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Modern Credulity.

DURING the last ten or twelve years there has been a remarkable recrudescence of the amulet, or mascot. Nowadays there must be few collections of jewelry which do not contain at least one piece for luck, whether it be a four-leaved shamrock, an effigy of a pig, cat, or other animal in one of the precious metals, a holed coin inset with a turquoise or other stone, real or imitation, or some similar object to which protective properties are attributed in some degree. It must afford a peculiar joy to Sir William Ridgeway to see his theory of the magical element in primitive jewelry translated into actual practice in civilised conditions. The more grotesque or bizarre the object, the greater the attachment of the owner. Hence the remarkable forms taken by ornaments in china and other material. Nor need the mascot be an inanimate object. Dogs, cats, monkeys, and other animals are pressed into service. In Paris hunchbacks have a regular *clientèle* among stockbrokers, who make a point of touching the deformity before an important deal; while one French actor is said always to have a hunchback in his dressing-room during a first night.

The mascot appeals in particular to those whose pursuits expose them to risk or to the effects of chance. It is quite in keeping that their use should be particularly prevalent among those addicted to betting and card-playing, among members of the theatrical profession, and among motorists. In the case of the last-named the practice is perhaps more common in France and the United States; but even in this country, at one time, quite a considerable proportion of cars carried a "Teddy" bear, a black cat, a golliwog, or a policeman on the bonnet. The fact that applications have been entered for patent rights in special types of improved mascots and luck-charms suggests a sense of humour not without cynicism in the would-be patentees.

During the war the belief in the efficacy of mascots was both extended and intensified. The Army has always had a certain inclination towards some form of luck-bringer, which, more often than not, is the regimental pet. The goat of the Royal Welsh Fusiliers is perhaps the best-known example. The recognised use of the mascot in the Army, however, is collective rather than personal; and it was the personal use which became so prominent during the war. It extended to the whole community, and not merely to those on active service. There were few into whose lives the elements of luck and chance did not seem to have entered with a tragic significance which was absent before the war.

The mascot is not the only form taken by an interest in the occult. Apart from the serious study of telepathy and other forms of psychic manifestation, as well as the more or less religious belief in faith-healing, there was, before the war, a great deal of half-frivolous and wholly superstitious belief in crystal-gazing, palmistry, and other means of foretelling the future which afforded an opportunity to innumerable charlatans to prey upon a credulous public. During the last few years, for reasons which are obvious, this interest has assumed a more serious character, and a desire, perhaps not consciously realised, to mitigate the loss of an intimate association has intensified the wish to know something of the life after death and to communicate with those who have "passed beyond." As a result, a mass of evidence has been brought forward which, it is maintained, establishes the possibility of communication with the spirits of the departed, and affords some indication of the character and conditions of existence after death. Investigations have been carried a step further. The evidence is no longer confined to the existence of spirits once embodied in human form. To earth-spirits, elementals, poltergeists, and other influences which are said to have manifested themselves by various means are now added fairies. Not only have fairies appeared visibly to a certain number of individuals, as reported by Sir A. Conan Doyle, but photographs of them have been taken and published in a popular magazine. The truly wonderful similarity between the real fairy or gnome, as photographed, and the conventional fairy of art is a remarkable tribute to the imaginative genius and insight of such artists as Mr. Arthur Rackham. Sir A. Conan Doyle, whom this resemblance has not escaped, would account for it by a tradition of a previous revelation.

It is clear that these beliefs cannot be treated as being all upon the same level. Mascots are undoubtedly largely a result of fashion, and in a number of cases—probably the majority—the owners would deny any faith in their efficacy. They are "just for luck." The spiritualist, however, holds his convictions with something of the fervour of a religious zealot, yet taking the beliefs as a whole they have one element in common. They represent a reversion to a very primitive point of view.

The revival of the mascot and other forms of the occult has been confined to the upper and well-to-do classes. Among the lower and less educated classes of Europe belief in certain forms of magic has never died out; it goes back to prehistoric times. In the Mediterranean the belief in the evil-eye retains all its old vitality; at Naples, during the current year, an old woman was harried as a witch; and a sheep's head, wrapped in human hair fastened with forty-three large nails, found in her possession, was seized by the police and burned in a church at the request of the excited populace. In the recent elections in Italy a political party of gamblers was formed, also at Naples, of which the chosen representatives were noted for the magical powers which they placed at the service of their clients. In this country the belief in the witch has not died out—in 1906, at Thames Police Court, a reputed witch was convicted of obtaining money by means of a trick, and other cases have occurred since that date. Love-charms and amulets against sickness and misfortune are common. A potato (against rheumatism), an oddly shaped bone, a fossil, a thread of red silk, even a modified phallus in glass or other material worn as a pendant, are objects familiar to the collector. These charms and amulets of the "folk," in both town and country, are more closely akin to primitive belief and less sophisticated than the mascot; but in both cases the psychological basis is identical.

To the anthropologist it is a commonplace that the belief in the efficacy of charms and amulets, like other forms of magic, rests upon ignorance of the operation of cause and effect. In the primitive mind this arises from an imperfect knowledge of natural forces. The owner of a mascot, though not unaware of the relation of cause and effect, ignores it and hopes to influence favourably antecedent conditions which are beyond his personal control. The desire to learn what conditions will prevail in the future, either from mere curiosity or in order that they may be controlled or utilised, as in a stock-exchange gamble or a bet, is responsible for the clairvoyant, the crystal-gazer, and other forms of fortune-teller. A further point of contact with primitive belief is that the use of the mascot implies faith in its efficacy; it has occult powers, a belief which differs in no way from that of the primitive mind that certain individuals and certain objects have *mana*. In the use of the figure of a policeman as a motor mascot we may even see a form of sympathetic magic; by its means the owner may hope to escape the attentions of the real policeman and the snare of the police trap.

A similar parallel can be drawn in the case of the whole-hearted believer in spiritualism. It requires little more than a superficial acquaintance with primitive animistic beliefs and practices to find their counterpart in the mental attitude and outlook of the modern spiritualist, while the medicine-man, especially when, as is often the case, he is endowed with an abnormal mental constitution and associated with a particular spirit or group of spirits, is the prototype of the medium and his "control."

To the sociologist this phase of modern credulity is of the greatest moment. Religion, with the attendant moral codes, has, on the whole, proved one of the strongest factors in the preservation of the social structure. Magic, when once it has served its purpose in the development of human society, has usually been antisocial, while spiritualism, at any rate in some of its recent manifestations, contravenes the generally accepted conceptions of religious belief. A certain amount of intellectual scepticism may be regarded as a healthy and necessary element in any society; but should the place of religion be taken by a reversion on any extended scale to a wholly primitive mode of thought, the prospect affords faint hope of social security and progress.

Education and World Citizenship.

The Salvaging of Civilisation. By H. G. Wells. Pp. 202. (London: Cassell and Co., Ltd.) 7*s.* 6*d.* net.

A BOOK by Mr. Wells, and especially a book on education, is always important. "The Salvaging of Civilisation" is no exception. Part of the book has already been published as a separate essay, part of it consists of lectures to an American audience, and a third part was doubtless prepared for the present volume; but it all fits together, because it all belongs to Mr. Wells's remarkably clear and orderly thought.

In his "Outline of History" Mr. Wells has sketched, in amazingly firm lines, the uncertain origins of our race. In the present book he presents, with the same firm touch, our equally uncertain future. It would be tempting to compare Mr. Wells as historian with Mr. Wells as prophet, for this is a prophetic book. It is concerned with the purpose and future of mankind, but with the distant, rather than with the immediate, future. Mr. Wells has gone scouting far ahead of those whose principal concern is with the next step towards international co-operation and world citizenship. In this volume he tells us what he has seen of the distant goal, but he has little to say of the first practical steps towards it. One thing, however, he is sure about. If the goal is ever to be reached, it is education that will get us there. "The task . . . is not primarily one for the diplomatists and lawyers and politicians at all. It is an educational one."

It is true that thought tends always to end in action, and it follows that deeds are the ultimate (and ideas only the intermediate) product of a system of education. The universities, for example, because of their increasing concern with applied science, especially during the war, are realising that their business is not only to discover and to disseminate knowledge, but also to see that practical effect is given to it. The practical effect here in question is no less than the political reconstruction of the world, so that, as Mr. Wells acknowledges, politicians, as well as educators, have a part to play; but "world-wide educational development and reform are the necessary preparations for and the necessary accompaniments of a political reconstruction of the world. The two are the right and left hands of the same thing. Neither can effect much without the other." But in the beginning, and for most of the way, it is the educator rather than the politician that plays the title-*rôle* in Mr. Wells's outline of history yet to be.

If, then, the end of education, like the end of thought itself, is action, we are not to be educated passively to imagine, but actively to seek, the ideal future for mankind; and our immediate purpose must be "to find release from the contentious loyalties and hostilities of the past which make collective world-wide action impossible at the present time, in a world-wide common vision of the history and destinies of the race." This purpose is to be central and dominant in the outlook that is to result from Mr. Wells's scheme of education. (We remark parenthetically that Mr. Wells's recognition of the supreme importance of purpose in the make-up of character might illustrate, if further examples were needed, how closely many of Mr. Wells's views accord with much that is best in modern thought on education. But there are some of Mr. Wells's opinions that would not obtain assent from those who are most competent to judge. Thus residence and tutorial superintendence were considered by Newman to be of the first importance in university education, but Mr. Wells thinks that an undergraduate of Trinity College, Cambridge, has "no very marked advantage" over an evening student in a northern industrial town.)

Mr. Wells further recognises that, to get things done, there must be unity of purpose among large numbers of men and women, as well as strong purposes dominating each of them individually. "It is manifest that unless some unity of purpose can be achieved in the world . . . the history of humanity must presently culminate in some sort of disaster." But the unity which Mr. Wells rightly demands for the central purposes of men and women the world over, he would also have for a large part of their outlook on the universe. Unity of outlook upon natural science, upon history, and upon literature, as well as upon the aim and purpose of human progress, he would secure by means of common text-books—"The Bible of Civilisation"—always being revised, but always and everywhere in use. Many of his readers will find this suggestion revolting; but they would be ill-advised to reject it without the most careful scrutiny. From many points of view it is far in advance of modern practice. Middle-aged students of mathematics will gratefully remember what Clerk Maxwell called

Hard truths made pleasant
By Routh and Besant
For one who hasn't
Got too much sense.

The codification of elementary applied mathematics by these great Cambridge coaches enormously facilitated the progress of most students who would otherwise have had to depend upon comparatively incompetent teachers and "over-much tedious lecturing," as Mr. Wells has it. It created, among Cambridge mathematicians, a school of thought that was probably advantageous to their subject as well as to themselves.

But Mr. Wells's scheme of world-wide education, like the national system of education foreshadowed for England in Mr. Fisher's great Act of 1918, depends for its realisation upon the money being available. Mr. Wells has no doubt where the money is to come from; and, in truth, there can be little doubt about the matter. According to a recent American book, the United States spent last year no less than 93 per cent. of the national revenues upon wars old and new: that is, on war loan charges, on war pensions, and on maintaining military and naval forces. Great Britain, not being made up of forty-eight States with separate incomes, naturally spent a smaller proportion of her national income on war charges; but last year, and again in the Estimates for this year, the proportion of the national revenues that this country is spending on wars old and new is no less than 64 per cent.—more than twelve shillings in every pound of taxes. When we remember that a simple agreement between a few great naval Powers is all that is needed to abolish battleships, and that a battleship costs, in capital, some 8,000,000*l.* sterling, or, in income (for interest, depreciation, and repairs, but not including *personnel*), 1,000,000*l.* a year—more than ten times the British contribution to the League of Nations—we wonder that this money is not diverted to remunerative expenditure. The whole contribution of the British Government to university education is only 2,000,000*l.* (of which half a million pounds is a special grant for superannuation purposes) this year, and used to be much less. It is thus equal to the cost of maintaining the structure and equipment of two battleships. Mr. Wells says that we need to press "for a ruthless subordination of naval, military, and Court expenditure to educational needs." At all events, we need to come to an agreement with the other nations of the world, most of whose incomes are at present insufficient to meet their expenditure, for a general limitation of armaments, that would enormously reduce the burdens of taxation and set free far more than sufficient money to expand and improve our educational organisations as rapidly as is humanly possible.

Mr. Wells's book is marred by minor defects, which are only minor because of the greatness of the whole. Thus he would apparently have his readers believe that the world commonwealth, which he regards as the ultimate goal, should be attained by the immediate absorption of the existing seventy or eighty independent sovereign States of the world into a single super-State. Such a first step would certainly be a false step, even if it were in any way practicable. How would it, for example, be possible to persuade Japan to place the control of her destinies in the hands of a Parliament, Congress, or Assembly most of the members of which would be of European race? The first step towards increasing the political unity of the nations is surely their co-operation in multifarious works for the benefit of mankind, and especially in the abolition of world-war. This is what is being done by the "quite inadequate League of Nations at Geneva," which consists, after all, of forty-eight sovereign States representing three-quarters of the population of the earth.

Moreover, Mr. Wells is surely mistaken in supposing that we must get rid of patriotism if we are to have an adequate sense of world citizenship. Loyalty to a smaller group is not necessarily inconsistent with higher loyalty to a larger group that includes the smaller. An undergraduate who is asked to play for his university and for his college on the same day will play for his university, and not for his college; but he is not on that account less loyal to his college. The Yorkshireman or the Cornishman who loves his county is not on that account an inferior Englishman; nor is one who loves England likely to be a less loyal member of the British Commonwealth of nations than one who has no feeling for his own people; nor, again, has it ever been suggested that loyal members of the British Commonwealth are on that account feebler supporters of the League of Nations.

J. C. M. G.

Practical Chemistry.

(1) *Introduction to Qualitative Chemical Analysis.* By Th. W. Fresenius. Seventeenth edition. Translated by C. Ainsworth Mitchell. Pp. xx+954. (London: J. and A. Churchill, 1921.) 36*s.* net.

(2) *A Text-book of Practical Chemistry.* By G. F. Hood and Major J. A. Carpenter. Pp. xii+527. (London: J. and A. Churchill, 1921.) 21*s.* net.

(3) *Public Health Chemical Analysis.* By R. C. Frederick and Dr. A. Forster. Pp. viii+305. (London: Constable and Co., Ltd., 1920.) 21*s.* net.

(1) THE treatises on chemical analysis—qualitative and quantitative—planned so far back as 1840 by C. Remigius Fresenius,

the original proprietor and director of the well-known Wiesbaden laboratory, have enjoyed an almost unchallenged position in Germany as standard works for more than three-quarters of a century. During that period they have been frequently revised and reprinted. English editions of these works have been published by the firm of J. and A. Churchill at various times, and are, of course, well known in this country and in America, but have never acquired the same popularity as in Germany. Manuals of chemical analysis written by English and American authors have been found more suitable for class and laboratory instruction. Chemical analysis is, of course, an art which can be acquired only by practice, and a book on the subject should be substantially a *vade-mecum,* which is defined to be anything, especially a book or manual, a person carries with him for daily use. Now this is precisely what the works of Fresenius are not. They have grown so unwieldy that it is impossible to use them as manuals or as the constant companion of the student on the laboratory bench. They are to be regarded rather as works of reference to be consulted in the college library, in which the learner may hope to find an account, more or less detailed, of everything connected with the subject, arranged systematically, and with bibliographical references to the original sources of information.

Mr. Mitchell's book is a translation of the seventeenth edition of the original work brought up to date and made to conform with modern conceptions by Dr. Th. Wilhelm Fresenius. In its English dress it is a portly octavo volume of nearly 1000 pages, and is, in effect, a text-book on general chemistry with special reference to qualitative analysis. Presumably, in its present form, it is primarily intended to supplement the course of lectures given in the Wiesbaden school. It has been translated into English with meticulous care, and so preserves certain blemishes which are characteristic of the original. Practically all the bibliographical references are to German periodicals, and largely to Fresenius's *Zeitschrift für analytische Chemie.* German names, of course, preponderate. English, French, and American chemists have made notable contributions to analytical chemistry, but their names are conspicuous by their absence. Mr. Mitchell is the editor of the *Analyst,* and he must have been struck by the entire omission of any reference to that journal, which now extends to forty-six volumes. Surely in this mass of analytical literature there must be an occasional grain of wheat that might have been allowed to germinate in a foreign soil. We do not know if the English editor was in any way restricted, but in preparing the translation for English-speaking peoples it was, we think, desirable that he should conform to generally accepted English nomenclature and terminology. When the International Committee on Atomic Weights was created, one of its earliest duties was to unify the nomenclature of the elements. Not only were the atomic weights to be made uniform throughout the various nations which were represented on the Committee, but also the names and symbols of corresponding elements. The general principle suggested was that the original name should be retained. This recommendation, although adopted by the American, French, and English representatives, was systematically ignored by their German colleagues. Glucinum, which was discovered by Vauquelin, was still called beryllium, apparently for no other reason than that Klaproth had so termed it. Columbium was first detected and so named by Hatchett in 1801, but this element is invariably called niobium by the Germans, because Rose in 1844 had inferred the presence of a new element, which he had thus named, in the columbites of Bodenmais. It was afterwards found that Rose's supposed new element had no existence; but, as the name "niobium" had been introduced into German chemical literature, it was applied to Hatchett's columbium, discovered more than forty years previously. We think, therefore, in the light of these facts, Mr. Mitchell would have been well advised to conform to English, French, and American procedure.

The book is free from typographical errors, and has evidently been carefully read. There are, however, a few errata which are duly noted; but that the atomic weight of titanium should be 48·1 instead of 40·1 (p. 197) is not one of them.

(2) Messrs. Hood and Carpenter's "Text-book of Practical Chemistry" is claimed by its authors to be "a whole-hearted attempt . . . to indicate the *best methods* of doing everything." Whatever may be thought of the claim, the book, in plan and execution, is in striking contrast with that just noticed. Whereas that work is specially, and almost exclusively, directed to the subject of qualitative analysis, the present authors seek to cover the whole domain of practical chemistry—inorganic and organic preparations, inorganic and organic qualitative and quantitative analysis by gravimetric, electrolytic, and volumetric methods, including gas analysis—within the compass of half the number of pages to which the work of Fresenius extends.

Although the book and its arrangement are, apparently, largely based upon the experience of the authors as science teachers in schools, it is presumably intended for a higher grade of instruction than that usually given to schoolboys. Indeed, the authors, at times, think it unnecessary to mention certain elementary matters, for the reason that they are probably already known to beginners. They have, however, not been very consistent in this respect. Very elementary things are occasionally treated at considerable length, and space is thereby sacrificed to comparatively unimportant subjects which might well have been devoted to fuller details of more advanced or more difficult matters. The work, in fact, suffers from a lack of a sense of proportion; it bears marks of haste in preparation, as if the authors had not thought out with sufficient care the details of their scheme. The general plan of the work is excellent, but it would be quite impossible for any student, however hard-working, to overtake the whole within the period usually allotted to his training. The time given to the preparation of substances, if he is expected to make any considerable proportion of those enumerated, would alone consume a large fraction of it.

Under the direction of a capable teacher the book is calculated to be of service, if judiciously used, as a laboratory manual. Anyone who had worked through it, with due attention to its directions, would be well equipped with a knowledge and experience of operative chemistry.

(3) The little work on "Public Health Chemical Analysis," by Mr. R. C. Frederick and Dr. Aquila Forster, is apparently designed for the use of the Medical Officer of Health who may be called upon to make analytical inquiries, or may desire to inform himself of the methods employed by the Public Analyst in connection with matters with which he is directly concerned. After a somewhat bald introduction on the general principles of gravimetric and volumetric analysis, the book deals with such subjects as the chemical examination of air, water, sewage, trade waste, and effluents; the analysis of ordinary foods, such as milk and milk-products, flour, bread, sugars, jams, confectionery, proprietary foods, alcoholic liquors, tea, coffee, cocoa, and condiments; the detection of metallic poisons in foodstuffs; disinfectants; soap; rag flock, etc. The methods described are those in common use by analysts, and present no features of novelty. They may be accepted as trustworthy, and well within the competence of an officer who may only occasionally be required to undertake them. The book is well printed, adequately illustrated, and provided with a good index.

The Nature of Man.

The Origin of Man and of his Superstitions. By Carveth Read. Pp. xii+350. (Cambridge: At the University Press, 1920.) 18*s*. net.

ONE of the legacies left by the Darwinian controversy has been an intense interest in the highly speculative questions centring round the transition that took place from our semi-human to our human ancestry. The subject has an intense fascination for many, and they will find ample room for the exercise of their imagination while reading the mass of material brought together by the author in support of his hypothesis. He assumes that our early ancestors were large anthropoid apes which took to hunting and a more carnivorous diet, and thus changed profoundly their "former, peaceable, frugivorous habit." Thus there was a selection of those qualities most effective for hunting game. Some of the Primates used unwrought weapons, co-operated in defence, and could communicate with each other—*e.g.* the early hunters went in packs, and thus resembled wolves; indeed, man "became at first a sort of wolf-ape."

In the course of his reflections upon the nature of man the author concludes that "man, in character, is more like a wolf or dog than he is like any other animal." Hence "the Nordic sub-race [of the Mediterranean, we may suppose], with its fair hair, . . . has the appearance of an Arctic beast of prey, like the polar bear." The adoption of a hunting life had many consequences: each pack had its own hunting ground; hence the idea of property; co-operative hunting increased intelligence. The "constructive impulse" thereby became an "absorbing passion," and the use of language was stimulated. The first wars, probably, were waged for hunting grounds; thus the more "virile" and compact of the "wolf-ape" packs predominated, and presumably led to that triumph of Nature, the "Arctic beast of prey"—the Nordic sub-race. Sports and games have been stimulated by the hunting life. Further, "I offer the suggestion that the origin of laughter and the enjoyment of broad humour . . . may be traced to . . . occasions of riotous exhilaration and licence" following on a successful hunt. Hunting life does not explain, says the author, the origin of magnanimity, friendliness, etc.

Mr. Read then turns to the origins of beliefs.

"Savages of the lowest culture have few beliefs that can be called positively injurious. . . . Taboos do more good by protecting person, property, and custom than they do harm by restricting the use of foods. . . . Many rites and observances are sanitary. Totemism rarely does any harm, and may once have symbolised usefully the unity of social groups. Totemic and magical dances give excellent physical training, promote the spirit of co-operation, are a sort of drill . . ."

The hunting pack fell to pieces owing to a variety of causes, but the situation was saved by the rise of magic—due to a "belief in mysterious forces and from confusing coincidence with causation"—and the magician or wizard, who kept the group together by his power to "make the boldest tribesmen quail." This process of consolidation was helped on by the growth of animism—"a confusion between dreams and objective experience"—and the strengthening of the power of ruling families. The rest of the book is occupied with a discussion on more or less conventional lines of the origins of belief. The author examines the various theories of Frazer, Tylor, Lang, and others, but it is not easy to see where lies the real connection between this and the opening parts of the book.

It is difficult to express an opinion in a few words on an argument which deals with matters mainly beyond our ken. Discussions can scarcely be termed "scientific" that begin with wholly hypothetical stages of society such as the hunting pack of "wolf-apes." The author evidently has not studied the actual facts concerning hunters, or he would have seen that his theory breaks down for the reason that existing hunting peoples approximate more closely to the higher anthropoid apes than to his hypothetical wolf-apes. Moreover, what evidence has he that early man was warlike, or that he went about in packs?

The book has several misprints: p. v., 1805 for 1905; p. 296, Puranas for Punan, Boschmans for Bushmen; p. 61, Battus, ? Battas of Sumatra. The author is also given to repetition—*e.g.* on pp. 2, 28, and 32 he tells us that anthropoids "occasionally eat birds' eggs and young birds; the gorilla has been said to eat small mammals."

W. J. PERRY.

Principles and Practice of Psychotherapy.

Psychology and Psychotherapy. By Dr. W. Brown. With a Foreword by Dr. W. A. Turner. Pp. xi+196. (London: Edward Arnold, 1921.) 8*s.* 6*d.* net.

INTO this small book Dr. W. Brown has succeeded in packing a great deal of information on a subject which is now attracting widespread attention. In his preface he enters a timely warning, which is supported by Dr. W. A. Turner in his foreword, that an essential pre-requisite for the practice of psychotherapy is a sound knowledge of general medicine, and particularly of neurology and psychiatry.

Dr. Brown has attempted to crowd so much into such a small compass that rather abrupt changes of theme somewhat interfere with the progressive development of a guiding line of thought. The early chapters discuss in a lucid manner the mechanism of dissociation and repression, which introduces us to the conception of the unconscious and the interpretation of dreams. Much consideration is devoted to the views of Freud, and Dr. Brown indicates clearly where and why he cannot altogether accept them. The section dealing with emotions is rather scanty for so important a subject, and here, perhaps, Freud's views are too summarily dismissed. A special section is allotted to the psychoneuroses of war; the great value of this contribution lies in the fact that Dr. Brown had unsurpassed opportunities for studying both the very early cases immediately behind the line in France, and later the more chronic cases which were met with in the special neurological hospitals at home. This twofold experience enables him to point out certain differences in type and to emphasise the great importance of early treatment in mental disturbances.

Dr. Brown has already published, in various medical journals, many articles dealing with his views on the principles underlying psychotherapy, and in this volume he seeks to crystallise them. He considers that there are four relatively independent factors at work, namely, psychocatharsis or abreaction, psychosynthesis or reassociation, autognosis or self-knowledge, and finally the personal influence of the physician. On the first of these factors he lays great stress, but indicates that the essential aim of them all is self-knowledge. He seems to have coined the term "autognosis" to designate a therapeutic process consisting of a small amount of mental exploration combined with a great deal of explanation and persuasion. Certainly no Freudian would allow that it is in any way comparable to a psychoanalysis.

The last section of the book is a most interesting little discourse on that bugbear of philosophy, the interrelationship of body and mind. Though he does not definitely commit himself, it would appear that Dr. Brown leans more to the theory of Bergson as unfolded in "Matter and Memory" than to any of the alternatives. He makes no mention of the more recent thoroughly monistic system of Kempf.

It is, however, not a little surprising to find that Dr. Brown refers to telepathy in terms which would imply that it is no longer a debatable theme, and uses it conveniently as a possible explanation of certain obscure phenomena which require a great deal of further investigation.

Apart from the few criticisms which we have made, the book gives an admirable elementary presentation of its subject-matter, and may confidently be recommended to every student of psychology. ALFRED CARVER.

Torres Strait and its Echinoderms.

Department of Marine Biology of the Carnegie Institution of Washington. Vol. x., *The Echinoderm Fauna of Torres Strait.* By Hubert Lyman Clark. (Publication No. 214.) Pp. viii+223+38 plates. (Washington, D.C.: The Carnegie Institution of Washington, 1921.) 15.50 dollars.

ONE result of an expedition to Torres Strait organised by the Carnegie Institution of Washington in 1913 has been that the department of marine biology of that institution has published an admirable memoir on the Echinoderm fauna by Dr. H. Lyman Clark. The 240 species there found are critically examined, as well as fifty species from adjacent regions. Notes on the habitat and habits are furnished in many cases. Forty-one new species were discovered, and some are here described for the first time; many of these and others are illustrated by photographs, and a number are represented in their natural colours from drawings by Mr. E. M. Grosse, of Sydney, on nineteen exquisite plates lithographed by Mr. H. S. Burton at the Government Printing Office of New South Wales. The technical and artistic skill here displayed do justice to the extreme beauty of the objects.

The chief interest of the memoir lies in the light that Dr. Clark's careful analysis of the Echinoderm assemblage sheds on the geographical changes which led to the formation of Torres Strait. C. Hedley's hypothesis of a Queensland gulf in Mesozoic times receives no support from the echinoderms. What may be called the original echinoderm fauna was, in Dr. Clark's opinion, on the north-west side of the present continent, and was of East Indian origin and Indo-Pacific composition. On the other hand, confirmation is afforded for Hedley's view that, as land areas east of New Guinea subsided, the Coral sea became connected with the Pacific; its western shores also receded until the Great Barrier Reef was formed. This sea was invaded by echinoderms from the Pacific, and these now compose the distinctive fauna of the Barrier Reef and the Murray Islands, and to some extent that of southern Queensland and New South Wales. Continued subsidence on both sides led at last to the formation of Torres Strait, and the East Indian echinoderms then migrated eastward and southward to the Queensland coast and Barrier Reef, where they mingled with the Pacific immigrants. The latter, however, have not passed westwards through the Strait.

The echinoderms on which these conclusions are based, though representing all the living classes, are confined to those from shore-waters, and the argument postulates that their migration must follow the shifting of the coasts, and cannot be greatly affected by the dispersal of pelagic larvæ through currents. The actual facts of the distribution are certainly more consistent with this assumption than with the opposite opinion of Mr. Jeffrey Bell. Dr. Clark has used, and used with masterly skill, the facts at his disposal; but over and over again he has to deplore the incompleteness of our knowledge. Some areas are still untouched by the collector; for instance, the Gulf of Carpentaria, in the very heart of the region under discussion, and the southern coast of New Guinea just to the north of it. From other important areas we have but the chance dredgings of a few cruises, and even where a more careful search has been made it has been restricted to a brief period; of the seasonal changes nothing is known beyond the fact of their occurrence. What rich harvest may follow from more extended exploration and more intensive study of selected areas is abundantly indicated by Dr. Clark's learned and suggestive survey.

F. A. B.

Our Bookshelf.

From the Unconscious to the Conscious. By Gustave Geley. Translated by Stanley de Brath. Pp. xxviii+328. (London: William Collins, Sons, and Co., Ltd., 1920.) 17s. 6d. net.

THERE is a well-known fact of biology called the histolysis of the insect, which was first investigated by Weissmann in 1864. When the insect has completed its larval stage and enters into the pupal stage, its tissues disappear, leaving none of their former cellular elements; all are converted into an apparently homogeneous mass, out of which the imago is generated *de novo*.

There is a lady, known in mediumistic circles as "Eva," of rather unprepossessing appearance, to judge by her photographs, who possesses a power of what is called materialisation. She is by no means unique in the possession of this faculty, but she has been trained, we are told, to give the most perfect exhibition of it which has yet been known. At great personal discomfort, often apparently involving actual pain, under the conditions of hypnotic trance and in a specially contrived darkened cabinet, she is said to exude, chiefly from the natural orifices of her body, a plastic, amorphous substance which assumes (as Hamlet said of his father's ghost) a questionable shape, usually a face or a hand. The shape is three-dimensional, and the author of this book, who has studied the case at first hand and under his own conditions in his own laboratory, tells us that he has himself touched it and even felt the bones beneath its skin. The exuded substance, notwithstanding its assumption of this solid shape, is invariably, and generally expeditiously, re-absorbed by the lady, and the suggestion is that it could not be detached or amputated without serious, if not fatal, injury to the lady.

The theory expounded in this book is that these two phenomena, the histolysis of the insect and the materialisation of the lady, are fundamentally and essentially identical, and the study of them has led the author to formulate a new principle, which he names dynamo-psychism. This, he claims, is a scientific principle which finally solves all the problems of life and evolution. As a philosophy it has had, he tells us, its forerunners in Schopenhauer's theory of will and in von Hartmann's theory of the unconscious; but the great merit which is claimed for the new formulation is its overcoming of the pessimism inherent in those theories. H. W. C.

(1) *The Copernicus of Antiquity (Aristarchus of Samos).* By Sir Thomas Heath. (Pioneers of Progress. Men of Science.) Pp. v+59. (London: S.P.C.K.; New York: The Macmillan Co., 1920.) 2*s*. 6*d*. net.

(2) *Kepler.* By W. W. Bryant. (Pioneers of Progress. Men of Science.) Pp. 62. (London: S.P.C.K.; New York: The Macmillan Co., 1920.) 2*s*.

(1) THE first of these two little books is the work of a master-hand. Sir Thomas Heath published in 1913 a valuable edition of the only extant writing of Aristarchus, preceded by an introduction of more than 300 pages, in which he gave a critical history of Greek cosmology up to the time of Aristarchus. In the present little book he also begins by giving a rapid sketch of the various systems of the world proposed by Greek philosophers. The statements of ancient writers are next quoted, proving beyond dispute that Aristarchus really put forward the heliocentric hypothesis. We could have wished that it had been shown in more detail how Aristarchus may have been led to propose this way of "saving the phenomena." Lastly, there is an account of the contents of the treatise of Aristarchus on the sizes and distances of the sun and moon, which is of considerable mathematical interest.

(2) Mr. Bryant's account of Kepler's life and work, though very readable, is not altogether satisfactory. The description of how the first two laws of Kepler were found is not clearly expressed and is incorrect in many details. When alluding to Kepler's ideas on gravity it should have been pointed out that his force was tangential to the orbit and not directed to the sun. Of the work on the harmony of the world we are told that "the fifth book contains a great deal of nonsense." That Kepler distinctly states that the harmony is only a mathematical conception, and that there is not really any music of the spheres, is not mentioned. The portrait given as a frontispiece is not of Kepler.

Cocoa and Chocolate: Their Chemistry and Manufacture. By R. Whymper. Second edition, revised and enlarged. Pp. xxi+568+xv plates. (London: J. and A. Churchill, 1921.) 42*s*. net.

THE first edition of this book appeared in 1912, and quickly established for itself a reputation as a useful book of reference, especially in connection with the problems of cocoa and chocolate manufacture, as distinct from those of cacao cultivation and preparation. The second edition has been largely rewritten and brought up to date—a considerable task in view of the important changes which have taken place in cacao production and chocolate manufacture since 1912.

The book is divided into three parts: (1) the history, botany, and agriculture of cacao; (2) the manufacture of chocolates and cocoa powders; and (3) the chemistry of cacao and its products. The few defects of the first edition were nearly all in part 1, and have been remedied, so that the book is now a reasonably complete account of the whole industry. It is well produced, and is provided with a good index and numerous carefully selected illustrations. Presenting, as it does, a broad survey of the whole subject, it should be particularly useful at the present time, when chocolate manufacture, at any rate in this country, is at a somewhat critical period in its history.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College and Papers in Elementary Engineering for Naval Cadetships and Royal Air Force for the Years 1911–1920. Edited by R. M. Milne. (London: Macmillan and Co., Ltd., 1921.) 10*s*. 6*d*.

ALL the papers described in the title which have been set during the last ten years are here collected in a single convenient volume. The answers to the questions, where necessary, have been provided by the editor at the end of the book. To those who are engaged in preparing candidates for Army examinations this publication will be extremely useful.

Scurvy: Past and Present. By Prof. Alfred F. Hess. Pp. vii+279. (Philadelphia and London: J. B. Lippincott Co., 1920.) 18*s*. net.

PROF. HESS gives in this work the results of an exhaustive study of scurvy in all its aspects—its history, pathology, causation, symptomatology, diagnosis, and treatment. The bibliography is most complete. The work is very convincing.

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.*]

The "Flight" of Flying-fish.

HAVING read with interest the letters by Prof. Wood-Jones and Mr. Julian S. Huxley in NATURE for April 21 and 28 respectively, I send some observations of my own which seem to have a bearing on this subject. In the early 'nineties I was engaged in the development of the meteorological kite of the Hargrave pattern, which was adopted at the Blue Hill Observatory for lifting self-recording apparatus in the air, and later adopted by the various bureaus of the world for aerological research. This work brought me in contact with the early pioneer workers on the problem of flight in the United States—Langley, Chanute, the Wrights, Cabbot, Means, Millet, and others—and I occasionally co-operated in experiments on the lifting and driving powers of various devices. One of these was a device in which a stiff rod had attached to one end a flexible rod of bamboo, one end of the bamboo strip being tied near the end of the rigid rod and the other about one-fourth of the way down, so that the bamboo rod formed a loop, over which was drawn a covering of cloth. Now, if one took the free end of the rigid rod and waved the end containing the bamboo loop up and down, he was immediately turned round by a forward motion of the outer end of the rigid rod. The reason of this clearly was that when he lifted the rigid rod upward the flexible loop bent downward, and there was a component of air pressure forward, while when he moved the rigid rod downward the flexible loop bent upward, and there was still a component of air pressure forward. When vibrating the rod up and down there was a persistent forward thrust, and this thrust was so great when the vibration was rapid that the operator was turned completely around in his tracks as on a pivot.

In 1905 I was in charge of the Tieserenc de Bort and Rotch Expedition for exploring the atmosphere with balloons and kites over the tropical part of the Atlantic. The *Otaria*, on which we travelled, was a small boat not much more than 100 ft. in length, with the decks near the water, so that I had an excellent opportunity of studying the movements of flying-fish, which we saw in great numbers.

As these fish left the water the powerful lateral strokes of the tail which lifted them into the air could be plainly seen. As they rose into the air the pectoral fins vibrated with great rapidity, and my earlier experiments with the rod and flexible web led me to believe that exactly this same principle was used by the flying-fish to drive itself forward. The forward part of the pectoral fin is rigid and the rear flexible, so that its rapid vibration gives a strong propelling force. When the fish had gained velocity and the rising impulse given by the tail had culminated, the fins ceased to vibrate and were used as aeroplanes, on which it glided forward, slowly sinking until its tail touched the water, when another lateral stroke lifted it into the air and the process was repeated. In this way the fish could remain in the air for long flights when necessary. The only way in which the motion differs from the flight of birds is that the vibration of the fins probably gives no lifting force, but only a forward driving force, and the fish needs to depend on the tail-strokes for the lift. Had the fish developed a concave under-surface of the fin it could probably have obtained both lifting and propelling force from the fins. H. H. CLAYTON.

Oficina Meteorologica, Buenos Aires,
June 20.

The Colours of Breathed-on Plates.

THE phenomena of breath-figures on glass are of considerable interest, and have been written upon in the columns of NATURE by the late Lord Rayleigh, Dr. John Aitken, and others. One specially interesting aspect of the subject to which I have recently devoted some attention is the explanation of the beautiful optical effects exhibited by breathed-on plates of glass. If a clean, cold plate of glass is lightly breathed on and then held in front of the eye, and if a small distant source of light is viewed through it, coloured haloes will be seen surrounding the source. The characteristic feature of the halo exhibited by a moderately heavy (but not too heavy) deposit is that the outermost ring in it is achromatic, with a reddish or brown inner margin, followed inside by a succession of rings of various colours. As the film of moisture evaporates, the halo contracts and the coloured rings move inwards, ultimately disappearing at the centre of the halo. The entire halo presents a radiating fibrous structure.

The explanation of these phenomena presents some difficulties. One is tempted to suppose (as, indeed, Donlé and Exner have already) either that the minute droplets of water condensed on the plate which diffract the light are of approximately equal size or that they are arranged at more or less constant distances from each other. A microscopic examination of the condensed film shows, however, that neither of these suppositions is anywhere near the truth. The size of the individual droplets shows a variation of several hundred per cent., and their arrangement in the film is entirely irregular, being determined presumably by the presence of invisible condensation nuclei on the surface of the plate—a view that is strongly supported by the fact that successive deposits on the plate are seen under the microscope to preserve the same configuration with a surprising degree of accuracy. Further, if the size of the droplets were the determining factor in the production of the diffraction haloes, it would be difficult to understand why as they evaporate the rings in the halo should *contract* in size.

These facts necessitate an entirely different supposition regarding the element of regularity in the film which enables it to give rise to a recognisable system of coloured diffraction haloes. Measurements I have made seem to show that the droplets in the film—whether large or small—have practically all the same angle of contact with the surface of the plate, this angle of contact diminishing as the film evaporates. The formation of the coloured haloes is, on this view, due to the passage of the light *through* the minute lens-shaped droplets; the maximum deviation of the light determined by the common angle of contact fixes the position of the outermost achromatic halo, and the colour-sequence following within it would be practically the same for all the droplets irrespective of their size. This would also furnish a satisfactory explanation of the contraction of the halo as the film evaporates. C. V. RAMAN.

22 Oxford Road, Putney, S.W.15, July 26.

Mutations and Evolution.

THE article on my recent little book on "Mutations and Evolution" in NATURE of July 14, p. 636, shows such insight in the exposition of some of the views there set forth that it may seem ungrateful of me to venture to reply to anything the reviewer has written. Nevertheless, there is one important point in which I feel that my argument has been missed. My conceptions of the relation between recapitulatory and mutational characters are not easy to state clearly in a brief space, and I am willing to admit obscurity in certain passages, as evidenced by your reviewer's failure to grasp my meaning, but I am not willing to plead guilty to the more serious charge of obscurantism.

The argument was not that mutations are limited in their scope by the existence of non-cellular structures in organisms, but rather that embryonic characters which show recapitulation, and at the same time imply re-adaptation of the organism, cannot have arisen by chance mutations in the germ-plasm, but must have arisen as environmentally induced responses which could become germinal only according to the principle of the inheritance of acquired characters.

By general agreement mutations arise as such in the germ-plasm, *i.e.* probably in the chromosomes. But there is another possible route into the germ-plasm, namely, *via* a modified soma (probably in its beginning a modified cytoplasm), ultimately affecting the germ-nuclei.

Orthogenetic changes I placed in a third category as showing recapitulation and yet arising in the germ-plasm, since they are non-adaptational, and hence probably not environmentally impressed on the organism. The relations between these three types of characters are admittedly obscure, but it does not follow that they are non-existent or that the conceptions regarding them are obscurantist. I wished particularly to contrast mutations and embryonic recapitulatory characters from the point of view of organic structure, indicating that the principles which will explain the one cannot adequately explain the other.

R. RUGGLES GATES.

King's College, Strand.

PROF. GATES's restatement of certain points in his original argument, if more explicit, nevertheless meets but one of the issues raised in my article. In answer to the doubt therein expressed as to whether he himself can be held blameless of the offence with which he charges others, he pleads "not guilty." But if "obscurantism" (the author's word, not mine) be judged too harsh a verdict on the passage cited, *obscurum per obscurius* in respect of this particular statement—and others—is not to be gainsaid. And shall we even then acquit the author on the more serious count? Or will the general reader desirous of comprehending the relation of Mendelian to Darwinian theory uphold the charge after perusal of the author's introduction? If he do not, he will unquestionably deserve the encomium which the author, so disarmingly, bestows upon myself.

THE WRITER OF THE ARTICLE.

Molluscan Fauna of Scottish Lakes, and a Pisidium New to the British Isles.

MAY I through the columns of NATURE invite the assistance of naturalists who may be visiting Scottish lakes and tarns on their holidays in making known the molluscan contents?

Whilst Mr. R. A. Phillips and Mr. Stelfox have investigated the mollusca of the Irish lakes, and Mr. C. Oldham those of much of Wales and England, our knowledge of the Scottish fauna is lamentably deficient. If living specimens are unobtainable, dead shells from the shores will be acceptable as showing what species are present. In either case, for purposes of identification, no special method of preservation is necessary—the specimens will travel perfectly if packed in sand or sawdust; but if spirit is procurable fresh specimens would be more useful if placed in that medium. In all cases, of course, locality and date are essential.

As instancing the interest attaching to the investigation, and the possibility of further important discoveries, I may mention that Dr. Nils Hj. Odhner, of the Rijksmuseum, Stockholm, has just identified some specimens from Loch Ness, in my collection, as being *Pisidium clessini*, Surbeck, a deep, cold-water species known also from Sweden and Switzerland, which he has also recognised from two other British localities.

B. B. WOODWARD.

4 Longfield Road, Ealing, London, W.5.

Cup and Ring Markings.

IN reply to Mr. Abbott's letter in NATURE of July 21, p. 652, I regret that he did not see the photographs to which I referred; had he done so he would have appreciated the difference between these and his own. As there is no tangible evidence that such reconstructed surfaces are due either to gelic selection or adsorptive precipitation, I submit that, pending the proving of the gel theory, it is safer to describe the process as "concretionary," for this term covers much ignorance, and is, at least, non-committal.

May I say that the ridged mortar, as shown in Mr. Abbott's interesting photograph, is not found only on the northern sides of buildings near the sea; I have excellent examples from Corfe Castle and other buildings in the district, from old field-walls at Kirkby Lonsdale, and from many other places inland?

There is a coign of calcareous sandstone in the wall of an old barn a few miles from Kirkby Lonsdale with the whole surface naturally ridged and ringed, while the mortar surrounding it is unaltered.

I have never suggested that similar patterns were not carved on some rock surfaces by prehistoric man, but that, if they were, these mystic markings were copied from Nature long before the days of mortar!

I regret I am now unable to find the photographs of 1896, but when I do Mr. Abbott shall see them.

C. CARUS-WILSON.

Science and Civilisation.

THE letter of Mr. Henderson Smith and Major A. G. Church in NATURE of July 28, p. 684, is most welcome as showing that scientific workers are at last beginning to realise that it is time for science to make itself felt, not only for the acquisition of knowledge and the improvement of machinery and production, but also for the establishment of a national and harmonious social order.

May I say that a scheme has already been evolved which should appeal to all truly scientific sociologists? It is based essentially on economic and eugenic principles, and is termed Neo-Malthusianism. It aims at eliminating poverty and other social evils by proportioning population to the means of subsistence, and at securing race improvement by maintaining the selective struggle of Darwin, substituting humane voluntary abstention from reproduction for brutal elimination by disease and starvation. It aims also at the elimination of class and international warfare through the diminution of the pressure of population, and at the reduction of vice and disease by promoting universal early marriage.

Anyone interested in this subject is invited to write to the hon. secretary of the Malthusian League, 124 Victoria Street, S.W.1.

C. V. DRYSDALE.

Remarks on Simple Relativity and the Relative Velocity of Light.

By SIR OLIVER LODGE, F.R.S.

I.

IN continuation of my article in the Relativity Number of NATURE (vol. cvi., p. 795, February 17, 1921), I propose to discuss more fully, and to express as clearly and simply as possible, some of the points on which philosophic disciples or expounders of Einstein have written, so as perhaps to remove a certain amount of misapprehension, and incidentally to set my own views before other physicists, in order that they may be controverted where necessary. On some other points of more general interest I have written in the *Fortnightly Review* for next September, especially on the foundation which had been laid by Einstein's predecessors before the philosophic doctrine of relativity was made definite and erected into a comprehensive physical theory.

The Fundamental Relativity Hypothesis.

Einstein's first fundamental assumption is that direct observation of our absolute motion through space is not only unachieved, but also in the nature of things impossible; wherefore it can be held that such motion has no intelligible meaning. Those who admit an æther prefer not to shut the door on inquiry, but meanwhile express their provisional agreement by saying that its various functions and properties are so uniform, so universal, and so interrelated, that observation of any suspected effect of motion through the æther is liable to be frustrated or negatived by some—so to say—inevitable opposite effect; and that the compensation, at any rate over a wide range, is complete.

Einstein's second fundamental assumption is that the one absolute quantity which *can* be observed, namely, the velocity of light—if it be a velocity—is unique and so fundamental that every observer must necessarily measure the same result if he make his measurements correctly, no matter what his own motion may be; which, after all, is only another way of saying that his own motion through the æther is pragmatically a meaningless expression.

It is not claimed that these assumptions, which are certainly consistent with the Larmor-Lorentz transformation equations—at least, when they include the factor β, expressive of the FitzGerald-Lorentz contraction—are really established by them. That would be reasoning in a circle. Nor do the equations necessarily substantiate any metaphysical assertions about time or space or æther; but they do lead to algebraic and legitimate deductions.

The Time and Space Transformation.

The importance of those transformations—correlating the states of the same material system travelling at different speeds—can scarcely be exaggerated. They have been arrived at in many ways, usually by aid of ideal and hypothetical and apparently impossible experiments, sometimes by considering that an event does not effectively happen until we have seen it happen, thus entailing relative delay; and they have been variously interpreted. The original gist of the equations was that a moving observer must not only take his distances as variable; he must consider his times variable too. He must have a local and fictitious time peculiar to himself, if he is to ignore his own motion and treat his direct measurements as conclusive.

Einstein's step was equivalent to dispensing with any overt fiction about this subjective or local measure of time, to claiming that it was as real as any other, though peculiar to each observer, and to seeing what emerged.

Now if we agree to waive any question of experimental practicability, and proceed in an ideal fashion, it is easy enough to obtain notions about the required transformation; and as I have not seen the equations obtained so directly or naively, I proceed to deduce them thus:—

A stationary observer, supposed able to time the passage of light from a source at a distance x, may be expected to get the result

$$\frac{x}{t}=c.$$

If he be moving towards the source with speed u, he will be relieving the light of some of the journey by doing that bit himself. The light need now only travel a smaller distance x' to meet him, and the observer will have travelled the remainder, namely, $x-x'$. So if the time taken on the jointly performed journey be t', and if he finds it possible to measure the distance x' at the instant the light reaches him, which is evidently the right moment, he will get

$$\frac{x'}{t'}=c \quad \text{as the speed of the light,}$$

and

$$\frac{x-x'}{t'}=u \quad \text{as his own speed.}$$

Given these three equations, we get by mechanical algebra without further reasoning

$$t=t'+\frac{ux'}{c^2},$$

as well as the more obvious

$$x=x'+ut',$$

without mentioning relativity at all.

If all these measurements could be really made, we should have

$$c+u=\frac{x}{t'},$$

and u could be determined in terms of c. But the measurements are impracticable as they stand, for how is an observer to know the instant at which a particular portion of light left the source? In other words, how is he to time an event on the source when he is dependent on the light itself for information of its occurrence? He might have the event telegraphed, but that information also is transmitted by the æther at the same pace. So the foiled inquirer will naturally try to get some additional data by reversing his motion and starting back again from his present position at distance x', so as to be moving away from the light instead of towards it. The light will now have to catch him up; and he may think, at first, that the ray which left the source at the instant he began his return journey will take the original time t to reach him, since it now has to travel the full distance x. But he will have to travel a little further than the original position, and take a little longer time, before he is overtaken; and he cannot write the reciprocal equations

$$t' = t - \frac{ux}{c^2}$$

and

$$x' = x - ut,$$

because they are inconsistent with the previous ones.

To make the two pairs of equations agree (as relativity demands), either x must equal x', which frustrates the whole experiment, or a common factor must be introduced, say β, such that

$$t' = \beta\left(t - \frac{ux}{c^2}\right), \text{ or } \beta t\left(1 - \frac{u}{c}\right);$$

and

$$t = \beta\left(t' + \frac{ux'}{c^2}\right), \text{ or } \beta t'\left(1 + \frac{u}{c}\right).$$

This will render them harmonious, and a suitable value (the only right value) of β is easily reckoned—again mechanically, without further hypothesis—namely,

$$\beta^2\left(1 - \frac{u^2}{c^2}\right) = 1.$$

If that is satisfied, the reversal of the journey will not give any different result; there is perfect reciprocity. You cannot by an experiment of reversing your motion with regard to light, or reflecting back the light with regard to the observer, discriminate between $c-u$ and $c+u$; nor can you discriminate either from c.

Now this β factor is the FitzGerald-Lorentz contraction; the experiment thus neutralised is the Michelson-Morley experiment; and the direct supposition that an observer must find $c-u$, and c, and $c+u$ all the same, or at least indistinguishable by observation, and that there is nothing more to be said, is the point of view of Einstein.

These names must suffice to suggest a flood of ideas to those who have read about the subject.

To sum up compactly:—

Assume that you cannot help measuring the same speed of light whether you be moving or stationary, so that x/t and x'/t' both equal c (the accented letters referring to the measurements made when you were moving with speed u to meet the light), then allow that x/t' is not equal to $c+u$, as you would expect, nor x'/t equal to $c-u$ (for in that case xx'/tt' would equal c^2-u^2 instead of c^2), but that, instead,

$$\frac{x}{t'} = \beta(c+u) \text{ and } \frac{x'}{t} = \beta(c-u),$$

which, together, require that

$$\beta^2 = \frac{c^2}{c^2 - u^2};$$

then all the rest follows.

The Contraction.

A customary and older interpretation of the introduction of the factor β—to complete and make accurate what then became the Larmor-Lorentz transformation—is that the measuring rod with which you are hypothetically supposed to measure x or x' shrinks to $1/\beta$ of its normal length if the experimenter is moving either to or fro with speed u, so that all distances in the direction of motion measure out a little bigger than they otherwise would; more steps of the yard measure having to be taken. Note that space or æther does not shrink, but only the matter in space. The distance x has not changed, but only the instrument with which you hypothetically measure it. That having shrunk, the fixed distance measures out longer. The same thing happens with the instrument whereby you are supposed to measure time. Both distance and time of journey are abbreviated by approach, but, to measurement, not so much as an unchanged measurer would give. They are both lengthened by recession, and the measurements give rather more increment than might have been expected.

The ratio between measurements made during uniform approach, and the same made during relative rest, is

$$\frac{x'}{x} = \frac{t'}{t} = \beta\left(1 - \frac{u}{c}\right) = \sqrt{\left(\frac{c-u}{c+u}\right)}.$$

This line, with the definition $c = x/t$, is the briefest possible summary of the transformation equations.

A short and easy way of getting, or at least of recording, the essence of the transformation is to allow for the contraction of the hypothetical measuring rod by multiplying any distance across space supposed to be measured by a flying observer—flying towards or away from a distant event which really occurred at the instant he started to fly—by an undefined numerical coefficient β, and omitting this factor from any distance which he could have measured at rest before starting.

Thus let an event occur at the origin, and let an observer at x and t immediately begin travelling towards it, so as to meet the light at a place which appears to him to be x' and t', the combined velocity over the original distance being $c+u$, he can correct his x' measurement, which has been traversed by the light alone, and write

$$\frac{x}{c+u} = \frac{\beta x'}{c};$$

while if he started from the leisurely measured x' and t' position, directly the event occurred at the origin, and receded so that the light overtook him at what appears to him to be a place x and t, coming with the relative velocity $c-u$, he can correct his x measurement for the whole distance traversed by the light, and write

$$\frac{x'}{c-u} = \frac{\beta x}{c};$$

saying, if he likes, that it is just the same as if he had stood still and the light had come to him with diminished speed. (Or he might time his own journey as $\frac{\beta x - x'}{u}$, and equate that to $\frac{\beta x}{c}$). Combining these equations with the definition

$$\frac{x'}{t'} = \frac{x}{t} = c,$$

and not troubling about the y and z co-ordinates, which remain unchanged and need no attention, we get the Lorentz transformation complete (and incidentally we see that the usual differential invariant $ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2$ is always zero for light).

Once the transformations

$$\begin{cases} x'=\beta(x-ut) \\ t'=\beta\left(t-\dfrac{ux}{c^2}\right) \end{cases} \text{ with their correlative } \begin{cases} x=\beta(x'+ut') \\ t=\beta\left(t'+\dfrac{ux'}{c^2}\right) \end{cases}$$

are introduced, the coefficient β is self-defined as $\beta^2(c^2-u^2)=c^2$, and results flow in thick and fast. Thus if we seek to superpose a velocity dx'/dt', or v, on the speed u, and reckon the result as dx/dt, or w, working mechanically on the above two equations, we do not find, as we might expect, $w=u+v$, but

$$w=\frac{u+v}{1+\dfrac{uv}{c^2}}.$$

This *appears* to have nothing to do with the β factor, but to depend only on the second term in the expression for t. We must remember, however, that without the β factor we could not write the reciprocal equations, which permit simple reversal of sign in v if it is opposed to u. The consequences of this law of composition of velocities are astonishing, and include among them the uniqueness and maximal character of the velocity c.

Confirmation.

The Einstein assumptions have never been directly ascertained by experiment. They are not the result of experiment at all; they are a reasoned type of hypothesis, and any provisional confirmation must be derived from the legitimacy of the conclusions which, from them and their extensions, the far-reaching genius of Einstein has shown to be attainable. Briefly we may cite the general type of confirmations, including those of his completer theory, thus:—

The velocity of light inside transparent matter, being less than its value in free space, is affected by its motion in the way Fresnel predicted and Fizeau confirmed. The equations give this result without the need of Fresnel's theory.

Even outside great masses of matter the velocity is now discovered to be slightly affected (still diminished, never increased) in a second-order way that Einstein predicted and astronomers confirmed. Starlight is deflected by this gravitational refractivity.

Not only so. The neighbourhood of a very large mass of matter introduces secondary higher-order effects into the æther in such a way as to affect not its luminiferous properties only, but its gravitational structure too; and the consequence is that the orbit of a planet sufficiently near the sun behaves, not exactly in accordance with the laws of particle dynamics in empty space, but with a slight modification, depending on the squares of small quantities, such as the general principle of relativity enabled Einstein to calculate. And, as everyone knows, an outstanding discrepancy—though one detected only through the extreme refinement of astronomy—was thus triumphantly removed from the planet Mercury, the only planet near enough to the sun to be sensibly affected.

Thus, then, the general mathematical trend of ideas on which the principle was founded may be claimed as confirmed in this *ex post facto* manner; but many varieties of expression, and attempts to interpret the principle philosophically, are far from establishment still.

Alternative Modes of Statement.

If we take up an agnostic position, we cannot say—and Prof. Einstein seems to agree—that, as a deduction from experiment, any philosophic or metaphysical position is really proven. What we can definitely say is that certain statements are consistent with all the experiments hitherto made, but we cannot say that every other mode of statement is ruled out. In nearly every case—probably in every case—the result of experiment can be expressed otherwise. Thus, for instance, my experiment with the rotating discs (Phil. Trans., vol. clxxxiv., 1893) showed that their motion neither added nor subtracted anything, nor affected the velocity of light in their immediate neighbourhood, although their circumference was travelling at a speed almost sufficient to tear the steel asunder, and although an exceedingly minute alteration in the speed of light could have been observed; but this negative result can be expounded, and indeed was expounded, by saying that the æther—the vehicle of light—is not carried forward or perturbed at all by the adjacent moving matter. And that is part of an entirely rational æther theory of the atomic structure of matter.

The famous Michelson-Morley experiment, again, wherein no result is found, although the apparatus *must* be immersed in a relative æther stream, can be, and was, explained by saying that every solid body suffers a FitzGerald-Lorentz deformation due to its motion relative to that stream.

Again, the most important Fizeau experiment, one which did yield a positive result, because here light was travelling through and inside transparent moving matter, and so was accelerated and retarded by a measurable amount—not, indeed, beyond the velocity c, but beyond the velocity c/n, where n is the index of refraction—this result was explained, and by Fresnel anticipated, by assuming (crudely) that a given proportion of the æther clung to moving matter and was transported with it, or (less crudely) that the presence of matter so modified or loaded the æther as not only to retard the light considerably in any case, but to retard it differently when in motion than when at rest. Electrically, this comes out with complete clarity, because the loading property—the matter-caused modification of the æther constants μ and K—really does belong to the matter, and travels with it.

So in every instance which had been already explored an explanation was forthcoming, and had been accepted as sufficiently plausible and satisfactory; but it was a different explanation in each case. Not differing so as to be inconsistent—they were all consistent with a certain view of the æther, and were all in agreement with the electrical theory of matter—but still, when Einstein showed that the law of composition of velocities appropriate to his principle of relativity accounted for them all as an immediate corollary, without effort and without any assumption beyond what was embodied in that principle—this feature of directness naturally aroused the keen attention of physicists.

(Discussion of the relative velocity of light is deferred to next week.)

(*To be continued.*)

Endowment of Scientific Research in the United States.[1]

IN NATURE for May 29, 1919, an account was given of the organisation of the National Research Council of the United States of America. Supported during the war largely by the Government, but now entirely by private bodies and firms (it has lately received a grant of 5,000,000 dollars from the Carnegie Corporation), this body owes its existence to a trend of opinion by no means confined to the capitalist classes which maintain it. The American Federation of Labour explicitly and emphatically professed its belief in the fundamental importance and beneficent results of scientific research—more especially research in pure science—in a manifesto quoted in the Report for 1918–19 of our own Department of Scientific and Industrial Research. This unanimity on the part of employer and employed in their recognition of the importance for the development of American industries of the promotion of research gives additional weight to the imposing array of facts and figures assembled by the National Research Council in the bulletin under notice, which deals with funds, other than Federal and State funds, available in 1920 for this purpose.

In the preparation of the following summary it has been assumed that where the total endowment, but not the amount annually available, is given in the bulletin, 5 per cent. of this total was available. In some cases no information is given as to the amount of the fund—either capital or interest—and these were necessarily omitted in compiling the money totals. The columns A, F, U give the number and aggregate annual value in *thousands of dollars* of the funds provided by, or in connection with:—A: academies, associations, societies, and museums; F: foundations, hospitals, and research institutes; U: universities and colleges.

	A		F		U	
	No.	1000 dols.	No.	1000 dols.	No.	1000 dols.
I. Medals and prizes	65	19	1	—	24	20
II. Grants	40	361	8	15,143	66	96
III. Institutional funds	14	255	30	2,322	176	2,056
IV. Fellowships and scholarships ...	6	34	6	120	263	352
Total ...	125	669	45	17,585	529	2,524

The most conspicuous figure in this table is the amount of the grants by foundations, etc., and this is almost entirely composed of appropriations (amounting to 15,000,000 dollars) made by the Rockefeller Foundation, New York City, "partly to agencies which it creates for carrying out specific programmes, and partly to other existing organisations to enable them to carry out specific programmes." Several other important annual appropriations are detailed below.

Source	Amount (1000 dols.)
Rockefeller Institute for Medical Research	1,100
Carnegie Institution of Washington—for research in astronomy, 221; physics, 329; botany, 65; biology, 131; nutrition, 52; eugenics, 31; embryology, 43	872
Carnegie Institution, minor grants ...	117
American Museum of Natural History—for promotion of research, exploration, etc.	278
Harvard Fund for medical research ...	363
J. De Lamar Funds for study and teaching of dietetics and of the origin, etc., of disease	377
John McCormick Institute for Infectious Diseases Research Fund	100
National Research Council fellowships for research in physics and chemistry ...	100
Massachusetts Institute of Technology, general budget appropriation for research	100

Thus, of the aggregate amount of the sums specified in the bulletin—20,778,000 dollars—more than 82 per cent. is attributable to Rockefeller and Carnegie benefactions, and more than 88 per cent. to these and the six other sources specified.

At the recent congress at Oxford of representatives of the universities of the British Empire much emphasis was laid on the fundamental importance of scientific research and on the necessity for providing material aids and training for it. The figures given above constitute a striking commentary on the following observations made by Prof. Joly at the congress: "Perhaps the most striking feature of American universities, as viewed by the British visitor, is the prevalence of research, and the lavish provision made for its prosecution. . . . There is research in everything. The American recognises to the full the value of the mental attitude induced by research, and this recognition is not confined to the university professor, from whom it may be expected, but extends, so far as I could gather, everywhere throughout the States." At some future date the National Research Council will perhaps take stock of the results of the application of these vast sums of money, and may possibly have a tale to tell of misdirected or unfruitful effort; but it can scarcely be doubted that the net results will affect substantially the welfare of mankind—perhaps so

[1] "Funds available in 1920 in the United States of America for the Encouragement of Scientific Research." Bulletin No. 9 of the National Research Council, 1701 Massachusetts Avenue, Washington, D.C., March, 1921. 1 dollar.

substantially as to give a new significance to the phrase "Almighty Dollar," and to affect the sociologist's estimate of the social order which has made possible the accumulation of multi-millionaire fortunes.

In a "Subject Index" the bulletin lists all the funds known to be available for the support or encouragement of research in the biological, mathematical, and physical sciences and their applications, and from this index has been prepared the following table, which, though not exhaustive, serves to indicate the subjects more generally favoured by founders and administrators of funds:—

Subjects	No. of Funds
Agriculture	12
Anthropology	24
Astronomy	33
Biology	36
Botany	13
Chemistry	57
Engineering	32
Geography	16
Geology, etc.	18
Industrial research	47
Medicine	147
Mineralogy	13
Pharmacology	14
Physics	49
Science, unrestricted (including appropriations of the Rockefeller Foundation)	120
Zoology	14

In the list of nine large endowments already given above, the ample provision for medical research is noticeable. Columbia University has a fund for cancer research producing 70,000 dollars per annum, and four other funds produce 291,000 dollars per annum for medical research. Cornell has 45,000 dollars per annum for research in veterinary medicine. Pennsylvania has lately received 500,000 dollars towards a tuberculosis research institute, and Iowa has a Welfare Research Station Fund for investigating "scientific methods of conserving and developing the normal child," for which it appropriates 25,000 dollars per annum.

A few other noteworthy funds may be particularised:—

Anthropology and Natural History.—Bishop Museum of Polynesian Ethnology, etc.: Research funds, 75,000 dollars per annum.

Bio-chemistry.—Leland Stanford Junior Food Research Institute: 700,000 dollars provided by the Carnegie Corporation for its support for ten years.

Engineering and Industrial Research.—United Engineering Societies' Fund, 500,000 dollars (capital). American Society of Heating and Ventilating Engineers: 21,000 dollars per annum for five years. Du Pont de Nemours Company Fellowships for Research in Chemistry in twenty-one universities: 750 dollars each.

Science, unrestricted.—Smithsonian Institution, Washington: Founded 1846, present fund 975,000 dollars. Brooklyn Institute of Arts and Sciences: Fund for research purposes of the museum, 600,000 dollars.

Mention may also be made of two foundations having an international character:—The American Field Service Fellowships for research in French universities: 30,000 dollars per annum; and the American Scandinavian Foundation, providing twenty travelling fellowships of 1000 dollars each.

The publication of this interesting bulletin provokes the question, What similar lists have been published in other countries? Particulars of scholarships, etc., open to graduates are to be found in the "British Empire Universities' Year-book," and it is understood that in the next edition information regarding other funds available for the encouragement of scientific research will be given; but in the meantime the only published lists comparable with those given in the bulletin are, it is believed, the lists of "Encouragements et Aides Financiers" included in a recently published work by MM. Tassy and Léris called "Les Ressources du Travail Intellectuel en France." The annual value of prizes distributed in France by the national academies and by societies dependent on private initiative is stated to exceed 1,500,000 francs, and an almost equal amount is said to be devoted to subventions to missions, travelling fellowships, and other aids to research.

Obituary.

LORD REAY, formerly Governor of Bombay, and an active worker for intellectual interests in many directions, died on August 1 in his eighty-second year. From a detailed notice in the *Times* we extract the following particulars of his career: Born on December 22, 1839, Lord Reay was educated at the Gymnasium at The Hague and at the University of Leyden, where he graduated in laws. In 1866 he made a tour through the United States for the purpose of studying the social and political condition of the country at a particularly interesting period of reconstruction. On his return to Holland he was elected president of a Society for the Promotion of Manufactures and Handicrafts, and in that capacity he organised the first industrial exhibition which was ever attempted in Holland. In 1871 he was returned to the Chamber of Representatives of the States-

General as Liberal member for Tiel, and again in 1875, the year in which his father succeeded to the Scottish title of Reay, on the death of the ninth baron. In 1877 he resigned his seat in the Dutch Chamber of Representatives, and became naturalised as a British subject. He was created a baron in the peerage of the United Kingdom in 1881, and in 1884 was elected rector of St. Andrews University.

In 1885 Lord Reay was appointed Governor of Bombay, where he brought about an amelioration of the Forest Laws, which gave universal satisfaction to the natives. Foremost among other questions which arose for solution was that of education, a subject which was always of the greatest interest to Lord Reay. His policy was to substitute local control for direct governmental supervision, to establish grants in aid in place of payment by results, and to develop a modern side in secondary schools. Technical education received a great impetus, and a permanent memorial of its development is the Victoria Jubilee Technical Institute for Mechanical Industries at Bombay. His Governorship ended in 1890, and his services to the Presidency were commemorated by the erection of a marble statue in Bombay.

Afterwards, as president of University College, London, of the Institute of International Law, and of the Franco-Scottish Society, and as member of the Senate of London University, Lord Reay found full scope for his energies. He became the first president of the British Academy in 1901, and was president also of the Royal Asiatic Society. On the resignation of the late Lord Londonderry in 1897 Lord Reay was unanimously elected chairman of the London School Board, a post which he retained until the abolition of the Board in 1904.

MR. WILLIAM TAYLOR, of Lhanbryd, who died recently at Elgin, aged seventy-two, was a most active zoologist and geologist, and made many contributions to science. Trained as a pharmaceutical chemist, he emigrated early in the 'seventies to Texas, where in the intervals of business he devoted much attention to the reptiles and small mammals. He corresponded with the British Museum, to which he sent many valuable specimens, accompanied by notes on their mode of life. In 1892 Mr. Taylor returned to Scotland, and henceforth lived in retirement in his native village of Lhanbryd. Here again he studied the mammals, especially the cetaceans stranded on the coast; but his most important work was the collection of fossil reptiles from the Triassic sandstone of Morayshire, and of fossil fishes from the Old Red Sandstone of the same county. Some of his fossils were sent to the Royal Scottish Museum, Edinburgh, where they were described by Dr. Traquair, but the greater part of his collection was acquired by the British Museum, where much of it was described by Dr. G. A. Boulenger and Dr. Smith Woodward. Several new species were named after him. Until 1914 Mr. Taylor made an annual tour to the south as far as London, thus keeping in touch with those who were interested in his researches, and he often attended the meetings of the British Association. He did not write much himself, but was always a keen observer, and gave valuable help to those who published technical accounts of his discoveries. He also did much to spread an interest in natural science in the district in which he lived.

THE death is announced of DR. J. E. BLOMFIELD at Sevenoaks on July 8. Dr. Blomfield was educated at Winchester, and later at the University of Oxford, where he obtained a demyship at Magdalen College in natural science. He afterwards entered the medical course, was elected Radcliffe travelling fellow, and worked at Jena, Vienna, and Paris. His clinical studies were pursued at University College Hospital, where he became house physician. On the advice of friends Dr. Blomfield decided to enter general practice, and from 1889 onwards practised at Sevenoaks. He was an accomplished microscopist, at an early date in his career published a paper on spermatogenesis, which attracted the attention of Charles Darwin, and later made a number of notes on, and preparations of, new growths in trees.

THE death is announced, at the age of sixty-one, of PROF. FRANCIS BACON CROCKER, professor of electrical engineering at Columbia University from 1893 to 1914, and president of the American Institute of Electrical Engineers in 1897. Prof. Crocker's work in the standardisation of electrical equipment throughout the world won him high praise from Lord Kelvin. He was the author of books on electric lighting, electric motors, the management of electrical machinery, and related subjects.

DR. W. E. STONE, whom a cablegram in the daily Press reports to have lost his life in the Assiniboine Mountains while trying to carry his wife up a cliff from which she had fallen, had been president of Purdue University, Indiana, since 1900. He had previously been professor of chemistry in the same institution, and earlier still had been officially employed as a chemist by the States of Massachusetts and Tennessee. He had published reports of numerous researches upon the carbohydrates. Dr. Stone was in his sixtieth year.

WE regret to see in the *Times* of August 2 the announcement of the death of PROF. EDMOND PERRIER, member of the Paris Academy of Sciences and of the Academy of Medicine, and honorary director of the Paris Museum of Natural History.

Notes.

THE French Association for the Advancement of Science is meeting this week at Rouen under the presidency of M. Rateau. The scientific proceedings of the association will be carried on in twenty-two sections and sub-sections. There will be two lectures—one on the synthesis of ammonia by M. G. Claude, and the other on aviation of to-day and in the future by M. Bréguet.

THE council of the Museums Association has elected Mr. T. Sheppard, of the Municipal Museums, Hull, as president of the association for 1922–23.

DR. D. SEGALLER, who has been with the British Dyestuffs Corporation, Ltd., since the firm of Messrs. Read Holliday and Sons was acquired by British Dyes, Ltd., is severing his connection with the Corporation. As head of the technical department he has been in charge of a staff of chemists engaged on research on various problems connected with the activities of the Corporation.

A DESCRIPTION of ball lightning seen in the sky at St. John's Wood during a thunderstorm in the early morning of June 26 has recently been received at the Meteorological Office. The phenomenon, a large incandescent mass floating in the air below the clouds and apparently stationary for some minutes, is of great rarity, and the Director of the Meteorological Office, London, S.W.7, would be greatly obliged if persons who observed it on this occasion would communicate with him. Prof. I. Galli has brought together a number of observations of globular lightning recorded in classical literature, as well as many from modern scientific publications, and has described them in several papers issued by the Portificia Accademia dei Nuovi Lincei of Rome.

IN consequence of the retirement of Sir Hercules Read, the department of the British Museum hitherto known as the Department of British and Medieval Antiquities and Ethnography has been divided, and the following appointments have been made by the principal trustees:—Mr. O. M. Dalton to be Keeper of the Department of British and Medieval Antiquities; Mr. R. L. Hobson to be Keeper of the Department of Ceramics and Ethnography; Mr. T. A. Joyce to be Deputy-Keeper in the Department of Ceramics and Ethnography. Mr. Reginald Smith, hitherto Deputy-Keeper in the undivided department, becomes Deputy-Keeper in the Department of British and Medieval Antiquities. The prehistoric collections fall into the Department of British and Medieval Antiquities, and the Oriental collections into that of Ceramics and Ethnography.

ON Thursday, July 21, a memorial was unveiled in the public gardens at Dartmouth to the memory of Thomas Newcomen, the great pioneer of the steam engine. Newcomen was born in Dartmouth in 1663; he followed the trade of blacksmith there, and was also a Baptist preacher. He appears to have been associated with Thomas Savery in his work on the use of steam, but to Newcomen belongs the credit of developing the cylinder and piston steam engine, the first one being erected near Dudley Castle in 1712. By 1716 similar engines were at work in Staffordshire, Warwickshire, Cornwall, and Flintshire, and the engine had no rival until the time of Watt. One or two Newcomen engines were at work until the beginning of the present century. During the latter part of his life Newcomen lived in London, and he died there on August 5, 1729. He was buried in the Bunhill Fields burying-ground. The memorial at Dartmouth consists of two engraved brass tablets mounted on a large rough granite block. After the memorial had been unveiled by the Mayoress, Mrs. C. Peek, a wreath was placed upon it as a tribute from the Newcomen Society, which was formed last year to further the study of the history of engineering and technology.

COL. HOWARD BURY's latest dispatch from the Mount Everest expedition to the *Times* is dated from Tingri Dzong on June 26. It describes the fortunes of the expedition during the march from the Arun Valley up the valley of the Bhong. On the way a visit was paid to Shekai Dzong, an important administrative centre and the site of a large monastery. Major Morshead and his surveyors have already mapped some 25,000 square miles of new country along the route of the expedition. Rinderpest in the Bhong Valley necessitated the use of donkeys only for transport, but they proved quite satisfactory. Tingri Dzong, which is to be the main base of the expedition, is forty-four miles in a direct line from Mount Everest, which rises gradually from the plain of Tingri Maidan without any intervening ridges. Some six weeks will be spent at Tingri and its neighbourhood in reconnoitring the slopes, and the expedition will then move to Kharta to spend another six weeks examining the valleys on the east and north-east of Mount Everest. Mr. A. F. R. Wollaston has rejoined the expedition after accompanying Mr. Raeburn back to Sikkim, and later will visit the neighbourhood of Gosainthan for botanical researches. Col. Bury says that the western slopes of Mount Everest appear to be very much steeper than had been anticipated, but he believes that the east and north-east slopes present the fewest difficulties. The weather was cloudy, and the expedition was getting few distant views.

THE first technical session of the International Commission on Illumination, the successor of the International Photometric Commission, was held in Paris on July 4–8. Those interested in illumination problems in Belgium, France, Great Britain, Italy, Spain, Switzerland, and the United States of America were represented at the session, which was opened by the Minister of Public Works, who welcomed the delegates in the name of the French Republic. The British delegates, nominated by the National Illumination Committee of Great Britain, were:—Major K. Edgcumbe (Institution of Electrical Engineers, chairman of the National Committee), Mr. C. C. Paterson (hon. secretary and treasurer of the International Commission), Mr. A. P. Trotter (Illuminating Engineering Society), Dr. E. H. Rayner (National Physical Laboratory), Mr. L. Gaster (Illuminating Engineering Society), Mr. R. Watson (Institution of Gas Engineers), and Mr. J. W. T. Walsh (National Physical Laboratory, assistant secretary of the International Commission). The subjects dealt with by the Commission were as follows:—(1) The unit of candle-power at present in use in this country and in France and the United States was adopted for international purposes, and is to be known as the "international candle." It is maintained by means of electric incandescent lamps at the National Laboratories of the three countries named. (2) The definitions of the terms "luminous flux," "luminous intensity," and "illumination," and the units of these quantities, viz. the lumen, the candle, and the lux (metre-candle), were agreed upon. (3) The subjects of heterochromatic photometry (including physical photometry and the characteristics of the "normal eye"), factory lighting, and automobile head-lighting were also discussed at the meetings, and sub-committees were appointed to study the questions from the international point of view during the next three years. The new president of the Commission is Dr. E. P. Hyde, director of the Nela Research Laboratories of America, and Major Edgcumbe is one of the three vice-presidents. The next meeting of the Commission was provisionally arranged to be held in New York in 1924.

CORRESPONDENCE has recently appeared in the *Times* on the subject of State awards for medical discovery. Sir Ronald Ross urges (July 13) that a system of small pensions, somewhat on the lines of Civil List pensions, ought to be established in order to compensate medical men and others for work which has been of advantage to the public without being remunerative to themselves, the medical profession rightly objecting to medical discoveries or inventions being kept secret or monopolised by those who make them. Sir Ronald Ross mentions an example:—Dr. H. made during the war valuable additions to our methods of diagnosis by X-rays, particularly by the use of a cardboard scale. He appealed to the Royal Commission on Awards to Inventors, but was refused an award on the ground that the chairman had "such a high esteem of the noble ideals which the medical profession had adopted in forgoing personal advantage, giving their services free, and so on, that he was in favour of maintaining this spirit, and altogether against the idea that the Royal Commission could be persuaded to give an award to a member of the medical profession." This means, as Sir Ronald Ross pertinently remarks, that while the inventors of life-destroying devices may be rewarded by the State, those of life-saving devices are to be rigorously excluded! To this Mr. Tindal-Robertson, Secretary of the Royal Commission on Awards, replied (July 15), quoting the general practice of the Commission, and stating that in the particular case of Dr. H. the ordinary principle was held to apply, that the sale of any article, whether patented or copyrighted or not, necessarily includes the right to use the article. Sir Ronald Ross replied to this letter (July 28), admitting that the Royal Commission, on the grounds laid down, could not help, but urging that the powers of the Royal Commission should be enlarged so as to enable it to deal with the claims in question. He quoted the precedent of Edward Jenner, who received a grant of 30,000*l.* from the State. It is noteworthy that the British Science Guild and the British Medical Association last year advocated the payment of pensions on the lines suggested by Sir Ronald Ross, and that the latter body reaffirmed the principle at its annual meeting in July.

RECENT excavations at Pompeii, which have been in progress since 1911, have disclosed what may one day prove to be the most interesting part of the city, but the results are still jealously concealed from the visitor. A correspondent of the *Times* of July 26 is, however, in a position to supply some information regarding them. Passing through the well-known Strada dell' Abondanza, a compitum or crossing of two streets is reached, where there is a large sacred picture. Such places were held sacred, and were generally marked with sacred pictures and an altar, where propitiatory sacrifices were made to the Lares, who had houses and street-crossings under their special protection. The fresco now unearthed is divided into three sections, the first representing the twelve Penates or city guardians, beginning with Jupiter and Juno and ending with Diana. To the right of this painting, which is probably more interesting than any other found at Pompeii except that of the Villa Dionysius, is a sacrificial scene in which a large-winged demon serpent, the emblem of the Lares, is seen approaching the altar with two eggs and a pine cone as a bribe to it to avert the Evil Eye. Beneath is a real altar of masonry, on which are still preserved the ashes of the last sacrifice that was offered before the fatal August 24, A.D. 79. Archæologists will await with much interest the publication of these important discoveries.

IN a communication to the Ipswich and District Field Club Mr. Reid Moir describes the excavation of several barrows (sepulchral mounds) on Brightwell Heath, near Ipswich. Within a radius of 8 ft. in the middle of one, on the original ground-level, were found fragments of a pottery beaker dating from the early Bronze age and a number of flint scrapers and other implements, which the author claims to be able to distinguish from Stone-age specimens by an examination of their flaked areas. The study has hitherto been complicated by the habit of collecting *all* the worked flints from a barrow, whether belonging to a burial or scattered at random in the soil thrown up to form the mound, and possibly of much earlier date. Full-size drawings are given, with side-views and an analytical table of the 152 scrapers and 106 flakes found. Another barrow contained a burial of the earliest Anglian period, about A.D. 460, with a thin bronze bowl containing the cremated bones and originally covered with linen secured by a cord under the rim; also a bone comb and ornamented bone disc closely resembling those found at Felixstowe, and now in the British Museum. The bronze bowl further contained part of an ivory armlet, two glass beads, and a clay draughtsman. Altogether an exceptional find that opens up a prospect of further successes on the Suffolk heaths.

MR. E. E. GREEN contributes to the July issue of the *Entomologist's Monthly Magazine* part vi. of his "Observations on British Coccidæ." In the present article three species of Eriococcus are described as new to science. *E. glyceriae* is based upon specimens obtained from *Glyceria maritima* growing at Blakeney Point, Norfolk; *E. placidus* was obtained from a species of grass (? Festuca) at Thurnham, Kent; and the third new species, *E. pseudinsignis,* occurred on a similar food-plant in the same locality. Mr. Green has added much to our knowledge of British scale-insects during the past few years as the result of painstaking field observations. Although the family includes some of the most destructive of all insects, the British forms, excepting the common mussel scale and a few other kinds, are seldom observed unless by the trained specialist. In the same periodical Mr. J. E. Collin continues his descriptive keys of Anthomyid flies of the genus Limnophora, Desv., inhabiting our islands.

AN interesting article on the biology and genetics of the very common ladybird beetle, *Adalia bipunctata,* is contributed by Mrs. O. A. M. Hawkes to the Proceedings of the Zoological Society for December, 1920. It is found that, although this beneficial insect will devour many species of aphids, it will not, for example, eat the common bean aphis except under stress of circumstances. Difficulties were experienced in the rearing of this and other species of ladybirds in captivity owing to their cannibalistic habit of devouring their eggs, larvæ, and pupæ. *A. bipunctata* has many colour forms, and these varieties offer suitable material for the study of inheritance of normally occurring variations. There is no evidence of dominance in crosses between its two chief forms, the red and the black, but matings of red with red produced only red with two exceptions. In matings of black with black both red and black forms resulted, but it was not possible to guarantee that the females had not had partners prior to the experimental tests.

AMONG the many activities of the late Mr. W. Denison Roebuck, of Leeds, none was pursued with greater determination than the collection of records of the distribution of land and fresh-water mollusca in the British Isles. Beginning in 1877, he was still adding fresh data up to his death in 1919, and the summary results of the 59,000 entries in his books are published in the last issue of the *Journal of Conchology* (vol. xvi., No. 6). No record was admitted to his "census" unless specimens had been seen and verified by referees appointed by the Conchological Society. The distributions ascertained by this accurate and painstaking work are set out in tables under 153 topographical divisions based on those devised by H. C. Watson, and are also shown for more than 150 species in five plates of small, but clear, maps. The whole forms an account which should be of substantial value not only to conchologists, but also to students of geographical distribution. It is to be hoped that its publication will stimulate naturalists to deal with other groups in the same way, and by collaboration render the enormous mass of data which must exist in individual collections of more general service. British entomology suggests itself particularly as a field in which important results might readily be obtained by systematised effort. Copies of Mr. Roebuck's work may be had from Mr. J. W. Jackson, University Museum, Manchester, at 5*s.* each.

A MEMORANDUM to the Government of India regarding the probable amount of monsoon rainfall in 1921 was issued by Dr. Gilbert T. Walker, Director-General of Observatories in India, dated June 7, 1921. The monsoon rainfall is affected by previous conditions over different parts of the earth, and these conditions have been on the present occasion unusually divergent. In India the development of the monsoon on the western side of the Peninsula had up to date been less vigorous than usual. Examining one of the features of interest, it is shown that scarcely any snow fell during the preceding winter in Baluchistan and very little on most of the hills of the North-West Frontier Province. The total winter precipitation over these areas is said to be the lowest for at least twenty years. Dr. Walker summarises the conclusions to be drawn from the controlling features with a statement that it would be unjustifiable to attach any importance to indications so feebly marked as those of the present year, and he adds that when their resultant effect is so trifling nothing is gained by attempting to reach a conclusion, and he does not consider the controlling factors decided enough to enable a trustworthy forecast to be prepared.

So far as efficiency and durability are concerned, there does not seem much to choose between the electrical and the mechanical methods of connecting the propellers of a ship with the steam turbines. Excellent results have been obtained by both methods. The electrical method, however, has much greater flexibility. There is no necessity to have the turbines near the shaft, and its direction of rotation can be reversed with the greatest ease. In *La Nature* for July 16 L. Jauch, the chief mechanician of the French Navy, compares the two methods, and concludes that the electrical drive will be much the more popular in the future. He points out that five battle-cruisers each requiring 180,000 h.p. and using electrical methods of driving the propeller are being built in America. The author calculates that at maximum power the efficiency of the mechanical type of gearing would be 2 per cent. higher. But this is offset by a 2 per cent. gain in favour of the electric drive at mean speeds and a 20 per cent. gain at low speeds. He points out that with the electric drive there is no fixed relation between the speed of the propeller and the speed of the steam turbine. Hence the latter can always be run near the speed at which its efficiency is a maximum.

THE Department of Commerce, Bureau of Standards, Washington, has just issued Circular Paper No. 100 on "Nickel" (20 cents). This is one of a series describing the physical properties of metals, together with a discussion of the relation of these properties to the composition and treatment of the materials. In it are described the properties of nickel and of its commercially important alloys: nickel-steel, ferro-nickel, copper-nickel, and nickel-chromium alloys. The pamphlet is illustrated by numerous photomicrographs and curves, and provided with a very complete bibliography. The collection of data will be valuable to metallurgists.

THE Wireless Press, Ltd., announces for early publication a volume by Prof. J. A. Fleming, who was recently awarded the Albert medal of the Royal Society of Arts in recognition of his many valuable contributions to electrical science. Under the title "Fifty Years of Electricity: The Memories of an Electrical Engineer," the work will record the progress of electrical engineering since 1870, the year in which Prof. Fleming attained his majority.

THE catalogue of optical instruments recently issued by Messrs. Adam Hilger, Ltd., 75A Camden Road, London, N.W.1, contains details of a number of instruments not previously obtainable in this country. Amongst them may be noted a monochromatic illuminator, an infra-red spectrometer, a vacuum spectrograph, a linear thermopile, a spectrophotometer, and several refractometers. Messrs. Hilger are offering a limited number of their instruments at a special reduction of 20 per cent. off their current prices.

ERRATUM.—We regret that the price of the fifth edition of Sir J. J. Thomson's "Elements of the Mathematical Theory of Electricity and Magnetism" was incorrectly given in NATURE of July 21, p. 647, as 30*s.* net instead of 25*s.* net.

Our Astronomical Column.

DISPLACEMENT OF LINES IN THE SPECTRUM OF VENUS. —The *Astrophys. Journ.* for June contains a paper by Dr. Chas. E. St. John and Mr. Seth B. Nicholson, in which they test the result announced by Mr. Evershed that his Venus spectrograms supported the view that the earth exerts a repulsive effect on the solar gases, analogous to that which the sun appears to exert on comets' tails. The authors took two series of Venus spectrograms: in 1919 with Venus east of the sun, and in 1919–20 with Venus west of the sun. Their analysis of the results leads them to conclude that the effect can be correlated with the altitude and the angular diameter of Venus; hence they conjecture that it is due to atmospheric dispersion, the centre of the visual image which was adjusted on the slit differing from the centre of the photographic image. They propose in future to take some further plates viewing the image through a blue screen, which should eliminate the above source of error. They have incidentally examined the measures to see if they afford any evidence of a rapid rotation of the planet, but conclude that "the difference between the morning and evening series . . . is not of an order that would indicate . . . a rate of rotation higher than that found by Slipher." In all the plates of the series, whether on Venus, the sky, or the sun, an iron-arc spectrum was photographed simultaneously.

PLANETARY PHOTOGRAPHY.—Pubns. Ast. Soc. Pacific, June, 1921, contains a lecture by Mr. E. C. Slipher on this subject, illustrated by numerous reproductions of photographs of Venus, Mars, Jupiter, and Saturn. Those of Venus failed to record any surface markings, but illustrate the changes of diameter and phase that occur in the synodic period. The photographs of Mars taken at Flagstaff are stated to number 100,000. Numerous exposures are made on each plate, in the hope that some will catch the moments of best definition. Mr. Slipher gives a long list of features that he claims can be verified from the plates. It must, however, be admitted that not all of these can be seen on the reproductions, though they may be visible on the original negatives. The polar cap is shown with great clearness, and it would seem to be worth while to make measures of its position angle in order to obtain an independent determination of the position of the axis.

The photographs of Saturn yield much interesting information. The great excess of luminosity of ring B over ring A, and the semi-transparency of the latter, permitting the outline of the ball to be seen through it, are well brought out; also the faintness of the ring when the sun is near its plane. There are reproductions of two exposures on April 28 last, when the earth and sun were on opposite sides of the ring-plane. There is a dark stripe across the centre of the disc, formed by the dark side of the ring and its shadow; it is narrowest in the middle, the two edges being curved in opposite directions. One feature shown in all the photographs is the extreme regularity of the fivefold belt in Saturn's southern hemisphere. The edges appear to be exactly parallel to the equator. One is inclined to mistrust this regularity on drawings, but the photographs are free from bias.

MEASUREMENT OF THE DIAMETER OF ARCTURUS.—Mr. F. G. Pease (Pubns. Ast. Soc. Pacific, June, 1921) gives an account of the work with the interferometer on the 100-in. Hooker telescope at Mount Wilson since the successful measurement of the diameter of Betelgeuse. Observations on Arcturus in February and March, with poor seeing, showed some diminution of the visibility of the fringes with increasing distance between mirrors. At length on April 15 the seeing was perfect, and the fringes were found to disappear when the mirrors were separated by 19·5 ft. As the maximum separation at present is 20 ft., it was not possible to proceed to the next point of greatest visibility of fringes; but the value 19·5 is considered to be correct within 0·5. Assuming an effective wavelength for type Ko as 5600, the angular diameter of Arcturus is 0·0237″, very near the mean of the values estimated by Eddington, Russell, and Hertzsprung. The parallax is taken as 0·116″ from the mean of the best recent measures, giving a linear diameter of 19,000,000 miles, or twenty-two times that of the sun.

Observations of Aldebaran on nights of poor definition give grounds for thinking that its angular diameter is somewhat greater than that of Arcturus; Pollux and α Ceti give indications of weakened fringes, but probably a longer beam than 20 ft. would be needed to make them disappear. The mirrors have hitherto been moved by hand, which has taken much time. Two screws driven by a single motor are now being mounted, which should greatly facilitate the measures.

The Universities and Technological Education.[1]

By PROF. W. W. WATTS, F.R.S.

TECHNOLOGICAL education may be defined as the development of those sides of learning which will enable us to extract the highest possible good from the resources of the world, and in the process to make life at least endurable and, if possible, pleasant to the maximum number of people; to avoid waste and extravagance in both production and use; to keep and leave the world beautiful and peaceful; and to do all this with such a margin of economy as to deplete as little as possible our children's heritage in the earth of which we are but tenants for life.

In the use of every kind of resource, animal, vegetable, or mineral, man has been woefully extravagant, partly through thoughtlessness, but mainly through ignorance. To take their share in improving this state of things is a task not unworthy of the greatest and most ancient universities, as well as of those of newer growth, and of those other institutions which, because of their heart-whole and deliberate devotion to this end, are not yet deemed worthy to be reckoned as universities.

Among the functions of these universities and institutions should be the training of men who are to lead the industries forward in the direction of higher efficiency, smoother and more salutary working, and increased production; men who shall know sufficient of the laws of Nature to extract through their operation all the energy and material to which we are entitled, and who never forget that Time the Avenger, tardy but sure, will exact from them the penalty for any thoughtlessness or neglect.

The Student.

It is fair to demand that the technological student should come from school with a really good general education and the culture which such an education should give. He should have such a knowledge of languages that he can not only use those he knows, but will also be able without great difficulty to acquire any other which may prove essential to him; such an acquaintance with literature that he really understands how to read and extract from the printed word what it is able to give him; facility in writing clearly and intelligently; so much knowledge of geography and history as will enable him to get hold of any information he may require; and a thorough grounding in mathematics and elementary science.

In the study of the group of sciences and arts germane to the professional training, the best that can be done is to pick out in each subject those matters which are common to a number of technological subjects, to teach them to mixed classes of convenient size, and to supplement them where necessary by special additional instruction or direction. The amount of common matter is much greater than is generally supposed, and such courses, if thoughtfully designed, will go a great part of the way. Here the strength of broad-based institutions is manifest, for in them it is possible, without undue expense, to make use of all existing departments. There must necessarily be either incompleteness or waste of effort and overlapping in the case of institutions devoted to a single branch of technology; and such institutions should never be founded unless it has been proved impossible for bodies of university rank to undertake the work.

[1] From a paper read before the Congress of the Universities of the Empire at Oxford on July 6.

Curricula.

It is as well to insist that technology must be based on a thorough knowledge, practical and theoretical, of the relevant sciences treated as pure sciences. In the past most industries have advanced by means of a cumbrous and exclusive course of trial and error. It is only in the more recent developments that advantage has been taken of the principles and general laws worked out by the scientific man in his laboratory, the royal roads in both the pursuit and the applications of science. In future the technologist must be a scientific man, not only in his knowledge, but also in his attitude and outlook. In his life-work he will not be really successful if he is satisfied with things that are. He is to be the introducer of new things in a *régime* which may fallaciously appear to have reached finality. This he can be only if his knowledge is wide and so ingrained in him that he can make full and practical use of it.

In every science the great aim should be to bring out the principles and the general laws which have been established, the lines of thought and experiment on which they rest, the means by which they can be and have been tested, and the consequences which flow from them. The teaching scheme is thus made easier as well as more efficient, for such principles are common ground, equally necessary to each branch of technological instruction. It is in the illustration of them that the teacher must bring out their contact with the technical practice of industry.

While holding fast to the principles of science, it is essential that the scheme at this stage should be exceedingly elastic and capable of rapid variation to meet the advance of industrial applications. What is at once the hardest task and the severest test of the successful teacher is not how much he can teach, but how much he dare leave out. In any case, he must be firm in meeting the question which few of us escape: "What use is this to me?" He can see farther than his students, farther even, perhaps, than his technical advisers, and he should be able to show that such apparent superfluities are like the hidden strands in concrete, without which the material would fail under some of the stresses it is designed to meet. It is his duty to remember that, whatever may be a student's intentions as to his future, he cannot be sure of controlling that future.

The guidance of technical advisory committees is of inestimable advantage, not only in the later year or years when purely scientific work is merging into the technical applications of it, but also to some extent while pure science is being studied. In both cases, however, their function should remain advisory and never become mandatory. The last word must rest either with the director or principal teacher, or with the faculty of which he is a member.

In the later year or years of the course the instruction will naturally become more highly specialised, and if the previous scientific training has been thorough and sound and the student has learnt how to make practical use of his knowledge, progress will usually be rapid.

It is essential, too, that at this stage, but preferably earlier as well, the student should be trained in writing of what he has learnt, or in summarising the results obtained by his own practical work, in clear and concise and, if possible, non-technical language which can be easily understood by the type of man under whom his professional work will be carried on. By this he will be able to display most clearly how much of his work he has really grasped and how far he sees into its consequences, while he will, at the same time, be acquiring a gift of great service to him in his career.

Touch with Industry.

It is a vital question at what stage contact with industry should be initiated. Until a student knows some of the features of the industry in which he will be engaged, he finds it difficult to realise the significance of many parts of his training. On the other hand, if he goes into the shops, the works, or the mine too soon, he is not possessed of enough knowledge to profit fully by his experience. The advantage of early touch outweighs its disadvantages, and contact should begin early, and be renewed at several stages of the course. The student may at first gain little actual knowledge in the mine or workshop, but in working there for a period by the side of the men whom he will afterwards direct he will gain a most valuable knowledge of their customs and limitations, their predilections and weaknesses; and he will be laying down a foundation of experience which will usefully guide him when he comes to the difficult task of handling men himself. At the same time, while watching the technical skill of the expert workman, he will acquire respect for accuracy and delicacy of workmanship and for that astonishing proficiency which prolonged practice alone can give. What is of scarcely less importance is that at this stage he will hear a whole gamut of technical nomenclature which has before been mere jargon to him, if he has met with it at all. No one is more intolerant of the phraseology of the expert than the "practical man," but no one is more tenacious of his own terminology. It is well that the student should learn the latter while he is still in the position of the under-dog, so that it may not trip him up later. As his course proceeds it is natural that workshop and field experience will become of greater educative value. He will be entrusted with higher work and so gain new experience.

Directors and Teachers.

One of the greatest difficulties in the future, as it has been in the past, will be the staffing of technological departments. Such departments must be directed by the right kind of men—men not only of good intention, but also of wide industrial knowledge, capable of dealing with students and of organising their staffs; men of ideas and energy, devoted to their own research and that of others; and, above all, men of achieved success. There seem to be but three ways of securing such men: (1) To pick the right man whenever and wherever found, pay him his price, and leave him to teach as and what he thinks best and to select his *personnel* and material, as well as his methods and lines of research; (2) to take from the industrial side men who have made their mark and a competence, but, from interest in their subject and love of the work, are willing to continue in harness in what is one of the pleasantest, if not the least exacting, of professions; or (3) to select competent and trustworthy men who have found touch with industry from the academic side, and to allow them to supplement their pay by private professional work conducted under proper restrictions. Under present conditions the universities will have to fill their posts from the last two classes.

Subordinate staffs have also to be considered. Here again the pay is generally inadequate to secure the services for long periods of the most desirable men, and it is arguable that it is well this should be so. There are many inducements to attract men to the staffs of applied science departments: the continuation of their technological education and the possibility of obtaining higher degrees, the developing of their teaching ability, the opportunity of increasing their proficiency in research and improving their status and reputation thereby, the earning of additional pay by carrying out industrial work of research character or otherwise, and the introduction to, and contact with, industrial men who will eventually have research work to dispose of or employment to offer. It is essential, however, that means should be provided to retain some, and those not the least promising, for longer periods in order to give stability to the department and to the head of it the responsible support which he is entitled to look for.

It will also be to the advantage of every department that it should be sufficiently strong to allow one or other of its members to take an occasional period of time for the purpose of study, research, or even business work. This would react not only on the value of the teaching, but also in spreading the reputation and increasing the efficiency of the department by maintaining closer touch between it and the business world. If well managed, it need not involve heavy additional cost. It is chiefly a question of organisation and of a liberal outlook.

Research.

It is essential that research should form part of the curriculum of every technological student. Whatever his future career, in addition to routine work, it is certain that he will come across new conditions and new difficulties, something for which he may have met no precedent—problems, in other words, which need to be investigated on scientific lines before they can be solved. It is not essential that the research should be other than of a purely scientific nature. What is essential is that he should get to realise that the easiest and quickest way may often be to obtain facts and inferences at first hand, that he should learn how to question Nature, and acquire confidence that, if he can put his questions skilfully, he will usually obtain, after Nature's way, an answer which will contain, though it may conceal, the solution to his problem.

It is still more necessary that the teachers should engage in research, and naturally this in most cases would have some more or less direct bearing on industrial problems. Apart from the fact that only a man engaged in the production of new knowledge can be a really first-class teacher, in no other way can he establish contact with the highest development of the industry in which he is interested and thus secure the confidence and respect of those engaged in it. An active research school is the best symptom of a live and active technological, as it is of a scientific, department; it tends to attract the right kind of student, trains the best kind of staff, and is a legitimate way of keeping the department before the eyes of business men.

If it is possible to pass the best students on to the staff for a short period before they take up outside appointments, and to afford them reasonable leisure to embark upon research, the school will be much strengthened and the worth of the students considerably enhanced. A certain amount of teaching work is by no means a drawback, for it will enable them to consolidate their knowledge and render it more accessible when wanted. A larger staff than otherwise may be thus maintained, and the department will be more stabilised in the event of having to face the possible loss of one or more of its senior members.

Another consequence of a strong research school will be to attract from outside those engaged in industry who have special problems of their own to solve which cannot be so well dealt with in the laboratories to which they have access in works or elsewhere. This should, of course, receive encouragement. The introduction of outsiders of the right kind to the laboratories is of service in several ways. It "spreads the light" by keeping industrials informed as to the progress of science and the improvements of methods of investigation, and as to the precise nature, cost, and limitations of scientific inquiry. It impresses upon them the necessity for experimental accuracy, and shows how closely the sciences are now interwoven, and how results obtained in one science or branch may be imported to assist progress in another. Better relations are established between the institution and the industries surrounding it, mutual confidence is engendered, and personal acquaintance is encouraged to the advantage, on one hand, of the industries, and, on the other, of the students who may find eventual employment therein.

A corollary is that in certain cases research by staff or students may be in part carried on in works laboratories outside the university, and the considerations just set out apply as well to this case. Care is requisite that industrial research should not degenerate into anything of the nature of routine or testing work. This should be excluded, and the universities should not in any way compete with firms which specialise in this direction. Only where this class of work involves problems which are new or exceptionally difficult, or need the employment, or even formulation, of new principles, should it be undertaken by university departments.

The Product.

The type of man which it should be the aim of the universities to turn out should possess those qualities which distinguish the best type of scientific man—not merely knowledge of his subject and technical ability to use that knowledge, but capability to introduce the scientific method into his conduct of everyday life and into his dealings with his colleagues and subordinates. He must be willing to study *all* the conditions of his problems before he is sufficiently satisfied with their solution to carry them into effect. These conditions require, not *a* solution, but *the* solution which can be brought into operation with the least possible disturbance of the things that are, without needless change of raw material, machinery, or *personnel*, but with the advantage of diminished cost, enlarged production, and increased value or efficiency.

If this is the aim, the product will be the best type of technologist. He will not necessarily be the type of man suited to occupy immediately the highest position in his business. But the work given him to perform will be so well done that it will be impossible for his character, competence, and ability long to escape the watchful attention of his chiefs. It will not be long before he is chosen for more and more responsible work until he attains high rank in his profession. I do not believe it is possible that men of managerial type, captains of industry, will ever be technically trained as such. The universities should endeavour to produce such a type of man that his superiors will take him by force, and almost against his will, from his technological work to direct the bigger issues.

Conclusions.

(1) As much as in any other walk of life, the education of the business man must be a liberal one. His mind must be as agile, and he must be as well provided with intellectual weapons, as any other well-educated man.

(2) A course of technological education thoughtfully laid out is, as an instrument for mind-training and in the nature of the product turned out, in no way inferior to the higher branches of language, literature, history, or philosophy. The work is as hard, the problems to be solved as difficult, the reasoning as acute, the intellectual joy in success as great; while its urgency to the nation and to mankind is one of the most pressing matters that educationists have to face.

(3) In the multiplicity and complexity of subjects there is no longer time for the most liberal of educations to be as broad as heretofore. Some universities are even specialising in a single dead language as an honours subject, holding, perhaps rightly, that a thorough knowledge of one is better than what can be attained, in the time available, of two. Technological education has anticipated this specialisation only by a few years.

(4) There is no less worthiness and dignity in the newer education than in the old. All higher education is, and always has been, technological. The learning of the older universities has been used, and has even been moulded for the purpose, to equip the parson, the poet, and the politician; and both the peer and the proletarian can gain from the study of classical literature some facts or theories to guide them in their respective vocations.

(5) The business man has good right to demand that institutions of university rank shall supply his demands as well as they have dealt with education for the professions. The polytechnic system has not had the success that was expected in educating his foremen and workmen. He must not be again disappointed when he seeks higher education for himself. He expects, and has a right to expect, that the type of education he needs shall be, not a by-play or a by-product, but a worthy aim in itself; and if the universities will not give it to him, he will take his own steps in the matter.

The Exploitation of Irish Peat.[1]

By PROF. HUGH RYAN.

THERE are about 6,000,000 tons of turf used every year in Ireland, but this quantity is almost insignificant in comparison with the total amount, about 4,000,000,000 tons, which can be won from the bogs of the country. The Irish Peat Inquiry Committee, of which the present writer was a member, was appointed to suggest what means should be taken to ascertain the conditions under which the peat could be profitably won, prepared, and used in the most favourably situated localities. The main report of the Committee, which is contained in the publications under notice, recommended the purchase by the State of a large bog in which hand and mechanical methods of winning peat could be tried side by side. These tests would require to be continued over a long period if

[1] "The Winning, Preparation, and Use of Peat in Ireland." Reports and other Documents. (Fuel Research Board. Department of Scientific and Industrial Research, 1921.) 3s.

they were to give trustworthy data, and they would have resulted in the winning of large amounts of peat, for which there would be little prospective market. With the view of decreasing the net expense of the experiments and at the same time of testing, on an adequately large scale, the commercial possibility of utilising peat for the generation of electric power, the Committee suggested the installation of an electric power station on a suitable area of the Bog of Allen, within 25 to 40 miles from Dublin. A portion of this power could be used locally to drive the peat-winning machines or agricultural machinery, in chemical industries, such as the manufacture of calcium cyanamide, and for lighting and power purposes in the neighbouring towns. The excess of electric power could be transmitted in bulk to the power station at Dublin.

As a result of a conference with the Fuel Research Board the Irish Committee submitted a much less ambitious, if less satisfactory, scheme, which consisted briefly of the purchase of a bog of about 10,000 acres at a price of about 2*l.* an acre, and the establishment in it of an experimental station to test the various methods proposed for winning peat. Even on this scale a considerable number of labourers would be required, and in order to encourage these to settle in the district the Committee proposed to have experiments conducted by the Department of Agriculture for Ireland on the reclamation of cutaway and virgin bog. The Fuel Research Board approved in general of this scheme in 1918, but the agricultural portion of the scheme was referred to the Irish Department of Agriculture about two years after the Peat Committee had submitted its report. The present publications contain also the report of the Sub-Committee on agricultural matters appointed by the Department of Agriculture. Owing to this unfavourable, and to a large extent unjustifiable, report of the Sub-Committee, it is not proposed to carry into effect the recommendations of the Irish Peat Inquiry Committee with regard to the winning of peat.

A serious obstacle which confronts everyone who attempts to devise a scheme for winning peat on a large scale is the labour difficulty. The peat-fuel season, depending on air-drying as it must do for commercial reasons, lasts only about four to six months of an average year. It is not easy, therefore, for the peat industry to attract the labourers required by it from other industries which offer them constant employment throughout the year. This applies especially to the men required for cutting and spreading the peat. Much of the work of the drying operations can be done by women and boys, who are in general available during the late summer months in any more or less thickly populated district. One of the chief problems which the Peat Committee had to consider was, therefore, how to limit so far as possible the number of men necessary for the winning of a definite quantity, say 250 tons, of turf each day of the cutting season (120 days). The same difficulty was experienced abroad, and was, to some extent, met there by the introduction of labour-saving devices such as the automatic machines of the Baumann and Wielandt types.

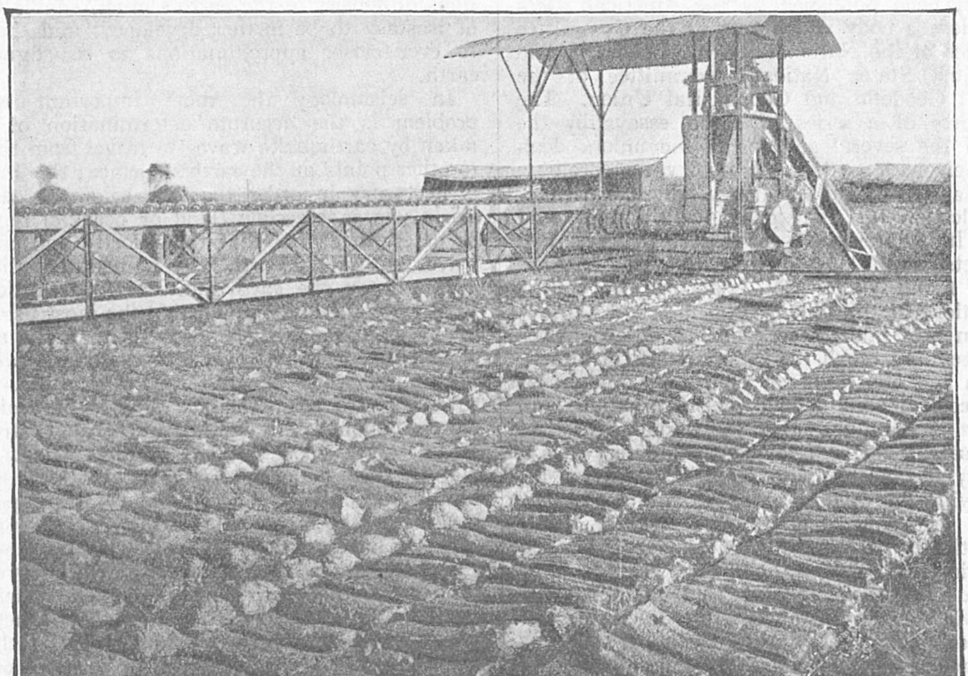

FIG. 1.—Baumann's automatic peat machine.

The Baumann machine consists of a ladder dredger which scrapes the peat off the inclined face of the bank and conveys it to the hopper of the cylindrical mixer and macerator, shown on the right-hand side of Fig. 1. The peat is pressed through the mouthpiece of the macerator as a rectangular band which is automatically cut into sods. The latter are caught on plates moving in a lattice girder, extending about 120 metres over the adjacent drying ground. When the lower half of the continuous chain of plates is completely filled with sods, these are tipped on the drying ground and the emptied plates return to the macerator over the upper portion of the latticed girder. One of these machines in Raubling Bog, Bavaria, attended by a gang of five men, had a daily output of spread sods corresponding to 55 tons of air-dry turf. Its dredger was driven by a 20-h.p. electromotor, its macerator by a similar motor of 40 h.p., and the cost of the complete machine was 1500*l.*

The Wielandt machine is similar in principle to the Baumann, but lighter in construction, largely owing to the adoption in it of a different spreading mechanism. The machine can be driven by a 25-h.p. electromotor, and its total cost, including motor and cables, was 1000*l.* four or five years ago, but is now much higher. During the war it was found at Elisabethfehn, in Oldenburg, that one of these machines, attended by one man and three or four youths, had an output in the season of 7000 tons of air-dry turf.

If the statements made abroad with regard to the efficiency of automatic machines are correct, four of these machines, attended by sixteen men in all, can dredge, form into sods, and spread in a day enough peat to yield, when air-dry, about 250 tons of turf. The same output of peat, cut and spread, by the method ordinarily practised in Ireland requires about 160 men. It is therefore a matter of great importance for the winning of peat on a large scale in Ireland that these claims should be subjected to a prolonged test under the conditions obtaining here. In conclusion the writer must again express his regret that the recommendations of the Peat Inquiry Committee were ultimately set aside for reasons which are in part due to misinterpretation of the Peat Committee's report, and in part to statements which were made by the Agricultural Sub-Committee, and are in sharp disagreement with the actual facts, in regard to the extent and the purchase price of Irish bogs.

Geophysical Problems.

A SURVEY of research problems in geophysics has recently been published by the American Geophysical Union, a body which acts as the Committee on Geophysics of the National Research Council, and as the United States National Committee of the International Geodetic and Geophysical Union. The survey consists of a series of seven essays by the chairmen of the several sections of the union, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, volcanology, and geological physics and chemistry. It is interesting to observe that the two latter subjects, so little studied in this country, are in America found sufficiently important to occupy separate sections of the union.

Advance in nearly all these branches of geophysics seems to depend on much the same method of attack, involving on the one hand an enormous amount of organised, co-ordinated labour of observation and measurement, and on the other individual theoretical study, necessarily of a freelance character, by a comparatively few people with scientific training, insight, and wide knowledge, at research institutes or universities. The first half of the task is being executed with increasing skill and success by the national scientific organisations of the leading countries, but the complementary half lags behind. Dr. C. F. Marvin, for instance, after describing the present achievements and future tasks of meteorological organisations, concludes that "seemingly the greatest need in meteorology is that of a master mind to direct itself comprehendingly and intensively to the great problems which the science still presents." The recency of the beginning made by meteorologists in the study of the upper air, now recognised to be fundamental for the upbuilding of a dynamical science of meteorology, suggests that perhaps also in other geophysical sciences progress may be obstructed by failure to perceive vitally important directions which observation and research must take.

The outstanding task of geodesy at the present time is described by Prof. Bowie as being that of co-ordinating the geodetic triangulations of the various countries by reducing them to a single datum, defined as the adopted latitude and longitude of some one station, the azimuth of a line radiating from that station, and the dimensions of the reference spheroid on which the triangulation is computed. This involves a herculean work of re-computation and re-adjustment of the triangulation networks, especially in Europe; in America much progress in this direction has already been made. Gravity surveys must be extended over the land surfaces, and a satisfactory method of observation evolved for the ocean areas of the globe; this will afford information as to the variations of density in the earth's crust, enable the theory of isostasy to be further developed, and thereby lead to ever closer approximations to the figure of the earth.

In seismology the most important world-wide problem is the accurate determination of the time taken by earthquake waves to travel from their origin to other points on the earth's surface; this information is necessary in order that the origin of earthquakes arising in inaccessible (land or oceanic) regions may be determined, and that the velocity and path of the waves within the earth may be deduced, thus throwing light on the earth's internal constitution. Prof. Reid expresses the opinion that the most useful means to this end lies in the improvement of the equipment of existing seismological observatories rather than in multiplication of the present number. The desirability also of methodical studies of limited areas where small shocks are frequent and strong ones occasional is also mentioned, with the view of determining the sequence of events leading up to the rupture producing a strong shock, and possibly of forecasting the region and time of such occurrences.

Dr. Bauer's article on terrestrial magnetism contains some interesting remarks on the progress of the analysis of the earth's magnetic field which is now being made in the department of the Carnegie Institution which he controls. It has been concluded that for many purposes the theoretical formula proceeding in series of spherical harmonics may be restricted to the few most important terms, leaving the residual field, representing continental and more local irregularities, for special study and treatment in accordance with their extent and character. Reference is also made to the important problems afforded by the magnetic variations, both those connected with auroræ and earth-currents, and the rarer ones occurring at times of solar eclipse. The baffling fundamental problems of the origin of the earth's main magnetic field and the cause of its secular variation are also touched upon.

Prof. Littlehales points out the influence which the ocean, being so large an expanse of the substance having the highest known capacity for heat, must exercise as a factor governing the distribution of terrestrial temperature, and the consequent importance of oceanography to geophysics in general. A *résumé* is given of the efforts so far made, by voyages of exploration and by investigations in marine laboratories, towards the study of the oceans in their many aspects; the system according to which progress is now being sought is the study, in detail, of definite oceanic stations periodically revisited every three months, for the purpose of making synoptic charts of temperature, salinity, gas content, currents, and so on, which it is hoped will prove amenable as material for mathematical investigation of the related phenomena.

In his essay on volcanology Dr. H. S. Washington describes the information which requires to be collected for the systematic study of the subject, and the programme of a volcanic observing station, such as those which have been established for some years at Vesuvius and Kilauea. The article on geophysicochemical problems, by Dr. R. B. Sosman, of the Carnegie Institution Geophysical Laboratory, concludes the report, and deals with the investigation of the physical properties and chemical reactions of the substances and aggregates which make up the earth.

Agricultural Research.

"THE Present Position of Research in Agriculture" formed the subject of a lecture delivered by Sir Daniel Hall at the Royal Society of Arts, and reported in the society's Journal for April 1 (No. 3567, vol. lxix.). Up to the time of the formation of the Development Commission in 1909, agricultural research was entirely unrecognised by the State. A considerable amount of information had been gained from the researches at the Rothamsted Experimental Station, which was started in 1843, and was entirely dependent on the endowment provided by its originator, Sir John Lawes; valuable researches were also being carried on at the Woburn Station of the Royal Agricultural Society, while from 1890 onwards the various agricultural colleges were commencing investigations along many different lines. To work of this kind the State granted not more than a few hundred pounds a year, and the Development Commission was expressly charged with the object of formulating some scheme for the promotion of research. The scheme adopted is now in working order, and by it the field is divided up into a number of subjects, one of which is allocated to each university or institute. By this means research is removed from immediate State control, concentration of effort ensured, and overlapping avoided, and each institute is able to carry out a continuous scheme of work. The question of the State control of research is one which is hotly debated. On one hand it is argued that the State pays, and therefore should control the expenditure; on the other, when the nature of research work is considered, it is obvious that the looser system of control prevailing in a university is much more productive of good work than the rigid methods of a Government department, while the type of man wanted for research is much more attracted to the former than to the latter. Moreover, if research came directly under Government control, then the programme of work would have to be submitted annually to the judgment and criticism of administrative bodies possessing no expert knowledge. That such a procedure is disastrous has been proved many times in other countries.

Another advantage arising out of the association of the research institutes with the universities lies in the co-operation thereby ensured with other workers in all fields of science, so that no matter in what direction the particular research may extend, the advice of men with expert knowledge is always available. It is also of the utmost importance to keep agricultural research in contact with the business of farming, and this is attained most easily through association with a university which teaches agriculture and is in touch with the surrounding farmers.

At present there are under the scheme eight institutes, each dealing with some particular branch of agricultural research, such as plant pathology, fruit-growing, dairying, etc. A research council, consisting of the directors of the various institutes, together with a few independent scientific men and the officials of the Government departments concerned, has been set up to ensure the co-ordination necessary between the different research centres. To this body also the Ministry is able to submit plans for any large-scale investigations requiring the co-operation of a number of the institutes. An important feature of the scheme has been the provision of a number of advisory officers who are attached to the various agricultural colleges. These men are free from most teaching duties, and are able to give advice and help to the farmers and horticulturists in their area while keeping in close touch with the directors of the related institutes and the officers of the Ministry's staff. In this way a systematic service is secured capable of dealing with plant pathology, etc., all over the country.

The total funds set aside in the current Estimates for this research scheme amount to 105,000*l.*, against 38,250*l.* for the year 1913–14. This ensures for each institute a definite number of salaried posts with reasonable prospects of promotion, so that agricultural research is no longer an absolute blind-alley employment.

The immensely important subject of animal disease has been very inadequately dealt with, but the many difficult questions involved are being investigated. The Ministry is now supporting a research laboratory at Addlestone, and grants are made to the Royal Veterinary College and the London School of Tropical Medicine for the pursuance of researches in animal diseases.

Having dealt with the organisation of research, the lecturer gave a short account of some of the most important practical results obtained recently from the various institutes. At Rothamsted a valuable investigation has been carried out on the method of the decomposition of farmyard manure. A cellulose fermenting organism was discovered which attacks straw in the presence of active nitrogen. At the same time there is considerable loss of nitrogen, so that it is most essential to protect the ordinary dung-heap from washing by rain, and also, in the case of rich cake-fed dung, it must be got on to the land early if heavy losses of nitrogen are to be avoided. Some of the principles emerging from this work have been very successfully applied to the treatment of sewage. At present the valuable nitrogenous compounds in sewage are mostly wasted, but by passing it through a straw filter bed under certain conditions some 60 per cent. of the nitrogen is removed by the organisms decomposing the straw, which thereby becomes a good manure, and, moreover, the effluent is harmless. Further trials are in progress with the object of making farmyard manure on a large scale without animals.

At Aberystwyth plant-breeding methods are being applied to grasses and clovers, while at Cambridge the scientific breeding of farm crops has given most valuable results; wheats have been produced which add 10 per cent. to the yield of the farm, while some of them combine the strength of the Canadian with the cropping power of the English varieties.

In connection with animal nutrition the Cambridge station is trying to obtain growth-curves showing the relation between the food consumed, the live and dead weight, and the useful meat, fat, and offal for each stage of the animal's development, while the station at Aberdeen is paying particular attention to the importance of vitamins in the nutrition of farm animals.

At Long Ashton and East Malling researches are being made in fruit growing and preserving, so that some quick method of storing fruit for future use may be available whenever a glut occurs in the market. Research on plant disease is being conducted more with the object of producing immune varieties than of finding curative methods. That this is the right line to take is shown by the fact that whereas all attempts to free a soil from wart-disease infection have been unsuccessful, there are certain immune potatoes which will grow without blemish in the most heavily infected soils.

The lecturer remarked that although our organisation for agricultural research is young, and we cannot compare with America or with Germany before the war, either in the number of workers engaged or in expenditure, yet "it is not too much to claim that the majority of really fruitful ideas and conceptions that have recently been current in agricultural science have sprung from English laboratories."

Meteorology of the Philippines.[1]

THIS work is rightly claimed in the preface by the director of the Philippine census to be of "great practical value." Observations from sixty official stations and fifty-three voluntary stations have been dealt with, and the maps and plates aid much in the simplification of the large amount of data contributed to the world's meteorology. The elements dealt with are temperatures, rainfall, humidity, cloudiness, wind direction and force, and typhoons.

Temperature is treated, as to both exposure and method of obtaining averages, in a manner quite comparable with the most approved European system. The mean annual temperature for the whole archipelago obtained from stations near the sea level is 26·9° C. (80·4° F.). The seven warmest months are April to October, and the five coldest November to March. May is the warmest, and January the coldest. Tables are given showing in great detail the mean, extreme, and range of temperature at all stations.

Rainfall distribution throughout the year forms the most interesting feature of the weather of the Philippines. The exposure to the prevailing winds occasions great differences in the amount of rain, in spite of the relatively small extent of the archipelago. The winter rains come direct from the Pacific and cause large falls over the eastern part of the archipelago; these are called the north-east monsoon rains. The summer and autumn rains are due chiefly to the influence of typhoons; these rains are most abundant in Luzon and the Visayas. The thunderstorm rains which occur in spring are of little importance compared with the other rains.

The annual means of seventy stations give 2366·1 mm. (93·18 in.) as the annual average rainfall for the Philippines. The annual averages at the several stations range from 4597·6 mm. (181·05 in.) to 989·8 mm. (38·98 in.). The greatest fall is at Baguio, due to its elevation and the local topographical features; the least at Zamboanga. The annual extremes are very divergent. The heaviest annual fall at Baguio is 9038·3 mm. (355·91 in.) in 1911.

A feature of some interest is the summary of the weather of official holidays in Manila for the sixteen years. This is a step in advance of European official discussions. C. H.

[1] "The Climate and Weather of the Philippines, 1903 to 1918." By the Rev. José Coronas, S.J., Chief of the Meteorological Division, Philippine Weather Bureau. Pp. 195+29 plates and 3 illustrated maps.

University and Educational Intelligence.

LEEDS.—The James Edmondson Ackroyd memorial fellowship has been awarded to Mr. F. W. Dry, who will undertake a research on the comparative anatomy, histology, and pigmentation of mammalian hair as a basis for breeding and other experiments. The value of the fellowship is 300*l.* per annum, renewable for a period of three years.

MANCHESTER.—Mr. J. M. Nuttall, senior lecturer in physics, has been appointed assistant director of the physical laboratories, and Mr. D. C. Henry lecturer in chemistry.

Mr. A. J. Hailwood has been awarded the Moseley memorial prize in physics.

THE Berlin correspondent of the *Times* announces that Prof. Walter Nernst has been elected Rector of the Berlin University.

DR. LIVINGSTON FARRAND has accepted election to the presidency of Cornell University in succession to Dr. J. G. Schurman, recently appointed American Minister to China. After graduating at Princeton in 1888 and at the Columbia College of Physicians and Surgeons in 1891, Dr. Farrand spent two years in study at Cambridge and Berlin. From 1893 to 1914 he was connected with Columbia University, first as instructor in psychology and later as professor of anthropology. He was president of Colorado University from 1914 until after the armistice, when he joined the American Red Cross. In 1917 and 1918 he directed the anti-tuberculosis work of the International Health Board in France. Dr. Farrand was at one time editor of the American *Journal of Public Health*, and has contributed largely to psychological and anthropological publications. In 1904 he published a study of the Indian population and physical geography of North America entitled "Basis of American History."

THE Roll of War Service of the University of London Officers Training Corps has been published by the Military Education Committee of the University. The first section, devoted to the roll of the fallen, contains the names and other particulars of 665 officers who were members or former members of the contingent. Section ii. records 1726 honours and distinctions awarded to 1068 officers. The roll of war service forming the third section gives particulars of 4276 officers and former officers and cadets of the contingent who served as officers in the war. The appendices contain statistical and historical information. Of the 4218 former cadets who served as officers during the war 1579 were first enrolled in the contingent before the war, the remainder (2639) during the war, but only 202 obtained their commissions before the war. The colleges of the University contributing the largest number of cadets are University College, 558; King's College, 484; Imperial College, 471; Guy's Hospital, 235; and St. Bartholomew's Hospital, 230. The illustrations include portraits of the late Lt.-Col. A. G. E. Egerton, Coldstream Guards, first Adjutant 1909–13, and the five former cadets who were awarded the V.C. The volume is published by the Military Education Committee of the University of London at 46 Russell Square, London, W.C.1, at 1 guinea, packing and postage 1s. extra; half leather binding $1\frac{1}{2}$ guineas, postage extra; and full leather binding 2 guineas, postage extra.

PROF. EINSTEIN'S main object in recently visiting America was to meet the Jewish community of the United States in order to enlist its support for the proposed University of Jerusalem. The foundation-stones of this University were laid in 1918, and preparations are being made to erect an institution worthy of the noblest ideals of modern knowledge. It is proposed to commence with physical and chemical departments, a medical faculty, an arts faculty, departments of law and commerce, and a Jewish faculty. The object of the promoters is to make the institution serve the interests of the Palestinian population as well as those of general culture. The University will be up to date in equipment and representative of the highest scholarship in each department: the association with the institution of men like Einstein, Wassermann, Bergson, Alexander, Lord Rothschild, etc., makes this perfectly clear. The University will be in no sense exclusive. So far as possible, Hebrew will be the medium of instruction, this being the language spoken by the Jews of Palestine, but it need scarcely be said that religious and racial tests will be unknown. Mr. C. Crossland, Director of the Fishery Service, Sudan Government, writes to us to express the fear that the University will be Jewish in a clerical sense, but we believe this need not be entertained for a moment, because Jews all over the world, and especially in Palestine, are absolutely opposed to any form of clericalism in social, political, or cultural life. The University of Jerusalem will be the only real university for a considerable section of the Orient, and it is to be hoped that it will become a great centre of culture for the Near East, acting as a link between the East and West, and thus helping to encourage feelings of friendship and co-operation between the representatives of the great civilisations of the past and of the modern world. Of course, as regards methods of teaching and research the University will be modelled entirely on European and American standards. The outcome of Prof. Einstein's visit is that the medical faculty of the University is now assured, and we can expect in the near future to have this faculty established in a country where the combating of disease is of particular importance. Other faculties and departments will follow as the means are obtained for them.

THE RIGHT HON. VISCOUNT HALDANE delivered an address on November 9 last before the Old Students' Association of the Royal College of Science, South Kensington, dealing with the subject of the nationalisation of the universities. The address has recently been issued in pamphlet form by H.M. Stationery Office. The title, as Lord Haldane observes, "is somewhat of a paradox, so far as I am concerned," since he proceeds to declare his unrelenting opposition to any suggestion that the universities of the United Kingdom should come under the control of any State Department. He submits that the most vital element in a university is that of an atmosphere "which in itself is the most excellent of things, and would be as difficult as it is rare were it not for that divine spark in the human soul which means that those who are gifted need but little to bring them to devote their whole energies to concentration on the highest ideas." That atmosphere no State Department can produce. Nevertheless, the State as representing the nation must have a care for the abiding well-being of the people. The highest education, that offered by the universities, touches, after all, but a fraction of the people. Not one in ten of the population get any education at all after they leave school at the age of fourteen, and not one in a thousand get the advantage of the higher education of the universities. The problem is how to bring higher education to bear upon the democracy. One crucial difficulty is the cost, only a fraction of which, about 28 per cent., is met by the fees which well-to-do parents vainly imagine represent the real cost of the education which their sons and daughters receive. Apart from the endowments of past benefactors, the balance must be found by the gifts of the benevolent, which represents in the United Kingdom less than half a million sterling annually against the five millions contributed in the United States. The rest of the expenditure must be met from public sources, either from the rates or from the Exchequer, but the universities must be left free as to the means and methods which they employ in order to realise their obligations to the community, which are not only to train duly prepared students for their various faculties, humanistic and scientific, but also to undertake extra-mural work such as the Workers' Educational Association demands.

THE University of Bristol has issued a striking and beautifully illustrated appeal with the view of raising, under the novel form of "a group scheme," a five-year million fund, the participants in which may spread their contributions over a period of five years. The appeal is headed "The First Line of National Defence," as, indeed, rightly considered, a university significantly is. Already more than one million pounds sterling has been contributed in money, land, and buildings, chiefly by the inhabitants of Bristol, and notably by the Wills family, and now the University owns 19 acres of land within the city area, upon which its various fine buildings have been erected or are in course of erection. The University obtained its charter in 1909, and its course of instruction for degrees includes the customary faculties of arts, science, medicine, and engineering, inclusive also of agriculture and theology, together with many forms of extra-mural activities dealing with adult education. It is specially devoted to research in the various faculties. More endowed chairs and an increased staff of lecturers are needed, together with money for the establishment of fellowships, for departmental libraries, for equipment, and for research. One thousand two hundred full-time students and more than 1000 part-time students are in attendance, and the demand will grow as facilities for secondary education are increased and developed. The area embraced within the operations of this "University of the West" extends from the Cotswolds throughout the four south-western counties to Land's End. It is confidently to be hoped that within this area there may be found, not only on the part of private benefactors, but also on that of the local authorities, an eager willingness to support the efforts which the Council of the University is making to bring within the reach of the inhabitants of the four counties the highest possible facilities of learning and research in all departments of knowledge. The Treasury grant is to be raised in 1922 from one million to a million and a half sterling, and the University of Bristol can participate in it in proportion to the amount publicly subscribed. All the universities of the kingdom are in like straits for means of development, and it is worth while in this connection to direct attention to the munificence displayed in the United States by private persons, who gave in one year, 1917–18, in support of the universities and colleges of that country, nearly 5,500,000*l.*, whilst benefactions to such institutions in the United Kingdom amounted in the three years, 1916–19, to only 1,192,000*l.*

Calendar of Scientific Pioneers.

August 5, 1872. Charles Eugène Delaunay died.—Known principally for his work on the theory of the moon, Delaunay in 1867 succeeded Poncelet in the chair of experimental physics in the Sorbonne, and in 1870 was made director of the Paris Observatory. He met his death by drowning off Cherbourg.

August 6, 1879. Johann von Lamont died.—Though a native of Scotland, Lamont spent his life in Germany. Like Gauss, Hansteen, and Sabine, he was a pioneer worker in terrestrial magnetism, and in 1851 discovered a decennial period in the daily range of magnetical declination and earth currents. He directed the Bogenhausen Observatory, near Munich, and catalogued 34,674 stars.

August 7, 1848. Jöns Jakob Berzelius died.—The contemporary of Dalton Davy, and Gay-Lussac, Berzelius occupied a pre-eminent position among chemists. He discovered cerium, selenium, and thorium, isolated silicon, zirconium, and tantalum, was a founder of electro-chemistry, and by his work on atomic weights furnished chemists with a set of exact constants of great importance. He was secretary and president of the Swedish Academy of Sciences.

August 7, 1898. James Hall died.—One of the most distinguished of American geologists, Hall for sixty-two years was connected with the Geological Survey of New York, and made valuable researches of the palæozoic invertebrata of that State.

August 7, 1912. François Alphonse Forel died.—Professor of anatomy and physiology at Lausanne, Forel was best known for his researches in limnology, and especially for his study of the seiches of Lake Geneva.

August 8, 1897. Victor Meyer died.—From Göttingen Meyer in 1889 went to Heidelberg as successor to Bunsen. He discovered thiophen, introduced a new method of determining vapour densities at high temperatures, and made investigations in stereochemistry.

August 8, 1919. Ernst Heinrich Haeckel died.—Professor of zoology at Jena for more than forty years, Haeckel was the first German biologist to make evolution the leading conception of biology. A prolific writer, his "Natural History of Creation" appeared in 1868, and his "Riddle of the Universe," containing his well-known monistic views, in 1899.

August 9, 1899. Sir Edward Frankland died.—The first professor of chemistry in Owens College, Manchester, Frankland afterwards succeeded Hofmann at the Royal School of Mines. His investigation of the laws of the formation of chemical compounds led to the theory of valency, and in applied chemistry he did very important work in connection with water-supply and the pollution of rivers. He received the Copley medal in 1894, and in 1897 was knighted.

August 10, 1802. Franz Maria Ulric Theodore Aepinus died.—Aepinus was born in 1724, and became mathematical tutor to the Russian Royal Family. Among physicists he is known as the author of "Tentamen Theoriæ Electricitatis et Magnetismi," 1759, the first systematic attempt to apply mathematics to these subjects.

August 10, 1915. Henry Gwyn Jeffreys Moseley died.—A graduate of Trinity College, Oxford, Moseley by a systematic determination of the X-ray spectra of many of the elements was led to the discovery that the properties of an element are defined by its atomic number, giving rise to "Moseley's numbers," which are recognised to be of fundamental importance. He was killed in action at Suvla, on the Gallipoli Peninsula, at the age of twenty-seven. E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, July 11.—M. Georges Lemoine in the chair.—C. **Moureu**: The second conference of the International Union of Pure and Applied Chemistry.—S. **Carrus**: Research on triply orthogonal systems.—M. **Alayrac**: The movement of a solid in a resistant medium. Some of the results in a recent communication by the author had been anticipated by M. Dulac.—MM. C. **Nordmann** and **Le Morvan**: The determination of the effective temperatures of some stars and their colour index. The value of the "colour index" of stars can be determined by the authors' method of colour photometry. This method results from two homogeneous measurements, and avoids all the causes of error and uncertainty due to the comparison of a magnitude determined separately by sight and by photography.—A. **Lafay**: The direct measurement of the mobilities of electrified particles in gases.—D. **Coster**: The fine structure of the series of X-rays.—A. **Marcelin**: The superficial extension of soluble or volatile bodies. Studies on the displacement of particles floating on water by the changes in surface tension caused by the introduction of a piece of camphor, menthol, and *iso*butylcamphol.—M. **Fric**: Contribution to the study of the stability of nitrocellulose powders. The changes in composition caused by ultra-violet light in solutions of the powders in acetone were followed by the resulting changes in the viscosity of the solutions.—P. **Lebeau** and M. **Picon**: The action of sodammonium on diphenylmethane, fluorene, and indene. Dimethylfluorene. Sodammonium reacts with indene and fluorene, giving substituted sodium derivatives, and at the same time hydrogen is added to a certain proportion of the hydrocarbon. Indene gave 50 per cent. of the dihydride.—MM. **Pariselle** and **Simon**: Syntheses of tertiary alcohols, starting with methylethylketone.—L. **Longchambon**: Rotatory power in crystallised media.—P. **Fallot** and H. **Termier**: The vertical extension of the marl facies containing pyritic Cephalopods in the Island of Ibiza.—J. **Mascart**: The method of working out averages in meteorology. A discussion of some of the difficulties underlying the problem of taking true meteorological averages.—P. **Schereschewsky**: The foundations of the rational classification of clouds.—J. **Politis**: The *rôle* of the chondriome in the formation of essential oils in plants.—M. **Molliard**: The function of potassium in the chemical actions and the reproductive functions of the fungi.—MM. **Cluzet** and **Bonnamour**: The electrocardiographic study of the arrest of the heart in electrocution.—H. **Marcelet**: The hydrogenation of some marine animal oils. The oils from eight species of fish were treated with hydrogen in presence of nickel carbonate as catalyst at a temperature of 250° C. The changes in the iodine figure and melting point are given in each case; all the oils lost their disagreeable smell under the treatment.—Mme. A. **Drzewina** and G. **Bohn**: The phenomena of autoprotection and autodestruction in aquatic animals.—A. **Trillat** and R. **Kaneko**: Activity of infection by the air. Studies on the infection of mice by the Danysz paratyphoid organism and by pneumococcus. Of the various methods compared, the infection by bacterial fogs proved to be the most delicate, positive results being obtained by much smaller weights of bacterial emulsion when carried by air than when introduced by subcutaneous injection, with food, etc.—H. **Frossard**: The action of the orbiculo-costo-diaphragmatic reflex on the sympathetic and parasympathetic systems.

July 18.—M. Georges Lemoine in the chair.—The president announced the death of M. Gabriel Lippmann.—A. **Haller** and Mme. **Ramart-Lucas**: The two dextrorotatory methylallylcamphocarbonates, the three propanol-2-camphocarbonolides, and the 2-camphopropanol derived from them.—P. A. **Dangeard**: The structure of the plant-cell in its relations with the theory of the chondriome. A summary of the author's work on this subject since 1918, and an account of his system of nomenclature.—M. **Janet**: The characteristics of certain partial differential systems comprising as many equations as unknown functions.—A. **Denjoy**: A mode of progressive integration and the corresponding characters of integrability.—J. **Andrade**: Possibilities of new types of chronometer.—L. **de Karasinski**: The resistance of materials.—E. **Rengade** and E. **Desvignes**: An arrangement for testing the hardness of refractory materials at a high temperature. The method employed is a modification of the Brinell test, in which the ball is replaced by a cone of Acheson graphite. The specimens were heated in an electric furnace and the temperature was determined by an optical pyrometer. The results of numerous observations carried out on clay and bauxite bricks at temperatures between 1150° C. and 1470° C. are given in a diagram. The bricks show a gradual softening, as has been already mentioned by MM. Le Chatelier and Bogitch. Silica bricks behave differently; up to about 1600° C. they give no imprint, then the brick breaks up suddenly.—A. **Dauvillier** and L. **de Broglie**: The distribution of the electrons in the heavy atoms.—A. **Debierne**: The diffraction of the X-rays by liquids.—H. **Pélabon**: The resistance of thallium sulphide and selenide. The resistance of the compounds Tl_2Se and Tl_2S in the solid state varies with their previous thermal treatment. The specific resistance varies with the temperature according to a law which remains the same, but the resistance is not determined when the temperature is known. In both cases there is an abrupt change in the resistance on melting.—P. **Pascal**: The magnetic properties of the alkaline earth metals in combination.—H. **Weiss** and P. **Lafitte**: The interpenetration of solids. An extension of experiments already described with zinc and copper to other pairs of metals.—E. **Decarrière**: The *rôle* of the gaseous impurities in the catalytic oxidation of ammonia gas. The results with traces of sulphuretted hydrogen have been given in a previous communication. Figures for acetylene are now given, and it is shown that the effect of this gas as impurity is more serious than that of sulphuretted hydrogen, since the lowering of the yield increases with the total amount of acetylene which has passed the catalyst, and is not simply dependent on the proportion actually present at any given time. If both sulphuretted hydrogen and acetylene are present as impurities in the ammonia, as is the case with ammonia prepared from commercial cyanamide, the former has a protective action and the injurious effect of the acetylene is in great part neutralised.—L. **Hackspill** and E. **Botolfsen**: The preparation of calcium carbide by calcium ammonium and acetylene. Pure calcium carbide is not obtained by Moissan's method, the decomposition at 150° C. of the compound $C_2Ca{\cdot}C_2H_2{\cdot}4NH_3$. The calcium carbide formed is very impure, and contains cyanamide, calcium cyanide, and free carbon.—C. D. **Zenghelis**: A new reaction of ammonia. A concentrated solution of silver nitrate in formaldehyde (formol) freshly made gives a mirror of metallic silver with traces of ammonia. The reaction was obtained with 0·00034 milligram of ammonia, and ammonia has been detected in potable water in a case where no indication was given by the Nessler reagent.—M. **Picon**: A new method of preparing the sodium derivatives of the true acetylene hydrocarbons. The acetylene is treated with sodium amide in liquid ammonia; the products are pure and the yields are high.—A. and J. **Pictet**: The polymerisation of the glucosanes.—A. **Mailhe**: The nitro- and amido-derivatives of methylethylbenzene.—L. **Doncieux**: An ancient passage of the pre-Wurmian Rhone through the plateau of Clarafond, Haute-Savoie.—J. **Savornin**: Extension of the continental Aquitanian to Morocco.—H. **Ricôme**: The causes of the inverse orientation of the root and stem.—M. **St. Jonesco**: The existence of anthocyanidines in the free state in the fruits of *Ruscus aculeatus* and *Solanum dulcamara*.—P. **Benoit**: The female gonophores of *Tubularia mesembryanthemum*.—P. **Wintrebert**: The existence of a transitory nervous dualism at the commencement of the neuro-muscular connection in Selacians.—G. **Bertrand** and R. **Vladesco**: The probable intervention of zinc in the phenomena of fertilisation in the animal vertebrates. In man the prostate gland is richer in zinc than the testicles, and its proportion of zinc exceeds that found in any of the other organs of the body. Similar ratios were found for the ox, but in the pig the seminal vesicles possess the maximum zinc content. It would appear that zinc plays an important part in the phenomena of reproduction in vertebrates.—E. **Aubel**: The action of the pyocyanic bacillus on asparagin. Among the reaction products malic, formic, fumaric, and propionic acids were identified.—P. **Courmont**, A. **Rochain**, and F. **Laupin**: The disappearance of pathogenic germs in the course of the purification of sewage by activated sludge. After six hours' treatment pathogenic organisms of the typhoid-paratyphoid group are nearly always present in the effluent; the cholera vibrion disappears.—F. **Diénert**: Concerning activated sludge. A study of the influence exercised by carbolic acid on the fermentations caused by activated sludge.—MM. **Desgrez**, **Guillemard**, and **Hemmerdinger**: The fixation of carbon monoxide diluted and carried by an air-current. An attempt to find a reagent suitable for the absorption of small proportions of carbon monoxide in a gas-mask. The best results were obtained by using pumice (27) saturated with a mixture of iodic anhydride (9) and sulphuric acid (2·5).

OTTAWA.

Royal Society of Canada, May 18–20.—Presidential address, Prof. J. C. **Fields**: Division in relation to the algebraic numbers.—Prof. A. S. **Eve**: Ionisation potential and the size of the atom.—Prof. A. S. **Eve** and E. S. **Biehler**: Detection of variation in electric earth-currents by coil and galvanometer.—Miss V. **Douglas** and Dr. J. A. **Gray**: The effective range of β-rays.—Dr. J. A. **Gray**: The velocity of sound in air and soil. Properties of X-rays excited by β-rays. The absorption of γ-rays. A note on the examination of materials by X-rays.—Dr. A. N. **Shaw** and L. S. **Smith**: The transmission of heat through the thin boundary films of air or of water at the surface of glass.—Dr. E. H. **Archibald**, C. E. **Stone**, and E. M. **White**: The viscosity of ether at low temperatures, and solution of acetic acid in liquid hydrogen bromide.—Dr. W. F. **Seyer**: Preliminary report on the lubricating properties of the different series of hydrocarbons.—Dr. D. F. **Steadman**: An automatic mercury pump.—W. A. **Hardy**: Some results of the destructive distillation of British Columbia alder and Douglas fir.—Dr. J. H. L. **Johnstone**: The variation of the "emanating power" of certain uranium minerals with temperature, and a new secondary radium emanation standard.—C. A. **Mackay**: The effect of thermo-luminescence on electrical conductivity.—J. **Patterson**: The anemometer factor. Pilot-balloon methods in

Canada.—Dr. L. V. **King**: Some new formulæ for the direct numerical calculation of the coefficient of mutual induction of coaxial circles. A new high-frequency vibration galvanometer. The photographic recording and measurement of radio-telegraph signals. A new lecture-room illustration of atomic models.—Prof. J. C. **McLennan**: The refractive indices of metallic vapours.—W. W. **Shaver**: The absorption spectra of liquid and gaseous oxygen.—Prof. J. C. **McLennan** and P. **Lowe**: The structure of the Balmer series lines of hydrogen.—Prof. J. C. **McLennan** and P. A. **Petrie**: The spectra of helium, hydrogen, and carbon in the extreme ultra-violet.—Prof. J. C. **McLennan**: The liquefaction of hydrogen.—W. A. **Lawrence**: Nitrophthalic anhydrides and acetylaminophthalic anhydrides with toluene and aluminium chlorides.—H. N. **Stephens**: Bromophthalic anhydrides with benzene and aluminium chloride.—N. A. **Clark**: The effect of certain chemicals on the rate of reproduction of yeast.—Prof. J. B. **Ferguson** and G. A. **Williams**: The passage of hydrogen and of helium through silica tubes.—W. B. **Leaf**: The action of methyl-green on yeast.—K. L. **Wismer**: Pressure-volume relations of superheated liquids.—W. H. **Martin**: Scattering of light by dust-free liquids.—Prof. F. B. **Kenrick**: Note on Wolski's paper on optically empty liquids.—Prof. J. B. **Ferguson**: Re-determination of the melting point of sodium chloride.—Prof. W. L. **Miller**: Researches in physical and organic chemistry carried out in the chemical laboratory of the University of Toronto.—Dr. J. C. **Glashan**: The reduction of the circulants to polynomial form with applications to the circulants of the 7th and 11th degrees.—Prof. A. H. S. **Gillson**: The gravitation potential of an anchor ring. Some tidal problems.—Prof. E. F. **Burton** and Miss E. S. **Bishop**: Law of distribution of particles in colloidal solutions.—S. **McLean**: Production of heat during charcoal absorption.—Prof. E. F. **Burton** and E. D. **McInnes**: The relation between coagulative power of electrolytes and concentration of colloidal solutions.—Dr. J. S. **Plaskett**: The radial velocities of 570 stars. The orbit and dimensions of TV Cassiopeiæ. The temperature control of the stellar spectrograph.—W. E. **Harper**: The orbital elements of the brighter components of Boss 497. The orbits of spectroscopic components of Boss 4622.—H. H. **Plaskett**: The intensity distribution in typical stellar spectra.—Dr. S. D. **Killam**: The solution of plane triangles by nomographic charts.—Dr. C. T. **Sullivan**: Note on the geometrical equivalence of certain invariants.—Dr. W. B. **Dawson**. The interpolation of breaks in tide curves for recording gauges.—Dr. F. T. **Shutt** and Miss A. H. **Burwash**: The vertical movement of alkali under irrigation in heavy clay soils. Notes on the nature of burn-outs.—Prof. H. F. **Dawes**: Reversible pendulum.—Prof. A. L. **Hughes**: Characteristic X-rays from boron.—Prof. J. **Satterly**: A new experiment in vibration.—Prof. J. C. **McLennan**: Note on the spectrum of potassium. Note on infra-red spectroscopy.—H. J. C. **Ireton**: Selected radiation emitted by specially excited mercury atoms.

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