. E. Annett and Hardayal Singh: Effect of Morphine Concentration on the B.P. Method of Morphine Estimation.

THURSDAY, DECEMBER 5.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. Miles Walker: The Supply of Single-phase Power from Three-phase Systems.

LINNEAN SOCIETY, at 5.—Prof. W. A. Haswell: A Revision of the Exogonidæ.—C. D. Soar: Exhibition of Coloured Drawings of British Mites.—The General Secretary: The Tulbagh-Linné Correspondence.

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