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Symbolic Language of Science.

WE have received from Prof. McAdie, of Blue Hill Observatory, an off-print of a note on the subject of uniformity in aerographic notation, which occupies nine pages (169-177) of the Blue Hill Meteorological Observations, forming vol. lxxxiii., part 4, of the Annals of the Harvard Observatory. It invites agreement with regard to the symbolic representation of the quantities and operations required for the discussion of problems in the dynamics and physics of the atmosphere in pursuance of a suggestion of Dr. Otto Klotz in *Science*, vol. xlvi., p. 360, 1917.

There can scarcely be any difference of opinion as to the desirability of arriving at an agreed practice in the use of symbols by different workers in the same subject. So far as the atmosphere is concerned, Prof. Bigelow held a very comprehensive review of the rank and file of the analysis of atmospheric operations in his discussion of cloud observations which forms the second volume of the Report of the Chief of the Weather Bureau for 1898–99; the first volume of the work on "Dynamic Meteorology and Hydrography," by V. Bjerknes and others (Carnegie Institution of Washington, 1910), sets out the representation of the physical quantities to be employed in a systematic manner, and a book by Mr. L. F. Richardson, now in the printer's hands, ranges over the same field. Ideas of uniformity are naturally developed to some extent in the various parts of the Computer's Handbook of the Meteorological Office, which endeavours to provide the worker in atmospheric dynamics and physics with the necessary material and forms for numerical computation arranged upon a systematic basis, and aspires to attach to each quantity its appropriate symbol.

But the subject bristles with difficulties of many kinds. We have available in practice, let us say, five alphabets ("lower case" roman and italic, "upper case" roman and italic, "lower case" Greek), a few letters taken from other alphabets, and a few additional symbols for units or operations. With these we have to represent the items of a considerable number of quite separate categories; for example, we want to represent: (1) defined quantities for specific units, as m for metre, g for gram; (2) quantities undefined as to unit, as ϕ for latitude and λ for longitude, which may be in radians or degrees, and u, v, w for velocity irrespective of unit; and (3) symbols of operation, as of multiplication, division, summation, and differentiation of various kinds.

In the absence of a sufficiency of letters or alphabets, we are accustomed to make out with suffixes and indices, but here we are liable to get into vexatious difficulties with the printer, and more particularly with the typist, who must be reckoned with in these days, and is apt to display a misguided ingenuity in substituting for a carefully selected symbol the nearest thing to it that can be got out of the keys; and, in any case, if the symbolism could be so arranged as to allow the print to "run on," it would be useful for both reader and publisher.

No adequate account can be given of the details of Prof. McAdie's scheme without reproducing it *in extenso*. With three alphabets and some suffixes and indices (apparently without making any use of the discrimination between roman and italic type), he represents ninety-four quantities, including such modern conceptions as electron, Planck's element of action, Taylor's eddy conductivity and viscosity, and Richardson's turbulivity. He uses them in five pages of fundamental relations. But the allocation is not altogether successful; the letters are all gone, and some very ordinary quantities, such as area and vapour-pressure, have no symbol. N means Avogadro's constant, S entropy, E energy, and W external work; but somehow or other, definition or no definition, N—S and W—E are written down as representing wind components. If it be agreed that kb means kilobar and s means space, there is a certain depravity in using kbs, as Prof. McAdie does, to mean simply a plural of kb.

Furthermore, it is not really possible with our limited number of letters to allocate so many of them for purely arithmetical purposes. Very many of them are wanted for algebra; in fact, many more than are actually available before any allocation takes place. Prof. McAdie allows only x, y, z, and t for co-ordinates, but we must be permitted to change our co-ordinates. In the past, polar co-ordinates, co-ordinates referred to moving axes, and direction cosines have claimed letters which Prof. McAdie proposes to hand over for fixation.

The fact is that the allocation of a letter in common use to one specific and conventional meaning is a very awkward policy. It is not unfair to argue that if we want a symbol to be allocated definitely to a new quantity, and taboo for everything else, we ought to invent a new figure and get it canonised by a sufficient authority to induce printers to stock it. It sounds impracticable, but is at least worth consideration, for meteorologists have already done it in the case of symbols for atmospheric phenomena. Otherwise workers in sciences which are adjacent and not altogether independent are likely to select the same letters for different quantities, and there must be confusion. Perhaps the language of science ought to expand its notation as ordinary language has done by proceeding from single letters to syllables, and that would certainly be an easy and effective way of dealing with the question if we could do away with the convention that multiplication needs no symbol of operation, and require that every operation should be represented by a suitable sign.

Indeed, all ideas of allocating symbols for special quantities lead up to the suggestion that the study of the effectiveness of the language of science ought no longer to be left to the casual play of forces of individual workers. An Academy of Science might with advantage have a literary side, and there might even be lectures on the art of expression, symbolically or otherwise, of scientific truths, with examples, some good and some bad, taken from scientific literature. Scientific institutions tend to separate themselves from the study of the classical languages and become independent centres of learning, and as they do so they ought to make adequate provision for the study of the history and literature of science in order to make sure that the literary form of the results which the institutions will present to the world will not be entirely neglected, as apparently it is now in some contributions to science. Scientific achievement is not really complete when only the author is satisfied with the results. It might be useful to make out how much scientific literature is neglected because its form is crabbed, repulsive, or even unintelligible.

These are quite natural expansions of the idea of economising the effort of the writer and reader by an agreement as to the use of symbols. That is an obvious and essential step, but we ought first to come to an agreement upon some general principles whether, to begin with, there is, or shall be, any difference in meaning between a symbol in roman and the same letter in italic. The Computer's Handbook draws a distinction. It reserves roman for units or symbols of operation. It uses italic to indicate varying quantities, and sometimes capitals for defined quantities. Thus g is gram, but g is gravitational acceleration; θ is temperature, but T is temperature on the absolute scale. Another general question is whether operations should be consistently indicated by letters or by signs, or either mode of indication be allowed as the writer finds convenient.

The difficulty in the way of getting agreement on these questions is not so much unwillingness on the part of workers as lack of authoritative reference to recognised classics. After carrying on an elaborate series of computations with the improvised symbolism that suggests itself as one goes along, it is too laborious to go over it again to bring it into agreement with someone else's notions; and as one is naturally led on gradually in the course of a research to take in more quantities, one can scarcely begin it by selecting a system of notation. It grows of itself as the work progresses. But if the Royal Society were to alternate the list of publications as an advertisement in the lining of its Transactions with a list of recognised symbols, or if in some other way some convention were made quite easy of reference, we should have little difficulty in adhering to it.

NAPIER SHAW.

The History of a Mind.

Pasteur: The History of a Mind. By Prof. Emile Duclaux. Translated by Erwin F. Smith and Florence Hedges. Pp. xxxii + 363. (Philadelphia and London: W. B. Saunders Company, 1920.) Price 21*s.* net.

PASTEUR has been fortunate in his biographers. There is the well-known life by René Vallery-Radot, which describes for us the man himself, his noble, impulsive character, his thirst for knowledge and zeal for humanity, and gives a general account of his researches and discoveries; an essay by Sir George Newman, which appeared some twenty years ago and deserves republication, expresses in eloquent terms an appreciation of Pasteur's life-work from the English point of view; while, for the purpose of scrutiny of the details of the discoveries themselves, we possess studies by two of the master's disciples, Duclaux and Roux. The volume now under review is a translation by two American pathologists of Emile Duclaux's "Histoire d'un Esprit." In French it is the volume which every serious student of Pasteur's work has read, and it is a little surprising to find, not only that twenty-four years have apparently elapsed before the appearance of an English translation, but also that the original work appears to be almost unknown outside France, according to the senior translator.

The introduction to the book takes mainly the form of a brief memoir of the author. As Boswell derives his fame from Dr. Johnson, and Lockhart is known as the biographer of Scott, so Duclaux will live chiefly in the shadow of Pasteur and by this book. As a chemist, he was first closely associated with Pasteur in 1862 at the École Normale; separated from him for a short time on becoming professor of chemistry at Tours, he was soon transferred to Clermont-Ferrand, where a portion of his time could be given to Pasteur's work; subsequently he went to Lyons as professor of physics for five years, and in 1878 he came to Paris as professor of meteorology in the Agronomic Institute. In 1888, when the Pasteur Institute was founded, Duclaux joined the staff assembled under the command of Pasteur, numbering such illustrious names as Chamberland, Roux, Nocard, Grancher, Metchnikoff, and Yersen among his colleagues. Duclaux's function was the intelligence department, the dissemination of discoveries to the world—not the actual research work. He founded *Les Annales de l'Institut Pasteur*, and in so doing created the channel through which the wealth of the discoveries made by Pasteur and his co-workers poured to the open sea of scientific knowledge. Duclaux was an organiser. He wrote well, with all the vivacity and picturesque style of which a master of the French language is capable; there is not a dull page in his scientific treatises. He found his *métier* as an editor and an interpreter of the labours of others. An ardent toiler, who early adopted Pasteur's motto, "*il faut travailler toujours*," Duclaux himself did little original work. His books, "Ferments et Maladies" (1882) and "Le Microbe et la Maladie" (1885) were records of Pasteur's labours; he collated and co-ordinated the scattered facts on enzymes, classed them into groups according to their reactions, and proposed a scheme of terminology for them. In a word, he was one of the earliest administrators in science. On the death of Pasteur, in 1895, he succeeded him as director of the Institute, and died himself in 1904.

In the book before us, Duclaux traces in detail the steps by which Pasteur was led to make his famous discoveries. "*Que peut bien être l'histoire d'un esprit?*" is the first sentence of the original work, and then the author proceeds to show how, in the hands of Duclaux, the task is possible. Guided by him, we follow Pasteur through the thicket of truth and error. We observe how, amid the storm of criticism and controversy, Pasteur advanced unshaken, and if ever he missed his way for a moment, as in the earlier days of the conflict on spontaneous generation, how speedily and surely he retraced his steps. Duclaux tells us the fascinating story of the first work on crystallography, when the foundations of stereochemistry were well and truly laid. As a chemist, Duclaux lingers over this early work; we can readily understand how great a pure chemist was lost in Pasteur when he chose to become the first bacteriologist. Yet, as Duclaux reveals to us, all Pasteur's life-work pursued an orderly sequence: the study of crystals led to the researches on ferments. "If one of the salts of racemic acid, paratartrate or acetate of ammonia, for instance, is placed in the ordinary conditions of fermentation, the dextro-tartaric acid remains in the liquor, the reason being that the ferment of that fermentation feeds more easily on the right than on the left molecules." Pasteur found then that molecular dissymmetry appeared as a modifying agent on chemical affinities in a physiological phenomenon, and it was a mere step for his mighty intellect to proceed to solve the problems of lactic and alcoholic fermentations, of spontaneous generations, and of the diseases of wines and silkworms. Short, too, was the step again for Pasteur from these studies towards the etiology of microbial diseases, the wonderful work on anthrax and on chicken cholera, the problems of immunity, virulence, and attenuation, and the crowning work on rabies.

All this we read with the avidity of a child for a twice-told tale, and the pen of Duclaux transports us back to the days when these discoveries were revolutionising the realms of medicine and surgery. Sir Rickman Godlee's "Life of Lord Lister" has reminded us afresh of the influence that Pasteur exercised on that great surgeon's work, a debt which Lister acknowledged from the inception of his own researches. Duclaux deals more briefly with the later discoveries of Pasteur, possibly because his own studies had lain more in the direction of the researches on crystallography and fermentations; this, however, is no blemish upon the book, which must always remain a classic in the history of science.

The translation has been faithfully done; at times too faithfully. Thus, on p. 7, "The general law, just now stated, that a science progresses above all by changing its point of view, explains the aid which it always derives from kindred sciences," is too literal a rendering of "La loi générale énoncée tout à l'heure, qu'une science progresse surtout en changeant ses points de vue, explique le secours qu'elle tire toujours des emprunts faits aux sciences ses voisines."

The book is well printed, and illustrated by several portraits of Pasteur at different ages and by two portraits of Duclaux. A good index has been prepared by the translators, who are also responsible for an innovation in a scientific work in respect of a "Who's Who" of persons mentioned in the book. Lister's knighthood is given, but not his peerage.

Duclaux's work thus presented should find new readers both in Great Britain and America.

A. S. M.

Applied Plant Ecology.

Plant Indicators: The Relation of Plant Communities to Process and Practice. By Frederic E. Clements. (Publication No. 290.) Pp. xvi+388+92 plates. (Washington: The Carnegie Institution of Washington, 1920.) Price 7 dollars.

DR. CLEMENTS'S enthusiastic and prolific researches in pure ecology are well known to botanists. In his latest publication he endeavours to apply his principles and methods to the practical problems of agriculture, stock-raising, and forestry, with special reference to the Western United States. According to his view, every plant is an indicator of "conditions, processes, or uses," because it is the product of the conditions under which it grows. The individual, the species, or the community may serve as an indicator, and the choice of the unit to be employed in a given case will depend partly upon the practical end in view, and partly upon the ecological data available. To give a concrete instance: the *species Mertensia sibirica* indicates the *condition* "deep shade" in the montane forest of Colorado. In using plant-communities as indicators Dr. Clements relies mainly upon the dominant species, so that in practice there appears to be no sharp distinction between specific and community indicators. His general classification of types of grazing-land, however, is based upon plant-communities, inasmuch as a uniform community of grass, weed, or browse is held to indicate suitability for cattle, sheep, or goats respectively, while a prairie or a grass-scrub mictium [*i.e.* a mixed community containing dominants both from grass- and from scrub-associations] [1] or savannah denotes the advisability of mixed grazing by two or three kinds of animals. As an example of "individual" indicator-criteria, it is stated that ten "water-ecads" [*i.e.* habitat-forms corresponding to ten different degrees of water-supply] of *Ranunculus sceleratus* have been produced experimentally; plate 11 further shows photographs of [natural] shade, alpine, and "normal" ecads of *Campanula rotundifolia, Gentiana amarella,* and *Androsace septentrionalis.*

The nature of plant-indicators, briefly explained above, forms the principal topic of the first section (chaps. i.–iii.), which also deals with the determination and application of indicators, and includes a short historical *résumé* of the indicator concept. Chap. iv. gives a summary review of the climax [*i.e.* climatic] formations of western North America, and, judged by the account of Chapparal-formations—which the reviewer is best able to appreciate from personal knowledge of analogous Mediterranean formations—is adequate on the descriptive side; some useful information regarding rainfall and other environmental factors is included, and the dominant species are recorded for each formation. Altogether this chapter, already outlined in a former paper [F. E. Clements, "Plant Succession," Carnegie Institution, No. 242, 1916], is a very useful addition to the literature of plant geography.

The most interesting portion of the book is the last—roughly one-third of the whole—in which Dr. Clements discusses in detail the practical employment of indicators in the interests of farmers, stock-raisers, and foresters. A striking feature

[1] Words in square brackets are the reviewer's.

of the agricultural section (chap. v.) is the proposal to base the legal classification of land upon indicator communities. The bearing of the study of climatic cycles on agricultural practice is dealt with in the light of facts already for the most part summarised in "Plant Succession." The large amount of space devoted to grazing-indicators (chap. vi., 66 pages) is accounted for partly by the very full discussion of over-grazing, in the detection of which condition indicator-species appear to be specially helpful, and partly by a digression on the general principles of range [ranch] improvement. As regards the forestry section (chap. vii.), the very scant attention paid to afforestation is disappointing to the European reader, though comprehensible in view of the relatively large area of natural forest growth still preserved intact in North America.

In order properly to appreciate Dr. Clements's arguments, it is above all necessary to understand his point of view, which is that of a thorough-going adaptationist who regards every feature in the behaviour or structure of an organism as a response to environment. His utmost concession to the influence of heredity is the admission that "structure also possesses a well-known inertia, as the result of which it may register the impact of factors but partially or slightly." Probably few biologists will be satisfied with so meagre an allowance for the factor of inherited constitution. Further, for Dr. Clements, "ecology is the central and vital part of botany," and other lines of botanical research are, or ought to be, subordinated thereto. One need not, therefore, be surprised to meet with sweeping proposals for the radical reform of taxonomy, involving the institution of a trinomial nomenclature [!] and the virtual abolition of the use of herbarium type-specimens. Unless we are prepared to jettison the taxonomic work of the past centuries in its entirety, it is to be feared that a hasty acceptance of such revolutionary suggestions would increase rather than diminish the difficulties that already beset the taxonomist and all who depend upon him. Doubtless "the practical man is [or would like to be] concerned primarily with real species rather than with the many varieties and forms into which some of them fall"; but the problem of what are "real species" remains to be solved, and surely this desirable end is more likely to be attained through a healthy co-operation among workers in the various branches of biology than by a *tour de force* in any one of them.

Apart from such debatable matter, "Plant Indicators" is a record of a large quantity of solid observation and experiment, and a stimulating book with a wider appeal than that of the average ecological memoir. Judgment as to the practical value of the indicator method must be suspended until it has undergone the test of extensive application under varied conditions and on an economic footing.

Dr. Clements properly lays stress on the special value of ecological research in new or partly settled regions. Oddly enough, no mention is made of those tropical countries which in every respect offer the most promising field to the ecologist, and to which American botanists have unrivalled facility of access. M. D.

The Food Problem of the United States.

The Nation's Food: A Statistical Study of a Physiological and Social Problem. By Prof. Raymond Pearl. Pp. 274. (Philadelphia and London: W. B. Saunders Co., 1920.) Price 16*s*. net.

ONE result of the Great War has been to bring into unusual prominence the problem of the world's food supply. Each civilised nation contains two great divisions, which in many ways are somewhat antagonistic, dependent respectively on food production and on industrial work. The problem differs in urgency for the two groups: for the food producer, living in the country, it is one of greater or smaller profits, but not of daily bread, of which he is certain; for the industrial town-dweller the problem is more serious, because the intricate social machine is easily thrown out of gear by a few disaffected spirits, and food is forthcoming only so long as the machine turns out sufficient goods to induce the production of more food than the countryman needs for his own consumption.

Prof. Raymond Pearl has given in this book a statistical study of the food problem of the United States, and with his usual thoroughness and breadth of view he has included in his inquiry so many ramifications that his investigation covers Europe also. It thus possesses extraordinary interest at the present time. His tables contain a wealth of material of which only a few indications can be given here. The contribution made by the United States to the food supply of the Allies during the war was remarkable. The pre-war average export of wheat and flour was 122·7 million bushels, of which 43·3 million went to the Western Allies; during the war, but before America's entry, it rose to 262·9 million bushels, of which 151·2 million went to the Allies; even in the first year of the war the Allies still received

114·8 million bushels. This astonishing change is a remarkable achievement for which the Allies may well be grateful and of which America may justly be proud. The total production of food naturally did not increase to the same extent. The data are:—

Total Food Production in the United States: Metric Tons, Millions.

	Total food	Protein	Fat	Carbo-hydrates	Total Calories, million millions
Average for 7 years, 1911–18	90·2	4·1	5·7	16·3	137·2
,, ,, 3 pre-war years	85·6	3·8	15·5	15·3	129·3
,, ,, war period ...	93·7	4·2	5·9	17·1	143·0

Animals contributed 58 per cent. of the total food, 50 per cent. of the protein, and 83 per cent. of the fat.

The table further shows what a vast amount of food has to be grown in order to produce a sufficiency of nutrients; only 29 per cent. of the total tonnage of human food is net nutrients; the remainder is water, ash, and inedible refuse.

Comparing the annual increases in the production of food with the growth of the population, Prof. Pearl arrives at the comforting conclusion that the food supplies of the United States are increasing more rapidly than the population, so that there is "as yet no occasion for worry along Malthusian lines in this country so far as subsistence is concerned."

Study of the details of Prof. Pearl's tables brings out a number of points of importance to administrators. The very small part played—and playable—by the so-called "home garden" movement is shown by the fact that the *total* vegetable production of farm and garden amounts to only 2 per cent. of the total Calorie production in human food, and of this 2 per cent. a large proportion is contributed by commercial concerns. Similarly, poultry contributes less than 2 per cent. of the Calories. Cows, pigs, and wheat are the great reservoirs, contributing together 62 per cent. of all the protein and carbohydrate used as human food, 69 per cent. of all the fat, and 65 per cent. of all the Calories. Obviously, if there is to be an increase in human food we must concentrate on these (and in England on the sheep as well), and not lose ourselves in less important items, although, on the other hand, we must not fail to develop even a 1 per cent. item.

The distribution of this enormous production is elaborately dealt with. The high-water mark of exports was reached in the year 1914–15; thereafter they fell, and in 1917–18 were down almost to pre-war level; but, of course, the exported food was all going to the Allies instead of being distributed over the world. The 1914–15 result is explained by supposing that all reserves were then cleared out—a process obviously possible once only. In spite of the high exports, more food remained in the United States than in the pre-war period, which may be connected with the larger and more prosperous domestic population.

Finally, a table is given showing the average daily consumption per "adult man." For convenience the British data are also given. The figures are as follows:—

	United States			United Kingdom	Physiological minimum
	Corrected for waste	Not corrected for waste		Not corrected for waste	
	Grams per day	Grams per day		Grams per day	Grams per day
Protein ...	114	120	...	113	100
Fat	127	169	...	130	100
Carbohydrate	433	541	...	571	500
Calories ...	3424	4288		4009	3400

The United Kingdom figures are taken from the Royal Society's Report (Cd. 8421), and show that we eat less than our cousins across the water, unless, indeed, we waste less.

E. J. RUSSELL.

Theory of Electric Cables.

The Theory of Electric Cables and Networks. By Dr. Alexander Russell. Second edition. Pp. x+348. (London: Constable and Co., Ltd., 1920.) Price 24*s*. net.

DR. RUSSELL'S well-known book on the theory of electric cables and networks is one which should be increasingly studied as the complex networks, which are now required in connection with large power stations, are constructed. The book is already well known to electrical engineers. It lays down those fundamental principles on which all designs of cable networks must be built up. The kilowatt capacity of central stations for generating electrical energy is now three times as large as it was when the first edition of Dr. Russell's book was published, and the importance of economical design in cables and networks is much more clearly recognised than it was twelve years ago.

The chief difference between the first edition and the second is the introduction of new chapters on alternating current theory and systems of supply, and in the inclusion of numerical examples which will make the book more useful for beginners. Some further extensions of Kelvin's law have been made, and an account is given of recent developments in cable construction. The scope of the work is so well known that it is not necessary to review it in detail. It deals with the properties of conductors and of insulating materials, methods of testing them, and the economy of the various systems of supply. It includes a number of important theorems relating to distributing networks, with the measurement of their insulation resistances and with the determination of the positions of faults.

The subject of dielectric strength is one on which Dr. Russell is a well-known authority, and the chapter on this subject is exceedingly good; it includes a number of useful tables for sparking voltages in air. There is a chapter on the grading and the heating of cables, and another on electrical safety valves, the book concluding with a chapter on lightning conductors. If the theories here given and their practical application were more clearly understood by all central station men, there would be a considerable reduction in the weight of copper which is now laid down in cable systems. It is to be hoped that an increasing amount of consideration will be given to the design of cables and distribution networks, and for this purpose the new edition of Dr. Russell's book will be of great value.

The Carbon Compounds.

A Text-book of Organic Chemistry. By E. de Barry Barnett. Pp. xii+380. (London: J. and A. Churchill, 1920.) Price 15*s.* net.

SINCE almost all lecture courses on organic chemistry follow certain main lines, it is to be expected from financial reasons that new text-books on the subject will not diverge far from the older books in their general treatment of the material. All that can be expected from the authors is the infusion of fresh interest by a variation in the scope of the books and in the handling of details. This is to be regretted; but it is apparently almost inevitable.

Within these limitations Mr. Barnett has written an excellent book. It is clearly put, very well illustrated, furnished with formulæ much superior to those usually found in text-books, and in addition possesses certain features distinguishing it from the ordinary run of its class. The most original of these is the guide to the literature of organic chemistry which terminates the introduction, and this is supplemented by references to books at the end of those chapters where further information may be required. By these means the student will gain a truer perspective of the subject, and will not be inclined to assume that his text-book has made him a past-master in the field.

If there is any fault in the book, it lies in the fact that the author appears to over-estimate the mental quickness of the ordinary student. The theoretical side of the subject is dealt with as a whole at the beginning of the volume, and it seems probable that the book would gain considerably if this part of it were extended. Also, cross-references to this section in the body of the text would improve the work.

The commercial applications of organic chemistry are emphasised more frequently than in most text-books, and enough information is given about the heterocyclic section to enable the student to appreciate its importance from the point of view of naturally occurring materials. In a new edition some description of indicators other than phenolphthalein might be given, and possibly a brief reference to the flavones and anthocyanins included in the heterocyclic section.

The book is laudably free from errors, and no misprint in it is likely to give any trouble to a careful reader. The only important slip appears to be the erroneous formula for chloropicrin given on p. 150.

As a whole the book is marked by its fresh treatment of the material, and is to be welcomed. Its main drawback lies in its price.

A. W. S.

Our Bookshelf.

Anthropology and History: Being the Twenty-second Robert Boyle Lecture, delivered before the Oxford University Junior Scientific Club on June 9, 1920. By Dr. W. McDougall. Pp. 25. (London: Humphrey Milford; Oxford University Press, 1920.) Price 2*s.* net.

THE object of this instructive lecture is to illustrate the importance of the study of anthropology as an adjunct to the study of history. Anthropology is not exclusively concerned with the measuring of skulls, or with the study of primitive man, save for the sake of cultured man. Without it, it is impossible to understand the causes of the rise and fall of nations, to forecast their future, or to guide the statesman from the experience of the past. An alien culture can rarely be imposed upon a people by external power and authority. As examples of the effect of race upon culture, the lecturer points to the disappearance of Buddhism from India and its progress in Tibet and China; the relative distribution of the Roman Catholic and Protestant forms of Christianity in Europe; and the power of expansion as illustrated by the success of Great Britain and the failure of France to create a colonial empire. These last, capacity and incapacity, were evolved in the prehistoric period, because no adequate explanation of them in the historical period can be postulated, and similar diverse qualities are assigned by the earliest historians to the ancestral stocks of both peoples.

The races capable of producing and sustaining civilisation at a high level are generally formed from the blending of several peoples of superior natural endowments, when social institutions are free from the feeling of caste. This last condition is important, because the concentration of natural endowments in a privileged order inevitably leads to atrophy and decline. Men and nations are both free to choose and pursue their course towards higher ends, and anthropology, studied as a branch of history, will suggest the means by which this progress can be attained.

The Journal of the Institute of Metals. Vol. xxiii., No. 1, 1920. Edited by G. Shaw Scott. Pp. xii+644+xxx plates. (London: The Institute of Metals, 1920.) Price 31*s*. 6*d*. net.

THE large size of this volume, as compared with that of previous issues, is an indication of the growing interest in the metallurgy of the non-ferrous metals. Sir George Goodwin's presidential address demonstrates the importance of those metals to the Navy, an importance which would in itself justify the existence of the institute. The fifth report to the Corrosion Committee carries this valuable investigation a stage further, and succeeds in throwing light on the problem of the corrosion of condenser tubes, the new facts concerning the skin on the surface of a drawn tube being of distinct value to the discussion of the possible methods of lessening corrosion. A similar subject is dealt with in a paper by Dr. Seligman and Mr. Williams on the action of hard waters on aluminium. Mr. Vivian's paper on the alloys of tin and phosphorus is an excellent piece of thermal analysis, dealing with a system of which one component is highly volatile, thus introducing great experimental difficulties. The alloys of zinc with less than 15 per cent. of aluminium and copper respectively are described in a paper from the National Physical Laboratory, and Dr. Haughton, of that laboratory, also contributes a preliminary account of the investigation of alloys by determination of the thermo-electromotive force. Some remarkable results obtained a few years ago by Mr. Alkins in the drawing of copper wire, which indicated a discontinuous change of properties at a certain stage of reduction, are now confirmed by very careful further experiments. The results contained in another paper in the same volume, on the properties of rolled copper, make it clear that rolling affects the metal much more irregularly than drawing, so that definite conclusions are not easily reached. Other subjects dealt with are the casting of brass of high tensile strength, and the production of idiomorphic crystals of copper.

C. H. D.

Dead Towns and Living Men: Being Pages from an Antiquary's Notebook. By C. L. Woolley. Pp. viii+259. (London: Oxford University Press, 1920.) Price 12*s*. 6*d*. net.

THIS is a lively account of a digger's life on ancient sites, mainly describing hobnobbing with Kurds and other amiable ruffians, or bluffing Turkish officials, revolver in hand. The methods may have been effective, but could scarcely be a settled mode of living. The first half of the title is rather neglected, as there is but little archæology, and only five views of Carchemish, which is the bait of the book. A dozen pages give a welcome account of the remains of the Hittite capital, of which as yet only a small part has been opened. The complete clearance of this capital of a scarcely known civilisation will take years to finish. When done, there are several other cities one beneath another, and the clearance of each of them will mean the removal of everything of later age. Obviously there should be a museum to hold all the Hittite sculptures, and the site bared to study the cities beneath, which descend 30 ft. below the level of four thousand years ago.

A different point of interest is the sketch of Egyptian mentality (pp. 39-44) when natives imagine that fine buildings are known, and offer to show them. This is a painfully frequent failing; here the view is taken that this is auto-suggestion really believed in, and capable of being extended to the minds of other people, who all become convinced of what does not exist. If we can take this view it will, perhaps, explain the Indian conjuring feats as being such suggestion on the minds of spectators. Can it also be the true view of the sights well known in Egypt, of men holding red-hot iron in the hands or mouth, which show no trace of blistering or burning after it? Is there a power of suggestion to compel hallucination on cool English observers? It is at least as likely as a power of resisting burns.

A Manual of Practical Anatomy: A Guide to the Dissection of the Human Body. By Prof. Thomas Walmsley. With a Preface by Prof. Thomas H. Bryce. In three parts. Part i., *The Upper and Lower Limbs.* Pp. viii+176. (London: Longmans, Green, and Co., 1920.) Price 9*s*. net.

PROF. WALMSLEY, in this manual, ranges himself with those teachers of anatomy who think that the subject should be studied almost exclusively in the dissecting-room, and that the student should be encouraged to build up his knowledge of the subject from personal observations. In his text, therefore, the author confines himself to the description of what any average student can readily discover for himself, and in his illustrations to simple line drawings such as any average student can easily reconstruct and supplement. The purely descriptive parts are also everywhere subordinate to the instructions which are given as to the manner of dissection and as to what may be observed in the actual process of dissection. The text is singularly accurate for a first edition, but certain of the diagrams are not quite so satisfactory. In Fig. 2 the cutaneous nerves of the back (cervical region) are in excess; in Fig. 4 the median part of the front of the leg is not shown supplied by cutaneous nerves; in Fig. 7 the formation of the median nerve takes place on the median side of the axillary artery; in Fig. 13 the coraco-brachialis muscle is shown on the median side of the musculo-cutaneous nerve; and in Fig. 51 the outer head of the musculus accessorius is omitted. These matters can be readily amended in any further edition, and scarcely detract from the value of the book, which in its length and simplicity is a not inadequate *riposte* to the larger and more elaborate manuals.

W. W.

Splendours of the Sky. By Isabel Martin Lewis. Pp. vii+343. (London: John Murray, 1920.) Price 8*s.* net.

THIS book can be warmly recommended to readers who desire to obtain a popular non-technical summary of the advances made in physical astronomy in the present century. The author's position as a computer for the American Nautical Almanac ensures an accurate knowledge of geometrical astronomy and of problems relating to distances and motions; and she writes in an enthusiastic tone that evinces a deep admiration for the "splendours of the sky."

The planets are reviewed in order. In discussing the vexed question of the rotation of Venus the author's judgment leans to the twenty-four-hour value, which implies a physical condition not unlike that on the earth. Prof. W. H. Pickering's explanation of the Martian canals as being due to the deposition of moisture by storms following fairly definite tracks is favoured as the most plausible one, but Lowell's irrigation theory is also described.

The remarkable solar work accomplished at Mount Wilson comes next, including the study of the sun's magnetic field, vortices round sunspots, and the recently named "hydrogen bombs." There is also mention of Einstein's prediction of the gravitational deflection of light, and the preparations made to test it at the eclipse of 1919. But the book went to press before the results were available.

The chapters on the stars include such recent work as Dr. Shapley's determination of the distances of clusters. It is necessary to criticise the suggestion on p. 247 that the M and N types are alternative routes to extinction. The galactic concentration of the N stars is proof of great distance and high luminosity; they are therefore giants, not dwarfs. A protest must be made against the use of the words "billion," "trillion," etc., in the American sense in a work published in London. An international agreement on the meaning of these terms would be welcome.

A. C. D. CROMMELIN.

Peetikay: An Essay towards the Abolition of Spelling: Being a Sequel to "Some Questions of Phonetic Theory," part i., 1916. By Dr. Wilfrid Perrett. Pp. 96. (Cambridge: W. Heffer and Sons, Ltd., 1920.) Price 6*s.* net.

IT is refreshing to find nowadays a scholarly essay written in a style so attractive as to engage the interest of even a casual reader. Dr. Perrett, in his quest for a land free from the horrors of orthography, is a hearty knight, who will merrily break a lance, if not a crown, with any pedant who comes along. He will have none of your "reformed" spelling, which is but one more shuffle of the historic pack of twenty-six letters among some forty sounds. He does not want to reform spelling indifferently well, so he creates a new alphabet, which is called "Peetikay," a word composed of his three first consonants and three first vowels. The basis of his vowel notation is the pitch of the whispered vowel, and he evolves a system of characters which are "real," giving at once some indication of both vowel quality and vowel length. His classification of consonant sounds starts from the voiceless mutes "p, t, k," being arranged finally in order of their place of formation. Particularly interesting, and frequently provocative of discussion, are his remarks upon the English sounds "h" and "r."

By means of his new notation Dr. Perrett aims at a just correspondence between signs visible and signs audible, so that English writing shall be English language in counterfeit. It is a book full of learning, well seasoned with humour, and brimming over with originality; it is a powerful blow at those who bleat about "vulgarity, degeneracy, and corruption of English," and an earnest appeal for "less professorism, and a little more shrewd insight and informed, constructive teaching."

A. LL. J.

A History of English Philosophy. By Prof. W. R. Sorley. Pp. xvi+380. (Cambridge: At the University Press, 1920.) Price 20*s.* net.

IN this very useful and handy volume we are given, in chronological order, a short record and brief epitome of the men of British birth who have a claim to be remembered on account of their philosophical writings. It begins with the medieval scholastics who wrote in Latin, and whose British birth is merely of biographical interest, and it ends with writers several of whom are still living, and among whom the author of this book is himself entitled to take rank. The attempt, however, to present this succession of British-born philosophers as a history of, or as material for a history of, English philosophy is not, and in the nature of the case cannot be, a success. In the history of philosophy English philosophy has denoted two distinct movements at definite periods. In the eighteenth century it denoted, throughout the intellectual world, the system of Newton and the principle of Locke. At the end of the nineteenth century English philosophy meant the evolution theory of Charles Darwin and the method of Herbert Spencer. In this book Newton and Darwin are mentioned as having given a direction to philosophy, but they are given no place among the philosophers. On the other hand, William Gilbert (quite rightly) is included, but this makes the omission of the two former only the more remarkable.

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.]*

Light Produced by Rubbing Quartz Pebbles Together.

I HOPE that the letter from Lieut.-Comdr. Damant in NATURE of October 21 may induce some chemist to endeavour to ascertain the cause of the peculiar "empyreumatic" odour which accompanies the flashes of light produced by rubbing two quartz pebbles one against the other. My attention was first directed to the fact that the flashing could be obtained, as well when the pebbles are rubbed together submerged in a basin of water as in air, by the Rev. Reginald Gatty.

I have ascertained that careful chemical cleaning of the surface of the pebbles does not prevent the production of the peculiar smell—which might have been due to a deposit of organic matter from the sea—on pebbles picked up on the seashore. I also have ascertained that bits of quartz from inland quarries give out the peculiar smell when they are rubbed together so as to produce flashes of light, and the same smell accompanies the light production when large crystals of rock-crystal are used. Further, I found that the light flashes can be produced when the quartz or crystal is submerged in alcohol. Probably other liquids would not arrest it. Consequently it should be possible to obtain the volatile odoriferous matter in solution when produced and to subject it to chemical examination. It would not be difficult to devise a little mechanism for producing flashes of light by grinding two quartzite pebbles together beneath a small quantity of liquid for some minutes, or even hours, and so to obtain in the liquid such emanations from the triturated quartz as are soluble in suitable liquid reagents. (See pp. 60–61 of my "Diversions of a Naturalist," Methuen, 1915.) E. RAY LANKESTER.

October 31.

Chemical Warfare, the Universities, and Scientific Workers.

I HAVE just received an invitation from the War Office "to become an associate member of the Committee now being constituted as part of the new peace organisation for chemical warfare research and experiment." The invitation was accompanied by what is stated to be the present list of associate members, containing more than sixty names well known in science. As it stands, this list is certainly a very powerful inducement to accept the invitation in the case of anyone content in this important matter to follow the lead of his more influential colleagues, for it comprises a very large proportion of the best known workers in the branch of science mainly involved. Unfortunately, however, it includes my own name, and I take it, therefore, that, in part at least, it is in reality a list of those to whom invitations are being issued rather than of those who have accepted the invitation.

The function of the Committee is stated to be "the development to the utmost extent of both the offensive and defensive aspects of chemical warfare." Its work is governed, as regards disclosures, by the terms of the Official Secrets Act, and every member of the Committee will be required to sign a statement that he has read the Act and is prepared to abide by its provisions. It is the intention to allocate, so far as practicable, research of a purely scientific nature in chemical warfare to universities and similar outside institutions.

Now, for my part, I think this is a very important matter which ought not to be left entirely to the personal choice of individuals, but should be most carefully considered by the universities and by scientific workers as corporate bodies. It was one thing for scientific men and the universities to be called upon in the stress of actual conflict to assist the fighting Services when they were forced by enemy action to protect themselves against, and in turn to develop, a mode of warfare until then proscribed by civilised nations, but it is surely quite another matter for them, in consequence, to be called upon without consultation to become a normal part of the peace organisation for developing it in secret, both in its offensive and defensive aspects, to the utmost possible extent.

I do not think there is any precedent for this departure. Universities train medical men indiscriminately for civil and military services, but the Army Medical Service is non-combatant, and is intended to ameliorate the horrors of war. Universities of late have recognised military subjects in their curricula for their diplomas, and lent their organisations for the purposes of what were in origin defensive military services, such as the Volunteer and Officers Training Corps.

Personally, I feel that universities and scientific men stand for something in the world higher than anything which has as yet found expression and representation in Governments, particularly in their international relations. In consequence, I fear that they will find themselves in a false position if they allow themselves by default to be depressed to the position of mere agents to develop this new and, as yet, still unlegalised mode of warfare. The uses likely to be made of their work are, in the present unsettled condition of the world, highly uncertain, except in so far as it is quite certain that the effective control over these uses is not the part in which they are invited to co-operate. No one can pretend that scientific organisations are strong enough to dictate, as in the case of the professional medical organisation, the purposes for which science shall be used in the community. My own individual view is against accepting this invitation until the question of the position of the universities and scientific men as corporate bodies, in the part of the organisation which they are not invited to join, has first been satisfactorily settled. I think the properly constituted unions of scientific workers should give the matter their consideration and lay down for the guidance of their members the conditions under which they should, if at all, accept the invitation. It would be most helpful to have the views of my colleagues, particularly of some of the sixty-four who are stated already to have joined the organisation as associate members, publicly expressed upon this very important matter.

FREDERICK SODDY.

British Laboratory and Scientific Glassware.

THE British glass industry is undoubtedly to be congratulated on attaining the excellent results described in Mr. Jenkinson's letter in NATURE of October 28, but I may venture to point out that it is little comfort to the user to know that good glass is made if no guidance is given him as to the particular brand referred to. Of the five samples tested it is true that the best was British, but the worst was also British. I gather from inquiries made that the faults complained of by laboratory workers are not so much defective resistance to alkalis, etc., but insufficient annealing and liability to break with changes of temperature. Table glass is well annealed, so that the defect in question is not insuperable, and a want of care in the manufacture is suggested. The increased loss by breakage has become a serious consideration in the running of practical classes since British glass has been in use. As pointed out in previous correspondence, the danger of restricting import lies in the lack of inducement to further improvement.

W. M. BAYLISS.

University College, London.

THE points raised by Mr. Jenkinson in his letter on the subject of laboratory and scientific glassware published in NATURE of October 28 should direct the attention of users of such glassware to the quality of the British-made product as compared with other well-know Continental brands.

No single type of glass can be superior to all others for all purposes. One glass may be superior as regards attack by water and acids, but inferior in respect to attack by alkaline solutions. As it would obviously be highly inconvenient in practice for chemists to use different types of glass for different reactions, a general average must be taken, and a study of the papers in the Journal of the Society of Glass Technology referred to by Mr. Jenkinson will convince any unbiassed person that the quality of British laboratory glass has been proved fully equal, if not superior, to that of any other laboratory glass from whatever source it may have been obtained.

In the earlier days of the war complaints were frequently heard as to the finish of British-made articles. Either they were too thin, too thick, uneven, or the colour and shape were unsatisfactory, etc. Whilst these complaints were frequently justified, they were chiefly due to lack of experience. The blowing of laboratory glassware of the desired thickness and even throughout requires considerable experience on the part of the glass-blower, and blowers trained in this branch of the industry were not available. The glass used in the manufacture of laboratory ware is much harder (less fusible and with a shorter viscosity range) than that to which the blowers were accustomed, and this militated against the rapid acquirement of the technical skill necessary to produce the best class of ware.

The hardness of the glass and the undesirability of using fining agents such as arsenic and antimony rendered it very difficult to obtain the molten glass homogeneous and free from small gas-bubbles, and necessitated increased furnace temperatures during melting, thus calling for alterations in the design of furnaces in use or the erection of new furnaces of special type.

The colour of British laboratory glass is admittedly inferior to that of the best foreign glass. This is due to the purity of the materials used, particularly the sand. British sands can be obtained with nearly the same degree of freedom from iron as the best Continental sands, but not in considerable quantity or of constant quality. For special purposes, where freedom from colour is essential—*e.g.* Nessler cylinders—specially selected qualities of British sands may be used, or even imported sands, but from the general point of view of the chemical and scientific glassware industry it is absolutely essential that we should be able to produce highly efficient laboratory ware without recourse to the importation of any material from outside the Empire, and so far as possible with only British materials.

Further experiment and experience both with materials and melting operations will undoubtedly lead to improvement in the appearance of the product, and we claim that as British manufacturers, with the aid of British men of science, we have mastered the difficulties attendant on the production of the necessary quality of glass so successfully. They will, given fair opportunity, master the less essential, but nevertheless desirable, property of pleasing appearance.

Scientific apparatus, particularly lamp-blown apparatus, has received a considerable amount of attention from manufacturers and men of science interested in the technology of the glass industry.

It is a fact, unfortunately, that in pre-war days the best work of this class was done by German and Austrian lamp-workers. This work is now carried on largely in this country (to a considerable extent by disabled soldiers and sailors), and great progress has been, and continues to be, made. Research work on the most suitable types of glass tubing for lamp-working purposes has been carried out with very successful results (Journal of the Society of Glass Technology, 1917, vol. i., p. 61; 1918, vol. ii., pp. 90, 154).

Manufacturers have followed up suggestions for possible improvement, sometimes with success and sometimes otherwise, but generally associated with considerable trouble and expense, and we may fairly claim that great improvement has been achieved in this direction, and that few grounds for legitimate complaint remain on the score of the annealing of British-made laboratory ware.

A further and most important section calls for mention, namely, the production of graduated apparatus. To some extent this is a factory operation, but the production of accurate and trustworthy graduated apparatus calls in addition for the most highly skilled, careful, and experienced work and supervision. The work entailed is much greater than appears on the surface. Experimental work has been carried out at the National Physical Laboratory and at Sheffield University, and the testing department of the National Physical Laboratory has drawn up stringent regulations for the certifying of first-class graduated apparatus, so that such apparatus with the National Physical Laboratory certificate of accuracy can be relied upon to be quite as trustworthy as the well-known German apparatus with the Reichsanstalt certificate.

Complaints and unfavourable comparisons have frequently been made in connection with British laboratory ware, and very few expressions of appreciation or gratitude to those manufacturers who stepped into the breach to supply an absolutely indispensable article, knowing that their productions were far from perfect, but striving, with the help of the best scientific aid in the country, to improve the quality of their ware. Very great progress has been made, but under the abnormal conditions ruling at present in this country it is essential that stability should be assured for some time to come until the industry has had time to settle down from what is practically an experimental stage to normal working conditions.

Is it conceivable that the research work done by Sir Herbert Jackson, Prof. Turner, the National Physical Laboratory, and others, and the patient and frequently thankless efforts of manufacturers to render this country independent in such an essentially key industry, should be wasted; and that the valuable experience already gained should be lost on account of the flooding of the English market with Continental productions—made so easy by the present rate of exchange between England and Germany—and the consequent transference of our energies to less essential, but certainly more lucrative, directions?

FRANK WOOD.

(Wood Bros. Glass Co., Ltd.)

Borough Flint Glass Works, Barnsley,

November 2.

Crystal Growth and Recrystallisation in Metals.

THE effects of heat on certain cast and plastically deformed metals have been studied in considerable detail by Prof. H. C. H. Carpenter and Miss C. F. Elam in an investigation which was published and discussed at the autumn meeting of the Institute of Metals held at Barrow-in-Furness under the presidency of Vice-Admiral Sir George Goodwin.

At the outset the authors state that the terms "recrystallisation" and "crystal growth," which signify quite different phenomena, have previously been used for the most part indiscriminately and interchangeably, with the result that the discussion of this subject has necessarily been confused and unsatisfactory. By "recrystallisation" is meant the complete reorientation of a crystal or group of crystals. The new arrangement starts from new centres, and is quite independent of the old system of orientation. It is, in fact, the birth of new, differently oriented crystals in a crystal aggregate, and the gradual change of the old to conform with the new. This always gives, in the first instance, a refined structure. When all trace of the old arrangement has disappeared it is considered that recrystallisation is complete. By crystal growth is meant the rearrangement of certain crystals in a crystal aggregate to conform with the orientation of certain other crystals, during which process the latter increase in size by the addition of reoriented material at the same time as the former decrease in size by the same amount. This process necessarily leads to an increase in crystal size.

Many of the authors' experiments have been carried out with an alloy of tin and antimony containing about 1·5 per cent. of the latter metal. This alloy possesses a very peculiar property, which makes it of special value for investigating the above phenomena, and for the first time has enabled the stages of crystal growth in a metallic complex to be studied experimentally. It presented, however, some special difficulties in polishing and etching. Cutting, filing, and even grinding on the finer emery papers bring about spontaneous recrystallisation of the surface layer. This entirely obscures the genuine structure of the specimen, and can be removed only by alternate polishing and etching. Ammonium sulphide solution is the best reagent for developing the structure, and by alternately immersing the specimen in the solution and rubbing it on selvyt or chamois leather with magnesia moistened with ammonium sulphide a very beautiful surface is obtained. This reagent attacks different crystals to very different degrees, so that some appear white, and others black, under the microscope. This proved of considerable assistance in the experiments, as it made it easy to identify a particular area under examination. If a polished and etched specimen was heated at 150°–200° C., and growth of any of the crystals took place, the position of the new boundary was marked by a line which is really a difference of level almost as if the specimen had been etched; but there was no visible change in the surface of the reoriented area.

That these lines represent the position of the new boundaries after heating could be shown by (1) taking a photograph of an area which included some of them; (2) repolishing and re-etching the specimen and rephotographing the same area. On comparing the two photographs the boundaries of the crystals as shown by the etching in (2) correspond exactly with the new lines in (1). It was always a simple matter to distinguish between a growing crystal and one that was being grown into. The alloy tarnishes on heating, being first yellow, then orange, red, purple, blue, and green in turn. Just as the crystals etch differently, so they tarnish differently; but they tarnish first in accordance with the original etch. There is always a colour contrast between adjacent crystals, and the colour fixes the original boundaries. If new boundaries appear *inside* this colour boundary, it shows that the adjacent crystal is growing into it; if *outside*, it shows that the crystal is growing into its neighbour.

A very remarkable feature about these boundary markings is that they are formed only when the specimen is removed from the furnace and cooled. If a specimen is heated and cooled three times, there will be three new boundaries round some of the crystals; if four times, there will be four, and so on. But if another specimen be heated along with the first, and taken out only when the former was removed for the fourth time, one new boundary marking alone would be visible. It is, therefore, an arrest in the progress of growth which makes these markings on the surface, and further heating does not obliterate them. There is, however, no sign of them after polishing and etching, only the final and genuine crystal boundary being then visible.

The authors publish numerous photographs illustrating these phenomena, and the accompanying series revealing the gradual decrease in size and final disappearance of a crystal in four stages is taken from a plate in their paper. The crystals concerned are represented by letters in Fig. 1. Fig. 2 shows the effect of heating once. The crystal A has been invaded by crystals C, D, and E. Crystal C continues to grow on further heating, and also crystal B to a small extent (Figs. 3 and 4). The state of things after heating four times is shown in Fig. 5. All four crystals have invaded A, and C and E have met. Fig. 6 is of the same area repolished and re-etched, and shows that A no longer exists. The orientations of crystals B, C, and D as revealed by the etching are very different from that of A. It is possible that the orientations of A and E do not differ greatly, yet each crystal has taken a considerable share of A.

From a large number of observations the authors have drawn the following conclusions: (1) Crystal growth always took place by gradual

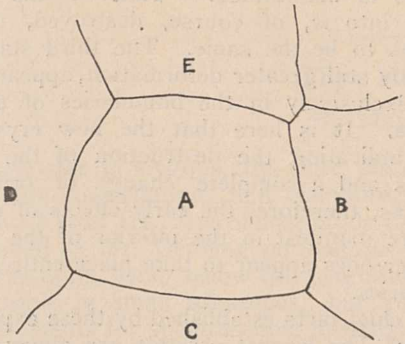


FIG. 1.

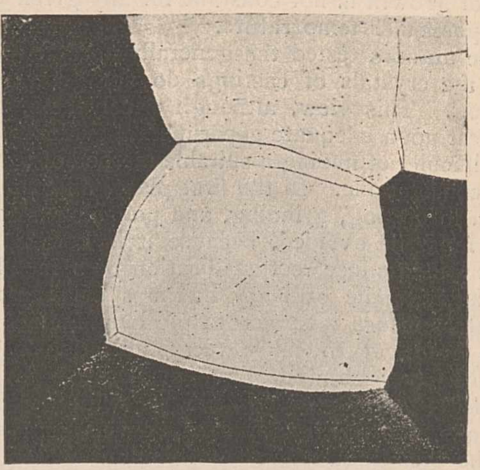


FIG. 2.—1st heat.

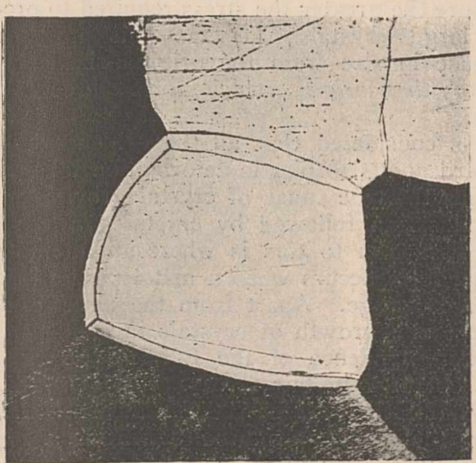


FIG. 3.—2nd heat.

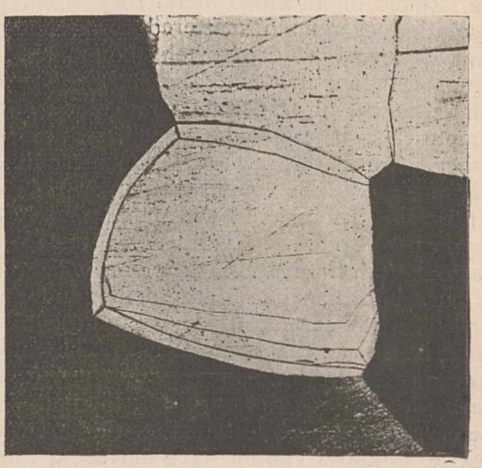


FIG. 4.—3rd heat.

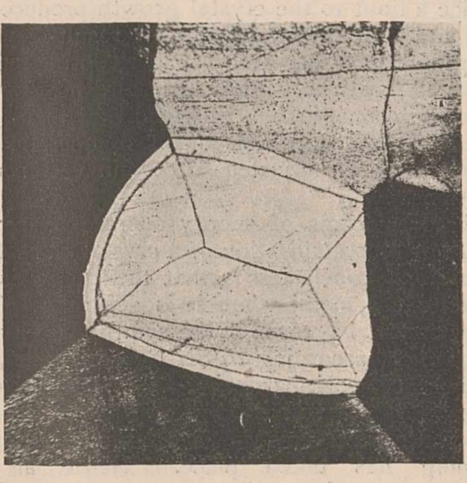


FIG. 5.—4th heat.

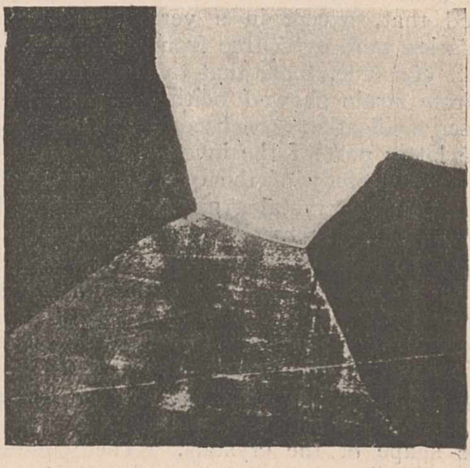


FIG. 6.—Same as Fig. 5, repolished and re-etched.

Magnification 100 diams. Reduced by one-sixth.

boundary migration, and not by coalescence; (2) growth may take place either of a large crystal into a small one, or of a small into a large—*i.e.* crystal growth does not depend on the relative size of crystals; (3) the relative orientations of the crystal which is being grown into and that which is growing do not appear to affect growth; (4) a crystal which is itself being invaded by one crystal may grow at the same time at the expense of another; (5) the change of orientation is accompanied by a difference in level of the surface which is the boundary usually observed; (6) the rate of growth is not constant for any given time at a particular temperature.

The authors tested the generally accepted view that the crystals of castings do not grow upon heating. This view, although widely held, does not rest upon adequate experimental evidence, and the difficulty of finding a suitable method of testing it is considerable. In the first place, all forms of strain in cutting, grinding, and polishing a specimen must be avoided, because it is known that work will produce recrystallisation of a metal on annealing. The ordinary methods of preparing a metal surface for microscopic examination are quite sufficient to cause recrystallisation of the surface layer on annealing, particularly in soft metals. After experimenting with various methods, the one finally adopted was suggested by the well-known fact that impurities tend to lie in the crystal boundaries of castings, whereas in the worked or annealed metal they either pass into solution or remain scattered throughout the crystals quite independent of the boundaries. It was reasoned that if it could be shown that after prolonged annealing the boundaries coincided with the impurities, it might be considered evidence that they were in the same position after annealing as before. The impurities must be such that they are insoluble in the metal and have a high melting point. Exhaustive tests were carried out with the metal aluminium, which, even in its purest form, contains the compound $FeAl_3$. In the cast metal some of this compound is always found existing in the boundaries. The authors publish a photograph showing that, even after annealing for ten weeks at 550° C., the boundaries of the crystals are still outlined by the impurities, and since the latter cannot have moved, it follows that neither have the boundaries. A specimen of rolled aluminium annealed for the same period showed that, except in a very few cases, the boundaries were quite free from impurities. The authors conclude, then, that the cast metal when free from strain showed neither crystal growth nor recrystallisation on subsequent heating.

The latter part of the investigation deals with an elaborate study of the quantitative effects of deformation on crystal growth and recrystallisation, and the structural changes produced in a crystal aggregate by deformation followed by heat may be summarised somewhat in the following way:—

The first effects are slight. They are revealed by slip bands, and in some cases by twins. The former are completely, and the latter to some extent, removed by heating. No change is observed in the shape of the crystals. The boundaries appear unaffected, and, apart from the twins, there is no change in orientation. Thus far only the interior of the crystals is affected. No identities are lost. Somewhat greater deformation, however, produces crystal growth, and at this stage the boundaries of the crystals become active. The activity is shown in the capacity of the growing crystal to push forward its boundary in certain directions, thereby invading other crystals, but even at this stage the orientation of the growing crystals is maintained. That of the crystals grown into is, of course, destroyed, unless it happens to be the same. The third stage, produced by still greater deformation, appears to take place exclusively in the boundaries of deformed crystals. It is here that the new crystals are born, indicating the destruction of the original crystals and a complete change of orientation. Whereas, therefore, the early effects of deformation are manifest in the interior of the crystals, the later ones appear to take place entirely at the boundaries.

The chief facts established by these experiments are: (1) The largest crystals are always formed after the minimum amount of stress sufficient to produce growth, which minimum is determined by the annealing temperature; (2) the lower the temperature the greater the stress required to produce the large crystals; (3) there is no gradual increase in size from the original-sized crystals up to the largest which form directly from them.

It is considered that all the evidence brought forward points to plastic deformation followed by heat as the true cause of crystal growth and recrystallisation followed by crystal growth. The only exception to this is where an alteration of crystal form occurs when a metal passes through a phase change. Apart from the direct evidence against any growth of crystals in castings, confirmatory evidence of the following nature has been obtained in this research: (1) Growth and recrystallisation can be induced by work; (2) the size of the crystals produced on heating at a given temperature after work is entirely dependent on the amount of deformation; (3) there is always in practice a limit to the crystal growth produced by work and heat in any metal as a result of which a single crystal has not yet been produced by prolonged heating. Such a result, however, is theoretically imaginable, provided that the degree of deformation and subsequent temperature of heating could be adjusted to certain very precise conditions.

Whatever forms of energy operate during the growth or recrystallisation of a crystal on heating, the authors' conclusion is that the energy is imparted to the metal when it is deformed. That energy cannot be stored in the amorphous vitreous films, which, according to Sir George Beilby, are the cause of work-hardening in metals, because, as the authors have shown, the growth of crystals in a worked metal proceeds after all mechanical softening has taken place. Hence all the amorphous metal must have recrystallised. It is, moreover, difficult to explain why the least deformation should produce the largest crystals on heating if growth depends on the presence of amorphous metal. Further, the energy cannot be stored in the amorphous cement around the crystals as conceived by Rosenhain, because (1) all the available evidence is against the view that the crystals of castings grow; (2) the greater the surface area of a crystal the more energy it should possess, and on this view a large crystal should absorb a small one. It has been shown that this is by no means always the case. It is considered that until much fuller knowledge of the structure and properties of crystals has been obtained, the true explanation of the effects of work upon metals will not be forthcoming.

The New Star in Cygnus.

By MAJOR W. J. S. LOCKYER.

THE new star in Cygnus, the third discovered in that constellation, and therefore designated Nova Cygni III., was of magnitude 3·5 when first observed by Mr. Denning on August 20, but is now very faint, being below 9th magnitude. It is still visible in small telescopes, but requires large instruments for spectroscopic investigation.

A summary of the earlier part of the star's history—*i.e.* previous to August 20—is brought together by Mr. Felix de Ray in the current issue of the *Observatory* (vol. xliii., No. 557, October), and is of great interest. Thus the object was not visible on June 3, 1905, when a plate taken of that region showed stars down to the 16th magnitude. On July 20 of the present year another plate taken there recorded stars down to magnitude 11; but still there was no trace of the nova. A photograph taken at Harvard on August 9, 1920, shows stars to the 9th magnitude, and no nova appears upon it; but the object was recorded there on August 19, and its magnitude was then 4·8. An earlier record than this is given on a plate taken by Nils Tamm in Sweden on August 16 of this year, when it was shown as a 7th-magnitude star.

The above records give an idea of the nature of the rise in magnitude of the nova, and these data (broken lines), combined with the excellent series of observations made at Greenwich (continuous lines), and published in the same number of the *Observatory* (p. 367), enable the light curve of the nova to be constructed. This curve is given in Fig. 1. It will be seen that, like all novæ, there is a very rapid rise to maximum brilliancy, followed for a short period by an almost as rapid decrease. After that the decrease is more gradual, but at a quicker rate than is generally the case in later stages of novæ.

It should be remarked that the Greenwich values here recorded are "smoothed" values—that is, a mean curve has been drawn through the original observed values. This process has the drawback of eliminating any small oscillations of magnitude which may occur in the original curve. Thus on the descending side of the curve there are undoubtedly instances where the nova not merely retained the same magnitude for two consecutive nights, but actually increased in brightness. Such fluctuations were, however, on a very small scale, and nothing like the pronounced regular variations which Nova Persei presented after it had reached the 4th magnitude, the amplitude of this fluctuation amounting to about one and a half magnitudes in periods of three or four days.

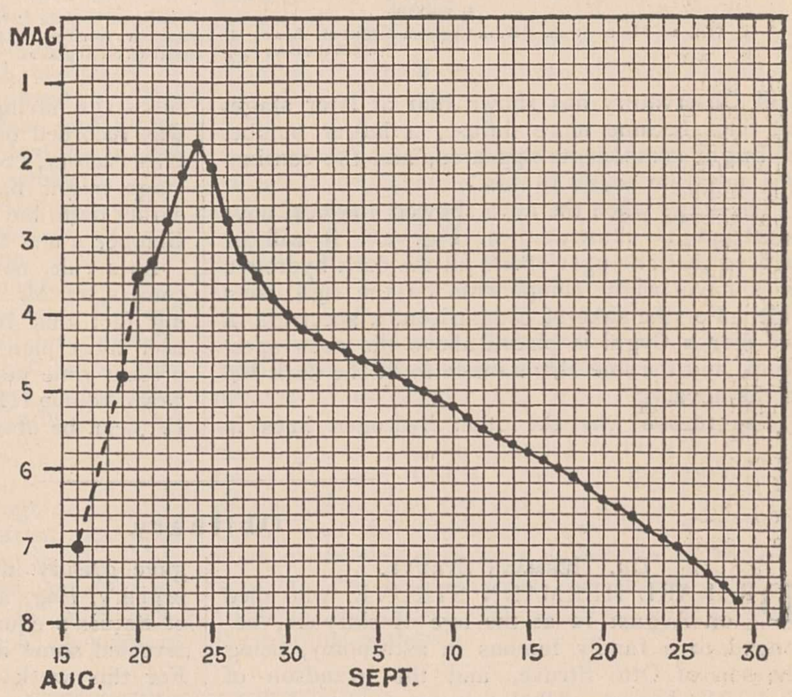


FIG. 1.—The light curve of Nova Cygni III., illustrating the rapid rise to maximum and the comparatively slow descent. The unbroken line is from observations made at Greenwich Observatory.

No less interesting has been the spectroscopic study of this nova. Up to the present time very little has been published on the subject, but no doubt several communications upon it will be made at the November meeting of the Royal Astronomical Society. In Section A of the British Association at the recent meeting Prof. Fowler showed some slides taken from negatives secured at the Hill Observatory, Sidmouth, on the night of August 22, when the nova was approaching its maximum.

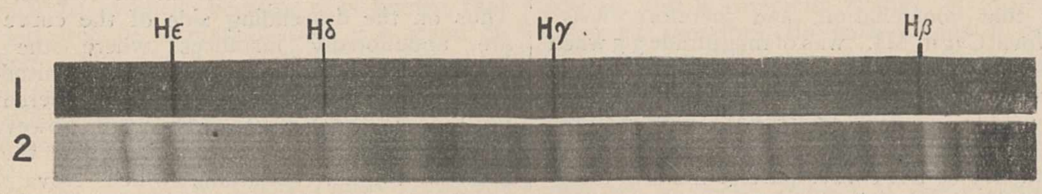
These photographs showed that the spectrum was practically identical with that of the star α Cygni—that is, it was practically an absorption spectrum. This star is noted for exhibiting fine, sharp lines representing metals at a very high temperature, these lines being enhanced when passing from the temperature of the arc to that of the spark. Two nights afterwards, when the nova attained its maximum brilliancy, all the lines became broad and fuzzy, and bright components to the lines began to show up at the red end of the spectrum. More recent work at the Hill Observatory has shown that at later stages all lines became more diffuse, a larger number of bright components appeared, and the continuous spectrum began to dim.

The stage when the nova showed a *typical* nova spectrum is illustrated in Fig. 2. It will be noticed that amongst others all the dark hydrogen lines have bright components on the right-hand side. For the sake of comparison, a spectrum of the star α Cygni is placed above the nova spectrum, and the line Hβ is made to fit the dark Hβ in the nova.

The reason why the other hydrogen lines in α Cygni do not fit those in the nova is that, owing to the great velocity in the nova, these lines are displaced towards the left—*i.e.* towards the violet. From measurements made, the velocity in the line of sight works out at about 400 to 900 km. per sec., depending on the date on which the photograph was taken. In this particular case—namely, August 26—the velocity was about 900 km. per sec., and was actually the maximum velocity attained.

At a late stage in their career novæ begin to exhibit the nebular lines. The first indication of this stage having been reached in the present nova was recorded on a photograph taken at the Hill Observatory, Sidmouth, on October 22. The stage might have been reached at possibly an earlier date, but no records were available between October 2 and the date mentioned above.

As a rule, new stars are far more scarce than comets, but Mr. Felix de Ray points out the interesting fact that for a couple of years novæ have been more plentiful than comets, and that at the present time no fewer than four novæ, including Nova Aquilæ III., Nova Lyræ, and Nova Ophiuchi IV., can be observed with small apertures.



1. α Cygni. 2. Nova Cygni, August 26.

FIG. 2.—The spectrum of Nova Cygni on August 26, showing the *typical* nova spectrum. The comparison spectrum is that of α Cygni, which the nova closely resembled on August 22.

Obituary.

DR. HERMANN STRUVE.

DR. KARL HERMANN STRUVE, who died on August 12 at the age of sixty-six, belonged to a family famous in astronomy, being the son of Otto Struve, and the grandson of F. G. W. Struve. All three were gold medallists of the Royal Astronomical Society, this being a unique case of hereditary distinction in the annals of that body.

K. H. Struve was born at Pulkova in 1854, being the third of the four sons of Otto Struve, who was then director of Pulkova Observatory. He studied at Dorpat University, where he showed special aptitude in physics and optics. Apparently it was the acquisition of the 30-in. refractor at Pulkova that tempted him to devote his life to astronomy. It was with this instrument that he made the splendid series of observations of Saturn's satellites for which his name will be chiefly remembered. He adopted the plan of comparing the satellites with each other, instead of with Saturn, which led to a great increase in accuracy. His discussion of the observations gave greatly improved values of the masses of primary, ring, and satellites, and of the positions of Saturn's equator and the orbit planes; it also revealed some interesting librations in longitude. For this work Struve was awarded the R.A.S. medal and the Damoiseau prize of the Paris Academy. A similar investigation on the system of Mars gave the position of Mars's equator, the amount of its oblateness, and the rate of motion of the nodes.

Other astronomical work included double-star measures, star parallaxes, micrometer measures of Eros, and drawings of Jupiter; moreover, in 1874 Struve took part in the Russian expedition to Port Possiet, Eastern Asia, to observe the transit of Venus.

In 1895 Struve became professor of astronomy at Königsberg, and director of the observatory, for which he obtained a 32·5-cm. refractor. In 1904 he succeeded Dr. W. Foerster as director of the Berlin-Babelsberg Observatory, retaining this post until his death. So late as 1916 he made further observations on Saturn's satellites with the 26-in. refractor there. He suffered for some time from heart trouble, and his death was probably accelerated by a bad fall last spring. He married in 1885, and leaves a son and daughter.

ALFRED LIONEL LEWIS.

WE regret to record the death of Mr. Alfred Lionel Lewis on October 22. Mr. Lewis, who was in his seventy-ninth year, joined the Anthropological Society of London in 1866, and was elected a member of its council in 1869. When the society was absorbed by the foundation of the Anthropological Institute in 1871, Mr. Lewis became a member of this body, of which at the time of his death he was one of the oldest members. He was elected a member of the council in 1876, and in 1886 he became treasurer, an office which he continued to hold for seventeen years. From 1905 to 1907 he served as vice-president. Mr. Lewis's interests were directed almost exclusively to archæology, and in particular to megalithic monuments, a subject on which he was for many years recognised, especially in France, as one of the foremost authorities. The great accuracy of his measured plans and drawings was not the least valuable feature in the numerous papers on this subject which he contributed to the Proceedings of the Anthropological Institute, the Prehistoric Congresses of France, the International Congresses on Prehistoric Archæology, the International Congress of Religions, and the British Association. He had already attained the fiftieth year of his membership of the last-named body, and had looked forward eagerly to taking part in 1921 in the celebration of the jubilee of the Royal Anthropological Institute.

THE death is announced, at the age of seventy-five, of DR. ANTON WEICHSELBAUM, emeritus professor of pathological anatomy in the University of Vienna. Soon after graduation, Weichselbaum became interested in pathology, and published work on the nature of rheumatoid arthritis. Before long he turned his attention to the then young science of bacteriology, and investigated the cause of pneumonia. About 1886, after a detailed investigation of a number of cases of this disease, he published a paper in which he described a coccus, the *Diplococcus pneumoniae*, as the causative organism, which corresponded with the organism previously described by Fraenkel. In 1887 his *magnum opus* appeared, on the discovery and description of the causal organism of cerebrospinal fever, the *Diplococcus intracellularis*, which is now almost universally accepted as the causative organism of this disease. In 1885 Weichselbaum succeeded Rokitansky in the chair of pathological anatomy, remaining on the active staff of the university until last year, when he was appointed emeritus professor. In 1912 he was installed as Rector Magnificus for the year, the highest honour in the gift of the university. Weichselbaum was a great investigator and a teacher of repute. In addition to numerous original papers and communications, he was the author of "Elements of Pathological Histology," which was translated into English.

THE death of MR. WILLIAM MELVILLE is recorded in *Engineering* for October 29 as having occurred on October 21. Mr. Melville was born in 1850, and served his pupilage with the North British Railway Co., under Mr. James Bell. He joined the Glasgow and South-Western Railway in 1874, and rose to be engineer-in-chief of the company, a position from which he retired in 1916. Mr. Melville was responsible for a large number of extensions and improvements on the railways and docks in Scotland, among which may be mentioned the widening of the City Union lines, Glasgow, which comprised the demolition of the old viaduct carrying the railway over the Clyde, and the substitution therefor of a new viaduct carrying four lines on the site of the old viaduct. He also extended St. Enoch Station, Glasgow, adding six new platforms to the six of the original station.

Notes.

WE are glad to note that a movement is on foot to establish a memorial to the late Mr. W. Duddell, whose early death in November, 1917, deprived many of a valued friend and cut short a career of scientific research of great brilliance. Mr. Duddell's work on the recording of the wave-form of alternating currents, including the development of the oscillograph, had great influence on alternating current theory as well as on telephony, while his well-known researches on the electric arc led up to a large field of development in wireless telegraphy. The memorial is to take the form of a medal to be awarded periodically by the council of the Physical Society at its discretion to those who have advanced physical knowledge by the invention or design of scientific instruments or of materials used in their construction. If sufficient funds are available, it is also proposed to form a fund to be devoted to the foundation of scholarships or prizes to be awarded to students of the Physical Society under conditions to be determined by the council. We are sure that the many friends whom Mr. Duddell made among the members of the Institution of Electrical Engineers and of the Röntgen Society, of both of which he had been president, and of the Physical Society, of which he was for some years the treasurer, will be glad of the opportunity to support the scheme. An influential committee has been formed under the chairmanship of Sir William Bragg (president of the Physical Society). Mr. R. S. Whipple (president of the Optical Society) is acting as hon. secretary to the Duddell Memorial Fund, and subscriptions may be sent to him at 15 Creighton Avenue, Muswell Hill, N.10.

WITH the advice and assistance of the National Research Council of the United States, a co-operating group of scientific investigators of insect pests and plant diseases, together with representatives of leading industrial concerns engaged in the manufacture of chemicals and appliances used in fighting these enemies of crops, has been organised under the name of the Crop Protection Institute. This institute will undertake and support a series of thorough scientific studies of the crop pests themselves and of the means for improving and standardising the materials and appliances used in fighting them. The Board of Trustees of the institute is composed of nine scientific men representing leading organisations interested in crop protection and four representatives of the manufacturing and commercial interests. The temporary secretary is Mr. Harrison E. Howe, chairman of the Division of Research Extension of the National Research Council. The annual losses as a result of the attacks on growing and stored crops by insect pests and plant diseases are enormous, despite all that has been done to lessen them. A conservative estimate of the loss of wheat in the United States in a single recent year on account of the black-stem rust is 180,000,000 bushels, and this pest is but one of many that attack the wheat every year.

THE Federal Government of Australia, acting in response to representations which have been made to it, has taken steps for the preservation of the aborigines who are under its jurisdiction. It has been decided to set aside part of the State lands in the Northern Territories as a reservation for the tribes. This aboriginal reserve will include the Mann and Petersen Ranges and practically the whole of Lake Amadeus. Areas have also been set aside by the Governments of South and Western Australia in the adjoining districts for the purpose of this reserve. No intimation has been received that medical attention will be provided, but it is to be hoped that, if no step in this direction has been taken, some form of medical service may be instituted, as it is essential to the success of any scheme to preserve the aboriginal from extinction.

THE presidential address delivered by Sir Robert Hadfield to the ninth annual conference of the British Commercial Gas Association at Sheffield on October 19 has now been published. The address deals with a number of problems connected with increased production and with the economy of natural resources. True economy does not consist in the mere cutting down of expenditure; wise expenditure on improved working conditions, on modern plant, on research, and on education is more than ever necessary. Increased production demands economy of fuel, diminished cost per unit of production, and the better organisation and training of labour by scientific planning and direction of the details of operations. This would be accompanied by a decrease of strain on the workers rather than by an increase, owing to the elimination of unnecessarily fatiguing methods and the extension of the use of labour-saving machinery. The universal adoption of modern methods of obtaining heat and power would result in cheaper factory construction, economy of space, increased speed and trustworthiness of output, and decreased consumption of fuel. Tables are given to show the present state of the national industries, and also to compare gas, coal, and electric heating from the point of view of cost and consumption of coal in the heating and melting of steel. It is evident that for heating to moderate temperatures coal is the cheapest fuel; whilst for melting, producer gas is by far the most economical. Electric energy cannot compete with gas in cost, except for certain classes of work at very high temperatures. The author again directs attention to the necessity of applying scientific principles more thoroughly to the design of furnaces, and urges the desirability of a study of the important researches of Groume-Grjimailo on the flow of heated gases through a furnace.

THE Carnegie Corporation of New York some time ago made a gift of five million dollars to the American National Research Council and National Academy of Sciences, of which about one million dollars is to be devoted to the erection of a building in Washington to serve as the home of these two closely related scientific organisations. The remainder of the total sum is to serve as an endowment for the maintenance of the Council. A site for the building, comprising an entire block of land near the present Lincoln Memorial in Potomac Park, has just been obtained at a cost of about 200,000 dollars through gifts from about a score of generous individuals, most of whom are business men associated with great industrial concerns or generally interested in the promotion of American science. The National Research Council, which was organised during the war to aid the Government in mobilising the scientific resources of America, in both *personnel* and material, for attack on scientific problems connected with America's war-time activities, has now been reorganised on a peace-time basis as a permanent institution for the promotion of scientific research and the dissemination of scientific information. It is not a Government Department or Bureau, but is privately supported and wholly controlled by the co-operating scientific men of the country. The major part of its membership is composed of appointed representatives of about forty American major scientific and technical societies. Dr. George E. Hale, director of the Mount Wilson Solar Observatory, is the honorary chairman, and Dr. H. A. Bumstead, professor of physics at Yale University, is the active chairman for the present year. Dr. Vernon Kellogg, formerly of Stanford University, is the permanent secretary.

THE Institut International d'Anthropologie has been formally constituted, with a provisional council of direction, consisting of representatives of seventeen nationalities.

MR. ALAN A. CAMPBELL SWINTON, chairman of the council of the Royal Society of Arts, will deliver the inaugural address of the 167th session on Wednesday, November 17, at 8 p.m. His subject will be "Wireless Telegraphy and Telephony."

THE annual general meeting of the National Union of Scientific Workers is to be held at King's College, Strand, on Saturday, November 13, at 2.30. An invitation to attend is extended to all scientific workers. The annual dinner of the union will take place in the evening of the same day.

THE Stockholm correspondent of the *Morning Post* announces that the Nobel prize in medicine for 1919 has been awarded to Dr. Jules Bordet, chief of the Pasteur Institute, Brussels, and the same prize for 1920 to Prof. August Krogh, professor of physiology in the University of Copenhagen.

THE PRINCE OF MONACO has summoned a meeting of representatives of the Oceanographic Section of the International Union of Geodesy and Geophysics for January 25, 1921, at Paris. An extensive programme of the work to be undertaken by the Section will be submitted to this meeting.

A DISCUSSION on the African arc and meridian will be held in the rooms of the Royal Astronomical Society on Friday, November 5, at 5 p.m. The chair will be taken by Col. E. H. Hills. Col. H. G. Lyons will open the discussion, which will be continued by Sir Charles Close, Col. E. M. Jack, Mr. A. R. Hinks, Mr. C. G. T. McCaw, and probably Sir S. G. Burrard and Sir G. Lenox-Conyngham.

THE British Motor Cycle and Cycle-car Research Association has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The association may be approached through Major H. R. Watling, "The Towers," Warwick Road, Coventry.

THE Civil Service Commission of Canada announces the promotion of Mr. Arthur Gibson to the position of Dominion Entomologist and head of the Entomological Branch of the Dominion Department of Agriculture. Mr. Gibson has been Acting Dominion Entomologist since the death of Dr. C. Gordon Hewitt in February last.

THE Institute of Industrial Administration, 110 Victoria Street, London, S.W.1, has among its objects "the general advancement of knowledge relative to the principles of industrial administration and their applications." The inaugural meeting was held on October 23, when an address on the industrial question was given by Viscount Haldane. Other meetings to be held are as follows:—November 9, The Influence of Exposed Records on Output, F. M. Lawson; November 23, Staff Selection and Promotion, E. W. Cousins; December 7, Road Transport as an Aid to Industrial Management, R. Twelvetrees; December 21, Standardisation of Rate-fixing Methods, J. E. Powell; January 11, 1921, The Measure of Output in Agriculture, W. J. Malden; and January 25, News and its Influence on Output, H. S. Rylands.

MR. F. S. SPIERS, secretary of the Faraday Society, was recently appointed by the King an Officer of the British Empire (O.B.E.), and reference was made to this honour at the opening of the joint meeting on the physics and chemistry of colloids described elsewhere in this issue. Mr. Spiers has been responsible for the organisation of the many valuable joint conferences arranged by the Faraday Society during Sir Robert Hadfield's presidency, and everyone who has attended any of them will be glad to know that his work has met with official recognition. He was secretary of the two British Scientific Products Exhibitions organised in 1918 and 1919 by the British Science Guild, and is secretary of the Institute of Physics, which there is every reason to believe will eventually occupy a very strong position among scientific bodies.

IN recent notes in the *Astr. Nachr.* (No. 5047) and the Paris *Comptes rendus* (vol. clxxi., p. 520) Prof. Carl Störmer describes most interesting results from photographic observations made at seven stations in Norway on the height of a very brilliant aurora seen on the night of March 22–23 last. More than six hundred photographs were taken. Only some of the plates have been fully studied, but these give for the summits of some of the auroral rays heights *of the order of* 500 *km.* Prof. Störmer describes a unique corona, seen on March 23 about 3h. 45m. a.m. G.M.T., of "long blue rays of indescribable beauty." Of this he himself, at his station at Bygdo, near Christiania, obtained several photographs, but unfortunately by that time all his other stations had run out of plates. He is anxious to know whether anyone else obtained a photograph of the blue rays, as he thinks their height was probably quite exceptional.

THE second reading of the British Empire Exhibition (Guarantee) Bill was carried in the House of Commons on November 1. The exhibition is to be held in London in 1923, and to be representative of the industries and resources of the British Empire. It will be privately organised, but has received official recognition and support. The King has given it his patronage, and the Prince of Wales is to be president of the General Committee. Under the Bill the Government proposes to guarantee the sum of 100,000*l.*, subject to private guarantees amounting to 500,000*l.* being forthcoming. As a condition of the guarantee, the Board of Trade is to approve the manager of the exhibition, the executive committee, and the general conditions under which the exhibition will be run, so that the Government may be in a position to secure that the exhibition is conducted with proper regard to economy and on lines which will ensure a success worthy of the object in view.

THE usual winter courses of the Ecole d'Anthropologie began at Paris on November 3. Prof. Manouvrier's subject is the anthropological problems of heredity; Prof. Hervé's the regional ethnology of France and the conclusion of a study of crossings; Prof. Mahoudeau's the naturalists and philosophers of the eighteenth century, and the struggle against creationism; Prof. de Mortillet's labour, industry, and commerce among primitive peoples; Prof. Capitan's the most recent observations upon the megaliths of Brittany, upon Alsatian and Belgian prehistorics, and, generally, upon the architecture and art of prehistoric times; Prof. Schrader continues his teaching on the normal and abnormal relations of modern civilisation with natural laws; Prof. Papillault lectures on the psycho-sociology of art; Prof. Zaborowski on the ancient and modern peoples of Europe and America; Prof. Anthony on morphological determinism in biology; and Prof. Vinson on the languages of Europe. We miss the usual announcement of conferences.

PROF. ROGET in his third Chadwick lecture, delivered on Friday, October 29, dealt with the future activities in the civil community of the public health department of the League of Red Cross Societies. The work to be undertaken has been divided up among seven sections. The first is concerned with social diseases. The lecturer pointed out the difficulty of including these affections in Red Cross work; nevertheless, he is of opinion that science is bound to do its utmost to stamp out the "social evil." At the same time every moral and religious influence must also be brought to bear on the subject. The second section will deal with the prevention of tuberculosis. Prof. Roget stated that both preventive methods and the segregation of tuberculous persons must be employed in this work. The third section will be devoted to the prevention of malaria, chiefly by carrying out scientific changes which have been proved to be effective in the administration of areas in which the disease is rife. Child welfare and nursing will be the work of the fourth section. With the collaboration of the visiting nurse with the mother work can be done which is peculiarly suited to Red Cross organisations. Another section is concerned with preventive medicine; preventive service could be efficient only when a large number of Red Cross laboratories had been placed at the disposal of the medical practitioner. The seventh section would have the greatest task of all, that of education. Museums, lectureships, health libraries, and literature were all necessary, particularly in those countries in which hygiene, sanitation, and clean housing are neglected.

IN an important paper by Mr. A. L. Kroeber on "California Culture Provinces" (University of California Publications in Ethnology, vol. xvii., No. 27) the author dismisses the theory held by American ethnologists that California represents a well-defined culture area. This region falls more properly into three areas: northern, central, and southern. Of these the northern is part of the culture of the North Pacific coast, with its centre in British Columbia. In the south the foundation of everything is Mexican, but the culture has taken its peculiar shape and colour on the spot. What the author says of the south-west may be generally applied to the other regions: "The truth is that the south-west is too insuperably complex to be condensed into a formula or surrounded with a line on the map."

OBSERVERS of social life in India have long been aware that certain varieties of the sári or sheet are distinctive marks of caste. In the October issue of *Man* Mr. R. S. Nicholson describes some remarkable methods of ornamentation of the sári which prevail in the Cuddapa district of the Madras Presidency. New cloths, though they may have been previously procured, are assumed in the eighth month of the Telugu year, corresponding with October–November. Each type of cloth has a special border, indicating the god in whose honour the cloth is worn—a special colour for the Nága or snake god, the Mother goddesses, and so on. These special marks on women's cloths seem to be peculiar to Southern India, and, so far as has hitherto been observed, do not prevail in the north.

MUCH interest has lately been excited by the attempted breeding of a pair of bee-eaters in Scotland. These birds took up their quarters on a sandbank of the River Esk at Musselburgh, and it seemed at one time probable that they would succeed in rearing young. A full account of this attempt and its lamentable ending is given by Dr. Eagle Clarke in the September–October issue of the *Scottish Naturalist*.

THE *Philippine Journal of Science* (vol. xvi., No. 4) is devoted to an interesting and valuable survey of the avifauna and flora of the Philippines. The author, Mr. R. C. McGregor, gives a condensed but vividly written account of the various types of forest of this region in relation, on one hand, to their economic value, and, on the other, to the problems they present to the ecologist. He then proceeds to give a lively review of the birds of this area and their distribution in regard to the different types of forest, supplementing his observations by comparisons with other types of tropical forests in Africa and America. To naturalists at large this essay will prove supremely interesting and helpful. Furthermore, it is illustrated by a number of beautiful plates.

MEMOIRS of the Agricultural Department of India, Entomological Series, vol. v., No. 5 (May, 1920), deals with two destructive species of rice-leaf hoppers. This well-illustrated brochure by C. S. Misra emphasises the great damage done by these insects. In the Chhattisgarh Division of the Central Provinces in 1914 they were reported to have damaged 3,000,000 acres, causing a loss approximately of 14,000,000 rupees. From observations conducted on the habits of these insects it was ascertained that they have a strong predilection for light. In order to apply the use of light traps satisfactorily it was necessary that the cultivators should co-operate in the work, but the Chhattisgarhi ryot is both superstitious and lethargic. No amount of persuasion could induce him to go to his fields at night and light the lamps, owing to his innate dread of evil spirits. Among other methods the necessity for clean cultivation and the elimination of all grassy areas in the immediate vicinity of the paddy fields is emphasised. The use of large field-bags, 6 ft. long, 4 ft. broad, and 4 ft. deep, attached to a light bamboo frame is also advised. Each bag can be carried by two men at a walking pace and drawn through the fields when the plants are small. The inside of the bags should be smeared with kerosene in order to prevent the leaf-hoppers from escaping when once they are caught. The possibility of selecting immune varieties of paddy is a subject worth consideration, together with the relation of the ripening period to the incidence of the pests.

SEALING operations at the Pribilof Islands closed for the season on August 10, and the United States Bureau of Fisheries reports that telegraphic information has been received stating that a total of 25,978 pelts had been taken during this calendar year (*Science*, October 8). Of this number 21,936 were taken on St. Paul Island and the remainder on St. George Island; 721 of the pelts were from seals seven years of age or older. A by-products plant was in operation on St. Paul Island which produced some 1800 gallons of oil and 29,000 lb. of meat or fertiliser. These figures could have been exceeded if the Bureau had been able to obtain more labourers from the Aleutian Islands. Comments are made on the rumour that the United States Government intends to remove restrictions on pelagic sealing in the North Pacific Ocean and Bering Sea. North of the thirtieth parallel of north latitude, and in the seas of Bering, Kamchatka, Okhotsk, and Japan, pelagic seal-fishing is prohibited by an agreement entered into in 1911 by the United States, Great Britain, Russia, and Japan, which is in perpetuity unless one or more of the signatories dissent from it. This agreement has never been rescinded, and in face of the benefits which have been shown to accrue from the proper management of fur-seal herds—in the fiscal year 1920 the United States revenue from the sale of skins was 1,457,790 dollars, and Great Britain and Japan take shares of 15 per cent. each of the annual catch—there is no likelihood of the re-introduction of pelagic seal-fishing. The Alaskan herd is protected by the patrolling vessels of the United States and Canada working in co-operation.

THE *Lancet* of October 23 contains an interesting account of an outbreak of Senecio disease, or cirrhosis of the liver due to Senecio poisoning, which occurred in the George district of Cape Province, Union of South Africa, in 1918. Dr. F. C. Willmot and Mr. G. W. Robertson, the authors of the article, state that the disease has been traced to the presence of the toxic seeds of *Senecio ilicifolius* and *Senecio Burchelli* in wheat harvested from fields in which these weeds were prevalent. They mention that precisely similar diseases (Molteno disease in South Africa, Winton's disease in New Zealand, and Pictou disease in Nova Scotia) have long been known in farm animals, especially horses, but they appear to be unaware that so long ago as 1911 Dr. H. E. Watt, working in the Imperial Institute laboratories, isolated from *Senecio latifolius*, the plant chiefly suspected of causing the disease in horses in South Africa, two toxic alkaloids, senecifoline and senecifolidine. These alkaloids were afterwards examined pharmacologically by Prof. Cushny, and found to produce hepatic cirrhosis in the animals used, the symptoms and post-mortem findings being identical in all respects with those recorded by the veterinary surgeons who have dealt with cases of Molteno, Winton's, or Pictou disease in South Africa, New Zealand, and Canada respectively. The outbreak now recorded by Dr. Willmot and Mr. Robertson is, however, probably the first instance of Senecio poisoning in human beings, and it raises the interesting question of the possible occurrence of cases in Europe, since *Senecio jacobaea*, the source of the disease in sheep in Nova Scotia, is a common weed in the United Kingdom and throughout Europe. In this country, however, the cleaning of wheat prior to its conversion into flour is probably so efficiently done that the risk is negligible.

WANDERING storms form the subject of an article by Prof. A. McAdie, of Harvard University, in the *Geographical Review* for July last. The communication is for the most part based on Sir Napier Shaw's "Manual of Meteorology," part iv., published during the war, which discusses the relation of the wind to barometric pressure and the travel of cyclones. Prof. McAdie instances three unusual storm tracks dealt with by Sir Napier Shaw, and alludes to the need in forecasting of knowledge of recurving storms, with especial reference to the aviator and his long-distance flights. A remarkable instance is given by the author of the erratic travel of a disturbance from May 8 to June 6, 1910. This is tracked from the Strait of Juan de Fuca to the Grand Banks, when it is said to have recurved again and again and to have come back to the Continent on May 26. It then merged with a storm that was moving north from Texas, and after meandering about to the east and north-east of Nova Scotia for ten days, until June 6, the disturbance dissipated.

THE October issue of the *Abstracts and Papers* published by the Institution of Civil Engineers contains 300 abstracts occupying more than 200 pages, and an index of 12 pages. The necessity for such a publication if the results of foreign investigations are to be made available in the engineering industries of this country will be apparent to every reader. Taking the abstracts which deal with the uses and properties of concrete for structural purposes, we find that a five years' experience in Germany of the use of furnace-slag as a substitute for gravel and sand in concrete has shown that slag-concrete is stronger than concrete made of Rhine sand. The conditions under which Portland cement can be stored for a couple of years without the strength of the concrete made from it suffering have been investigated in America. In Germany a saving of 17 per cent. has been effected by the substitution of concrete for brick in workmen's dwellings. In South Africa the manufacture of large pipes of concrete by the centrifugal process has proved successful. In Belgium the best way of driving concrete piles without injury to them has been investigated; while the American Railway Engineers' Association has found concrete road-beds uniformly successful.

IN the *Journal de Physique* for August last MM. H. Abraham, E. Bloch, and L. Bloch describe their direct-reading thermionic voltmeter which is manufactured by Carpentier. The invention of this instrument is a notable step in the development of the science of electrical measurement. Hitherto it has been impossible to get a direct-reading voltmeter which would read one volt of alternating pressure accurately. This instrument gives a direct reading for the ten-millionth part of an alternating volt. It consists of two thermionic amplifiers, followed by two thermionic valves in parallel, the "plate" current of which is measured by an ordinary direct-current milliammeter. With the help of this instrument the measurement of very minute alternating currents and pressures is as simple as everyday measurements with ordinary voltmeters and ammeters. By its use absolute measurements of inductances and capacities are made in a few minutes with a maximum inaccuracy of about 1 in 1000. By the use of suitable electrical "filters" very approximately sine-shaped waves are obtained by blocking out the disturbing harmonics. The authors have shown recently in the same journal how the frequency of the alternating currents can be determined with high accuracy. Its sensitiveness is shown by the fact that it can measure, by means of a direct reading of the pointer, the capacity of a sphere one millimetre in radius. The instrument has very many useful applications.

SOME comments on the statistics just issued by *Lloyd's Register* for the quarter ending on September 30 appear in *Engineering* for October 22. Before the war the merchant tonnage under construction in this country usually exceeded the total building in all other countries in the world; at present the tonnage building abroad exceeds our tonnage under construction by about 103,000 tons. At the end of September the vessels building in this country numbered 961 with a total gross tonnage of 3,731,098, an increase during the year of more than 32 per cent.; in comparison with the figure for September, 1913, the increase is more than 90 per cent. The individual tonnage in no case exceeds 25,000. With regard to the tonnage building abroad, the most noticeable feature is the decline in the tonnage building in the United States, where there are now only 312 vessels with an aggregate gross tonnage of 1,772,193 in hand, as compared with 767 vessels and a gross tonnage of 3,470,748 for the corresponding quarter of last year. Of the vessels now under construction, 114 with a total gross tonnage of 796,060 are intended for carrying oil in bulk. The United States is building 79 of these ships, and there are 32 building in the United Kingdom. Only five small steamers are being constructed of reinforced concrete in the United Kingdom, their total tonnage amounting to 2354; eleven vessels of this type are being built abroad, having a total tonnage of 24,069.

THE miscellaneous catalogue (No. 2, 1920) of second-hand books just issued by Mr. W. H. Robinson, 4 Nelson Street, Newcastle-upon-Tyne, contains nearly a thousand items, about two hundred of which deal with scientific subjects. The prices asked for the works appear very reasonable. The catalogue can be obtained upon application.

WE have received from the firm of Scientific Appliances, Southampton Row, W.C.1, a copy of its illustrated catalogue, which shows the apparatus available in two sections of the establishment. Section E contains electrical and magnetic apparatus, and fittings such as telephone sets, lighting sets, Wimshurst machines, accumulators, etc. Section O comprises optical appliances and drawing materials.

Our Astronomical Column.

COMETS.—Dr. Kudara, who rediscovered Tempel's second comet last May, gives the following revised elements for it in *Popular Astronomy* for October. He also gives the corrected R.A. for the observation on May 25 last as 22h. 55m. 43·7s.:

$$T = 1920 \text{ June } 16{\cdot}196 \text{ G.M.T.}$$

$$\left.\begin{aligned} \omega &= 186^\circ\ 39'\ 0'' \\ \Omega &= 120^\circ\ 46'\ 5'' \\ i &= 12^\circ\ 45'\ 14'' \\ \phi &= 33^\circ\ 54'\ 21'' \end{aligned}\right\} 1920{\cdot}0$$

$$\mu = 687{\cdot}51''$$

$$\log a = 0{\cdot}47515$$

The period is the shortest of any known comet with the exception of that of Encke.

Popular Astronomy also contains the following elements of Borrelly's comet (1905 II.) deduced by Mr. F. E. Seagrave from observations on 1918 October 9 and December 6 and 1919 February 4:

$T = 1918$ Nov. 16·8632 G.M.T.	$\phi = 37^\circ\ 57'\ 11''$
$\omega = 352^\circ\ 23'\ 32''$	$\mu = 514{\cdot}023''$
$\Omega = 76^\circ\ 57'\ 2''$	$\log a = 0{\cdot}559350$
$i = 30^\circ\ 29'\ 14''$	

MOUNT WILSON OBSERVATIONS OF CAPELLA.—Some account of the remarkable observations of Capella as a double star at Mount Wilson, using interferometer methods on the 100-in. equatorial, was given in NATURE last April. The *Astrophysical Journal* for June contains further details; the theory of the interferometer is described by Mr. A. A. Michelson, while Mr. J. A. Anderson discusses the observations of Capella, and finds the orbit from observations on six days ranging from 1919 December 30 to 1920 April 23, combined with the spectroscopic data. The following are the adopted elements: Period = 104·006 days; periastron = Julian day 2422387·9; $a = 0{\cdot}05249'' = 130{,}924{,}000$ km.; $e = 0{\cdot}016$; $i = 140^\circ\ 30'$; $\omega = 117{\cdot}3^\circ$; parallax = 0·0600″; masses of components in terms of sun, 4·62 and 3·65. These elements satisfy the observations with no error exceeding 0·00004″ in distance and 0·9° in position-angle, but the author points out that a longer series would probably show much larger residuals, since the interferometer multiplies the theoretical resolving power by $2\frac{1}{2}$ only.

From the close resemblance of the spectrum of one of the components with that of the sun it is probable that the surface brilliancy is much the same as the sun's, in which case the diameter of each star would be of the order of ten times that of the sun, or one-tenth of the distance between them. It is noted that the visual magnitudes of the two components must be very nearly the same, since the interference fringes completely vanished on superposition.

VARIATION IN THE LIGHT OF JUPITER.—A novel use of the photo-electric cell was made by Herr P. Guthnick at the Berlin-Babelsberg Observatory in an investigation as to whether the light of Jupiter showed any variation in the course of the planet's rotation owing to different markings being presented to us. In fact, last December and January there was a distinct variation having an amplitude of 0·14 magnitude. However, this rapidly diminished, and by February was only 0·04 magnitude. The author remarks that this rapid change gives support to the temporary variability in the light of Neptune in a period of eight hours observed by Prof. Hall and discussed in Monthly Notices, vols. xliv. and lxxv. Unfortunately, Neptune is too faint for observation with the photo-electric cell, otherwise a determination of its rotation-period might result.

Educational Science.*

By SIR ROBERT BLAIR, LL.D.

THE value to education of science and the scientific method has hitherto been for the most part indirect and incidental. It has consisted very largely in deductions from another branch of study, namely, psychology, and has resulted for the most part from the invasion into education of those who were not themselves educationists. A moment has now been reached when education itself should be made the subject of a distinct department of science, when teachers themselves should become men of science.

There is in this respect a close analogy between education and medicine. Training the mind implies a knowledge of the mind, just as healing the body implies a knowledge of the body. Thus, logically, education is based upon psychology, as medicine is based on anatomy and physiology. And there the text-books of educational method are usually content to leave it. But medicine is much more than applied physiology. It constitutes an independent system of facts, gathered and analysed, not by physiologists in the laboratory, but by physicians working in the hospital or by the bedside. In the same way, then, education as a science should be something more than mere applied psychology. It must be built up not out of the speculations of theorists, or from the deductions of psychologists, but by direct, definite, *ad hoc* inquiries concentrated upon the problems of the classroom by teachers themselves. When by their own researches teachers have demonstrated that their art is, in fact, a science, then, and not until then, will the public allow them the moral, social, and economic status which it already accords to other professions. The engineer and the doctor are duly recognised as scientific experts. The educationist should see to it that his science also becomes recognised, no longer as a general topic upon which any cultured layman may dogmatise, but as a technical branch of science, in which the educationist alone, in virtue of his special knowledge, his special training, his special experience, is the acknowledged expert.

Educational science has hitherto followed two main lines of investigation: first, the evaluation and improvement of teachers' methods, and, secondly, the diagnosis and treatment of children's individual capacities.

I. THE PSYCHOLOGY OF THE INDIVIDUAL CHILD.

It is upon the latter problem, or group of problems, that experimental work has in the past been chiefly directed, and in the immediate future is likely to be concentrated with the most fruitful results. The recent advances in "individual psychology"—the youngest branch of that infant science—have greatly emphasised the need, and assisted the development, of individual teaching. The keynote of successful instruction is to adapt that instruction to the individual child. But before instruction can be so adapted the needs and the capacities of the individual child must first be discovered.

A. *Diagnosis.*

Such discovery (as in all sciences) may proceed by two methods: by observation and by experiment.

(1) The former method is, in education, the older, At one time, in the hands of Stanley Hall and his followers—the pioneers of the child-study movement —observation yielded fruitful results. And it is perhaps to be regretted that of late simple observation and description have been neglected for the more ambitious method of experimental tests. There is much that a vigilant teacher can do without using any special apparatus and without conducting any special experiment. Conscientious records of the behaviour and responses of individual children, accurately described without any admixture of inference or hypothesis, would lay broad foundations upon which subsequent investigators could build. The study of children's temperament and character, for example —factors which have not yet been accorded their due weight in education—must for the present proceed upon these simpler lines.

(2) With experimental tests the progress made during the last decade has been enormous. The intelligence scale devised by Binet for the diagnosis of mental deficiency, the mental tests employed by the American Army, the vocational tests now coming into use for the selection of employees—these have done much to familiarise, not school teachers and school doctors only, but also the general public, with the aims and possibilities of psychological measurement. More recently an endeavour has been made to assess directly the results of school instruction, and to record in quantitative terms the course of progress from year to year, by means of standardised tests for educational attainments. In this country research committees of the British Association and of the Child-Study Society have already commenced the standardisation of normal performances in such subjects as reading and arithmetic. In America attempts have been made to standardise even more elusive subjects, such as drawing, handwork, English composition, and the subjects of the curriculum of the secondary school.

B. *Treatment.*

This work of diagnosis has done much to foster individual and differential teaching—the adaptation of education to individual children, or at least to special groups and types. It has not only assisted the machinery of segregation—of selecting the mentally deficient child at one end of the scale and the scholarship child at the other—but it has also provided a method for assessing the results of different teaching methods as applied to these segregated groups. Progress has been most pronounced in the case of the sub-normal. The mentally defective are now taught in special schools, and receive an instruction of a specially adapted type. Some advance has more recently been made in differentiating the various grades and kinds of so-called deficiency, and in discriminating between the deficient and the merely backward and dull. With regard to the morally defective and delinquent little scientific work has been attempted in this country, with the sole exception of the new experiment initiated by the Birmingham justices. In the United States some twenty centres or clinics have been established for the psychological examination of exceptional children; and in England school medical officers and others have urged the need for "intermediate" classes or schools not only to accommodate backward and borderline cases and cases of limited or special defect (*e.g.* "number-defect" and so-called "word-blindness"), but also to act as clearing-houses.

In Germany and elsewhere special interest has been aroused in super-normal children. The few investigations already made show clearly that additional attention, expenditure, study, and provision will yield

* From the opening address of the President of Section L (Educational Science) delivered at the Cardiff Meeting of the British Association on August 24.

for the community a far richer return in the case of the super-normal than in the sub-normal.

At Harvard and elsewhere psychologists have for some time been elaborating psychological tests to select those who are best fitted for different types of vocation. The investigation is still only in its initial stages, but it is clear that if vocational guidance were based, in part at least, upon observations and records made at school instead of being based upon the limited interests and knowledge of the child and his parents, then not only employers, but also employees, their work, and the community as a whole, would profit. A large proportion of the vast wastage involved in the current system of indiscriminate engagement on probation would be saved.

The influence of sex, social status, and race upon individual differences in educational abilities has been studied upon a small scale. The differences are marked; and differences in sex and social status, when better understood, might well be taken into account both in diagnosing mental deficiency and in awarding scholarships. As a rule, however, those due to sex and race are smaller than is popularly supposed. How far these differences, and those associated with social status, are inborn and ineradicable, and how far they are due to differences in training and in tradition can scarcely be determined without a vast array of data.

II. TEACHING METHODS.

The subjects taught and the methods of teaching have considerably changed during recent years. In the more progressive types of schools several broad tendencies may be discerned. All owe their acceptance in part to the results of scientific investigators.

(1) Far less emphasis is now laid upon the *disciplinary value of subjects*, and upon subjects the value of which is almost solely disciplinary. Following in the steps of a series of American investigators, Winch and Sleight in this country have shown very clearly that practice in one kind of activity produces improvements in other kinds of activities only under very limited and special conditions.' The whole conception of transfer of training is thus changed, or (some maintain) destroyed; and the earlier notion of education as the strengthening, through exercise, of certain general faculties has consequently been revolutionised. There is a tendency to select subjects and methods of teaching rather for their material than for their general value.

(2) Far less emphasis is now laid upon an advance according to strict *logical sequence* in teaching a given subject of the curriculum to children of successive ages. The steps and methods are being adapted rather to the natural capacities and interests of the child of each age. This genetic point of view has received great help and encouragement from experimental psychology. Binet's own scale of intelligence was intended largely as a study in the mental development of the normal child. The developmental phases of particular characteristics (*e.g.* children's ideals) and special characteristics of particular developmental phases (*e.g.* adolescence) have been elaborately studied by Stanley Hall and his followers. Psychology, indeed, has done much to emphasise the importance of the post-pubertal period—the school-leaving age, and the years that follow. Such studies have an obvious bearing upon the curriculum and methods for our new continuation schools. But it is, perhaps, in the revolutionary changes in the teaching methods of the infants' schools—changes that are already profoundly influencing the methods of the senior department—that the influence of scientific study has been most strongly at work.

(3) Increasing emphasis is now being laid upon *mental and motor activities*. Early educational practice, like early psychology, was excessively intellectualistic. Recent child-study, however, has emphasised the importance of the motor and of the emotional aspects the child's mental life. As a consequence, the theory and practice of education have assumed more of the pragmatic character which has characterised contemporary philosophy.

The progressive introduction of manual and practical subjects, both in and for themselves, and as aspects of other subjects, forms the most notable instance of this tendency. The educational process is assumed to start not from the child's sensations (as nineteenth-century theory was so apt to maintain), but rather from his motor reactions to certain perceptual objects—objects of vital importance to him and to his species under primitive conditions, and therefore appealing to certain instinctive impulses. Further, the child's activities in the school should be not, indeed, identical, but continuous, with the activities of his subsequent profession or trade. Upon these grounds handicraft should now find a place in every school curriculum. It will be inserted both for its own sake and for the sake of its connections with other subjects, whether they be subjects of school life, of after life, or of human life generally.

(4) As a result of recent psychological work, more attention is now being paid to the *emotional, moral, and aesthetic* activities. This is a second instance of the same reaction from excessive intellectualism. Education in this country has ever claimed to form character as well as to impart knowledge. Formerly this aim characterised the public schools rather than the public elementary schools. Recently, however, much has been done to infuse into the latter something of the spirit of the public schools. The principle of self-government, for example, has been applied with success not only in certain elementary schools, but also in several colonies for juvenile delinquents. And in the latter case its success has been attributed by the initiators directly to the fact that it is corollary of sound child-psychology.

Bearing closely upon the subject of moral and emotional training is the work of the psycho-analysts. Freud has shown that many forms of mental inefficiency in later life—both major (such as hysteria, neurosis, certain kinds of "shell-shock," etc.) and minor (such as lapses of memory, of action, slips of tongue and pen)—are traceable to the repression of emotional experiences in earlier life. The principles themselves may, perhaps, still be regarded as, in part, a matter of controversy. But the discoveries upon which they are based vividly illustrate the enormous importance of the natural instincts, interests, and activities inherited by the child as part of his biological equipment; and, together with the work done by English psychologists such as Shand and McDougall upon the emotional basis of character, have already had a considerable influence upon educational theory in this country.

(5) Increasing emphasis is now being laid upon *freedom* for individual effort and initiative. Here, again, the corollaries drawn from the psycho-analytic doctrines as to the dangers of repression are most suggestive. Already a better understanding of child-nature has led to the substitution of "internal" for "external" discipline; and the predetermined routine demanded of entire classes is giving way to the growing recognition of the educational value of spontaneous efforts initiated by the individual, alone or in social co-operation with his fellows.

In appealing for greater freedom still, the new psychology is in line with the more advanced educational experiments, such as the work done by Madame Montessori and the founders of the Little Commonwealth.

(6) The *hygiene and technique of mental work* is itself being based upon scientific investigation. Of the numerous problems in the conditions and character of mental work generally, two deserve special mention—fatigue and the economy and technique of learning.

But of all the results of educational psychology, perhaps the most valuable is the slow but progressive inculcation of the whole teaching profession with a scientific spirit in their work, and a scientific attitude towards their pupils and their problems. Matter taught and teaching methods are no longer exclusively determined by mere tradition or mere opinion. They are being based more and more upon impartial observation, careful records, and statistical analysis—often assisted by laboratory technique—of the actual behaviour of individual children.

Popular Relativity and the Velocity of Light.[1]

By SIR OLIVER LODGE, F.R.S.

IN using the phrase "popular relativity" I indicate that what I am criticising is not Einstein's equations—which seem to have justified themselves by results—but some of the modes of interpreting them in ordinary language. Especially do I attack that proposition which asserts that to every observer the velocity of light will not only be constant in reality, but will also superficially appear constant even when he ignores his own motion through the light-conveying medium—a proposition or postulate or axiom which has been shown to lead to curious and, as I think, illegitimate complications, threatening to land physicists in regions to which they have no right of entry, and tempting them to interfere with metaphysical abstractions beyond their proper ken.

Not that a physicist's proper ken is limited to what he immediately observes; he is entitled, and indeed required, to interpret appearances rationally by taking into account every relevant adventitious circumstance, including complications due to his own unobserved, and perhaps unobservable, travel through space.

In a relativity discussion at the Physical Society recently a member is reported to have asked the pertinent question: "Does an observer merely observe, or does he think as well?" If he thinks, I urge that he can allow for changes in his measuring instruments and any other consequences of possible motion, and can refrain from making deductions about space and time on the strength of experiments on matter.

He will know that his senses are material senses, and that all his experiments are made ultimately by their aid. He will know that he can only experiment even on the æther of space indirectly by means of matter, for he has no other means of getting a grip on it. Possibly he may be unable to grip it even thus, but matter gives him his only chance; he certainly cannot experiment on abstractions like space and time.

On the basis of material experiments he may be able to make deductions or draw inferences about the æther, because that certainly has some inter-relations with matter; but it is probably illegitimate, on the basis of material experiments, to make deductions about space and time at all; they are not likely to be affected by anything that matter can do, and it is only matter with which we can directly deal.

The relation between space and time that represents the velocity of light gives us directly one property of the æther, viz. the product of its electric and magnetic constants, both of which separately are at present unknown. Every student who accepts the æther of space as a reality is probably ready to admit that the velocity of light through free æther is an absolute constant, not dependent on anything that either the observer or the source is doing, has done, or may do.

But this admission has been erected into a fetish by the theory of relativity, at least when expressed in ordinary words, and is interpreted as requiring that to every observer, whatever he may be doing, the velocity of light in every direction will *appear* the same.

That is not only a different, it is a contradictory, proposition. Given the constancy of the real velocity of light—if an observer travel to meet it, it must appear to arrive more quickly than if he travel away from it, provided he has any means of making the observation at all. He may be unable to make the observation, but suppose he can make it, say by the aid of Jupiter's satellites, and detected a discrepancy, he need not infer any real change in the velocity of light; because, if he thinks, he can attribute any observed difference to his own motion, and thereby emerge with clear and simple views. If he sets out with the gratuitous notion that he can never become aware of his own motion, or that his own motion has no meaning, he will indeed encounter a puzzling universe, and will presently long for a Copernicus to unravel the subjective complexities of observation.

But it may well be extremely difficult for an observer to measure the velocity of light through the æther except with the aid of some return signal which the æther likewise has to transmit in the opposite direction; and in that case he may find that the to-and-fro pair of journeys take exactly the same time in every direction.

This, as everyone knows, has been done for a to-and-fro journey of a beam of light. And the timing is exact, not only to the first order of small quantities, as might readily be expected, but to the second order also—an exactitude which, if rigid unchangeable materials could be used, would not be expected, and ought not to occur. But if the dimensions of the material object used as the foundation-stone of his apparatus are subject to change by reason of motion, and if the changes are in accordance with the electrical theory of matter, as suggested by FitzGerald and elaborated by Lorentz, then everything becomes clear again until we come to astronomical and gravitational applications, and the precisely negative result of Michelson and Morley is precisely explained.

A mathematical doctrine of relativity may be based upon this experimental result, and may be convenient for reasoning purposes, but no such doctrine is required by the facts. The facts are patient of the doctrine; they do not compel it, nor do they justify it. Any comprehensive mathematical expression is liable to permit other modes of interpretation, as well as the simplest and truest or the one most directly applicable to the problem in hand. It is devised to cover one set of facts, but in its generality it is apt

[1] The substance of this controversial note was communicated to Section A of the British Association at the Cardiff meeting on August 27.

to cover more. Why, then, proceed to build up on an equation an elaborate metaphysical structure? And, especially, why imagine that the success of the Einstein equation proves the observed velocity of light to be the same whatever the motion of the observer? If the observer thinks, and if he is aware of the FitzGerald-Lorentz contraction, he will know that such a proposition is not true; he will know that the velocity of light is not equal in all directions in a relatively drifting medium, that the wave-front is not concentric to the observer, and that the Michelson experiment gives no proof of anything of the kind.

The uniformity of the æther makes the obtaining of positive results difficult; there seem to be always compensations. Some day we may be able to evade this experimental difficulty, but meanwhile, if we choose to make the supposition that motion of the observer can never have any directly observable effect, or that one set of axes of reference is necessarily equivalent to every other and indistinguishable by any kind of superficial observation, then we seem to be in accord with present experience. From that supposition definite consequences can, with adequate skill, be deduced, and the deductions have been subjected to successful verification.

But if on the strength of that remarkable achievement some enthusiasts proceed to formulate propositions which by ignoring the motion of the observer and all its consequences complicate the rest of the universe unduly, then, however much we may admire their skill and ability, I ask whether they ought not to be regarded as Bolsheviks and pulled up.

Emil Fischer's Contributions to Organic Chemistry.[1]

By DR. M. O. FORSTER, F.R.S.

EMIL FISCHER was born on October 9, 1852, at Euskirchen, and his death on July 14, 1919, occurred at a time when every element of constructive and harmonising influence was most sorely needed. Since 1892, when he succeeded von Hofmann, he had fulfilled the duties of professor and director of the chemical institute in the University of Berlin with increasing distinction. Physically commanding, his authority rested on the solid foundation of natural dignity. The brisk, upright carriage marked the man of action; the glowing eyes revealed his attitude of constant, keen inquiry; it was impossible to escape his contagious enthusiasm.

Fischer addressed himself to organic chemical research at the opening of its brightest epoch. Having described the preparation of phenylhydrazine in 1875, he devoted many succeeding years to developing the transformations of that remarkable substance. During this period he also collaborated with his cousin, Otto Fischer, in elucidating the constitution of rosaniline bases, their first joint paper appearing in 1876. It is noteworthy that, in spite of his early interest in the chemistry of these and other colouring matters, and notwithstanding his association with von Baeyer, beginning in Strasbourg and continuing until he left Munich to occupy the chair of chemistry at Erlangen in 1882, he nevertheless resisted the temptation to succeed Caro as director of research in the Badische factory, although at this time (1883) the colour industry was in the early flush of its active growth.

When reviewed as a chapter which is closed, Fischer's work must be regarded as having established upon a firm basis the fundamental science of biochemistry. The assimilation of carbon dioxide and water by plants, the variety and complexity of saccharide molecules proceeding therefrom, the degradation of the proteins, the probable course of their synthesis from amino-acids, and the power of assemblage or of disruption exerted by enzymes on all these building materials of the animal and vegetable kingdoms are subjects which Fischer not merely illuminated, but was the first to place in coherent arrangement and intelligible sequence. Recognition of the fact that all this was accomplished, not by revolutionary processes or theories, but by skilful development of the thoughts and operations expanded by Liebig, von Hofmann, Pasteur, and von Baeyer, is perhaps the highest tribute which can be paid to his genius.

Fischer's association with the branch of chemistry which first brought him fame began in 1884, when he discovered phenylglucosazone, produced from glucose, fructose, and mannose by the action of phenylhydrazine. At that time only two aldohexoses (glucose and galactose) and two ketohexoses (fructose and sorbose) were known and recognised as straight-chain pentahydroxy-derivatives. According to the requirements of van't Hoff's theory, a pentahydroxy-aldehyde of this class, in which five carbon atoms are each associated with one hydroxyl group, should appear in sixteen stereoisomeric forms, eight of these being enantiomorphs of the remainder. The bare statement that Fischer and his collaborators elucidated the configuration of twelve such isomerides, most of which they synthesised for that purpose, although perhaps an accurate summary of his opening achievement, conveys but a nebulous impression of the character and amount of the labour involved. Moreover, his discovery of γ-methylglucoside in 1914, and the consequent recognition of cyclic relations distinct from that occurring in α- and β-glucose, have opened the way to a multitude of contingent isomerides, those of *d*-glucose alone numbering ten. Thus Fischer not only elaborated his own sugar chemistry, but also added to this the foundation of a new carbohydrate classification.

The directive influence on Fischer's work in this field was the discovery, in association with Tafel in 1887, of α- and β-acrose. The former sugar he identified with *dl*-fructose, whilst β-acrose is now recognised as *dl*-sorbose. The above-mentioned synthetical operations, and many others connected with pentoses, tetroses, and artificial sugars containing more than six atoms of carbon, were effected by means of the cyanohydrin reaction, Pasteur's method of separating optical antipodes, and the discovery that when a monobasic sugar-acid is heated with quinoline at 140° C. the configuration of the carbon atom adjacent to the carboxyl group becomes epimerised (1890).

One of the most remarkable achievements in a series unsurpassed by any organic chemist was Fischer's synthesis of the principal constituent of Chinese tannin. In 1852 Strecker had shown that gall-nut tannin is a compound of grape-sugar and gallic acid, but latterly the conclusion had become discredited, and tannin was regarded as consisting mainly of digallic acid. This was synthesised in 1908 by Fischer and found to be crystalline, although astringent, and in 1912 he showed that the principal constituent of Chinese tannin does give glucose on hydrolysis. By a series of complex synthetical opera-

[1] Synopsis of the Emil Fischer Memorial Lecture delivered before the Chemical Society on October 28.

tions in association with Bergmann he prepared in 1918 the penta-(*m*-digalloyl)-derivatives of α- and β-glucose, and found them to be indistinguishable from the principle of Chinese tannin excepting for a slight difference in optical activity.

Fischer is entitled to a high place amongst the notable figures in chemical history associated with problems arising from the structure of uric acid and its derivatives. This work, begun in 1881, when he resolved caffeine into methylcarbamide and dimethylalloxan, reached its climax in 1898, when he derived purine from uric acid by means of indirect deoxidation. It has now passed into the text-books, and the classification of all such materials, many of which are important products of animal and vegetable metabolism, is based on his notation of 1897.

In view of their extent and the far-reaching biochemical conclusions based upon them, the labours of Fischer in the region of proteins make the same appeal to the imagination and evoke the same delight in craftsmanship as his activities amongst carbohydrates. Recognising amino-acids as the building materials of albuminoid molecules, he devised an unrivalled practical method for isolating them from the complex mixtures which follow the hydrolytic disruption of the proteins. Accumulating a large number of such units in their optically active forms, he proceeded to reassemble them as anhydrides, and thus elaborated molecules which, although much simpler than natural proteins, nevertheless approach them in physical properties. These were called polypeptides, and one of them, an octadecapeptide described in 1907, attained a molecular weight of 1213. The experimental methods developed in the course of these investigations are too complex for summary description, but they represent an extraordinary technical feat, and establish a connecting link between laboratory syntheses and the peptones arising from incomplete disruption of protein molecules. The investigation is limited only by material considerations, for a calculation made by Fischer in 1916 showed that the octadecapeptide has 816 possible isomerides, whilst a polypeptide involving thirty amino-acid molecules differing widely, but not entirely, amongst themselves may have isomerides reaching $1{\cdot}28 \times 10^{27}$ in number.

Throughout these inquiries Fischer made frequent and skilful use of enzymes, developing a technique which will offer substantial guidance to later investigators of vital changes. In 1894, having assembled a variety of artificial carbohydrates, he studied their behaviour towards different families of yeast, drawing the fundamental conclusion that the fermentative enzyme is an asymmetric agent attacking only those molecules of which the configuration does not differ too widely from that of *d*-glucose. Applying this principle to the natural and artificial *d*-glucosides, he ranged these in two groups, the α-*d*-glucosides being hydrolysed by maltase and indifferent towards emulsin, the β-*d*-glucosides exhibiting converse behaviour. The *l*-glucosides, *d*-galactosides, arabinosides, xylosides, rhamnosides, and glucoheptosides were not affected by either enzyme, and the glucosidic relation of sucrose, maltose, and lactose was determined by similar means. It was the knowledge thus gained which led Fischer to represent enzyme-action by the analogy of a lock-and-key, and to conclude that disaccharides are fermented only as a consequence of preliminary hydrolysis. Turning his attention to secretions of animal origin (1896), he studied the behaviour of carbohydrates and glucosides towards a great variety of tissue extracts and juices, but it was when these were applied by him, in association with Abderhalden (1903), to the proteins and polypeptides that the most fruitful results arose, from which it followed very clearly that the synthetic polypeptides are susceptible to zymolysis only when constructed of those amino-acids which occur in the natural proteins themselves.

Although the subjects to which Fischer mainly devoted his attention were not related directly to problems of manufacture, he quickly made contact with the chemical industry, and many of the processes in use at the Bayer, Höchst, and Böhringer factories were based upon principles developed in his laboratory; the improvement which he effected in the production of diethylbarbituric acid led to this compound becoming one of the most valuable hypnotics in pharmacy under the name "veronal." Whilst shunning publicity in its grosser forms, he played an active part in the German chemical world, and the reliance placed on his judgment by leaders of the German chemical industry ultimately grew into an attitude of trust which was quite exceptional. It was this which enabled him to become instrumental in establishing the Kaiser-Wilhelm-Institut für Chemie, a research foundation independent of teaching duties inaugurated in 1912. A pronounced individualist, he trusted personalities more than organisations and wisdom more than learning, his own kindling personality and clear wisdom being freely applied to the furtherance of scientific method, both industrial and academic.

It is not difficult to imagine the demands which were made upon him during the war period, the five years which were destined to be his last. In a directive capacity he was associated with many of the commissions charged with solving chemical problems connected with the great conflict, but it was the food shortage which engrossed his attention most urgently. There is no doubt that these labours and their fruitless issue preyed too heavily upon a constitution undermined by lifelong over-application to exhausting labour, and in view of the great age attained by his father, who passed the ninety-fourth year, his own demise was premature in every sense.

Even when due allowance has been made for the storehouse of accumulated facts upon which the chemists of his era were empowered to draw and for the variety of technique which was at their command, it can scarcely be claimed that in wealth of revelation and manipulative skill Emil Fischer is eclipsed by any of his predecessors. It is difficult to imagine that he can be surpassed by any of his successors, but whether this be so or not, his achievement will remain for all time a monument of industry, a masterpice of symmetry, and a gospel of inspiration.

The Physics and Chemistry of Colloids and their Bearing on Industrial Questions.

THE Faraday and Physical Societies held a joint discussion on "The Physics and Chemistry of Colloids and their Bearing on Industrial Questions" on October 25 in the spacious lecture theatre of the Institution of Mechanical Engineers. The societies were extremely fortunate in having the subject introduced by Prof. Theodor Svedberg, of the University of Upsala, who gave an excellent *résumé*, mainly from the physical point of view, of the present state of knowledge of the subject of colloids on the theoretical side. Prof. Svedberg's written contribution included an excellent bibliography of the subject, which will be found most helpful to physicists and others who wish to become acquainted with modern theoretical developments. The ensuing discussion was divided into the following five sections: (1) "Emulsions and Emulsification," opened by Prof. F. G. Donnan; (2) "The Physical Properties of Elastic Gels," opened by Mr. E. Hatschek and Prof. H. R. Procter; (3) "Glass and Pyrosols," opened by Sir Herbert Jackson; (4) "Non-aqueous Systems," opened by Sir Robert Robertson; and (5) "Precipitation in Disperse Systems: Cataphoresis and Electro-endosmose," opened by Prof. A. W. Porter.

In section (1) the discussion centred mainly around the important problem of the reversal of phases in emulsions produced by electrolytes. The results of experiments on soap emulsions carried out by Mr. S. S. Bhatnagar at University College, London, were given by the author, who concluded that there was a strict parallel between the reversal of phases in emulsions and the precipitation of suspensions by electrolytes. Apart from the considerable theoretical interest attaching to the subject, the matter is of practical importance in that it is closely associated with the action of soaps as protective colloids, to which property it appears probable their detergent nature is due. The speakers were unanimous in affirming the efficiency of the electrical method, first suggested by Clayton (Brit. Assoc. Colloid Reports, No. 2, p. 114, 1918), of ascertaining the point at which phase reversal takes place. A matter of considerable importance referred to by Prof. W. C. McC. Lewis, and agreed to by other speakers, was the necessity when studying the effects of electrolytes on colloids of employing solutions possessing the same conductivity rather than those of identical molar concentrations.

The discussion on the physical properties of elastic gels revealed how scanty is the present state of our knowledge of the mechanism of gel formation and the importance of further research in this direction. Mr. Hatschek emphasised the importance of an extended study of the mechanical properties of gels, which hitherto had been confined prectically to gelatin, in which chemical complications may arise. A much more promising field presented itself in non-aqueous systems, *e.g.* vulcanised rubber in benzene. In an investigation into the mechanical properties of gelatin Mr. Hatschek had obtained the astonishing result that, after straining a rectangular prism of 10 per cent. gelatin gel for five days, not only had the stress practically disappeared, so that on removing the constraint the strain remained, but the optical anisotropy remained after removal of the stress.

Prof. Procter, in advocating his well-known solid-solution theory—which, he explained, differed from the sponge-like structure theory mainly on the question of size—pointed out that the difference was not unimportant, since microscopic size of network excludes or complicates the simple chemical causes which are sufficient for the solid-solution view. The opposite view involves a mechanical structure which itself demands explanation. Critics of the solid-solution theory, however, found it difficult to believe that a 1 per cent. agar gel is a solid solution, and Prof. Procter admitted that the case of agar presented great difficulties.

Some very important work relating to gel structure has been carried out in the laboratories of Prof. McBain at Bristol on soap solutions, which in Prof. McBain's opinion excludes the cellular-structure theory. It has been shown in his laboratory that a half-normal solution of sodium oleate could be made to exist in any one of three forms: (*a*) Transparent liquid (sol), (*b*) a jelly (gel), and (*c*) a curd. The sol and gel are absolutely identical in every respect except in mechanical properties. They display identity of Na-ion content, refractive index, osmotic pressure, and conductivity, so that it appears that the particles present are identical in the sol and gel. On the contrary, in the curd form some of the soap separates out into fibrils and the conductivity disappears, this process being analogous to crystallisation. Prof. McBain considered these results to bear out the view of Zsigmondy and others that the particles in both sol and gel exist in micellar form and are linked together in some way analogous to the structure of liquid crystals. An example of the extraordinary character of the sol-gel transformation was brought to notice by Prof. Svedberg. A non-aqueous gel was formed of cadmium in alcohol having a cadmium concentration of only 0·1 per cent., in which the slightest vibration was sufficient to break down the whole structure and change it to the sol state.

Sir Herbert Jackson, in opening up the subject of glass and pyrosols, expressed doubt, except perhaps in some cases of colouring, as to whether glass came within the domain of colloids. With good glasses ordinary methods of illumination failed to reveal the Tyndall phenomenon, this being visible only with very strong illumination. The figures obtained by etching glasses he considered to be merely surface-tension effects, and afforded no evidence whatever of the colloidal nature of glass. In regard to the colouring of glasses much research is needed into the conditions under which various colours are produced. Evidence was adduced by Sir Herbert which makes it appear probable that the colouring substances have specific effects, although pure diffraction effects depending on the sizes of particles undoubtedly exist.

Non-aqueous colloid systems were dealt with under three headings: (*a*) Nitro-cellulose, (*b*) Celluloid, and (*c*) Rubber. Sir Robert Robertson dealt with the colloidal properties of nitro-cellulose gelatinised by means of suitable solvents, which properties have an important bearing on the manufacture of propellants. Useful relationships had been established between the viscosities of solutions of cellulose, those of the resulting solutions of nitro-cellulose, and the mechanical properties of the final dried material. By controlling the viscosities of the solutions the required mechanical properties of the resultant dried nitro-cellulose mixtures were assured. In connection with celluloid the discussion centred largely around the solvent property of binary mixtures, such as ether-alcohol, which is very different from that of the constituents separately. The ether-alcohol complex theory originally put forward by Baker was largely criticised. The discussion on the colloidal properties of rubber was confined practically to a communication by Mr. B. D. Porritt, who, in describing the effects of light on rubber, emphasised the important part played in rubber deterioration by oxygen, both as a catalyst and by direct chemical action. The inclusion of a dye to absorb ultra-violet light helps to prevent the deterioration. Experiments on the sol-gel transformation produced in rubber solutions by light and oxygen were described.

Perhaps the most important paper of the whole discussion, in that it represented a distinct advance in theory, was that by Mr. J. N. Mukherjee in section (5). Starting with the view that the charge on a suspensoid particle is due to adsorption, arising from chemical forces, of the ion the particle has in common with the peptising or stabilising electrolyte, Mr. Mukherjee has deduced a relation between the "electrical adsorbability" of the oppositely charged ion of the precipitating electrolyte and its valency and mobility. This theory not only results in the same series of cations arranged in order of adsorbability as that for the precipitation of negatively charged suspensoids, but also agrees extremely well with the most trustworthy experimental results on electro-endosmose.

On the whole, it may be said that the discussion centred around the physical properties of colloids rather than around their industrial applications, which are complex. Advancement in our knowledge of colloids can be made only by simplifying experimental conditions as much as possible, and thence building up step by step to the more complex cases. The full report of the discussion will be published in due course by the Department of Scientific and Industrial Research, and should be read by all those who are interested in this fascinating subject.

University and Educational Intelligence.

BRISTOL.—At Congregation held on October 22 the honorary degree of M.A. was conferred on Mr. Avery Adams, who has held the office of secretary to the Bristol Education Committee for thirty-three years; Mr. G. H. Burkhardt, head of the North Wilts Secondary School and Technical Institution; and Mr. W. A. Knight, head of Sexey's School at Bruton, Somerset.

CAMBRIDGE.—The trustees of the Capt. Scott Memorial Polar Research Trust have offered the University a sum of 6000*l.* towards the provision of a suitable wing or annexe to a proposed new school of geography, the special wing to serve as a Polar research institute. There is a prospect of financial help towards the maintenance and upkeep of the institute from the same source. The institute is to act as a centre both for information on Polar matters and for the working up of results, and it is to include a Polar library, a museum of Polar equipment, a collection of biological and geological specimens, and a set of rooms for research work. Cambridge University is chosen for the site of the institute as a centre which has already proved itself friendly to such research; it contains a nucleus of Polar men able to use and take a keen interest in the department, and is likely to continue to produce men equipped with the necessary knowledge and spirit for further work in Polar regions. An appeal will shortly be issued for funds to endow the larger building required for geographical studies.

A committee at Cambridge has collected a fund to commemorate Sir James Frazer's great services to learning. It is proposed to endow a Frazer lectureship in social anthropology, the lecture to be given annually in rotation at Oxford, Cambridge, Glasgow, and Liverpool.

It is proposed to make Dr. Duckworth, of Jesus College, reader in human anatomy. Dr. T. J. I'A. Bromwich, of St. John's College, has been re-appointed University lecturer in mathematics. Prof. J. T. Wilson has been elected a fellow of St. John's College.

The vote on the proposed statute admitting women to membership of the University has been fixed for December 8.

MAJOR DAVID DAVIES, M.P., has given 12,500*l.* to found a chair of tuberculosis at the Welsh National Medical School, University of Wales.

FOUR free lectures on "Four Great Geometers" (Archimedes, Galileo, Newton, and Clerk Maxwell) are announced for delivery by Mr. W. D. Eggar at Gresham College, Basinghall Street, E.C.2, on November 16–19. The lecture hour is 6 o'clock.

THE sum of 425,000*l.* has been stated by Mr. H. A. L. Fisher, President of the Board of Education, in reply to a question in Parliament, to be the price which the Duke of Bedford and his trustees have agreed to accept for the Bloomsbury site offered by the Government to the Senate of the University of London.

NOTICE is given by the University of London of the award in 1921 of the 100*l.* Rogers prize, the subject for which is "Hyperthyroidism and its Surgical Treatment." Copies of the regulations governing the competition and information as to the date on which the essays must be received can be obtained from the Academic Registrar, University of London, South Kensington, S.W.7.

VISCOUNT HALDANE will deliver an address entitled "The Nationalisation of Universities" at a reunion of old students of the Royal College of Science on Tuesday next, November 9, at the Imperial College Union, Prince Consort Road, South Kensington, London, S.W.7. The president of the Old Students' Association, Sir Richard Gregory, will take the chair at 8 p.m. The address will be followed by discussion.

THE prospectus of the courses to be held at the Municipal College of Technology, Manchester, during the year 1920–21 has been issued. Full-time courses extending over three years, which lead to certificates and degrees, are provided in mechanical, electrical, and sanitary engineering, and in the chemical and textile industries. Another feature of the college is the provision of part-time day courses for engineers' and other apprentices whose employers allow them to devote one whole day per week to study. Part-time evening courses which extend over five years are also given for the purpose of training men for responsible posts in industrial affairs. Research and advanced study receive attention, and students are prepared in part-time classes for degrees at Manchester and London in natural and technological sciences. A new degree of Doctor of Philosophy has been instituted with the object of encouraging research; candidates for this degree must be graduates of a university who have pursued an approved course of advanced study or research in Manchester University for a period of at least two years, of which not more than one year may be spent in another approved institution. Details of the full-time courses are given, but for particulars of the part-time classes application should be made to the Registrar for the prospectus of the department concerned.

ON September 29 the executive of the Engineering Training Association met, by authority of the council of that body, to consider the transference of the work of the association to the Federation of British Industries or to the Engineering and National Employers' Federations. Representatives of these different bodies were present, and outlined the motives which induced their respective organisations to make the offer. Mr. Richmond, on behalf of the Engineering and National Employers' Federations, stated that the chief reason for his society's offer was the increasing frequency and the greater importance of training questions which occur in the agenda of the federation's conferences with Labour. Until now they had been satisfied with the work of the Engineering Training Association, but they felt that as the latter body was about to cease to be an independent unit they were in the best position to carry on its work without interfering with that of other organisations. Mr. Prescott, speaking for the Federation of British Industries, said that they were prepared to carry on the work of the Engineering Training Association if they were asked to do so, or to stand aside if they felt satisfied that the work would be done properly by someone else. The co-ordination of industrial education was part of the work of his body, but if he could receive assurances that the Engineering and National Employers' Federations would keep the educational section of the Federation of British Industries fully informed, and that the two societies would co-operate in the fullest possible way, he would be glad to withdraw the offer of the latter in favour of the Employers' Federation. After a discussion the executive of the Engineering Training Association decided to accept the offer of the Engineering and National Employers' Federations, and details of the transfer were delegated to the honorary organiser, Mr. A. E. Berriman.

Societies and Academies.

PARIS.

Academy of Sciences, October 11.—M. Henri Deslandres in the chair.—The president announced the death of Prof. Yves Delage.—G. **Bigourdan**: Corrections of the normal time-signals emitted by the Bureau international de l'Heure from January 1 to March 19, 1920. Two tables give corrections of the ordinary partly automatic signals and of the beats 1 and 300 of the scientific signals.—Y. **Delage**: The application of the Pitot tube to the determination of the velocity of ships and to the registration of the distances traversed. The Pitot tube has been much used for the determination of fluid velocities with respect to immersed solid objects; it can also be utilised to determine the velocity of an object moving in still water, and its application to the measurement of the speed of a vessel is described in the present communication. Various devices are given for working the indicator at a distance from the Pitot tube, for rendering the indications independent of the variations of the load of the vessel, and for arranging that the movements of the needle shall be proportional to V and not to V^2, so that from the continuous curve the total distance traversed can be estimated.—C. **Moureu** and G. **Mignonac**: The dehydrogenation of alcohols by catalytic oxidation under reduced pressure. The general method described in a previous paper for the preparation of aldehydes and ketones by the catalytic oxidation of the corresponding alcohols by air in presence of reduced silver gives excellent results for the alcohols of low molecular weight, but the yield diminishes as the molecular weight of the alcohol increases. By working under reduced pressure (20 mm. to 40 mm.) this difficulty is removed.—P. **Termier**: The mylonites of the fourth Briançon *écaille*.—The secretary announced the death of M. Daniel Pauline Œhlert, correspondant for the section of mineralogy.—A. **Chatelet**: The enumeration and constitution of any Abelian body whatever.—L. **Antoine**: The possibility of extending the homœomorphy of two figures to their vicinity.—J. **Andrade**: Friction and isochronism.—Ch. **Déné**: Waves of shock. The results of the study of a series of photographs of a stationary projectile placed in a stream of air moving at the rate of 450 metres per second. As the secondary waves are stationary, they can be more easily photographed and studied.—W. A. **Loth**: A new method of navigation, permitting any vessel to enter and leave our (French) ports without risk when the usual means of determining the route are missing. An armoured cable traversed by an alternating current with a musical frequency is laid on the sea-floor along the track to be followed, and a telephonic receiving apparatus of special design is carried by the entering vessel. One person without specialised knowledge can bring in a ship, as has been shown by practical trials at Brest.—R. **Dubrisay**: The application of a new method of physico-chemical volumetry. The solutions under examination are mixed with an equal volume of phenol and the temperature of miscibility is determined. The method has been applied to the study of mixtures of solutions of sulphuric acid and sodium hydroxide, and two angular points are shown on the experimental curve corresponding to the formation of $NaHSO_4$ and Na_2SO_4. It is noteworthy that when the neutralisation curve of sulphuric acid is followed by electrical conductivity or by cryoscopy no point corresponding to the formation of $NaHSO_4$ is detected.—P. **Bugnon**: Causes of the transversal course of the libero-ligneous bundles at the nodes of the Gramineæ.—C. **Beau**: The trophic *rôle* of the endophytes of orchids.—G. **Astre**: The biology of the molluscs in the French coast dunes and its relations with botanical geography. A discussion of the distribution of molluscs as affected by varying conditions of dryness. Apart from some secondary modifications of minor importance, the malacological fauna of the dunes is not one which has evolved in view of adaptation to a special medium, but a fauna already pre-adapted on the Mediterranean coasts, and which has simply extended its area of distribution.—P. **Wintrebert**: The aneural conduction of the ectoderm in the embryos of Amphibians.—M. **Caullery** and F. **Mesnil**: The existence of asexual multiplication in certain Sabellians (*Potamilla Torelli* and *Myxicola dinardensis*).—L. **Besson**: Relations between the meteorological elements and the number of deaths through inflammatory diseases of the respiratory organs in Paris. The data covered 522 weeks, and showed a clear relation between the number of deaths and the mean temperature three weeks before. From 0° C. to 14° C. the fall in the number of deaths was proportional to the rise in temperature. Above 20° C. the deaths remained constant and independent of the temperature.

HOBART.

Royal Society of Tasmania, September 13.—Mr. L. Rodway, vice-president, in the chair.—Dr. W. L. **Crowther**: The Tasmanian aborigines. The general habits of the race were traced and the osteology of the aborigines was described.—H. H. **Scott** and C. **Lord**: *Nototherium Mitchelli.* The apendicular skeleton, including the mamus, and pes (hitherto unknown). The paper dealt in detail with the osteological formations of the feet of the Nototheria. After describing in detail the various characteristics of these and other portions of the specimen under review, the authors append various recapitulative notes on their studies to date. In the course of these they point out that their aim has been to show that the rhinoceros type was not absent from the fauna of Australia in ages past. True to the structural type of the country, the animals retained the marsupial habit, simply grafting on to it the results of that evolutionary trend that has culminated in other lands in the Perissodactylan lengulates. For the scientific use of the skeleton of *Nototherium Mitchelli* the authors are indebted to Mr. K. M. Harrisson, of Smithton, who generously placed the specimens at their disposal for the purpose named. Mr. Harrisson has also presented the whole of the remains to the Tasmanian Museum, Hobart, with a view to their future exhibition in that institution.—W. L. **Crowther** and C. **Lord**: A descriptive catalogue of the osteological specimens relating to *Homo tasmanensis* contained in the Tasmanian Museum. For their introductory remarks the authors state that during the course of the preparation of a paper dealing with certain recent valuable additions to the Tasmanian Museum it became necessary to revise the complete collection of the osteological specimens relating to the Tasmanian aboriginals. The present list forms a record of the largest single collection of osteological remains of the extinct Tasmanian aboriginals. The main portion of the paper deals with 361 osteological specimens relating to the Tasmanian aboriginals, each bone being described.

Books Received.

Recent Advances in Physical and Inorganic Chemistry. By Prof. A. W. Stewart. Fourth edition. Pp. xvi+286+v plates. (London: Longmans, Green and Co.) 18*s*. net.

Aeronautics in Theory and Experiment. By W. L. Cowley and Dr. H. Levi. Second edition. Pp. xii+331+plates. (London: E. Arnold.) 25*s*. net.

Spiritualism and the New Psychology. By M. Culpin. Pp. xvi+159. (London: E. Arnold.) 6*s*. net.

Recueil de l'Institut Botanique Léo Errera. Tome iv. Pp. xi+653+plates. 50 francs. Tome x., Fasc. 1. Pp. 80. (Bruxelles: M. Lamertin.)

Imperial Institute. Indian Trade Inquiry. Reports on Rice. Pp. ix+164. (London: J. Murray.) 6*s*. net.

Diagnosis and Treatment of Brain Injuries with and without a Fracture of the Skull. By Prof. W. Sharpe. Pp. vii+757. (Philadelphia and London: J. B. Lippincott Co.) 35*s*. net.

The Wild Unmasked. By F. St. Mars. Pp. 376. (London and Edinburgh: W. and R. Chambers, Ltd.) 6*s*. net.

Obstetrics: Normal and Operative. By Prof. G. P. Shears. Third edition. Pp. xxii+745. (Philadelphia and London: J. B. Lippincott Co.) 35*s*. net.

Habits and Characters of British Wild Animals. By H. M. Batten. Pp. 346. (London and Edinburgh: W. and R. Chambers, Ltd.) 21*s*. net.

An Account of the Crustacea of Norway. By G. O. Sars. Vol. vii.: Copepoda. Supplement, parts iii. and iv.: Harpacticoida (continued). Pp. 25–52+xvii–xxxii plates. Parts v. and vi.: Harpacticoida (continued). Pp. 53–72+xxxiii–xlviii plates. (Bergen: Bergen Museum.)

Anleitung zum Nachweis zur Trennung und Bestimmung der Reinen und aus Glukosiden esw. erhaltenen Monosaccharide und Aldehydsauren. By Dr. A. W. van der Haar. Pp. xvi+345. (Berlin: Gebrüder Borntraeger.) 64 marks.

Die Reaktionen des freien Stickstoffs. By Prof. W. Moldenhauer. Pp. viii+178. (Berlin: Gebrüder Borntraeger.) 26 marks.

The Chemistry of Crop Production. By Prof. T. B. Wood. Pp. vii+193. (London: University Tutorial Press, Ltd.) 5*s*. 6*d*.

A Dictionary of Scientific Terms. By I. F. Henderson and Dr. W. D. Henderson. Pp. viii+354. (Edinburgh and London: Oliver and Boyd.) 18*s*. net.

Bio-Moulding Origins in Evolution. By Dr. H. Elliot-Blake. Pp. 140. (London: J. G. Hammond and Co., Ltd.)

The Serbian Epidemics of Typhus and Relapsing Fever in 1915. By Col. W. Hunt. Pp. 29–158. (London: J. Bale, Sons and Danielsson, Ltd.) 7*s*. 6*d*. net.

Notes on Geological Map-Reading. By A. Harker. Pp. 64. (Cambridge: W. Heffer and Sons, Ltd.) 3*s*. 6*d*. net.

Betty and Bobtail at Pine-Tree Farm. By Lilian Gask. Pp. 224. (London: G. G. Harrap and Co., Ltd.) 6*s*. net.

Physiology. By Dr. F. Roberts. Pp. viii+389. (London: J. and A. Churchill.) 15*s*. net.

Instinct and the Unconscious. By Dr. W. H. R. Rivers. Pp. viii+252. (Cambridge: At the University Press.) 16*s*. net.

Department of Applied Statistics, University of London, University College. Questions of the Day and of the Fray, No. X. The Science of Man: Its Needs and its Prospects. By Prof. K. Pearson (Presidential Address to Section H of the British Association, Cardiff.) Pp. 17. (London: Cambridge University Press.) 1*s*. 6*d*. net.

Islands Far Away. By Agnes G. King. Pp. xxvii+256. (London: Sifton, Praed and Co., Ltd.) 18*s*. net.

Classification des Sciences: Les Idées Maîtresses des Sciences et leurs Rapports. By Prof. A. Naville. Troisième édition. Pp. iii+322. (Paris: F. Alcan.) 10.50 francs.

Tools and Weapons: Illustrated by the Egyptian Collection in University College, London, and 2000 Outlines from other Sources. By Prof. W. M. Flinders Petrie. Pp. vii+71+lxxix plates. (London: Constable and Co., Ltd.; B. Quaritch.) 35*s*. net.

The General Principle of Relativity: In its Philosophical and Historical Aspect. By Prof. H. Wildon Carr. Pp. x+165. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Laboratory and Field Exercises for "General Botany." By Prof. H. D. Densmore. Pp. viii+199. (Boston and London: Ginn and Co.) 3*s*. 9*d*. net.

Medical Electricity. By Dr. H. L. Jones. Eighth edition, revised. Pp. xv+575. (London: H. K. Lewis and Co., Ltd.) 22*s*. 6*d*. net.

Samuel Hartlib: A Sketch of his Life and his Relations to J. A. Comenius. By Dr. G. H. Turnbull. Pp. viii+79. (London: Oxford University Press.) 5*s*. net.

The British Academy. International Scholarship. Presidential Address delivered at the Annual Meeting of the British Academy, July 21, 1920. By Sir F. G. Kenyon. Pp. 14. (London: Oxford University Press.) 1*s*. 6*d*. net.

This Wonderful Universe. A Little Book about Suns and Worlds, Moons and Meteors, Comets and Nebulæ. By Agnes Giberne. New illustrated edition, completely rewritten. Pp. x+182. (London: S.P.C.K.; New York: The Macmillan Co.) 6*s*. 6*d*. net.

The Nature of Animal Light. By Prof. E. N. Harvey. Pp. x+182. (Philadelphia and London: J. B. Lippincott Co.) 10*s*. 6*d*. net.

Diary of Societies.

THURSDAY, NOVEMBER 4.

ROYAL SOCIETY, at 4.30.—Prof. H. Lamb: The Vibrations of an Elastic Plate in Contact with Water.—Prof. H. M. Macdonald: The Transmission of Electric Waves around the Earth's Surface.—Lord Rayleigh: A Re-examination of the Light scattered by Gases in respect of Polarisation. II. Experiments on Helium and Argon.—Prof. C. F. Jenkin: Dilatation and Compressibility of Liquid Carbonic Acid.—W. T. David: Radiation in Explosions of Hydrogen and Air.—Dr. R. E. Slade and G. I. Higson: Photochemical Investigations of the Photographic Plate.—Dr. E. H Chapman: The Relationship between Pressure and Temperature at the same Level in the Free Atmosphere.—Prof. J. C. McLennan: Note on Vacuum Grating Spectroscopy.

SOCIETY OF ENGINEERS (Inc.) (at Burlington House), at 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. R. C. B. Wall: Chorea (Bradshaw Lecture).

LINNEAN SOCIETY, at 5.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Wing-Comdr. Flack: The Human Machine in Relation to Flying.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.45.—Dr. C. F. Sonntag: The Action of Baths on the Skin and Nervous System.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Mrs. S. S. Brierley: Discussion on Vocational Tests.

CHEMICAL SOCIETY, at 8.—L. Higginbotham and H. Stephen: The Preparation of 4-, 5-, and 6-Methyl-coumarin-2-ones. and some Derivatives of *o*-, *m*-, and *p*-Tolyloxyacetic Acids.—H. Stephen:

A New Method for the Preparation of 2:4-Dihydroxy- and 2:4:4′-Trihydroxy-benzophenone, and some Observations relating to the Hoesch Reaction.—W. J. Pope and E. E. Turner: Triphenylarsine and Diphenylarsenous Salts.—R. H. Atkinson, C. T. Heycock, and W. J. Pope: The Preparation and Physical Properties of Carbonyl Chloride.—H. W. Bausor, C. S. Gibson, and W. J. Pope: Interaction of Ethylene and Selenium Monochloride.—G. Van B. Gilmour: A Study of the Reactions of Sugars and Polyatomic Alcohols in Boric Acid and Borate Solutions, with some Analytical Applications.—F. L. Pyman and L. A. Ravald: The Sulphonation of Glyoxalines.—F. L. Pyman and L. A. Ravald; o- and p-Tolueneazoglyoxalines.—M. E. Laing and J. W. McBain: Investigation of Sodium Oleate Solutions in the Three Physical States of Curd, Gel, and Sol.—J. C. Irvine and E. S. Steele: The Constitution of Polysaccharides. Part I. The Relationship of Inulin to Fructose.—B. E. Hunt: The Preparation of Ethyl Iodide.—R. C. Menzies: Action of Sulphur Trioxide on Aromatic Ethers.—G. T. Morgan and H. D. K. Drew: Researches on Residual Affinity and Co-ordination. Part II. Acetylacetones of Selenium and Tellurium.—R. B. Drew: The Formation of 2:3:6-Trinitrotoluene in the Nitration of Toluene.—J. N. E. Day and J. F. Thorpe: The Formation and Reactions of Imino-compounds. Part XX. The Condensation of Aldehydes with Cyanoacetamide.—O. Becker and J. F. Thorpe: The Formation and Stability of Spiro-compounds. Part III. Spiro-compounds from Cyclopentane.—H. Chattopadhyaya and P. C. Ghosh: Condensation of Dimethyldihydroresorcin with Aromatic Aldehydes.—E. B. Maxted: The Influence of Lead on the Catalytic Activity of Platinum.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—J. D. Barris and M. Donaldson: Acute Inversion of the Uterus. Treatment by Blood Transfusion and Late Replacement.—Drs. R. A. Hendry, A. Routh, and J. Adams: Latent Syphilis During Pregnancy.

FRIDAY, NOVEMBER 5.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—Prof. F. W. Oliver: The Reclamation of Waste Land by Botanical Means.—Dr. E. J. Russell: The Reclamation of Waste Land by Agricultural Means.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.

GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—Discussion on the African Arc and Meridian, to be opened by Col. H. G. Lyons, and continued by Sir Charles Close, Col. E. M. Jack, A. R. Hinks, C. G. T. McCaw, and others

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at the Patent Office Library), at 5.30.—E. W. Hulme: Introduction to the Literature of Historical Engineering.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Richard T. Glazebrook: Limit Gauging (Thomas Hawksley Lecture).

JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—E. Cooper: Some Further Locomotive History.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. D. W. Buxton: The Psychology of Anæsthesia.

MONDAY, NOVEMBER 8.

BIOCHEMICAL SOCIETY (at Imperial College of Science).

ROYAL SOCIETY OF MEDICINE (War Section), at 5.30.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Meeting), at 7.—C. Poole: Electric and Hydraulic Elevators.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual Presidential Address.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—Dean W. R. Inge: Is the Time Series Reversible? (Presidential Address).

SURVEYORS' INSTITUTION, at 8.—J. Wilmot: Presidential Address.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Brig.-Gen. The Hon. C. G. Bruce: Mount Everest.

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.30.—Clinical Meeting.

TUESDAY, NOVEMBER 9.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. G. Browne: Arabian Medicine after Avicenna (FitzPatrick Lecture).

SOCIOLOGICAL SOCIETY (at 65 Belgrave Road, S.W.1), at 5.15.—Mrs. V. Branford: Theology and Sociology.

MINERALOGICAL SOCIETY (at Geological Society), at 5.30.—(Anniversary Meeting.)—Dr. E. S. Simpson: A Graphic Method for the Comparison of Minerals with Four Variable Components forming Two Isomorphous Pairs.—L. J. Spencer: Fibrolite (=Sillimanite) as a Gem-stone, from Burma and Ceylon.—Dr. J. W. Evans: The Origin of the Alkali Rocks.—A. F. Hallimond, with an analysis by J. H. Whiteley: Monticellite, from a Mixer Slag.—Dr. H. H. Thomas and A. F. Hallimond: A Refractometer for the Determination of Liquid Mixtures.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—Presidential Address.

OLD STUDENTS' ASSOCIATION OF THE ROYAL COLLEGE OF SCIENCE (at Imperial College Union, South Kensington), at 8.—Viscount Haldane: The Nationalisation of Universities.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Dr. W. H. R. Rivers: The Origin of Hypergamy.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. E. F. Buzzard: Some Aspects of Mental Hygiene (Presidential Address).

WEDNESDAY, NOVEMBER 10.

ROYAL SOCIETY OF MEDICINE (Surgery: Proctology Sub-section), at 5.30.—E. Miles: Presidential Address.—L. Mummery: The Operative Treatment of the Prolapse of the Rectum in Adults.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.—J. H. S. Dickenson: Some Notes on the Report of the Steel Research Committee.

THURSDAY, NOVEMBER 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—Dr. W. G. Ridewood: The Calcification of the Vertebral Centra in Sharks and Rays.—Dr. A. Compton: Studies in the Mechanism of Enzyme Action. I. *Rôle* of the Reaction of the Medium in fixing the Optimum Temperature of a Ferment.—C. H. Kellaway: The Effect of certain Dietary Deficiencies on the Suprarenal Glands.—E. J. Collins: The Genetics of Sex in *Funaria hygrometrica*.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Annual General Meeting.

ROYAL SOCIETY OF MEDICINE, at 5.—Sir Almroth Wright: Medical Research.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. G. Browne: Arabian Medicine after Avicenna (FitzPatrick Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir D'Arcy Power: The Education of a Surgeon under Thomas Vicary (Thomas Vicary Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Ll. B. Atkinson: Inaugural Address.

OPTICAL SOCIETY, at 7.30.—Major E. O. Henrici: The Use of Internal Focussing Telescopes for Stadia Surveying.—Dr. R. J. E. Hanson: Visual Fatigue and Eye Strain in the Use of Telescopes.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. H. Head and Others: Discussion on Aphasia.

FRIDAY, NOVEMBER 12.

INSTITUTE OF CHEMISTRY, at 4.—To Receive Report of the Extraordinary General Meeting of October 28 and confirm the Resolutions and By-laws passed thereat.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Dr. F. S. Goucher: Ionisation and Excitation of Radiation by Electron Impact in Helium.—J. Guild: Fringe Systems in Uncompensated Interferometers.—J. Guild: The Location of Interference Fringes.—Dr. G. Barr: A New Relay for Moderately Heavy Currents.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.—Dr. F. Parkes Weber: Chronic Myeloid Leukæmia—Death from Acute Anæmia due to Massive Hæmorrhages (Hæmatomata), Simulation of Slight Pyuria by Leukæmic Oozing in the Urine.—Z. Cope: Diathragmatic Shoulder Pain.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.—Informal Meeting.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Dr. J. Taylor: Some Neurological Aspects of Ophthalmic Cases (Presidential Address).—P. Smith: The Blood-vessels in the Eye of the Ox.

CONTENTS.