THURSDAY, JULY 6, 1916.

OCCUPATION AND HEALTH.

Occupations: From the Social, Hygienic, and Medical Points of View. By Sir Thomas Oliver. Pp. x+110. (Cambridge: At the University Press, 1916.) Price 6*s.* net.

THE subject of this book is the influence of occupation upon health. After a brief historical introduction the author deals with the effect upon health of contamination of the air by smoke and dust, both out of doors and in factories, this discussion being followed by chapters on fatigue, on the hygienic condition of factories, on the relation of occupation to mortality, and on the choice of a career. Finally, an account is given of the harmful effects of certain dusty occupations, of gases, and of electric currents.

The brief space at his disposal and the wide scope of the subject have doubtless made it impossible for the author to give more than the merest outline of the relation of occupation to health. He does not appear, however, to have been altogether happy in his treatment of the question. Although the book contains a mass of interesting information, the reader constantly receives the impression that he is being presented with a succession of disconnected and unrelated statements. No stress has been laid upon fundamental principles, such as that health may be affected either by the nature of the occupation, or by the conditions in which the occupation is carried on. Nor has any attempt been made to distinguish essential from subsidiary factors. The chapter on fatigue, for example, contains scarcely any reference to the means by which industrial fatigue can be recognised or prevented, although recent work has shown both that diminished output is the surest evidence of fatigue, and that the introduction of short rest periods at intervals during the working day lessens the risk of over-fatigue. In view of the extreme importance of the subject, both for employer and employed, a fuller treatment of industrial fatigue would have been advantageous. The book suffers, moreover, from faulty English and from much needless repetition; a paragraph on pp. 55 and 56 is reproduced, for instance, almost word for word on pp. 65 and 66.

The least satisfactory portions of the book are those dealing with the causation of fatigue, and with the action of gases on the body; these are not up to date. In the section on the causation and nature of fatigue the author adopts the obsolete view that toxins formed during muscular exercise are the cause of fatigue; and no reference is made to the modern conception of fatigue, although most, if not all, physiologists now hold that the accumulation of lactic acid in active muscles is an important factor in its production. Again, in the chapter on gases, the author speaks of carbon monoxide toxæmia and apparently regards this gas as directly poisonous; thus the statement is made (p. 89) that carbon monoxide "may exercise a paralysing influence upon the nerves of the heart, or upon the nerve centres in the medulla oblongata." These statements are erroneous, since Haldane has shown that carbon monoxide is not directly poisonous, and that its harmful effects are due solely to the fact that it displaces oxygen from combination with hæmoglobin; and their inclusion in this book seriously detracts from its scientific value.

In spite of these defects the book contains much that is useful, especially in the chapters on factory hygiene and on dusty occupations, and although it cannot be recommended from a scientific point of view it may prove of value to the general reader.

F. A. B.

EXPERIMENTAL SPECTROSCOPY.

Collected Papers on Spectroscopy. By Prof. G. D. Liveing and Sir J. Dewar. Pp. xv+566. (Cambridge: At the University Press, 1915.) Price 30*s.* net.

THE names of Profs. Liveing and Dewar stand out prominently in the history of modern spectroscopy, and the publication of their collected papers will be cordially welcomed by all who are interested in this rapidly advancing subject. The chief results of their investigations have doubtless already become widely known through references which have appeared in text-books and in papers by other workers, but to those actually engaged in spectroscopic research it will be a great convenience to have the complete papers in this handy form. Moreover, it will be especially stimulating to students to be able to follow, step by step, the development of the authors' ideas and methods of observation.

The papers have been reprinted from the original sources, with only printers' errors corrected and the addition of a diagram for the sake of greater clearness in the description of an instrument. It may be questioned whether the wisest course has been adopted in the arrangement of the papers, which merely follow each other in the order of dates of publication. There are several instances in which a number of different papers refer to the same subject, and an arrangement in groups would not often have required the dividing up of a paper into sections. Inconvenience arising from the plan adopted, however, is considerably reduced by the addition of a classified index. There is also a useful index of names.

Excluding abstracts of papers which also appear in full, and a few lectures dealing with subjects of the authors' researches, the number of separate papers is about seventy, dating from 1877 to 1904. The first is a brief account of the phosphorescence and flame spectra of calcium fluoride, and it is fortunate that this is the only case in which positions in the spectrum are not expressed on the scale of wave-lengths. It is not possible even to enumerate the subjects of the remaining papers, but it may be mentioned that among the more extensive investigations, each of which occupies several papers, are those on the reversal

of the lines of metallic vapours, the spectra of carbon and its compounds, the ultra-violet spectra of the elements, the emission spectrum of water vapour, the spectrum of magnesium, the absorption spectrum of oxygen, and the spectra of the rare gases. There are also several papers referring to new forms of spectroscopes or details of instruments.

The general impression conveyed to the reviewer by the volume is not so much of striking discoveries as of a steady output of careful work which almost invariably contributed materially to the general advance of spectroscopy. Nevertheless, only a small part of the work can be described as having been of a routine character, and the papers have a special value on account of the great variety of experimental methods devised by the authors with definite objects in view. Thus the student or the beginner in spectroscopic research will find an abundance of useful hints on manipulation which it would be difficult to find in a convenient form elsewhere.

Perhaps the most laborious piece of work undertaken by the authors was that on the ultra-violet spectra of the elements, which involved the taking of some thousands of photographs, and the determination of wave-lengths under conditions much more difficult than would be the case at the present time. The recognition of "harmonic series" of lines, with alternating sharp and diffuse members, was a notable outcome of this work, and although the authors were not completely rewarded by the discovery of the laws of spectral series, their observations greatly facilitated the subsequent investigations of series lines by Rydberg.

Spectroscopy is full of pitfalls, largely on account of the difficulty of preparing perfectly pure substances for experiment, but the authors have had the satisfaction of themselves correcting some of their misinterpretations of observations, as in the case of certain silicon lines at first assigned to carbon, and a triplet of the Swan spectrum attributed, in the first instance, to cyanogen. It might have been expected, however, that they would have taken advantage of the opportunity of indicating, by footnotes or otherwise, further developments in connection with some of the subjects dealt with. It might have been pointed out, for example, that about 50 per cent. of the unidentified lines of atmospheric gases not condensed at the temperature of liquid hydrogen are accounted for by the second spectrum of neon discovered by Merton.

The publication of this volume can scarcely fail to stimulate further research in many directions. One point which has received less attention than it deserves is the observation by the authors that the mixed vapours of magnesium and sodium, in their experiments on reversals, yielded an absorption line about wave-length 5300, which did not appear with either vapour separately, or when sodium was replaced by potassium. Other lines were similarly found to be characteristic of a mixture of magnesium and potassium. Since mixtures of vapours are involved in the sun and stars, as well as in many of the laboratory applications of spectrum analysis, the possibility of the development of lines characteristic of mixtures would appear to be of fundamental importance. There are probably few observations which favour this supposition, but a more extended investigation is certainly desirable.

The volume concludes with a supplementary memoir, not previously published, on the separation of gases by electric discharges with various electrodes. It fully maintains the high standard of the earlier investigations, and will be appreciated, for example, by anyone who has attempted to prepare a vacuum tube of oxygen uncontaminated with carbon impurities.

The authors may well take pride in this handsome record of their long-continued labours in the field of spectroscopy, but it may be hoped that the volume is not intended to mark the termination of their contributions to the subject.

YORKSHIRE TROUT FLIES.

Brook and River Trouting: A Manual of Modern North Country Methods, with Coloured Illustrations of Flies and Fly-dressing Materials. By H. H. Edmonds and N. N. Lee. Pp. 106. (Bradford: Published by the Authors.) Price 10*s.* 6*d.* net.

THIS is an attractive little book, well produced, admirably illustrated, and written by two anglers who obviously know their subject. As what may be called a "local" manual it is as good as anything that has been produced for a long time. It has special claim to consideration in its handling of the question of flies. The authors select some three dozen patterns, commonly and profitably used on north-country streams, and make it possible for the amateur fly-dresser to be sure of getting them right by giving, besides the verbal instructions, coloured plates which show both the flies and the materials of which they are made. One plate also gives the colour shades by which fly-tying silk may be matched. The result is a really practical text-book on which, so far as it goes, the amateur can safely depend. No doubt it will be apparent to many readers that it might go farther, and that a good many favourite flies are omitted from its list. But it is at any rate arguable that the list is sufficient without them, and that an angler entirely without prejudices would do as well with it as he would with any other list of similar length designed to meet similar conditions.

The authors give brief but sound instructions as to methods of fishing on north-country streams, fly-fishing, both wet and dry, creeper and stone-fly fishing, clear-water worming, and spinning the minnow. In each case they illustrate precept by detailed experience, always a useful and interesting plan. When an angler can say "by doing so-and-so I killed so many on such-and-such occasions," and can describe the events which led up to and characterised the successes, it is more convincing than the use of bare imperatives.

The present authors have the requisite experience on which to draw, and a knack of using it pleasantly. They might have made larger demands on our patience than they have without risk of overstraining it.

It is to be understood that anyone who rules his fishing by this book surrenders himself to north-country ideas. For instance, he uses lightly dressed patterns, he learns to talk of "bloas," he renounces such tried favourites as the "blue upright" or the "coch y bonddu," becomes, in short, wedded to a particular convention. He might have to contract a similar alliance in other districts—in the Lake country, where they have "bleas," among the "bumbles" of Derbyshire, or when taking to the "half-stones" and "pheasant-tails" of the West.

Probably there is little loss of efficiency involved in such a surrender, but it is not wholly satisfactory for all that. A consideration of the various local conventions of pattern induces the reflection that there is a good deal of unnecessary confusion, some waste of effort, and some sacrifice of intelligence caused by the present system of local "water-tight compartments." Roughly, the insect life of all wet-fly streams is the same, whatever their district. Roughly, also, the intentions of all local fly-tiers are the same, to imitate those insects. But local nomenclature and idiom have largely obscured this. It would be a valuable, and we should say an extremely interesting, task for some competent fly-dresser and angler to collate all the local patterns, to select the best imitations without respect of districts, and to attempt a standardisation of wet flies which should include whatever is most worth having. Ronalds, of course, did something of the kind, and did it very well, but that was a long time ago. Since then we have had Mr. Halford's invaluable work on chalk-stream flies, and Mr. Skues's revelations on nymphs. So there are more data for such a work as is suggested.

GERMANY AND RACIAL CHARACTERS.

The Germans: (1) *The Teutonic Gospel of Race;* (2) *The Old Germany and the New.* By J. M. Robertson. Pp. viii + 291. (London: Williams and Norgate, 1916.) Price 7*s.* 6*d.*

IN the first part of his book Mr. Robertson gives an admirable and timely exposition of the crude falsity of certain current doctrines of race. The much-used "Aryan," if understood ethnologically, is almost meaningless; all that we know is that certain peoples speak Aryan languages. We do not know that those peoples, *e.g.*, in Europe, are the descendants of the invaders who brought the original Aryan speech. Similarly with skull-measurement. Many writers have claimed a generic superiority for the long-headed type—which, according to Gobineau, is that of the Teuton warrior—regardless of insuperable difficulties. For example, the Swedes are dolichocephalic, and they are not a leading nation; worse still, it is found that their best individuals are less dolichocephalic than the average. And dolichocephaly is characteristic of the negro, the Eskimo, and the gorilla. Equally fallacious is the Germans' claim that their ancestors were exceptional in their considerate treatment of women; Plutarch proves that the Ligurians excelled them, as the North American Indians did later on. Indeed, all talk about "Germanic" virtues is absurd if its aim is to glorify Germany; for East Germany is partly Slav, and Belgium and North-east France are ethnologically more Germanic than Bavaria.

Part ii. traces the process by which the Germany of Kant and Herder and Goethe became the Germany of Treitschke, Bernhardi, and the author of "The Hymn of Hate." Mr. Robertson gives an excellent historical survey, and, coming to recent times, quotes telling proofs of Germany's scheming for Britain's downfall from the writings of Prince von Bülow and other statesmen. It is clear enough now that only our supremacy at sea saved us from attack in 1900. The great blunder of Germany in 1914 was in supposing that Britain would not fulfil her treaty obligations to Belgium. Having no principles herself, no recognition of international morality, she expected a similar lack in others. Formerly few of us could believe in her criminal attitude. Now she has opened our eyes, and we see that her power must be crushed before stable peace in Europe can be hoped for.

OUR BOOKSHELF.

The Value of Science in the Smithy and Forge. By W. H. Cathcart. Pp. xiv + 163. (London: Charles Griffin and Co., Ltd., 1916.) Price 4*s.* net.

THIS handy volume is a welcome addition to the metallurgical series already issued by the same publishers. It is written by a practical smith, who is president of the Associated Foremen Smiths of Scotland. The object is to impress upon young craftsmen the value and importance of some scientific knowledge. The earlier part of the book, or about one-fourth in all, contains examples of calculations relating to forgings and simple mathematical and geometrical problems applied to practical cases. The remaining portions of the volume are those which will probably attract more attention. The subjects dealt with include metallography, heat treatment of iron and steel, the chemistry of welding, and case-hardening. In these subjects the author has acquired a skill which is altogether exceptional in a practical smith, and he writes with an enthusiasm and intimate knowledge which should commend the volume to a wider circle of readers than that for which it was originally intended.

Dr. Stead has contributed a short introduction to the volume and has taken much interest in its production. Mr. Cathcart has proved an apt pupil of Dr. Stead, upon whose researches he largely draws. References to the work of Rosenhain, Ewing, Sauveur, and others make the account more complete. It assumes some previous knowledge on the part of the young craftsman, which

he may not possess; but for those who can follow it the book should be full of charm, of interest, and of real utility. T. T.

More Minor Horrors. By Dr. A. E. Shipley. Pp. xiv+163. (London: Smith, Elder and Co., 1916.) Price 1*s.* 6*d.* net.

THIS little volume is to be regarded as a sequel to the author's "Minor Horrors of War," and, like the latter, is written in a style calculated to entertain and instruct the layman. Dr. Shipley's innate humour leavens the "horrors" that are commonly associated with the subjects which he treats of, but at the same time he imparts information which is both accurate and up to date.

The book opens with a dissertation on the ubiquitous cockroach and its various phases of activity. The following chapter treats of the ox warble-fly, the larva of which, by destroying the continuity of the integument of our oxen, affects detrimentally an important munition of war. Mosquitoes come in for a very full share of treatment, with special reference to those which serve as carriers of malaria and yellow fever. The extension of the war into Asiatic Turkey may have possibly suggested to the author the inclusion of the fig moth in the present volume, and to dilate on the ravages it entails among the chief product of Smyrna. Among other topics the common stable fly is well described, and timely reference is made to the *rôle* which it may very likely perform in the spread of infantile paralysis.

The book is well printed and illustrated, and for the modest expenditure of eighteenpence we can glean an insight into the ways and means of some of the undesirable companions of our countrymen now fighting in divers lands and seas. A. D. IMMS.

Rhizopod Protozoa. The Causes of Cancer and Other Diseases, being Part iv. of "Protozoa and Disease." By J. J. Clarke. Pp. xiv+187. (London: Ballière, Tindall and Cox, 1915.) Price 7*s.* 6*d.* net.

IN this book the author brings together data and observations which he considers enable him to state definitely that cancer and certain other diseases are caused by protozoa belonging to the same group of organisms as the Mycetozoa. The author has studied the mycetozoon *Dydimium difforme,* and believes that similar structures and developmental forms are met with in it and in cancers, molluscum, etc., from which he concludes that these appearances in the latter must be due to a parasite of the same botanical or zoological position as the mycetozoon. He similarly holds that the Negri bodies of rabies, the trachoma bodies, the Councilman bodies of small-pox, etc., are the actual parasites, and are protozoa, and are not, as is usually held, the "garments" enclosing an ultra-microscopic organism.

Mr. Jackson Clarke is well known for his pronounced views on the cancer question, but so far he has failed to carry conviction, and we doubt if this work will do much to advance his propaganda. The book is lavishly illustrated by a number of beautiful drawings.

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.*]

Economic Geology and an Imperial Bureau of Scientific Intelligence.

THE subject of Sir R. Hadfield's address to the Ferrous Section of the Metallurgical Committee of the Advisory Council for Scientific Research (see NATURE, May 25, p. 264) is of much interest.

As far back as 1901 the Department of Agriculture and Technical Instruction for Ireland, recognising the need for obtaining information as to the economic raw materials which would be worthy of development in Ireland, decided to appoint a practical man trained in this special work. I had the honour to be the person appointed as their economic geologist.

The inquiry thus begun has resulted in furnishing considerable data as to the mineral industries already existing, and as to mineral deposits capable of development. Some progress has been made, the exports of raw materials (stones, slates, metal ores) having risen in value from 380,188*l.* in 1909 to 524,458*l.* in 1914. In the course of the inquiry a comprehensive collection of mineral raw materials, building stones, etc., was got together and shown at various exhibitions in Ireland, also at the Imperial Institute, London, and at the St. Louis Exposition, U.S.A., with the object of attracting capital to develop the deposits, finding a market for the materials already being worked, etc. The Department has thus organised what is in effect a bureau of investigation and information upon the economic side of the mineral resources of the country. Through this bureau the Department give a degree of assistance in the form of inquiry and information which goes as far as is deemed proper to Government action in any country, and of a kind which is not furnished by Government departments elsewhere in the United Kingdom.

I am in thorough agreement with Sir R. Hadfield in his proposal for the establishment of a central bureau of information as to the materials existing within the British Empire. I well know the need for such a bureau, which, in my opinion, should also collect information regarding materials exported from enemy countries, and which might be replaced by our own products. Since the beginning of hostilities I have been engaged in special inquiries and experiments, having in view, amongst other purposes, the finding of possible substitutes for raw materials imported from enemy countries, and if such a bureau had been in existence it would have been of much assistance in this work. I have had an opportunity of visiting the Philadelphia Commercial Museum, and the Commercial Museum, Brussels, and much appreciate the advantages of these institutions.

A circumstance in Irish conditions which tends considerably to facilitate the work of State action in the development of minerals is the fact that under the Land Purchase Acts of 1903 and subsequent years the mineral rights of the land sold are, as a rule, vested in the Irish Land Commission. The Department work in this matter in close co-operation with the Land Commission, my services being placed by special arrangement at the disposal of this body. The policy regarding the leasing of mineral rights is to give fair and equitable terms to the prospector.

E. ST. JOHN LYBURN.

4 Upper Merrion Street, Dublin, June 19.

The Neglect of Science.

THE following aphorisms, which have a strangely modern air, are quoted in Flaubert's "Lettres" (Paris, 1884):—

Est-il nécessaire d'observer que cette vaste science [la chimie] est absolument déplacée dans un enseignement général? A quoi sert-elle pour le ministre, pour le magistrat, pour le militaire, pour le marin, pour le négociant?

DE MAISTRE, "Lettres et opuscules inédits."

Il appartient aux prélats, aux nobles, aux grands officiers de l'Etat, d'être les dépositaires et les gardiens des vérités conservatrices, d'apprendre aux nations ce qui est mal et ce qui est bien, ce qui est vrai et ce qui est faux dans l'ordre moral et spirituel. Les autres n'ont pas le droit de raisonner sur ces sortes de matières. Ils ont les sciences naturelles pour s'amuser. De quoi pourraient-ils se plaindre?

DE MAISTRE, "Soirées de Saint-Pétersbourg." 8e *Entretien*, p. 131.

Si l'on n'en vient pas aux anciennes maximes, si l'éducation n'est pas rendue aux prêtres et si la science n'est pas mise partout à la seconde place, les maux qui nous attendent sont incalculables: nous serons abrutis par la science, et c'est le dernier degré de l'abrutissement.

DE MAISTRE, "Essai sur les principes générateurs."

Glasgow, July 1. D. M.

World-Time.

"SUMMER TIME" has come to some of the cities and towns of Canada; while the continental railways and their affiliations keep to their old "hour-belt times." I find I have to make my daily meteorological notes in 60th meridian time, although my watch runs one hour ahead. The confusion when the different time notations of tide tables, astronomical tables, railway time tables, and the town clock have to be observed cannot be obviated. It may train us, however, to be ready to adopt world-time when it is offered.

Is it not now desirable that with our continental railways and telegraphs, transoceanic cables and omnipresent wireless, we should use the same time in every part of the world? For railway travel, telegraphic contracts, news, and scientific observations it would be exact, simple, and without danger of confusion.

Suppose, when the sun is vertical to the 180th meridian from Greenwich, every clock and watch in the world should point to the hour 0 at the beginning of "the day." When vertical to the meridian of Greenwich it would be 12 everywhere. When approaching the 180th meridian the clocks would be approaching 24.

Every locality would settle its most convenient time for breakfast, etc., at, *e.g.*, 6, 8, 12, 14, or 23 o'clock. From May 1 to October 1 we could henceforward with comfort adopt the unwritten law of fixing the events one hour earlier. Nothing to puzzle over—not necessary even to change your watch an hour four times in going from Halifax to Victoria. The telegram dates in the newspapers would give us the true interval of time since the event without a calculation. Even the reductions of the diurnal temperatures of the meteorologist would be no more troublesome than they are at present under the so-called "daylight-saving," time-consuming attempt to deceive the public to its advantage.

Halifax, Nova Scotia, June 16. A. H. MACKAY.

Birds' Songs and the Diatonic Scale.

THE records of birds' songs given in the *Times* of June 14 and following days, and referred to in the interesting article by Dr. W. Warde Fowler in NATURE of June 29, are almost entirely confined to the major triad and its inversions. These three notes, though taking their place in the diatonic scale, are the least artificial part of that scale, being the third, fourth, and fifth harmonics of a fundamental note. The writer has so frequently heard these three notes sung in good tune by the blackbird in rural districts and in different parts of the country that the suggestion that the song is due to imitation seems untenable; neither does it seem necessary to attribute to the bird a mental appreciation of correct intonation. The writer hazards the suggestion that these elementary intervals are produced without mental or undue muscular effort as harmonics, just as a bugler sounds his calls on these same notes by evoking the different harmonics of his instrument.

32 Willoughby Road, N.W., July 2. C. O. BARTRUM.

STATE AFFORESTATION.

SIR JOHN STIRLING MAXWELL in three recent articles in the *Times* (June 19, 20, and 26) deals with State afforestation, which will probably prove to be one of the best means for the settlement of soldiers and sailors on the land after the war, and at the same time be effective in utilising the large tracts of waste land which are unsuitable for tillage and unprofitable for grazing. In spite of the numerous official Commissions and Committees which during the past twenty years have all agreed on the urgent need of national afforestation, little progress has been made. The Development Grant was instituted in 1909 for the express purpose of "the purchase and preparation of land for afforestation and the setting up of a number of experimental forests on a large scale"; but these objects have not been achieved. Sir John points out the probable reasons for this failure. In the past poor management and irregular sales on the majority of privately owned woodland estates, in conjunction with an unorganised timber trade and heavy and unequal rates of freight by rail on home-grown as compared with imported timber, have all combined "to turn profit into loss, and give forestry a bad name." This influenced the Development Commissioners, who limited their encouragement of forestry to "certain small but useful grants in aid of education, and in finding money to provide local forestry advisers. Of actual afforestation, a few acres planted in the water catchment areas of Liverpool and Edinburgh are the only instalments."

Conditions have naturally not improved since August, 1914. Owing to the rapidly increasing price and serious diminution in the import of foreign timber, the Government has been forced to draw extensively on home supplies; and an enormous amount of timber is now being felled in all parts of the country. This is necessary as a war measure; but we do not hear of any

Forest planting

precautions being taken to secure the replanting of the felled areas. The destruction of our woodlands, already much too small for our needs, is alarming. The consideration now of some definite forest policy, to be carried out immediately after the war, is a pressing matter.

Sir John Maxwell proposes a scheme for the gradual planting of the better class of waste land now included in sheep grazings and deer forests. About 6,000,000 acres can probably be profitably planted, of which 2,000,000 acres might be undertaken during the next twenty years. This is to be carried out in combination with the establishment of small holdings, the occupiers of which will do the necessary work of planting in winter, while attending to their little farms in summer. It is estimated that 10,000 acres, which under sheep or deer at present support ten or twelve families, will, if the bulk be planted, afford direct support to more than a hundred families. The dales of northern England, the valleys of Wales, and the glens of Scotland afford perfect sites for such settlements. This forest policy, here so briefly outlined, is based on an elaborate study, "The Forest Survey of Glen Mor," made by Lord Lovat and Captain Stirling of Keir, and published in 1911 by the Royal Scottish Arboricultural Society. This scheme of afforestation has the great advantage that it does not interfere in any way with existing cultivation.

The concluding article urges the immediate appointment of a small body, say three Forestry Commissioners, to whom shall be assigned the task of creating a definite area of forest within a definite time. It will take at least two years to make the necessary preparations, so that this new Commission, devoted to forestry and to nothing else, should be appointed at once. About a hundred forestry officers will utimately be required, who would be trained in forestry for two years, partly in France or Denmark and partly in this country —young men with a good scientific education to be selected, and "the temptation to employ retired Indian foresters in these posts to be resisted."

Other immediate steps advocated are the survey of districts suitable for afforestation and the selection of forest sites. The land is to be acquired by purchase or perpetual lease—compulsion to be resorted to and the price to be settled by arbitration when terms cannot be otherwise arranged. The forests should be 4000 to 10,000 acres in extent, but not necessarily inside a ring fence, as a forest may be composed of separate blocks (each not less than 500 acres in area) situated in the same district. The necessary housing for the foresters, woodmen, and labourers cannot be undertaken while the war lasts; but if men are to be absorbed from the Army after peace is made, temporary buildings, of which there will be no lack, can be used. Many other practical proposals are embodied in this comprehensive plan for the economic establishment of State forests in Great Britain and Ireland.

SCIENTIFIC DEVELOPMENT IN RUSSIA.

A REVIEW, however cursory, of scientific work in Russia during the past two years must take account of two features of outstanding interest and importance. One is the appointment, on the initiative of the Imperial Academy of Sciences of Petrograd, of a commission to investigate and report on the natural resources of the Russian Empire with a view to their scientific and practical development and utilisation.

Stated in one bald sentence this may not appear particularly impressive, but looked at through the lens of imagination it is revealed as a stupendous project with far-reaching aims and destined to lead to incalculable results. The prime incentive is the fact that in Russia, as elsewhere, the eyes of the nation have been opened and attention has been focussed on what was in times of peace known to many, deplored by some, and passively acquiesced in by all: the extent to which its economic life has been honeycombed by the greater energy, enterprise, and initiative of the Germans. It is now realised that this economic dependence, extending to many things which might just as well have been supplied by native industry, went far beyond the limits of a natural and legitimate exchange of products between neighbouring countries, and the Empire is firmly resolved to make a determined effort to put an end to an intolerable anomaly. Russia stands at the parting of the ways, and we in this year of grace are, it may be, witnessing the economic birth of a nation.

As may be supposed, the development of such a comprehensive scheme to the point of effective utility has not been accomplished without much discussion and some hostile criticism. One critic "doubts if the time is well chosen for embarking on such an ambitious enterprise when the strength of the Empire is being taxed to the utmost by this terrible war. The end proposed is highly desirable, but . . . the programme is so enormous that the preliminary steps alone will take years, to say nothing of the long interval that must elapse between scientific investigation and practical fruition . . ."; and he goes on to point out many problems to the immediate solution of which the Academy might in this crisis more profitably apply its energies. However, the commission has in a surprisingly short time got to work—the first sitting took place only in October of last year—and is issuing a series of monographs, several of which have already been published, each written by a specialist, dealing, by way of a commencement, with the vast field, in many directions undeveloped, in others lying fallow, of Russian mining and metallurgy.

The other item of interest is the convening of a conference by the Imperial Academy of Sciences to consider the proposal to found a Russian Botanical Society with its own official journal. There is a great deal of botanical investigation carried on in Russia by various institutions scattered all over the country, but it is felt that

great advantage would accrue from co-ordination and centralisation, and that the founding of such a society is only the just due of the importance of Russian botany "in view of the eminent position which Russia is destined to occupy after the war."

But side by side with these special activities, which are the direct outcome of the quickening of the nation's pulse, there is, as in normal times, a great amount of quiet, unobtrusive research in the domains of biological and physical science. Though there may be no epoch-making discovery to record, there is scarcely a field of mental activity left untilled. Many a peaceful backwater is being navigated undisturbed by the clash of arms, and it is pleasant to read of ethnographical and philological investigations, or of an expedition to the Jablonovy Range to study the local fauna, with its picturesque account of explorations in steppes, morasses, and virgin forests. It is interesting to note, in this connection, that there is scarcely a provincial town of any importance in Russia without its medical society and association of local naturalists, or, as the charming Russian idiom has it, "lovers of nature lore," true amateurs in the best sense of the word and all contributing their quota to the common stock. Worthy of mention also are the efforts made for the preservation, as far as may be possible in the circumstances, of valuable treasures of art, science, and archæology in the war-zone, such efforts not to be confined to the limits of the Empire, but to be extended to enemy territory occupied by Russia. It is pointed out that priceless products of human culture may be saved if timely measures be taken, and to this end the service of various scientific experts has been secured and the sympathetic co-operation of the military staff enlisted.

Finally, mention must be made of the decision of the Imperial Academy of Sciences on the question of the exclusion of alien enemies from the list of honorary members. As the result of a conference held in March of last year to consider the matter the Academy expresses itself as loth, by such exclusion, to place any obstacles in the way of the resumption after the war of that international co-operation for the progress of science which will, it foresees, play a greater part than ever in the development of European civilisation, "when an end has been made of those hegemonistic strivings which, not content with the sphere of politics, have invaded that of science." Truly a dignified attitude, worthy of an august institution which can look back with just pride on well-nigh two centuries of enlightened effort and solid achievement.

MORTALITY TABLES AND PREVENTIVE MEDICINE.

THE presidential address of Dr. W. W. Campbell to the American Association for the Advancement of Science at its San Francisco meeting, which was reprinted in NATURE of December 2, 1915 (xcvi., pp. 381–386), raised a question of much interest from both the scientific and practical points of view. Starting from the principle of the infallible and universal obedience to law, the strict accountability of effect to cause, which is the property of all matter, Dr. Campbell showed that the recent discoveries in preventive and curative medicine are among the most valued contributions to civilisation in the entire range of scientific research. He argued that they had increased the average length of life by many years, and that, while that increase had been greatest for children and women and those not in robust health, it had also been great for those healthy men whose lives have been accepted as risks to be insured by the life insurance companies. He suggested that during the past thirty years the increase in the duration of those lives has meant a money-saving far surpassing all the sums that universities, research institutes, and individuals have ever spent in medical investigation. In the same spirit of scientific enthusiasm, Sir William Ramsay said at Havre, a few days before the European war broke out, that "Pasteur and Lister had saved more lives than the most sanguinary of wars had destroyed."

We need not question these authoritative statements. There is a high probability that the duration of human life has increased; there is also a high probability that recent progress in preventive and curative medicine has greatly contributed to that increase. But there are also other causes which may have contributed to it. The extent of the improvement in longevity which had taken place during the nineteenth century was discussed by the fourth International Congress of Actuaries at New York, and a paper was read by Mr. Warner, actuary of the Law Union Insurance Company in London, in which he estimated the average age at death of males in England and Wales at 27·15 in 1840, 28·35 in 1870, and 33·63 in 1900; and that of females at 29·38 in 1840, 30·88 in 1870, and 36·90 in 1900—the increase during the second thirty years having been in both cases more than four times that of the previous thirty years. Though the data upon which these estimates were founded are admitted to be imperfect, their results tend to confirm the conclusions to which we have referred as highly probable. The contributory causes would seem to be greater care of infant life, better sanitation, temperance, general prosperity leading to more abundant and wholesome nutrition, and perhaps also more attention to athletics and ablutions.

Dr. Campbell, indeed, says that "life assurance business has been based upon mortality tables which represented the expectation of life under the relatively unhealthy conditions which existed a half-century ago. Those tables do not fit modern conditions." We agree with him that the law of uniformity is the foundation of actuarial science, and that given a sufficient average the rate of mortality now existing may be expected to continue to prevail as long as circumstances remain the same; but in the practical conduct of life insurance that is not the only thing to be considered. A short sketch in broad outline of its past history may serve to explain what we mean.

The early insurance companies charged a flat rate of 5*l.* per cent. for members of all ages, which was unfair to their younger members, but profitable to the companies. Then Price was lucky enough to come across the work of that worthy clerk of Northampton whose bills of mortality were prefaced each year by verses of the poet Cowper, and by the aid of those bills constructed a table of mortality. His method was erroneous, but the error was on the right side, for he made the mortality to be greater than it really was, and so as long as the Northampton table was used the prosperity of the companies continued. Then Milne constructed another table from the mortality experienced at Carlisle. Milne's methods were correct, but his table, being based on a limited local experience, was founded on insufficient data and was unevenly graduated. Still it served as a standard table for very many years, until Farr prepared from the Registrar-General's returns for the whole population the English life tables. These failed in the other direction; they were too general. We are not including in these observations the industrial insurances.

In these circumstances the Institute of Actuaries constructed a table from the actual experience of the companies, known as the H^m or healthy male table; but by the year 1893, as Mr. George King wrote, "it came to be felt that the Institute of Actuaries' experience was passing out of date." It was resolved to construct a table of mortality on the experience of sixty companies during the thirty years from 1863 to 1893, leaving out of account all the experience of the earlier days of the companies. In 1901 (not "a half-century ago," as Dr. Campbell puts it) tables based on this experience were published, and they are now the standard tables in use.

It appears from all we have said that the insurance companies have been alive to the fact that the duration of life has been gradually increasing, and have not been unwilling to give their policyholders from time to time the benefit of the advance of knowledge in that respect. The war has now come to throw a new and lurid light on this question. It has destroyed the lives or ruined the health of many of those "whose lives have been accepted as risks to be insured." But it will come to an end some day, and normal conditions will in time be restored. Meanwhile, we may be well content with the materials with which actuarial science has already furnished us.

TROPICAL DISEASES.

THE Bulletin of the St. Louis University for January, 1916, contains a report of the work of the expedition sent by the University to British Honduras last summer for the study of tropical diseases. This expedition, intentionally planned for the purpose of a preliminary study of methods of procedure, etc., illustrates the advantage of these research expeditions. It is not that laboratories do not exist and that research is not carried out in British Honduras, but such an expedition comes with a fresh outlook on problems, and matters which may be taken to be among the most ordinary events, scarcely worthy of record in official reports, strike the members of an expedition with an entirely fresh force. We may illustrate this by two interesting examples, though perhaps not of great importance. We do not recollect in the official reports of British Honduras—and, indeed, it may be because one does not read official reports sufficiently carefully—the occurrence of poisoning, said to be common during the summer months, by the baracouta fish, nor do we recollect having heard of this on the West Coast of Africa, where the baracouta forms a welcome addition to the ordinary diet of skinny chickens. Again, the "botlass" fly (unidentified), after alighting on the skin, leaves a black, hard spot and the bite is very painful. This, again, to us is a new fact and one certainly that should be investigated.

The Bulletin has a special interest in that it contains an "In Memoriam" notice of the life and work of Dr. Edward Nelson Tobey, who was in charge of this expedition to British Honduras to study tropical diseases. He lost his life on the ship *Marowijne*, in a West Indian hurricane, on August 14. His life, as recorded here, was "one of unreached ambition and of unrealised hope. It was all effort and venture, with but little fruition and rest." The words of Meredith's sonnet on "Internal Harmony"—

> So that I draw the breath of finer air
> Station is nought, nor footways laurel-strewn
> Nor rivals tightly belted for the race.
> Good speed to them! My place is here or there;
> My pride is that among them I have place:
> And thus I keep this instrument in tune—

are, as those who knew "old Tobey" personally can confidently assert, well applicable to him.

J. W. W. S.

THE MITTAG-LEFFLER INSTITUTE.

IT was announced in our issue of March 23 (p. 85) that Mme. Mittag-Leffler and her husband, Prof. G. Mittag-Leffler, the eminent mathematician, had made a will devoting the whole of their property to the promotion of pure mathematics. Details of this significant foundation are given in the *Revue générale des Sciences* of May 30, from which the following particulars have been derived:—

The bequest includes their freehold villa with its contents, among which is a fine mathematical library; and an endowment to provide for its upkeep, salary of its curator, and other specified purposes. To encourage the study of pure mathematics in Sweden, Denmark, Finland, and Norway there are to be bursaries tenable by young people of both sexes belonging to these countries; they must show real aptitude for research in pure mathematics, but may pursue their studies at home or abroad. There is to be a gold medal, similar to the minor Nobel medal, for pure mathematicians belonging to the aforesaid countries who produce works above the average; and a prize for pure mathematics, to be awarded, if possible,

at least once in every six years, which is open to the whole world. The only express condition is that the award is to be for discoveries of real importance in the domain of pure mathematics.

It is intended that the director of the institute should be an eminent, and at the same time sympathetic, mathematician. The library will be available for all serious students, and they will have the privilege of consulting the director. Part of his duties will consist in giving courses of lectures to a limited number of "really gifted auditors, keenly interested in his discourses." Prof. Mittag-Leffler states that, in making his arrangements, he has taken as his model the Pasteur Institute; and the final clause of this enlightened and far-seeing document is as follows:—

Our will owes its origin to the lively conviction that a people which does not hold Mathematics in high esteem will never be able to fulfil the loftiest duties of civilisation; and that consequently it will fail to enjoy that international consideration which, in the long run, forms an effective means of preserving our status in the world, and of maintaining our right to live our individual life.[1]

We have only to add that in our opinion this is a noble example of well-directed patriotism and philanthropy which ought to lead to many imitations.

NOTES.

We learn with much regret that Prince Boris Galitzin, professor of physics in the Imperial Academy of Sciences, Petrograd, and a distinguished worker in seismology, died on April 21/May 4.

We notice with deep regret the announcement of the death on June 30, at seventy years of age, of Sir Gaston Maspero, the well-known Egyptologist and permanent secretary of the Académie des Inscriptions et Belles-Lettres, Paris.

The twenty-seventh annual meeting of the Museums Association will be held at Ipswich on Tuesday and Wednesday, July 11 and 12, under the presidency of Mr. E. Rimbault Dibdin, Curator of the Walker Art Gallery, Liverpool.

The annual general meeting of the Eugenics Education Society will be held at the Grafton Galleries, London, W., to-day (July 6), at 4 p.m., when the presidential address will be delivered by Mr. Leonard Darwin.

A special Prize Fellowship of 100*l*., offered by the Federation of University Women to encourage research on some questions of special interest in the present national crisis, has been awarded by the Federation to Dr. Alice Lee, Fellow of University College, London. Miss Lee has collaborated for some years with Dr. Karl Pearson in many statistical investigations, and is also the author of several independent communications. She is about to undertake an investigation into the birth-rate as affected by present conditions.

In the *Times* of July 3 its special correspondent, in describing the battle on the Somme, refers to the occasional inaudibility of the gun-firing at short distances. "Last night" (June 29), he says, "I watched the bombardment from a position commanding a view of a large section of the front. . . . It was a soft dark night, with a light westerly wind. . . . The comparative noiselessness of the bombardment from near at hand last night was very curious." On the hilltop where he stood he was unable to hear "any sound save of the guns immediately by us, with occasional bursts of sound coming quite illogically from far away. And all the while the flare and flashing of the shells was continuous."

We regret to announce that M. Emile Waxweiler, who before the war was the director of the Solvay Institute of Sociology at Brussels University, was killed in London on June 26 by a motor-car. An appreciative account of M. Waxweiler's work, in the *Times* of June 29, points out that the sociological studies produced by him and under his direction were models of scientific inquiry. Among his best-known works before the war are his "High Wages in the United States" and "Profit Sharing." He was recently appointed director of the Belgian Office of Economic Studies, established in London to ascertain the needs of Belgian trade and industry; and he was also chosen as a delegate to the recent Economic Conference at Paris, where he was the right hand of the Belgian Premier, M. de Broqueville.

A deputation from the Royal Scottish Arboricultural Society met a number of Scottish members at the House of Commons on July 4 and laid before them the case for the creation of a Department of Forestry connected with the Board of Agriculture, for the development of forestry in Scotland, and the preparation of schemes of afforestation. In connection with this subject the Parliamentary correspondent of the *Times* states that the Government has decided to conduct an inquiry into the subject of afforestation after the war. The inquiry has been entrusted to a sub-committee of the Reconstruction Committee of the Cabinet.

The failure of the Uruguayan trawler *Instituto Pesca* to reach Sir Ernest Shackleton's men on Elephant Island was not surprising in view of the fact that she is an unprotected vessel and made the attempt in the Antarctic midwinter. The Uruguayan Government, however, has ordered her to lie at Punta Arenas awaiting a more favourable opportunity. Meanwhile the damage she sustained in the ice is being repaired. Open water up to Elephant Island is quite possible in any month of the year, but it can never be relied on, and so the chances of the *Instituto Pesca* succeeding are most problematical. The Argentine sloop *Uruguay*, which rescued the wrecked Swedish expedition in 1903, is unfit for service. But it is reported that the Chilian Government has a wooden whaler, which has been offered to Sir Ernest Shackleton. If she is in good repair, this vessel should be able to reach the marooned men, for even if heavy pack is encountered a strong wooden ship could either force a passage or lie and wait for the pack to slacken. This appears to be the only possible ship in South American waters. A suitable ship could be secured in this country, but, at the earliest, could not reach Elephant Island before the end of August. If, however, Sir Ernest Shackleton reports that the shipping resources of South America cannot meet the demand, a vessel will be sent from home.

The Manchester City Council (governing body of the Manchester School of Technology) has just decided to establish forthwith a new sub-department of the school for post-graduate study and research in coal-

[1] "Notre testament doit son origine à la vivante conviction qu'un peuple qui n'accorde pas aux Mathématiques un rang élevé dans son estime, ne sera jamais en état de remplir les plus hautes tâches civilisatrices et de jouir, par suite, de la considération internationale qui, elle aussi, constitue à la longue un moyen efficace de conserver notre situation dans le monde et de sauvegarder notre droit à vivre notre propre vie."

tar products and dyestuffs, and has appointed Prof. A. G. Green, F.R.S., to take charge of it. Prof. Green recently resigned the chair of tinctorial chemistry at Leeds University in order to direct the research department of the largest Lancashire firm of dyestuff manufacturers. His sub-department will be under the general direction of Prof. Knecht, who is head of the department of applied chemistry, and is expert in the use of dyestuffs, as Prof. Green is expert in their manufacture. With two such distinguished chemists in command, the Manchester School of Technology should be able to render invaluable assistance to producers and users of dyes, and so to assist materially in the development of this specially important branch of British chemical industry.

PROF. PAUL JANET, of the Sorbonne, gives in the *Revue générale des Sciences* a short account of the work of the late Prof. Eric Gerard, of the Montefiore Electrotechnical Institute, Liège. He was born in Liège on September 22, 1856, and, after graduating as an engineer at the University there in 1878, completed his studies at Paris. In 1881 he returned to Liège as professor of applied electricity at the School of Mines, and two years later was made director of the newly founded Montefiore Institute. His great abilities, both as an administrator and as a teacher, rapidly raised the institute to the prominent position it has occupied for so many years, and his "Leçons sur l'Electricité," which appeared in 1890, was recognised as a masterpiece throughout the electrotechnical world. He represented Belgium on all international electrical commissions, and his opinions had great weight with his colleagues. When Liège was attacked by the Germans in 1914 he was recuperating after the term's work at his country house, sixteen miles south-east of Liège, and only with difficulty got away to Holland. Early this year he came to England, but on his health giving way he returned to Paris, and died there on March 28 without having seen his own country.

AT the meeting of the Royal Society of Edinburgh held on July 3 the following Honorary Fellows were elected:—*British Honorary Fellows*:—Sir Francis Darwin, Cambridge; Dr. J. W. L. Glaisher, Trinity College, Cambridge; Prof. J. N. Langley, professor of physiology, Cambridge; Prof. C. Lapworth, emeritus professor of geology, University of Birmingham; Prof. A. Macalister, professor of anatomy, Cambridge; Prof. A. Schuster, emeritus professor of physics, University of Manchester. *Foreign Honorary Fellows*:—Prof. C. Barrois, professor of geology and mineralogy, Lille; Prof. D. H. Campbell, professor of botany, Leland Stanford University, Cal., U.S.A.; Prof. M. E. Gley, professor of physiology, Paris; Prof. C. Golgi, professor of anatomy, Rome; General W. C. Gorgas, U.S. Army Medical Department; Prof. G. B. Grassi, professor of comparative anatomy, Rome; Prof. E. C. Pickering, professor of astronomy, Cambridge, U.S.A.; Prof. E. Warming, emeritus professor of botany and keeper of the Royal Botanic Gardens, Copenhagen. The following prizes of the society were presented:—The Keith Prize Award for the biennial period 1913–1915 to Dr. J. H. Ashworth for his papers on "Larvæ of Lingula and Pelagodiscus" and on "Sclerocheilus," published in the Transactions of the Society, and for other papers on the morphology and histology of Polychæta; and the Neill Prize Award for the biennial period 1913–1915 to Dr. R. Campbell for his paper on "The Upper Cambrian Rocks at Craigeven Bay, Stonehaven," and "Downtonian and Old Red Sandstone Rocks of Kincardineshire," published in the Transactions of the Society.

THE Albert Medal of the Royal Society of Arts for the current year has been awarded to Prof. Elias Metchnikoff, For.Mem.R.S., "in recognition of the value of his investigations into the causes of immunity in infective diseases, which have led to important changes in medical practice, and to the establishment of principles certain to have a most beneficial influence on the improvement of public health." The annual report of the council, published in the Journal of the Society for June 30, refers to the award as follows: "The discoveries of Prof. Metchnikoff in regard to the nature of immunity to infective diseases have contributed, more than the work of any other living man, to the control of such diseases, and to the consequent improvement in the health of great European populations, and the safeguarding of those who have to face the dangers of bacterial infection, whether on the battlefield or as pioneers in tropical climates. For many years, as professor of zoology at Odessa, he was an ardent student of lower forms of life. It was by the study with the microscope of the cell activities of sponges and transparent marine organisms that he arrived at his discovery of phagocytosis. These researches into the development and metamorphoses of invertebrates prepared the way for his great discovery, as he was led by the observation of the action of the mesoderm cells in the embryonic organs of echinoderms to the knowledge that the white blood-cells or phagocytes devour the invading microbes in vertebrates also, and he was thus able to show the universal applicability of his generalisation. Prof. Metchnikoff's services to zoology and pathology are of world-wide repute, and have already been recognised by the award of the Nobel Prize for Medicine, and of the Copley Medal of the Royal Society."

TWO methods of mounting fossil vertebrates are described in the *Museums Journal* for June. One of these includes the skeleton of Stenomylus, a diminutive relation of the camel. This has been recently mounted in the British Museum of Natural History in a standing posture, and partly embedded in plaster. The other is that of the skeleton of an extinct reptile, *Thescelosaurus neglectus*, which is exhibited in the United States National Museum "almost in the position in which the bones were found." It is not clear, from the description here given, whether the term "almost" refers merely to slight restoration or implies a remounting, as in the original matrix. In the latter case the method has nothing to commend it, but rather the reverse.

THE annual report of the Zoological Society of Scotland appears this year in a slightly abbreviated form, owing to the falling off of income incidental to the war. It is devoutly to be hoped that the society has weathered the worst of the storm, for the newly established Zoological Park bids fair to excel even its rival in London, at least in so far as sumptuousness in the housing of the animals is concerned. In this, of course, the natural advantages of the site play an important part. Diminishing funds have made strict economy an urgent necessity, but it is to be hoped that no further curtailments will be needed. The Carnegie Trustees have generously promised the sum of 10,000*l.* for the purpose of building and equipping an aquarium in the park, but it is not the intention of the council to proceed with the work until after the war.

THE report of the director of the Aquarium of the Zoological Society of New York, which has just reached us, has some interesting comments on the use of metal tanks for the transport of live fish.

Finding that the galvanised tanks commonly used suffered much from the rough handling to which they were subjected on shipboard, wooden tanks were substituted. These have a capacity of 156 gallons, and have proved in every way preferable. A great saving both of labour and expense has been effected by feeding the fish on alternate days instead of every day. The mortality has also decreased, an excess of fat having resulted from a too liberal diet. Altogether more than 3000 fishes, representing 140 species, are exhibited here, and among these are an unusually fine series of tropical species, and "jew-fishes" up to 500 lb. in weight. The porpoises died during the year from water fouled by sewage; to avoid losses from this source filtering tanks have been established, with eminently satisfactory results.

IN *Californian Fish and Game*, the journal published by the Board of Fish and Game Commissioners of San Francisco, vol. ii., No. 2, Mr. Chase Littlejohn gives a brief but valuable account of the habits and hunting of the sea-otter, which is fast nearing extinction. As the author was himself for some years engaged in hunting this animal, his summary makes an important addition to our knowledge of its life-history. Unlike all other aquatic mammals, the sea-otter, he tells us, swims on its back, turning swiftly over when about to dive, but he affords no information as to the part played by the tail while swimming at the surface. Sea-urchins appear to be the staple food of this animal, and these are brought to the surface and eaten as the swimmer floats upon his back. Squids and seaweed are also eaten, and occasionally fish. After man, the greatest enemy of the sea-otter is the killer-whale, from which it contrives, at times, to escape by floating at the surface as if dead. In the early days of the author's hunting, sea-otters were met with off the coasts of Japan in "schools" of as many as 400, but owing to the merciless persecution to which they have been subjected hunting is now no longer a profitable undertaking and has been abandoned.

British Birds for June contains the first of what promises to be a valuable series of records on the breeding habits of the sparrow-hawk. In the present contribution the author, Mr. J. H. Owen, describes the behaviour of the adults towards the young during rain. Ordinarily, after the young are a few days old, the hen does not require her mate to bring food to the nest. In rain, and especially in heavy rain, this is not so. She takes no notice of his calls, and he has to bring the food and deposit it on the nest. If the rain is not very heavy she will then break it up and distribute it, but in a heavy downpour she will wait until its violence has ceased rather than expose her offspring to the danger of a soaking. During pelting rain the hen, hurrying home at the first sign of the impending storm, stands over her young with outspread wings, taking especial care to cover her youngest completely. When the storm ceases she will take up her position on some neighbouring tree and expose her sodden plumage to the sun and air. The down of the nestlings seems never to get thoroughly soaked, and no attempt is made to preen it until some time after the hen has left them. This account is illustrated by some excellent photographs.

IN the Journal of the Royal Horticultural Society (vol. xli., part 3, for May) Mr. C. H. Senn contributes a useful paper on leaf vegetables and how to cook them. Vegetables are essential to both good eating and good health, so that their proper preparation and cooking are matters of the first importance. Compared with other articles of diet—fish, meat, and poultry—vegetables when properly cooked can be converted into correctly balanced food at about one-third the cost. The importance of paying attention to such matters is therefore essential, especially at the present time.

THE importance of the Canary Island palm, *Phoenix canariensis*, is referred to in Kew Bulletin No. 4. Dr. G. V. Perez states that it is the best wind-break for plantations and also that it is an ideal tree to plant along river-banks to prevent soil erosion. In addition, the hard kernels are found in the Canaries to be one of the best and most fattening foods for pigs, and they are also relished by goats. Dr. Perez mentions that he is feeding a milch-cow on the kernels after steeping them for a few days in water, and has found them useful for fattening turkeys. Palm honey can be obtained from the trees by tapping. The practice of tapping the palms was probably introduced from the opposite coast of Africa by the aborigines of the islands.

IN vol. lxxvi. of the Journal of the Royal Agricultural Society, recently issued, Dr. Winifred Brenchley describes the weeds on arable land and the best means for their suppression. Surveys of considerable areas of agricultural England have shown that comparatively few weeds are definitely associated with a single type of soil. Some of the most noxious weeds, from the farmer's point of view, are quite indifferent to soil variations; others, although of general distribution, are more frequently found on certain soils; while a small number are characteristic of particular soils, more especially sand and chalk. The methods of suppression applicable to annual and perennial weeds are dealt with generally, special treatments being prescribed for the most noxious species. Thus charlock (*Brassica arvensis*) is very susceptible to sprays of copper and iron sulphates, which do no harm to cereals growing in the same field, as their long, narrow leaves do not hold the poisons like the rough leaves of the weed. In this connection it may be noted that arsenical sprays have been used successfully abroad for weed eradication on a large scale. Sometimes a weed becomes so firmly established that ordinary methods are useless, and fallowing or a change in the rotation must be tried. As a rule, thorough cultivation of the soil at the right times—and it is here that Dr. Brenchley's paper will greatly help the farmer—is all that is required.

SOME notes on the meteorological observations of Roald Amundsen's Antarctic expedition of 1911–12 appear in *Naturen*, a monthly publication of the Bergen Museum, for March and April, 1916 (vol. xl., Nos. 3 and 4). The paper is by H. Mohn, who was responsible for the volume on meteorology in the scientific publications of the expedition. Prof. Mohn points out that the observations support the idea, advocated by Prof. Meinardus, that there is a cyclonic movement of air over the Antarctic plateau. The winds seem to have a comparatively high temperature and the characteristics of cyclonic winds. The pressure observations showed a decrease towards the Pole. The existence of cyclonic conditions over the continent would account for the heavy snowfall that must have been required for the formation of the ice-cap. On the other hand, it must be remembered that there are evidences that the snowfall in Antarctica is less than it was and insufficient to account for the formation of the ice. Certainly it is not proved that the inferior snowfall on the plateau is heavy, and it must not be forgotten that we have no winter observations, except on the coast.

AFTER many vicissitudes and much conflict of opinion, a water-supply scheme for Aberdeen has been definitely laid down, and although some time will necessarily elapse before the undertaking can be carried out in its entirety and the town enjoy the full advantages of the additional supply, it is recognised on all sides that the settlement of the vexed question is a matter for congratulation. The present supply is drawn from the Dee, and, despite strong advocacy of the merits of the Avon and the Dye, the future supply will continue to be drawn from the same source, though from a point some distance further upstream. The new intake will be at Cairnton, on the left bank of the river, twenty miles above Aberdeen. One of the principal objections raised against the Dee scheme was that, before interception, the stream passes through several populous districts, such as Braemar, Balmoral, and Ballater, which must inevitably cause some degree of pollution. On the other hand, the wide, shallow, and pebbly bed of the river lends itself admirably to the oxidation of its waters. It has been felt preferable not to rely merely on filtration and storage, but to bring about further purification by the excess lime treatment. A section of this work has already been installed, and is described, with illustrations, in the *Engineer* of June 23. The population to be supplied with water numbers 170,000, and the average daily consumption per head is computed at 40 gallons. The new scheme, as a first instalment, will provide $8\frac{1}{2}$ million gallons per day, and afterwards an additional $1\frac{1}{2}$ million gallons per day.

OUR ASTRONOMICAL COLUMN.

A JUNE METEORIC DISPLAY.—Mr. W. F. Denning writes from Bristol:—"On the evening of June 28, after a cloudy, oppressive day, the atmosphere cleared. On going out into my garden to commence observations at about 10.25 G.M.T., I almost immediately saw that a very rich and unexpected display of meteors was in progress.

"Continuing to watch until 12.15, I saw fifty-five meteors, including many fine ones. Then clouds interrupted, but these had drifted away and left the sky clear again at 12.45, and fourteen additional meteors were seen in half an hour.

"The radiant was at 230°+54°, and there seemed to be a well-marked companion centre near β Boötis at 223°+41°. The meteors were slow, and all the brighter ones left evanescent trains of sparks. The shower seems quite unknown, but there are rich radiants in Quadrans on January 2 and October 2."

THE VISIBILITY OF STARS IN DAYLIGHT.—Among other interesting items, a note in the *Observatory* (June) records that Sirius was seen with the naked eye by Mr. A. E. M. Fleming one minute before sunset on April 18. It may be stated here that M. Bigourdan has now obtained grounds for believing that the observation referred to in NATURE, June 15, should really be ascribed to Peiresc (*Comptes rendus*, No. 24).

THE LARGE METEORITE OF FEBRUARY 13, 1915.—This object fell in the Chusan Archipelago, near Video, and an interesting description of the facts attending its fall, by Mr. W. F. Tyler, appears in the Journal of the Royal Asiatic Society (vol. xlvi., 1915). Mr. Tyler alludes to many of the observations and discusses the real path, but the data were somewhat conflicting, and he found it impossible to harmonise them and derive a perfectly trustworthy result. He concludes that the meteorite probably exhibited a curved flight, being directed from N.N.E. at first and from N.W. towards the end. As to the actual dimensions of the meteor, Mr. Tyler concludes that the incandescent mass at one point of its path was 1500 ft. in diameter, while at the end it had declined to 80 ft.

Mr. Tyler has done the best he could with discordant materials, but it is far easier to assume that the obviously rough observations were wrong than that the meteor had a very devious course. The writer would prefer to adopt a straight course of about 60 geographical miles from N. by W.

As to the diameter, the actual nucleus was probably not more than two or three feet in diameter. It is well known that meteoric bodies when incandescent appear enormously larger than they really are. Thus the meteorite which fell near Wigan on October 13, 1914, gave a brilliant illumination and thunder-like reports over a wide area, though it only weighed 33 lb. when afterwards discovered.

THE MOTION OF THE NUCLEI OF COMET 1915*e* (TAYLOR).—In a series of measures of the nuclei of Taylor's comet, made at Bergedorf by H. Thiele between February 19 and April 3, the distance showed little change, but the position angle varied considerably. The observation gave a period of about thirty days. If this is considered to be a rotational motion the total mass of the comet would be about 10^{-10} (*Astronomische Nachrichten*, No. 4846).

ON CENTRE—LIMB SHIFTS OF SOLAR WAVE-LENGTHS.—An important memoir dealing with this subject, by Mr. J. Evershed and Dr. T. Royds, appears as Bulletin No. xlix. of the Kodaikanal Observatory. The alterations of wave-lengths of certain iron lines have been studied in greater detail over the sun's disc, and it appears that they begin to be measurable not far from the centre (0·3 of the radius). Thus the displacements cannot be due to differential pressure effects. The inverse relation between the limb shift and centre shift is held to indicate that they have a common origin. The authors prefer to seek the cause in line-of-sight motion rather than in anomalous dispersion, although recognising the possibility of basing thereon an attractive explanation. The Döppler effects would result if there exists a general motion directed away from the earth all over the disc. A crucial test of the hypothesis, it is suggested, would be afforded by measures of lines in the spectrum of that face of the sun reflected from the planet Venus.

METALLOGRAPHIC METHODS IN AMERICA.

IN a paper on "A Metallographic Description of Some Ancient Peruvian Bronzes from Machu Picchu," Mr. C. H. Matthewson, in the *American Journal of Science* (No. 240, December, 1915), gives an interesting account of the detailed application of modern metallographic methods to the study of ancient metal objects with the view of arriving at an insight into the methods of working employed by those who fashioned the various objects. Some work of this kind has already been done by Garland, Hadfield, and Rosenhain, but the present paper carries the matter further, for the author has carried out a somewhat extensive series of experiments on the behaviour of the tin-copper alloys under cold and hot working and annealing, in order to arrive as closely as possible at the precise mode of treatment which each of the thirty-three objects examined had undergone. While in general terms it has always been possible to determine from a microscopic examination of such an object whether it has been cast or wrought, Matthewson endeavours to carry the matter further and to

establish with some degree of accuracy at what temperature working has been carried out and what ranges and durations of annealing have been employed. For this purpose he makes use of measurements of grain-size, of a classification of the degree of "coring" or of "homgenisation" which has been produced, and also of the various indications of cold work or overstrain. Quite apart from its archæological interest, the paper represents a valuable study of the behaviour of the tin-copper alloys ranging in tin-content from about 2 to 14 per cent. under mechanical deformation and annealing. Less happy are the author's excursions into the domain of theories of plastic strain and of annealing in metals generally; they burden a lengthy paper with much additional matter scarcely relevant to the subject.

From the Scientific Materials Co., of Pittsburgh, U.S.A., we have received pamphlets descriptive of the Simatco apparatus for the determination of transformation or critical points in iron, steel, or alloys, and of appliances for general metallographic work. While it is difficult to form any real opinion on such appliances without having seen them and tested them in actual use, the fact that special apparatus of this kind is now being placed upon the market in America is significant of the widespread development and application of metallography. So far as can be gathered from the very clear descriptions and illustrations of the apparatus given in the pamphlets, much of it appears to be highly convenient and ingenious; on the other hand, certain features are obviously open to serious criticism. For instance, the claim is made that a very simple form of well-lagged electrically-wound furnace can by means of a special rheostat be caused to give a uniform rate of rise and fall of temperature over a wide range, and it seems most unlikely that this can be realised. The form of specimen adopted is also open to objection on the ground that much of the metal is further away from the thermo-couple than is necessary or permissible. The shape adopted arises from the use of a leading-in tube of special shape—in itself very convenient—by which the wires of the thermo-couples are brought into the specimen. This shape of tube, however, demands a very wide hole, and the effort to compensate for this by a "deep immersion" results in an unsatisfactory shape. Further, for indicating the temperatures of the thermo-junctions, both for inverse rate and for differential curves, nothing better is provided than a galvanometer with a pointer moving over an ordinary scale. The entire apparatus thus appears to be suitable only for work of the less delicate or accurate kind, which, however, is of very considerable importance in works practice.

PROBLEMS OF CORAL REEFS.

RECENT work on coral reefs has established firmly the part played by submergence in the production of encircling and barrier reefs. At the same time, such reefs are shown to be based on extensive platforms, from which there is a further descent to oceanic waters. Mr. T. W. Vaughan points out (*Amer. Journ. of Science*, vol. xli., 1916, p. 134) that the banks off Newfoundland, Nova Scotia, and Cape Cod "would furnish proper habitats for reef-building corals did they not lie outside the life-zone of such organisms," while the corresponding plateaus of Florida and the Central American coast support many reefs. He attributes the general overflowing of the marginal land areas in recent geological time to "some diastrophic change in the earth," and is unwilling to accept Glacial control as accounting for all the facts. His paper is an introduction to one on the "Relations of Coral Reefs to Crust Movements in the Fiji Islands," by E. C. Andrews, of Sydney (*ibid.*, p. 135), in which submergence is regarded as essential to the formation of the Great Barrier Reef of Queensland, while the barrier reefs of the Fijis are reviewed as narrow growths rising from land areas that have been recently submerged. Prof. R. A. Daly follows (*ibid.*, p. 153) with a paper on "Problems of the Pacific Islands," and emphasises the presence of platforms one or two miles to one hundred miles in width as bases for the growth of reefs. He also considers the case of Queensland, and the numerous sections given, drawn to scale, are an important contribution to geography. "The problem of the coral reef," he concludes, "is, in essence, the problem of the platform." Mr. T. W. Vaughan, in the Journal of the Washington Academy of Sciences, vol. vi., 1916, p. 53, describes the association of platforms and reefs in the Virgin and Leeward Islands, where the platforms were moulded by marine erosion during Pleistocene time and then submerged, the changes of sea-level thus according with Daly's theory of Glacial control. Readers of NATURE will remember a recent consideration of this theory (vol. xcvii., p. 191).

G. A. J. C.

SPECTRA IN ELECTRIC FIELDS.

SHORTLY after Stark's discovery that certain spectral lines could be split up into two or more components by an electrical field, an account was given in NATURE (May 14, 1914, vol xciii., p. 280), under the title "An Electrical Analogy of the Zeemann Effect," of the experiments of the Italian physicist, Lo Surdo, upon the Balmer series. It was shown by Lo Surdo that the resolution of the four lines in the visible spectrum followed some remarkably simple laws. In a paper, dated December 19, 1915, in the *Rendiconti della R. Accademia dei Lincei*, C. Sonaglia shows that Lo Surdo's laws hold for the first line in the ultra-violet, *i.e.* the fifth of the Balmer series. The total number of components into which the line can be resolved is seven, corresponding to the value of the parameter n in the Balmer formula which gives the line, and the number of components the vibrations of which are perpendicular to the field is five, equal to the number which gives the position of the line in the series.

In the same volume, No. xxiv., are two papers by Rita Brunetti, which detail the results obtained on the helium spectrum by Lo Surdo's method. In the third subsidiary series, in which four lines have been examined, it is found that the number of components into which a line can be resolved is again equal to the value of the parameter n giving the position of the line in the series. For each line there are three unpolarised components, while the number of polarised components is equal to $(n-3)$. In the first subsidiary series only the first member, for which $n=3$, possesses any polarised component; for all the lines of this series the number of unpolarised components of any line is $(n-2)$. It is interesting to notice, when British science is so much under discussion, that the optical apparatus used in all these researches was supplied by an English firm.

We have also received vol. xxiv., 96 pp., of *Atti della fondazione scientifica Cagnola dalla sua Istituzione in Poi*, containing a report by Prof. G. Vanni on the progress and present position of wireless telegraphy and telephony. For choice of material, lucidity, and an interesting style this little volume would be difficult to beat. The literature is brought up to about the end of 1914.

R. S. W.

SCIENCE IN EDUCATION AND INDUSTRY.

LORD CREWE announced at a meeting of the governing body of the Imperial College of Science and Technology on June 30 that it is the intention of the Government to appoint a Special Committee to inquire into the question of the position of science in national education. It is proposed that the Committee, working in close concert with the President of the Board of Education, shall include representatives of pure science, of applications of science to commerce and industry, and also those who are able from general experience to correlate scientific teaching with education as a whole. The Committee will have a close connection with Government, and Lord Crewe himself will be the chairman. The general objects of the Committee will be, broadly speaking, to inquire into the position of science in our educational system, especially in universities and secondary schools. Its duty will be to advise the authorities how to promote the advancement of pure science and also the interest of trades, industries, and professions dependent on the application of science, not neglecting the needs of a liberal education.

These objects are almost identical with those which the British Science Guild and its various important committees have been urging upon public attention for the past ten years, without much practical support from the scientific societies and educational associations, which only awakened to their importance after the war had been upon us for some months. The new Committee is to be connected with the Reconstruction Committee appointed by the Prime Minister in March last to consider and advise upon the problems that will arise on the conclusion of peace, and to co-ordinate the work which has already been done by the Departments in this direction. Lord Crewe said on June 30 that it had been thought wise that the Prime Minister's Reconstruction Committee should undertake the general supervision and review of the changes which might be required in our national system of education, rather than that this inquiry should, as had been recommended, be entrusted to a Royal Commission. The possibility of immediate action by any Department on any point on which necessity for action was proved was a most distinct and substantial gain over what would be possible if the procedure had been by Royal Commission. It was clear that a review of our education generally could not be regarded as strictly one of the subjects of reconstruction after the war, but, on the other hand, the two things could not be disconnected.

Any suggestions or other communications from individuals or organisations bearing upon the inquiries now being undertaken should be addressed to Mr. Vaughan Nash, C.V.O., C.B., Secretary of the Reconstruction Committee, 6A Dean's Yard, Westminster. They will be considered and referred in suitable cases to the Department concerned or to one of the Sub-committees to which particular subjects or groups of subjects have been referred by the Reconstruction Committee.

SCIENCE AND THE BREWING INDUSTRY.[1]

AT the commencement of the period under review, when the author first became definitely associated with the brewing industry, at Burton-on-Trent in 1866, brewing operations were conducted on purely empirical lines, the real nature of the processes involved being unknown. The rational scientific control of these operations which is possible to-day is the outcome of a vast amount of experimental study of brewing problems, and this study has not only extended the bounds of natural science beyond all expectations, but has indirectly conferred incalculable benefits on the human race by its influence on the development of medicine, surgery, and sanitation. The views of Berzelius and Liebig on fermentation were still widely accepted fifty years ago, and the maladies to which beer was subject were attributed to some indefinable transformations of its albuminoid constituents. The true nature of alcoholic fermentation as a normal function of the living yeast cell was elucidated by Pasteur, who rendered immense services to the fermentation industries by his studies on the technology of vinegar, wine (1863–66), and beer (1871–76), bringing to light for the first time the action of bacteria in producing disorders of these beverages. What is not generally recognised is that his later work on infectious diseases and immunisation, which laid the foundation of the subsequent wonderful developments of preventive medicine and hygiene, was the direct outcome of these researches on the fermentation industries, and was in large measure rendered possible by a technique which he acquired therein.

The reactions which take place in the brewer's mash-tun were investigated by O'Sullivan at one of the Burton breweries, from about 1870 onwards, in a series of researches of the first importance, not only to brewing, but to the chemistry of enzyme action. Applying the polarimeter, an instrument rarely used in this country at that time, he studied the action of malt-diastase on starch, demonstrated that the crystallisable sugar formed is not dextrose, but maltose, and studied the quantitative relation of the maltose and dextrin under varying conditions of temperature.

The study of malting processes was stimulated by the transference of the excise tax from malt to beer, in 1881, when certain restrictions on malting operations imposed by the authorities were removed. In a long series of researches the author, in collaboration with G. H. Morris and others, succeeded in bringing to light the principal chemical and morphological changes which go on in the barley grain during the early stages of germination, and laid the foundation of a scientific control of malting processes. He demonstrated that the embryo of the grain is related to the endosperm as a vegetable parasite to its host, that there is no structural connection between the two, and that if the surrounding integuments common to both are removed the embryo can be readily separated from the endosperm and reared into a perfect plant by the application of suitable nutriment. In the germinating barley grain the food reserve in the endosperm is made available for the embryo by means of diastatic, cytatic, and proteolytic enzymes secreted by the epithelial cells of the scutellum of the embryo; these enzymes, projected into the endosperm, dissolve the cell walls and corrode and dissolve the starch granules.

The study of the micro-organisms of fermentation received a fresh impulse, some years after the conclusion of Pasteur's studies on beer, from the work of Emil Chr. Hansen at Copenhagen. He introduced new methods of investigation, distinguished the primary brewers' yeast, *Saccaromyces cerevisiae*, from other types capable of producing secondary changes in beer, and introduced the practice, common on the Continent, of using pure-culture yeasts, produced from a single cell, for brewing.

Many of the problems which arise in connection with the fermentation industries deserve the closest attention of physiologists and pathologists, inasmuch

[1] Abstract of a paper read before the Institute of Brewing, May 8, on "Some Reminiscences of Fifty Years' Experience of the Application of Scientific Method to Brewing Practice," by Dr. Horace T. Brown, F.R.S.

as they present aspects of biochemistry and cell-functioning in a relatively simple form free from many of the complications encountered with higher organisms. One such problem is the activation of enzymes which is sometimes produced by the presence of living cells. The author observed, for instance, that certain kinds of starch granules, capable of resisting indefinitely the action of a highly diastatic liquid in which they were immersed, were readily attacked by the diastase after a trace of yeast had been added. Possibly the explanation is to be sought in the reversible nature of enzyme action and the continuous removal of certain products by the yeast. The subject may perhaps throw some light on the influence of "vitamines" on animal nutrition. The allied problem of symbiosis is exemplified in a relatively simple form by the "amylo-process" employed in certain distilleries at Seclin, in France. In this process the sterilised amylaceous material is saccharified and converted into alcohol and carbon dioxide in one operation by the joint action of a mould fungus which produces diastase, and a yeast which effects fermentation. Another subject which should be of interest to the physiologist relates to the quantitative relation between the reproduction of yeast cells and the supply of oxygen available. The author found that when cells are sparsely distributed through a nutrient liquid the oxygen initially dissolved in the liquid is rapidly absorbed by the cells, and the "oxygen-charge" per cell thus taken up determines the reproductive capacity of the yeast, provided no further oxygen is available. The author gives further examples of the extension of scientific knowledge resulting from the study of brewing problems, and discusses at length some of the more technical matters which still await solution.

THE PLAINS OF NORTHERN INDIA AND THEIR RELATIONSHIP TO THE HIMALAYA MOUNTAINS.[1]

A HUNDRED years ago the accepted idea was that mountain ranges were due to the upward pressure of liquid lava, and that their elevation had been caused by volcanic forces. But when geologists began to study the structure of rocks, they found that mountains had suffered from horizontal compression, which was evident from the folding of strata. This discovery led to the idea that mountains had been elevated, not by vertical forces, but by horizontal forces, which squeezed the rock upward. The wrinkling of the earth's crust into mountains by horizontal forces was explained by the cooling of the earth; this is the well-known contraction theory; the earth's interior is held to cool and to contract, and the outer crust is supposed to get too large for the shrinking core and to wrinkle.

About 1860 the observations of the plumb-line brought to light a most important and totally unexpected fact, namely, that the Himalaya were not exercising an attraction at all commensurate with their bulk.

The plumb-line was observed at Kaliana, 60 miles from the foot of the mountains; the observers found that the Himalaya were exercising no appreciable attraction. By the theory of gravitation the plumb-line ought to be deflected at Kaliana 58 seconds towards the hills. It is not deflected at all; it hangs vertically. This discovery was the first contribution made by geodesy to the study of mountains. The discovery was this, that the Himalaya behaved as if they had no mass, as if they were an empty eggshell; they seemed to be made of rock, and yet they exercised no more attraction than air. From the Kaliana observations Pratt deduced his famous theory of mountain compensation; he explained the Kaliana mystery by assuming that the rocks underlying the mountains must be lighter and less dense than those underlying plains and oceans. The visible mountain masses, he said, are compensated by deficiencies of rock underneath them. This is the theory of mountain compensation. The compensation of the Himalaya is not believed now to be exactly complete and perfect; they seem to be compensated to the extent of about 80 per cent.; their total resultant mass is thus about one-fifth only of their visible mass standing above sea-level. The discovery of mountain compensation struck a blow at all theories which attributed the elevation of mountains to any additional masses that had been pushed in from the sides. The elevation of mountains by subterranean lava squeezed in from the side had to be rejected because it gave to mountains additional mass; the wrinkling of the earth's surface by lateral horizontal forces had to be rejected because it gave to mountains additional mass pushed in from the sides. As the Himalaya possess only one-fifth of their apparent visible mass, I am led to suggest that the principal cause of their elevation has been the vertical expansion of the rocks underlying them, vertical expansion due to physical or chemical change.

Mountains Originate at Great Depths.

A very important work has been that of Mr. Hayford, who has recently discussed the results of the plumb-line at a large number of stations in America. He has confirmed Pratt. Hayford has investigated the depth to which the deficiency of density underlying mountains goes down, and he has found that that depth is between 60 and 90 miles. That is to say, he has shown that the depth of subterranean compensation is very great compared with the height of mountains. The discovery that mountains originate from the great depth of 60 to 90 miles is the second important contribution of geodesy to this study. The first was compensation, the second is great depth.

Southerly Deflections Prevail over the Ganges Plains.

Now let me tell you of the third discovery due to this plumb-line. The survey found that at 60 miles from the hills this plumb-line hung vertically, and Pratt deduced the theory of mountain compensation. But when the survey began to extend their operations, a new phenomenon came to light, which caused great surprise. All over northern India at distances exceeding 70 miles from the hills, this plumb-line was found to hang decisively away from the mountains; here at Lucknow it is deflected 9 seconds to the south. If the Himalaya were simply compensated, this plumb-line should be hanging at Lucknow exactly vertical; if the mountains were not compensated, it should be deflected here about 50 seconds towards the north. But it is deflected 9 seconds towards the south. The observers were astonished to find that at places in sight of Himalayan peaks the plumb-line turned away from the mountain mass; that at Amritsar, in sight of the Dhauladhar snows, it was deflected towards the low Punjab plains; at Bombay it was deflected seawards away from the Western Ghats; on the east coast of India it was deflected seawards away from the Eastern Ghats.

The new lesson to be learnt from the plumb-line is this: a hidden subterranean channel of deficient density must be skirting the mountains of India. Here in North India is a wide zone of deficient density, of crustal attenuation; it is the presence of this zone of deficiency that accounts for the southerly deflection

[1] Abridged from an address to the Indian Science Congress at Lucknow on January 13 by the president, Sir Sidney Burrard, F.R.S.

of the plumb-line. What is the meaning of this zone? How has it come into existence?

If you look at this section the earth's crust in these outer Himalaya has been compressed laterally: of this there is no doubt. The area between the snowy range and the foothills is a zone of crustal compression. And I suggest for your consideration that the Gangetic trough, this zone of deficiency, is a zone of tension in the crust. The crust has been stretched here and attenuated. Here you have compression, and alongside is the tension. The tension is the complement of the compression. I have pointed out that the Himalaya mountains are largely, but not completely, compensated by their underlying deficiencies of density; their compensation is, however, rendered complete by the presence of the Ganges trough; if the Himalayan compression and the Gangetic tension are considered together, it will be found that there is no extra mass.

Hypothesis of a Rift.

I showed you on the evidence of the plumb-line that the Gangetic trough was a zone of crustal attenuation, a zone in which the earth's crust was deficient in density. I then took one step forward and suggested that it was a zone of tension. I will now take another step forward and suggest to you that there has occurred an actual opening in the subcrust, and that the outer crust has fallen in owing to the failure of its foundations. I suggest that the Ganges plains cover a great rift in the earth's crust.

The earth is a cooling globe; an increase of temperature occurs as we descend into mines; and this temperature gradient is a proof that the earth is losing heat by conduction outwards. The discovery of radium has not affected the argument.

The rock composing the crust and subcrust is, however, a bad conductor, and the interior of the earth will not shrink away from its crust, as has been assumed in the contraction theory. The inner core of the earth is, in fact, not losing heat appreciably. The outer shell was the first to lose its heat, then the shell below it, and the subcrust is now losing its heat more quickly than the interior core. As the outer shells contract from cooling they become too small for the core, and they crack. Supposing we had here a great globe of rock, red-hot throughout; how would it cool? Can you imagine it cooling in such a way that the core became too small for the outer shell, and the outer shell became wrinkled? No; the outer shell would cool first, and would crack.

The outer shell of the earth was the first to crack millions of years ago; now a lower shell, the subcrustal shell, is cracking. When a crack occurs in the subcrust, parts of the upper crust fall in.

You will see that this Indus-Ganges trough has the appearance of a crack. And there are reasons for believing that these Himalaya have been split off from this ancient table-land, and have been moved northwards and crumpled up into mountains.

From the Bay of Bengal to the Mediterranean.

Geologists have discovered that the ancient table-land of the Vindhyas and Deccan is a remnant of a much greater table-land that in very early ages included Africa and Arabia. Africa and Arabia and the Deccan table-land are, in fact, fragments of one extensive and ancient continent.

To the west of Karachi we see the Persian Gulf and the plains of the Tigris-Euphrates. The plains of the Tigris-Euphrates are very similar to those of the Ganges: they consist of mud, sand, and sediment lying in a long trough between the ancient table-land of Arabia and the mountains of Persia.

Further west we find the Euphrates trough is continued by the Mediterranean Sea, and the Mediterranean is bounded on the north by the Taurus mountains, by the Balkans, Carpathians, Apennines, and Alps.

Throughout the whole distance from Calcutta to Sicily we see that the old table-land, India-Arabia-Africa, is bounded on the north by a long trough, and that this trough is, in its turn, bounded by the younger mountain ranges from the Himalaya to the Alps. Geologists have discovered that all these mountain ranges were elevated in the same era; they are all of the same age.

I submit for your consideration that the Ganges-Indus-Euphrates-Mediterranean trough is an indication at the earth's surface of a rift in the subcrust.

The whole zone from Java to Sicily has been visited by earthquakes throughout the historic period. And the recent earthquakes in Shillong, Dharmsala, and Messina show that seismic activity is continuing in our time. This is, in fact, one of the zones of the earth along which earthquakes occur most frequently.

The Bombay Coast.

I must now invite your attention to the Bombay coast. From the Tapti to Cape Comorin runs the range of mountains known as the Western Ghats. This range is parallel to the coast of India and about 40 miles inland; it rises suddenly with a steep scarp. The strata are almost as horizontal as when first laid down; they have never been compressed or folded.

The survey has observed the plumb-line at different points along this coast; it is always deflected strongly towards the sea. To the west of Bombay and Mangalore there is the deep sea; and to the east there is a massive range more than 4000 ft. high; yet the plumb-line will hang seawards. If the Western Ghats possessed the mass which they appear to possess, and which the Suess school ascribes to them, then the Bombay plumb-line should be deflected 15 seconds towards them. If, on the other hand, the Western Ghats are compensated by deficiencies of mass underlying them in accordance with the compensation theories of Pratt and Hayford, then the plumb-line should hang vertically at Bombay. But the plumb-line takes neither of these courses; it hangs towards the sea. We have been puzzled for years by the plumb-line at Bombay; we used to think that the rock under the ocean must be so dense and heavy that it was able to pull the plumb-lines towards the sea. Major Cowie, however, observed in the south of Kathiawar, and found that the plumb-line here had a strong landward deflection. The seaward deflections occur throughout the Bombay coast, but not round Kathiawar. It is only quite recently that we have realised we have at Bombay the same phenomenon as at Lucknow.

In northern India the plumb-line will persist in hanging away from the visible mountains, and at Bombay it takes the same course, and when I consider its constant seaward deflection I can only suggest to you that a crack in the subcrust has extended from Cape Comorin to Cambay, and that as this crack has occurred the Western Ghats have been elevated. The crack has been filled by masses of fallen rock and by alluvial deposits brought down by rivers.

Geologists have shown that this range consists, from latitude 20° to 16°, of the lavas of the Deccan, comparatively recent rocks, whilst from latitude 16° to 8° the range consists of ancient metamorphic rocks. The rocks of the northern part of the range are of a different age and structure and origin from those of the southern.

Nevertheless, geodesists contend that this is one and

the same range; the rocks composing it have had nothing to do with its elevation. The Western Ghats have been elevated, after the Deccan lavas had become solidified, into surface rocks. Their elevation took place in the Tertiary age.

The Depth of the Gangetic Rift.

In considering the depth of the Gangetic rift we must appeal, first, to geodesy, and then to seismology. Now geodesy tells us that the compensation of the Himalaya (*i.e.* the root of the Himalaya) extends downwards to a great depth. I regard the Gangetic plains and the Himalayan range to be the two parts of one whole; I believe that they have originated together, and if the depth of Himalayan compensation extends down to 60 miles, then I think that the Gangetic rift may extend down to that depth also.

Now let us turn to seismology; seismologists are able to form rough estimates of the depths of earthquakes. In the Dharmsala earthquake Middlemiss estimated its depth to be between 12 and 40 miles. Middlemiss's maximum value is not very different from the geodetic value.

It is an interesting question to consider whether a fissure in rocks could extend downwards to a great depth. From a place near the Indus in Kashmir it is possible to see a continuous wall of rock 4 miles in height, on the flank of Nanga Parbat. Mount Everest stands erect 5½ miles above sea-level; its summit stands firm and rigid 11 miles above the depths of the Bay of Bengal. We have, therefore, evidence that the materials of the crust are strong enough to admit of the continued existence of great differences in altitude.

But Mount Everest is standing in air, whereas a crack in the subcrust becomes filled with rocks falling in and with fluid rock magma from below; and the walls of the crack thus get a support that Mount Everest does not possess. It seems to me quite possible that a crack such as I have described may have extended down to a depth of 60 miles by successive fractures at increasing depths, the opening being filled by falling material.

Internal Causes of Mountain Elevation.

I have shown you how zones of subsidence in the crust are bordered by mountains, and I have now to discuss the relationship of subsidence to elevation, of troughs to mountains. The Red Sea is a zone of fracture, and it is bordered on each side by a zone of elevation. But along the Bombay coast the zone of subsidence is bordered only on the one side by a zone of elevation. The subcrustal crack from Surat to Cape Comorin has been accompanied by a vertical uplift of the Ghats, and I suggest for your consideration that the vertical force which elevated the Ghats was the expansion of the underlying rock due to physical or chemical change.

Mr. Hayden informs me that the specific gravity of the rock composing the Neilgherries varies from 2·67 to 3·03—that is, 14 per cent.—and that the rock of the Hazaribagh plateau varies from 2·5 to 3·1—24 per cent.

The Western Ghats appear to have risen about 4000 ft. Now we know that the Western Ghats are largely compensated by underlying deficiency of density; if the compensation of the Western Ghats extends downwards to a depth of 60 miles, then an expansion of 2 per cent. would be more than sufficient to account for the elevation of the Ghats. Mr. Hayden finds variations of 14 and of 24 per cent. in the densities of surface rocks, and yet an expansion of only 2 per cent. would account for both the elevation and the compensation of the Ghats.

The heterogeneous rocks composing the earth's crust are continually undergoing changes of structure, known to geologists as metamorphism. At a depth of 30 miles the temperature is sufficiently high to melt all known rocks; but increase of pressure raises the melting point, and the increase of pressure underground may be sufficiently great to counteract the effects of the increase of temperature. So that at a depth of even 60 miles rocks may still be solid and rigid, as geodesy leads us to believe they are.

The main ranges of the Himalaya are composed of granite; this granite has protruded upwards from below. I suggest that the protrusion of granite is due to expansion of rocks in the subcrust. The great Himalayan range is 5 miles high, and the compensation of this range—that is, its underlying deficiency of density—is estimated to extend downwards to a depth of perhaps 75 miles. An underground expansion of 7 per cent. would be sufficient to account for the elevation of the Himalaya.

Many of the faults which intersect the Himalaya may, I think, be ascribed to the shearing which must have ensued when certain areas of the crust were forced vertically upwards by the metamorphism of subcrustal rock. Many distortions of surface strata may be ascribed to local variations in the vertical expansion of deep-seated rocks.

The peculiar sinuous curve of the northern Tibetan border, concave on the east, convex on the west, is reproduced in the north of Persia, and again in the Carpathians. The Persian ranges all have a trend from south-east to north-west, except that the Caspian subsidence seems to have pushed rudely in from the north and forced the northern range into a sinuous curve. It is significant that at the point of the Caspian push stands the peak of Demavend, the highest point in all Persia. *Elevation is the companion of subsidence.*

The conclusions which I have ventured to submit to this meeting may be summarised as follows:—

(1) The fundamental cause of both elevation and subsidence is the occurrence of a crack in the subcrust.

(2) Mountains are compensated by underlying deficiencies of matter.

(3) Mountains have risen out of the crust from a great depth, possibly 60 miles.

(4) Mountains owe their elevation mainly to the vertical expansion of subjacent rock.

I have now had the great privilege of placing certain problems before you. My endeavour has been to point out to this congress, and especially to its younger members, the many scientific secrets that are lying hidden under the plains of northern India.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—No honorary degrees were conferred at this year's Encænia, but on June 29 Mr. Douglas W. Freshfield received the honorary degree of D.C.L. The Public Orator, in presenting Mr. Freshfield, laid especial stress on his advocacy of the claims of geography for full recognition among university studies. He spoke also of Mr. Freshfield's eminence as a mountaineer, of his personal devotion to the theory and practice of geographical science, and of his achievements as a man of letters.

SHEFFIELD.—In connection with the new department of glass technology the University has instituted a diploma in the subject. The course of study will cover three years, but candidates who have spent at least two years in the glass industry may be exempted from attendance in the first year's course under certain conditions. The last two years' study will be devoted almost entirely to the chemistry, physics, and

technology of glass, with a certain amount of instruction in engineering principles and mechanical drawing.

THREE scholarships, of the approximate value of 50*l.* each, are offered by the *Common Cause* (the organ of the National Union of Women's Suffrage Societies) to women who wish to qualify for positions as industrial chemists. Applications must be made not later than the morning of July 17 to the scholarship secretary, the *Common Cause,* 14 Great Smith Street, London, S.W., from whom further particulars can be obtained.

DR. A. H. GRAVES, who during the year 1914–1915 was engaged in botanical research at the laboratory of Prof. V. H. Blackman, Imperial College of Science and Technology, London, has been appointed associate professor of biology in the new Connecticut College for Women at New London, Connecticut, U.S.A. Dr. Graves was formerly assistant professor of botany in the Sheffield Scientific School of Yale University, and instructor in forest botany in the Yale Forest School.

THE eighth annual meeting and conference of the Secondary Schools Association will be held at Caxton Hall, Westminster, S.W., on Wednesday, July 12, at 2 o'clock p.m. Sir Philip Magnus, M.P., will preside. Two papers will be read on this occasion, namely, (1) "Scientific Habits and Knowledge," by Mr. F. Beames, senior science master at Bristol Grammar School, and (2) "Scientific Method in Education," by Mr. S. E. Brown, headmaster of the Liverpool Collegiate School.

REGIMENTAL care committees and relatives and friends of British prisoners of war will do them a good service by bringing to the notice of the interned, in their letters to them, the fact that if they are desirous of carrying on serious reading they can obtain, free of charge, educational books on almost any subject by writing to Mr. A. T. Davies at the Board of Education, Whitehall, London, S.W. To facilitate the dispatch of parcels of books and, if possible, the organisation of an educational library in every camp, all applications for books should, as a rule, be sent through, or endorsed by, the senior, or other responsible, British officer *or* N.C.O. in the camp. Where for any reason (which should be stated in the application) this course is impracticable, requests from individual prisoners will be acceded to so far as possible.

THE General Education Board of the United States announces that grants amounting to 158,000*l.* were made at its annual spring meeting. The largest grant was one of 50,000*l.* for the medical department of Washington University, St. Louis, Missouri. This gift makes 200,000*l.* appropriated by the General Education Board to this institution towards a total of 300,000*l.* for the purpose of placing the teaching of medicine, surgery, and pediatrics on the so-called full-time basis. Including the appropriations now made, the General Education Board has, since its organisation in 1902, made grants amounting to 3,677,400*l.* This amount was either appropriated outright or towards total funds to be raised amounting in all to 12,897,400*l.* Of the grants made during this period, about 600,000*l.* was for medical schools, 2,500,000*l.* for universities and colleges, 20,000*l.* for further prosecution of educational researches, 180,000*l.* for colleges and schools for negroes, 60,000*l.* for professors of secondary education, and 20,000*l.* for farm demonstration work.

THE Board of Education has issued a circular dealing with several points in connection with the education services and military service. Teachers, full-time students in public schools of various grades, and education officials who are not passed as fit for general service are not to be called up without reference to the War Office, which will consult with the Board of Education. The procedure now applicable in the case of attested teachers and officials fit for general service may also be used in the case of unattested as well as of attested, but reference is in future to be made to the War Office (not the Board of Education as heretofore). Full-time students fit for general service are not for the present to be called up until they attain the age of eighteen; but the Army Council may terminate this arrangement after July 31. The Army Council, on grounds of public interest, will consider applications endorsed by the Board of Education for the postponement of military service in the case of specially selected students of science or technology. The applications must be limited to research students or post-graduate students, and other students who are likely to attain a standard equivalent to first- or second-class honours in courses leading to degrees. Applications on behalf of such students are to be made in the first instance to the Board of Education by the authorities of the universities and colleges concerned.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 16.—Prof. G. W. O. Howe in the chair.—Capt. C. E. S. **Phillips**: Experiments with mercury jet interrupters. The paper describes an experimental attempt to ascertain the form of the mercury column issuing from a hole in the side of a rotating drum, that is continuously supplied with mercury by centrifugal action. Incidentally a new form of interrupter is introduced, in which the interior is visible through a window in the lid. Experiments with various forms of orifice are described, and it is pointed out that the issuing stream is only slightly affected by this means. An explanation is given of the fact that a vertical slit orifice will not produce a ribbon of mercury, and that no matter how much the diameter of the orifice is increased beyond about 2 mm., the cross section of the mercury column remains unaltered. A method is described, however, by which a much larger stream of mercury can be obtained from the rotating drum, if necessary.—G. D. **West**: A method of measuring the pressure of light by means of thin metal foil. Part ii. The pressure of the radiation emitted by a carbon filament lamp, at a distance of a few centimetres, is sufficient to cause a microscopically measurable deflection of the end of a strip of gold or aluminium foil, suspended in a closed test tube. By this means the radiation pressure may be measured, and the results may be checked by a comparison with the energy density of the radiation, as deduced from the initial rate of rise of temperature of an exposed blackened copper plate. In a previous paper experiments were carried out in atmospheres of air and hydrogen, and at pressures extending from 76 cm. to 1 cm. of mercury. Under certain conditions it was found possible to obtain satisfactory results. The present paper deals with experiments at pressures from 1 cm. of mercury down to the highest exhaustions that could be reached. Experiments on the pressure of light may thus be advantageously carried out at the highest vacua obtainable, or at pressures as far above 0·002 cm. of mercury as convection currents will permit. The latter alternative is the easier, and leads to more consistent results.—Edith **Humphrey** and E. **Hatschek**: The viscosity of

suspensions of rigid particles at different rates of shear. This investigation was undertaken with a view of testing the Einstein-Hatschek formula at variable rates of shear. According to this formula the viscosity of a suspension of rigid spherical particles grows in linear ratio with the aggregate volume of suspended particles, and is independent of their size, so long as the latter conforms to Stokes's formula. The suspension chosen was one of rice starch of 0·003 mm., and less, diameter, in a mixture of carbon tetrachloride and toluene having the same specific gravity. The results of the investigation are:—(1) The viscosity of a suspension is a function of the rate of shear, and increases as the latter decreases, the difference being more marked at higher concentrations; (2) for all rates of shear the viscosity of the suspension increases more rapidly than the aggregate volume of suspended matter; (3) for any one rate of shear the relative viscosity of a suspension, *i.e.* its absolute viscosity divided by the absolute viscosity of the medium at the same rate of shear, also increases more rapidly than the percentage of suspended matter, the divergence from the linear increase demanded by the formula becoming less as the rate of shear becomes greater, so that a linear law may possibly hold good at rates of shear higher than those attainable in the present apparatus without turbulence. The general conclusion is that the assumption on which the Einstein-Hatschek formula is based, viz. non-interference between adjoining particles, is not tenable in the case of suspensions containing between 2 and 6 per cent. of suspended matter.—Dr. A. **Griffiths** and others: A correction of some work on diffusion. When salt diffuses through water, in general there must be a movement of the water due to volume-changes associated with variations in concentration. In the papers to which the recalculation refers reference was made to the velocity of the liquid or solution; but what was meant by the velocity of the liquid was not explained. The author now deals with the velocity of the water-component of the solution, to which a clear mathematical meaning can be given.

Royal Microscopical Society, June 21.—Mr. E. Heron-Allen, president, in the chair.—Miss G. **Lister**: The life-history of Mycetozoa, with special reference to Ceratiomyxa. The author referred to the work of Dr. Jahn, of the Berlin University, proving that the amœbulæ produced by division of the swarm-spores united in pairs as gametes to produce zygotes, from which the plasmodia grew. The nuclei of the zygotes had twice as many chromosomes as the nuclei of the gametes. In Ceratiomyxa Dr. Jahn was the first to observe the division of nuclei in the young sporophores prior to spore-formation; this was found to be a reduction division, and took place during the "network" stage of the maturing sporophore. To illustrate these observations, lantern slides taken from the preparations lent by Dr. Jahn were shown on the screen, as well as a series of slides showing the more striking forms of sporangia met with among the Mycetozoa.

PARIS.

Academy of Sciences, June 19.—M. Camille Jordan in the chair.—G. **Bigourdan**: Honoré Gaultier and some confusion which has arisen concerning him.—G. **Bigourdan**: The propagation of sound to a great distance in the open air. It is known that intense sounds, produced by explosions, are not regularly propagated round the source, but that there are zones of silence and zones in which the sound is heard. The cannonade at the front offers an opportunity for the experimental study of this phenomenon, and a plan is outlined for its systematic study.—H. **Le Chatelier**: The maximum solubility of calcium sulphate. A reply to some criticisms of M. Colson.—A. **Chauveau**: The precautions necessary in the study of tuberculosis in persons employed in Parisian wine-bars. A reply to the views expressed by M. Landowzy. The author maintains that tuberculous infection is independent of alcoholism.—A. **Verschaffel**: A new method for the study of the graduations of a circle.—R. **Garnier**: Study of the general integral of equation (VI.) of M. Painlevé in the neighbourhood of its transcendant singularities.—E. **Baticle**: The pressure exerted by a pulverulent mass with a free plane surface on a sustaining wall.—S. **Posternak**: The isomers $T_{7\cdot8}$ and $T_{5\cdot6}$ of stearolic acid. Only four of the sixteen possible isomers of the normal chain acetylenic acids, $C_{18}H_{32}O_2$, have up to the present been described. The preparation and properties of two additional isomers are described in the present paper.—M. **Dalloni**: The marine Bartonian in the Pyrenees.—M. **de Lamothe**: The ancient outlines of the coast of the basin of the Somme, and their concordance with those of the western Mediterranean.—E. **Belot**: The asymmetry of the Pacific, the law of the antipodes, and the general profound forms of the earth in the hypothesis of a primitive southern deluge.—B. **Galitzine**: The localisation of the epicentre of an earthquake. The author recently developed a method for fixing the position of the epicentre of an earthquake from observations at a single station. Since this method has been adversely criticised, the records at the Pulkovo Observatory have been examined, and in 18 per cent. of the shocks registered the epicentre could be localised.—G. **Bourguignon**: The measurement of resistances by discharges of condensers, using a sensitive milliammeter as a ballistic galvanometer. For physiological purposes, the method gives a maximum error of 4 per cent.—A. Ch. **Hollande**: The anti-coagulating power of acid aniline dyes towards albuminoid materials. Acid aniline dyes combine with albuminoids forming coloured acido-albumens; these are not coagulated at 100° C., nor even after twenty minutes in an autoclave at 120° C.—M. **Steppanides**: A colorimetric method used by the Romans for testing drinking water. Claim for priority against M. Trillat.

WASHINGTON, D.C.

National Academy of Sciences, May (Proceedings No. 5, vol. ii.).—W. **Hull** and Marion **Rice**: The high-frequency spectrum of tungsten. The authors show two photographs of the spectrum of X-rays taken in the usual manner in a rock-salt crystal. They also give figures which show the ionisation current as a function of the angle of incidence. A comparison with previous results obtained by others is sketched.—R. L. **Moore**: The foundations of plane analysis situs. As point, limit-point, and regions (of certain types) are fundamental in analysis situs, the author has set up two systems of postulates for plane analysis situs based upon these notions; each set is sufficient for a considerable body of theorems.—E. B. **Wilson** and C. L. E. **Moore**: A general theory of surfaces. Continuing the work of Kommerell, E. Levi, and Segre, a theory of two-dimensional surfaces in *n*-dimensional space is developed by the method of analysis outlined by Ricci in his absolute differential calculus.—J. C. **Hunsaker**: Dynamical stability of aeroplanes. A comparative detailed study of two aeroplanes, one a standard military tractor, the other designed for inherent stability, is made for the purpose of reaching general conclusions of a practical nature with respect to aeroplane design. It appears that inherent stability (except at low speed) can be obtained by careful design without departing seriously from the standard type now in use.—W. M. **Davis**: Clift islands in the coral seas. The

author extends his former work on "The Origin of Corals Reefs" to include the explanation of the clifts of exceptional reef-encircled islands, of which no adequate explanation has previously been given.—C. D. **Perrine**: Some relations between the proper motions, radial velocities, and magnitudes of stars of Classes B and A. The velocity distribution of classes B–B5 and A differ from the distributions found for the F, G, K, and M classes by Kapteyn and Adams.—C. D. **Perrine**: Asymmetry in the proper motions and radial velocities of stars of Class B and their possible relation to a motion of rotation. Stars of Class B show differences in the proper motions in the two regions of the Milky Way at right angles to the direction of solar motion; the differences appear to be best explained by a general motion of rotation of the system of stars in a retrograde direction about an axis perpendicular to the Milky Way.—E. B. **Wilson**: Theory of an aeroplane encountering gusts. The longitudinal motion of an aeroplane encountering head-on, vertical, or rotary gusts is discussed by the method of small oscillations. An inherently stable machine striking a head gust of J ft. per second soars to an altitude of about $4\frac{1}{2}$ J ft. above its initial level, and, after executing oscillations, remains about $3\frac{1}{2}$ J ft. above the original level.—T. **Michelson**: Terms of relationship and social organisation. From the point of view of Algonquian tribes terms of relationship are linguistic and disseminative phenomena, though in other cases they may be primarily psychological and sociological.

BOOKS RECEIVED.

Department of the Interior. Bureau of Education. Report of the Commissioner of Education for the year ended June 30, 1915. Vol. i. Pp. xx+780. (Washington: Government Printing Office.)

Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds, for the fiscal year ending June 30, 1915. Pp. 231. (Washington: Government Printing Office.)

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the year ending June 30, 1915. Pp. 215. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Thirty-sixth Annual Report of the Director of the U.S. Geological Survey for the fiscal year ended June 30, 1915. (Washington: Government Printing Office.)

Report on the Progress of Agriculture in India for 1914–15. Pp. ii+82. (Calcutta: Superintendent, Government Printing.) 6*d*.

Government of India. Bureau of Education. Indian Education in 1914–15. Pp. 77. (Calcutta: Superintendent, Government Printing.) 3*s*.

Jahrbuch des Norwegischen Meteorologischen Instituts für 1915. Pp. xi+140. (Kristiania: Grøndahl and Son.)

Nedbøriagttagelser I Norge utgit av Det Norske Meteorologiske Institut. Pp. xi+66. (Kristiania: Aschehoug and Co.) Kr.3.00.

The Heat Treatment of Tool Steel. By H. Brearley. Second edition. Pp. xv+223. (London: Longmans and Co.) 10*s*. 6*d*. net.

Macmillan's Geographical Exercise Books. V. Asia and Australasia, with questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 7*d*.

Theory of Errors and Least Squares. By Le Roy D. Weld. Pp. xii+100. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Vinegar: Its Manufacture and Examination. By C. A. Mitchell. Pp. xvi+201. (London: C. Griffin and Co., Ltd.) 8*s*. 6*d*. net.

Department of Commerce. U.S. Coast and Geodetic Survey. Serial No. 21: Results of Observations made at the U.S. Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, 1913 and 1914. Pp. 105. (Washington: Government Printing Office.)

Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1915. Pp. viii+307. (Ottawa: J. de L. Taché.) 15 cents.

Canada. Department of Mines. Geological Survey. Memoir 79: Ore Deposits of the Beaverdell Map Area. By L. Reinecke. Pp. v+178. (Ottawa: Government Printing Bureau.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute. Pp. xlv+112. (London: Gresham College.)

DIARY OF SOCIETIES.

FRIDAY, JULY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Geology and Scenery of the Cardiff District: Prof. T. F. Sibly.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.