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## University Staffs and University Finance.

THE recent revision of the conditions of tenure and salary of the non-professorial staff at the University of Edinburgh, referred to in a letter published in NATURE of May 24, raises again the whole question of the position of these grades at universities generally, and the extent to which their position is satisfactory alike to themselves and to the institutions they serve. That such staffs believe themselves the victims of grievances is apparent to any one conversant with the present situation at most universities in Great Britain.

During the past quarter century, with the growth of specialisation and the increase in student numbers, a progressive change has occurred in the character of the work undertaken by a large proportion of these staffs. From the stage of being mere personal assistants to the professor, they are now very frequently directly responsible for honours courses and for the supervision of the work of research students. From the point of view both of disseminating existing knowledge and of opening up and exploring new fields of inquiry, they have become an indispensable section of every university.

Unless adequate facilities are provided, however, and the conditions such as to enable these individuals to devote their free time to original reading, thought, and inquiry, it is clear that this work cannot be conducted efficiently. It is notorious that demonstrators and lecturers of various grades, with increasing social responsibilities as they grow older, with no security of tenure, inadequate salaries for the positions they are expected to maintain or the interests they are required to develop, crowded in their grades with no prospect for the great mass of real advancement because of the paucity of higher posts, spend arduous nights away from home, teaching evening classes or undertaking other hack-work to supplement their meagre salaries. It is absurd to pretend that under such conditions their normal duties can be efficiently conducted, and an inquiry into the whole question of payment and the evils that are arising from continued under-payment is undoubtedly urgent before the rot has time to inflict permanent harm on university teaching.

The whole standard of staffing is affected by this question. The obvious lack of prospects of the junior staffs acts as a deterrent upon the better graduate from entry into the profession, and impels the ambitious demonstrator or lecturer, eminently suited as he may be to an academic career, to turn to secondary school teaching, where, with even inferior qualifications, he is certain to rise from 300*l.* or more per annum to 500*l.* or 600*l.* instead of remaining at a fixed salary of 300*l*. or 400*l*. While it is true that certain individuals will always be attracted to university work, irrespective of the conditions, it is quite clear that the factor of low salaries is operating to drive the better type of graduate into school teaching and government service and to force the universities to retain on their staffs inferior men. The effect of this on our educational system will presently be apparent. While it is essential that the best personnel should be attracted to the academic teaching profession, they will only be induced to enter and remain by offering a career comparable to that obtainable in other fields. This can scarcely be said to be the case at present at Edinburgh, as we are informed in a memorandum issued by a committee of the staff that during the past year the average salary of the members of the non-professorial staff (248) was about 260*l*. and that for the professorial staff (52) about 1100*l*. It may be noted that where the work and responsibility of the one grade shade continuously into those of the other, this disparity in reward is too acute to be regarded as wholesome.

It is, however, not merely with the question of salary that these grades are apparently dissatisfied. While it is a fact that in a few universities, within the past few years, some members of the lectureship and readership grades have been admitted to membership of senates, no adequate scheme of direct representation of non-professorial grades on the senates and governing bodies of universities has been put universally into operation. There is in general no constituted machinery whereby members of these grades may make known their views on matters affecting the general policy of the university and their own interest. Such a state of affairs cannot, of course, endure. The devolution in administrative and educational responsibility and initiative, essential in the modern university, implies on the part of the staff a progressive experience and familiarity with problems affected by university policy which ought, in the interests of efficiency, to be fully utilised. No greater mistake could be made by any governing body than to regard the staff as mere employees or "hands."

Associated with these two aspects of the question, that of finance and that of policy, must be mentioned the tendency which has manifested itself of earmarking increases of capital, whether by gift or otherwise, for the foundation of new chairs or the creation of new buildings. If gifts of this nature are never to be expended on the salaries of the staff, not even towards the salaries of the additional staff required to carry on the work of the new extensions, the position of the non-professoriat must become more acute, especially since it has become customary to discuss the salaries of the latter always in relation to current income.

From the point of view of the institutions themselves the problem is not easy. Faced with a decrease in student membership and revenue from fees, increases in expenditure and decreases in grants, heavy rates and requests for the extension of their functions, their lot indeed is not a happy one. The standard of teaching must be maintained, the research spirit must be fostered, and the educational needs of a rising democracy catered for.

The problem is twofold—administrative and financial. A little, perhaps very little, might be effected by increased economies in administration, but in the shaping of a progressive and enlightened policy everything is to be gained and nothing lost by the fullest representation of the staffs on the governing bodies. On the financial side, however, the position is much more critical. The saturation point has probably already been reached as regards income from fees; further increase is, moreover, undesirable in the light of present-day demands for the removal of financial barriers to a university education. Meanwhile, as an immediate proposal, if the Government is in earnest in its professions on education and on the injustices of Local Rating, we see no reason why clauses exempting educational institutions from local taxation should not be introduced into the Bill on Local Rating which we understand it has in contemplation. This would in effect secure to universities a contribution from local authorities equal to the present taxation paid by these institutions without the unpleasant necessity of begging for such a grant. The suggestion seems at any rate worthy of consideration.

In any event, the financial situation of the universities in Great Britain is really too critical for any mere tinkering to ease it permanently. All such institutions have more than a merely local interest, and as such their finances require to be considered on a broader basis. Their functions and responsibilities interweave and overlap, and to require each body to produce a budget which balances in itself is foolish finance. At what point the universities will be ready for drastic changes it is impossible to say, but some such change is inevitable and probably imminent. A broadening of the budgeting basis, a closer and more deliberate interlocking of the functions of separate institutions, would probably result not merely in a more effective economy in administration, but would unify the standard of grading in the staffs from one university to another. The time is, indeed, ripe for a Royal Commission on the financial position of the Universities of Great Britain, excluding Oxford and Cambridge.

## Rice.

*Rice.* By Prof. E. B. Copeland. Pp. xiv+352+18 plates. (London: Macmillan and Co., Ltd., 1924.) 20*s*. net.

IF all the rice grown in India were planted in the British Isles, there would not be standing room for it. Yet the area under rice in India, with the exception of Bengal, is practically confined to a coastal fringe and is far from supplying the requirements of the people. The *per capita* ration for a rice-eating population would probably fall something short of three pounds a day, and the consumption in India is more like one pound. The staple food in a great tract in the north is wheat (there are 50,000 square miles of wheat in India), while the main cereal food of the population in the remainder consists of various millets. In other words, the ninety million acres under rice in India fall far short of the requirements of the country, and to a large proportion of the population rice is an almost unobtainable luxury. At the conclusion of the Armistice, festive gatherings were held in all parts of India, and at one in which the writer took part, representatives of all the neighbouring tribes were given a substantial meal. It transpired that some of these had never tasted rice, and, the quantity not being stinted, the unique spectacle was witnessed of the emaciated human frame swelling visibly during one short afternoon into comfortable rotundity.

China and Japan are two other great rice countries, and although statistics are not available, it is probable that somewhat similar conditions prevail there also, in spite of a distinctly higher scale of living, for we know that vast quantities of millets are grown in both of them. In northern China wheat is the main cereal. On comparing the maps of world distribution of rice and wheat, these crops are seen to be wonderfully complementary, the former spreading over the warmer portions and the latter over the colder; but the true rice zone has a much more restricted range, being concentrated in the monsoon tract in south-east Asia —Japan, China, India, Indo-China, and the Malay Archipelago.

Outside the region of the monsoons, rice appears sporadically all over the tropics, often being introduced to feed Asiatic labour, and even extends beyond the limits of the tropics into southern Europe, north and south Africa, and the New World (maize, of course, being the staple cereal there); but the area devoted to its cultivation in these parts is practically negligible when compared with that in the monsoon countries named above. The statement that one often meets with, that more than half the human race eat rice, is presumably based upon the large populations crowded into south-eastern Asia, but it should be accepted with some reservation. This appears to be recognised by Prof. Copeland, for he merely remarks that "it is probably the staple food of the greatest number of people."

The book is frankly one-sided, but this may, perhaps, be regarded as one of its greatest merits. Any attempt to cover the whole rice world, with its multitudinous varieties and agricultural practices, would require such a volume or series of volumes as would be a weariness to the general reader, if not out of his reach on account of costliness. We have nothing but praise for the author on the result of his effort, coupled with a sense of gratitude for his summarising, in small compass, the more important literature which has sprung up in various centres as the result of their invasion by western science. Most of this literature is altogether inaccessible, even to students in Great Britain. Prof. Copeland deliberately chooses the United States and the Philippines for his main descriptions of agricultural practice, on the sound plea of his thorough familiarity with the cultivation of rice in these countries. Of the countries dealt with, the United States claim fifty pages and the Philippines forty, while sixty pages are divided into short sections on India, Siam, China, Indo-China, Ceylon, Malaya, Java, Japan, Africa, Latin America, Spain, and Italy; more than half of these pages go to India (13), Java (8), Japan (7), and Italy (8). The rest of the book contains general chapters on botany, climate, soil and water, diseases and pests, seed and varieties, and the uses of rice; and in these chapters there are frequent references to such literature as has been published in all of these countries.

The choice of the United States and the Philippines for main treatment is abundantly justified by the fact that they represent the extremes in climate and agricultural practices. It has been stated that although labour is twenty times cheaper in China than in the United States, rice can be grown at less cost in the latter country. One man can only work one or two acres of rice in China, whereas, with the up-to-date agricultural machinery developed in cereal culture in temperate countries, a man can manage 80 acres in the United States. Yet the average yield of rice per acre appears to be only moderate. Analysing the crops in various countries given in the latest Statistical Year-book of the International Institute at Rome, we find that the greatest yields are obtained in Spain and Hawaii. High yields are also obtained in Italy, Egypt, and Japan; moderate in the United States, Java, India and Indo-China; while very low ones characterise Ceylon, the Philippines and Borneo. Judging from this point of view, the choice of the Philippines would not appear to be so satisfactory, especially as the total output is very small in comparison with that of the great continental monsoon areas. But no country can be compared with these islands in the variety and picturesqueness of its paddy fields, as is at once evidenced by the two striking photographs of the Igorot cultivation in N. Luzon, fitly illustrating the labour involved through countless generations in terracing the almost impossible slopes among the mountains which are characteristic of the group. We must, however, guard against the idea that these terraces are in any way typical, and refer the reader to the pictures opposite to p. 234 for the more usual appearance of the paddy fields in the tropics. For the rest, the Philippines present sufficiently clear cases of the practices of indigenous tropical rice-growing; and there is always the author's plea as to his own intimate personal knowledge, which outweighs other considerations. His account of rice cultivation in the Philippines is indeed clear and interesting.

Prof. Copeland's agricultural classification of rices could, however, with advantage be somewhat widened, if for no other reason than to emphasise the extreme adaptability of this remarkable plant, on which the author insists. The classes given for the Philippines are four in number: clearing or *caingin*, upland or *secano, sabog* or broadcasting, and typical lowland (presumably transplanting). These are all present in India, although, as in the Philippines, the first named is extremely rare and fast disappearing; but at least two if not three classes should be added to make the classification more complete. The most interesting case is that of "dry paddy," which is grown just like many other crops in parts of India, on dry land with small rainfall under intensive dry farming methods. This paddy is drill-sown and best grown on black cotton soil; indeed, we believe that it is one of the curious *payira* crops, which will grow to maturity, once a sufficient fall of rain ensures satisfactory germination, without any further moisture than that of the air. This is obtained by the soil from certain moisture-laden winds ("crop winds," or *payira*), which blow during two or three months of the dry season. Then Indian "wet paddy" should be divided into two classes, which may be called swamp and irrigated respectively; the first, where the seed is sown on the margins of temporary lakes filled by the surplus of the monsoon rains and slowly drying up as the paddy ripens; and the second or ordinary lowland paddy, where it is absolutely necessary that a constant slow current of water four to six inches deep should pass over the ground, thus continuously changing the water. Then there is the "deep water paddy" mentioned by the author in another place: as to this, briefly, the writer has seen the oxen ploughing the land with the water almost hiding them completely, and the crop is said to be frequently harvested in boats. It is, of course, obvious that each of these methods will only be applicable to distinct varieties of the plant, and the agricultural practices are entirely different. Some interesting photographs of field work illustrate the chapter on the Philippines, and these fairly represent those in the monsoon tract.

In the United States section, Prof. Copeland concentrates his attention on the irrigated, Californian zone which is practically rainless during the growth of the crop. The areas in thousands of acres in the four principal rice States were in 1920 (the maximum), in Louisiana 700, Texas 281, Arkansas 175, and California 162, but were considerably less in 1923. The brief account given of the first three, the Gulf States, is useful, but, as good accounts in bulletin form are available of the Californian area and much less so regarding the other, we should naturally have preferred a straightforward account of this larger and older rice tract. This is especially so because of what we may call the fascinating account given by the author of the section chosen, a term which can scarcely be applied to such information as we have been able to gather on the Gulf States cultivation.

Turning to the general chapters, the first is appropriately devoted to the botany of the rice plant, and, as we gather, this chapter is written at any rate largely by another author. The morphological details of the rice plant are not very easy to describe without a series of adequate drawings, and this chapter is not illustrated. There is no picture of the rice plant, or of any of its parts, and some of the peculiarities, such as the leaf parts, are somewhat difficult to envisage; while a clearly drawn longitudinal section of the grain would make much of this and later chapters more easy to read and understand. It is scarcely usual to describe a graminaceous flower as "perfect," because the rice plant has six stamens in place of the usual three: the seed is described as "consisting of two thin coats, the endosperm and the embryo," and this scarcely conveys the fact that it is built on identical lines with the wheat seed.

In the part dealing with the physiology of wet paddy, a review of the literature regarding nitrogen assimilation is quoted as showing that the rice plant differs from most others in depending on ammonium salts rather than nitrates. These conclusions may be correct for the free draining soils of Hawaii, but we doubt whether they will be so for wet paddy in the east. As bearing upon this subject, we may refer to work done by Harrison and others on the soil gases given off during the growth of wet paddy in Madras, in a series of six memoirs during the period

1913–1920, which have apparently escaped the authors. Green manuring forms an important part in the local agriculture of the paddy fields, this substance being provided by the weed flora growing during the dry period, any vegetable residues in the soil, and often very large quantities of added matter in the form of special classes of leaves. Harrison, on investigating the result of puddling this vegetable matter, which is the orthodox method of preparing the land for paddy in the east, came across an extremely interesting case of symbiosis, between the rice plant and the surface scum. This scum consists of algæ and bacteria which form an impenetrable gelatinous film on the surface of the water as growth proceeds. The gases escaping from the decomposing green manure get entangled in the scum, and play a considerable part in the nutrition of the crop. On analysis, the bubbles are found to contain methane, carbonic dioxide, pure nitrogen, and free hydrogen, in quantities roughly indicated by the figures 70, 30, 5, and 3 respectively. But as the plants grow the bubbles change in constitution; the hydrogen and carbonic acid disappear and the nitrogen steadily increases in proportion to the methane, until at heading time and onwards it becomes the predominant constituent. The details of this change are too intricate to be dealt with here, but the net result is that the carbonic acid gas is utilised by the algæ for their growth with the usual evolution of oxygen which, unable to escape, highly oxygenates the water and thus enables the roots to live in apparently impossible anaerobic conditions. All of the nitrogen from the decaying vegetable matter is lost in the free state, and Harrison surmises that the nitrogen required by the plant is obtained entirely from the mineral salts stored as nitrate in the soil during the alternating dry period when the ground is covered by the weed flora.

Another much longer chapter, on "seeds and varieties," and mainly botanical, occurs later in the book, and as it covers numerous points dealt with in the first chapter it is a little difficult to understand its complete separation. This is one of the most interesting chapters in the book, and discusses in detail the many difficulties in the way of those who have made tentative attempts at classifying the rices of their locality. Varieties of rice differ morphologically and physiologically, and those which are difficult to distinguish in the first sense are not infrequently totally unable to live under the same conditions. One of the most marked distinguishing characters, perhaps, is the period required by the different rices to mature, a factor which fits so remarkably with the varying length of time during which, in a dry country like India, there is sufficient water available for the growth of the crop. The author dallies with the idea that this varying maturation of the crop may have something to do with the length of day or some similar factor of climate, but this is difficult to apply to India where, in the peninsula at any rate, there is little difference in this respect throughout the year, and there are probably more varieties of rice in India than in all the rest of the world together. A case quoted from memory will sufficiently explain the difficulty in accepting this explanation. In parts of the Tanjore delta, it is the custom to plant two kinds of rice together, a short and a long type (say, 4 months and 9 months). When the short crop is ready, the whole field is cut and the matured rice reaped; this drastic action is said not to injure the long paddy, still in the tillering stage, but even to improve its crop by causing additional branching of the hitherto shaded young plants.

After discussing the attempts of various authors at classifying the rices of their localities, the author presents, in the form of a carefully compiled *questionnaire*, a list of the information required in all future descriptions, covering two and a half pages of small print. Among other interesting details he refers to the uncanny faculty of rice-eating peoples of distinguishing the varieties in the form of rice bought in the market by their flavour and cooking qualities. This experience, gained in the Philippines, also astonished the writer in Madras, when an eminent Indian agriculturist informed him that he was able to distinguish 186 different local kinds by the same characters. Such statements have been received with suspicion in Great Britain and, naturally, would appear incredible to us, who are at best acquainted with only a few kinds, bereft by their preparation of their distinctive flavours and much of their nutritive qualities.

This, however, is not the only case met with of the extraordinary power of discrimination in food possessed by the great races of vegetarians in the tropics, and the writer has been accustomed to describe it as a separate sense which is unknown to the peoples of temperate regions and especially to meat eaters. To bring home the point in another way equally remarkable: in a recent severe drought, almost amounting to the official "famine," in South India, shiploads of Burma rice—practically the only kind which reaches Great Britain from the east—were brought over by the Government; and it is recorded that one of the greatest difficulties encountered by the officials in charge of the famine camps was to induce the starving people to eat this unaccustomed food. Some, possibly in a weak condition, were said to have died of starvation with an adequate quantity of this rice lying before them.

The most important part, however, of this long chapter of 64 pages is the summary prepared by Prof. Copeland of the scientific work, mostly done during the last decade, aiming at the improvement of the crop, both in the East and in Europe and the United States. The crops in the tropics are almost always grown as a mixture of varieties or even species, and it is obvious that the first step is always to separate these, whether by mass selection, which usually comes first, or by the separation of pure lines; and it is in the latter direction that practically all the economic successes have hitherto been obtained. This is the case with wheat, cotton, jute, and other crops, and more so still with rice: almost the only crop in which crossing has been the main line of work is the sugar-cane, which is always reproduced in cultivation by the vegetative method. But the analysis of the separate characters of these crops has also commenced in most cases, bringing with it a world of difficulties, which show that progress along this line in the improvement of crops will be a long and intricate matter.

In the case of rice, the author asserts that the raising of improved varieties by cross fertilisation is additionally handicapped by the form of the flowers. The glumes are so thick and tightly closed until just before or even after anthesis, that natural crossing is of the rarest; and he can only point to one case in which artificial pollination has been successfully accomplished. In this case, the severity of the method, cutting right across the glumes with a sharp pair of scissors and emasculating by fine forceps, seems sufficiently drastic to defeat the ends in view. We may only remark that various scientific workers in India do not appear to have met with this difficulty in crossing rice varieties.

Space limits prevent an adequate consideration of the remaining general chapters, namely, those on climate, etc., pests and diseases, and the uses of rice. The first of these is very short, but the questions that arise are referred to in all parts of the book. As regards the second, rice in the tropics has always been spoken of as a crop which, by its extensive method of cultivation, has escaped the devastation by pests and disease so largely met with in other crops, and this is largely true. Undoubtedly, for various reasons there has been less attention paid to the crop in the tropics than to other cultivated plants; but the formidable summary which is presented in the 50 pages devoted to the subject—largely of work in Europe and the United States—is sufficient to raise doubts as to the correctness of this comfortable preconceived idea. The absence of any picture, beyond a couple of plates by Dammerman of borers in Java, is a distinct loss in this chapter.

The uses of rice, dealt with in the short final chapter of 10 pages, are briefly summarised; but, of course, a great deal more could have been said about them. The statement that the straw is "useless for fodder" will scarcely be accepted in India (as an example of a country where pasture is either non-existent or inadequate), for paddy straw is the main and often the only fodder during the greater part of the year in rice-growing tracts. It is true that this is less marked in Burma, where Indian visitors are accustomed to deplore the wasteful treatment of the straw; but here, owing to the sparse population, other sources are available for fodder and there is a larger amount of waste land than in any part of India. This sparse population is, it may be remarked, the chief reason for the export of rice from the east, for paddy is scarcely ever grown as a "money crop," any more than millets are: it is only when there is a surplus owing to an unusually good monsoon that enough can be spared to send any to the countries of the west. One last point, the use of the word "paddy" is rather strictly confined in the East to the crop and the raw unhusked product, and the additional meaning, which we have not met with before, of the space between the bunds confining the water, is to be deprecated.

C. A. B.

## Science and Folly.

*Foibles and Fallacies of Science: an Account of Celebrated Scientific Vagaries.* By Prof. Daniel W. Hering. Pp. xiii+294. (New York: D. Van Nostrand Co., 1924.) 2.50 dollars.

"LORD, what fools these mortals be," quotes the reader as he lays down Prof. Hering's book "Foibles and Fallacies of Science." Astrology, the transmutation of metals, perpetual motion, divination, prophecies, charlatanism, are some of the titles of the chapters, and they give a good idea of the contents of a book which contains much curious and interesting information.

But is the title of the book correct? The foibles and fallacies about which Prof. Hering writes are certainly not those "of science"; they are really those "of human nature." In fact, the chief interest of the book is the light it throws upon the folly of mankind, not only of the so-called uneducated masses, but also frequently of the highest intellects of the age.

All branches of science—at least all the older branches—have suffered from the pseudo-scientific and the charlatan; in fact, one could judge of the extent to which a branch of science comes into contact with human life by the extent of the foibles and fallacies which have grown about it. It is an instructive study to try to work out the psychology of the makers of one type of fallacy, and as the weather has always been a favourite subject for the pseudo-scientific, we may usefully give a little thought to considering the ways of the weather prophets who figure so largely in Prof. Hering's book.

We need not devote much attention to the astrologer, for weather was not a speciality of his; it was only an incidental. It is in the compilers of almanacs that we first meet with the professional weather forecaster. The first of these predicting almanacs appears to have been Old Moore's, which claims 1700 as the date of its birth and is, we believe, still going strong. Similar almanacs are published in most countries, from which it would appear that there are still people who find these weather forecasts interesting and probably useful. That it is not only unintelligent people who put their trust in such forecasts is clear from the remarks one has frequently heard about the weather columns and diagrams which have appeared since the War in one of our contemporaries devoted to country pursuits, travel and sport. How can we explain this except by that peculiar trait of the human mind which makes us remember those things which fit in with our preconceived ideas and ignore those which would prove us wrong? Every success of a forecaster in whom we believe is remembered, and as we take no particular notice of the failures, our impression—perfectly conscientious—is one of unbroken or nearly unbroken success. Unfortunately, the same process produces an impression of a series of failures on the part of the official forecaster, for no other reason than that, because we are British, we distrust everything official, note his failures, and take his successes as a matter of course.

What, however, are we to say about the makers of the forecasts? Surely they check their forecasts and must be painfully aware of many dismal failures? Any one who has had much to do with this class of weather prophet must have been struck by their great sincerity. There is no money to be made out of weather forecasting, so charlatanism is no solution of the problem. The explanation, and we speak from much experience, is that these men have as a rule evolved a most complicated system on which they base their forecasts, and these systems are never in their final form. Hence, after every failure they re-examine the grounds on which they made their forecast, and then find that if they had only taken so and so into account, or put less stress on something else, they would have got a perfect forecast. The examination, instead of making them mistrust their system, rather makes them realise how perfect it is if only it is accurately applied.

Prof. Hering also devotes several pages to rain-making and rain-makers, and describes the chief methods employed, but he does not mention the method, evolved as a result of the visit of the British Association to Australia, of electrifying the upper atmosphere by means of kites and balloons, which was offered to the Australian Government by a gentleman with a very appropriate name. Here again we meet with a remarkable amount of credulity; for in most cases the rain-maker thoroughly believes in his method and is sure it will work if only tried on a sufficiently large scale. There is, however, one clever man who makes a very good living out of rain-making. Mr. Hatfield is prepared to go anywhere and make rain on the principle of payment by results. If Mr. Hatfield makes no rain, he asks for no pay; while if he does make rain, he only asks for payment at the moderate rate of 3000 dollars an inch. His rain-making equipment consists of a huge tank 20 feet high, in which he brews a mystic chemical mixture which he says "opens up the clouds." Mr. Hatfield has been extensively employed on these terms in the United States, apparently to the mutual satisfaction of every one concerned. It is difficult to see anything wrong with this, viewed as a business transaction.

If we have estimated the character and motives of the pseudo-scientific weather prophet correctly, he is not such a bad fellow after all, and probably the same could be said of most of those responsible for the other foibles and fallacies described in the book, but we doubt whether Prof. Hering would agree with us, for he is somewhat hard on scientific folly.

G. C. S.

## Cambridge Biographies.

*Alumni Cantabrigienses: a Biographical List of all known Students, Graduates, and Holders of Office at the University of Cambridge, from the Earliest Times to 1900.* Compiled by Dr. John Venn and J. A. Venn. Part 1 (in 4 vols.). *From the Earliest Times to 1751.* Vol. 3: *Kaile—Ryves.* Pp. v+504. (Cambridge: At the University Press, 1924.) 150*s.* net.

THE death of Dr. John Venn since the preface to Volume II. of this monumental work was written allows the reviewer to pay tribute to his magnificent services to Cambridge history and at the same time to emphasise the value of his son's contribution, not merely to the present volume, but also to the whole work. On him alone will now fall the duty of completing the Appendix, including the corrections and additions to the first three volumes. Isaac Newton apart, the present volume (Kaile—Ryves) does not include the names of many well known to science.

Among those whose names stand out on a first selection we may mention John Ray, the well-known naturalist, Nevil Maskelyne, Astronomer Royal, Thomas Millington, the alleged discoverer of sexuality in plants, and Robert Record, who introduced algebra to Britain. On slightly lower scientific grounds we may refer to Sir Hugh Platt, who conducted horticultural and agricultural experiments at Bethnal Green and in St. Martin's Lane, to John Lumley, who founded a lecture at the Royal College of Physicians, to Thomas Plume, founder of the Plumian professorship, to George Parker, second Earl of Macclesfield, president of the Royal Society, and to Roger Palmer, mathematician and political pamphleteer, afterwards created Earl Castlemaine and more generally remembered through his wife.

If science, however, does not figure prominently in this volume, the active part that Cambridge men played in all the religious and political movements of their time emerges clearly. Thus we find Thomas Legh, much employed in the suppression of the monasteries, and Matthew Mackarel, executed for supporting an insurrection against their suppression. Thomas Percye was one of the most active organisers of the Gunpowder Plot, while Thomas Knyvet searched the cellars of the houses of Parliament and discovered the plot. Several of the regicides were Cambridge men, as was also George Monck, Duke of Albemarle, largely instrumental in the Restoration. The ill-fated James, Duke of Monmouth, was Chancellor of the University, while Titus Oates tried two colleges but failed to secure a degree. Migration from one college to another was much more common in earlier times than nowadays.

Cambridge was also the home of many heretics. Hugh Latimer and Nicholas Ridley were the best known of those who were burnt at the stake. Many others settled in America and the West Indies to escape persecution. The strong position held by Cambridge men among English poets is reflected in the present volume in the names of John Milton, Christopher Marlowe, and Richard Lovelace, while other literary names worthy of mention are Thomas Nash, Thomas Otway, Matthew Prior, Andrew Marvell, and Samuel Pepys. The latter supplies one of the many human touches in a volume of short biographies. Others are found in the accounts of Thomas King, scholar of Eton and King's, who afterwards "kept the coffee-house in Covent Garden, called by his name"; of John Ruddle, the priest who exorcised a Cornish ghost; of Dr. William Oliver of "Bath Oliver" biscuit fame; and of Thomas Reresby, who was fined 1000*l*. in the Star Chamber for boxing the ears of Sir William Wentworth on the County Bench at Rotherham.

## Our Bookshelf.

*Uses of Waste Materials: the Collection of Waste Materials and their Uses for Human and Animal Food, in Fertilisers, and in Certain Industries, 1914–1922.* By Prof. Arturo Bruttini. (International Institute of Agriculture, Rome.) Pp. xx+367. (London: P. S. King and Son, Ltd., 1923.) 12*s*. net.

ONE of the outstanding features of the War was the abnormal shortage of food for man and beast, fertilisers for agricultural use, and of many other substances regarded as essential for various economic purposes. The urgency of the need led to a diligent search for substitutes, many of which were found among unregarded bye-products and so-called waste materials and among wild and cultivated plants of every description. Many of these substitutes merely supplied the need of the moment, and fell into disuse as soon as the crisis was past. Others were of more permanent value and in certain cases have retained a definite economic position.

As time goes on it becomes increasingly difficult to realise the great amount of work and thought that was applied to the discovery and exploitation of these waste materials, and Prof. Bruttini has rendered good service to the community by placing on record not only details of the commodities themselves, but also a history of the legislative and administrative measures adopted by the various belligerent countries to deal with these matters. No other writer has covered the ground so completely, and the "Uses of Waste Materials" provides an excellent outline of the information available to date, with adequate references to more detailed papers where such exist.

In outline the book deals first with the legislative and administrative aspects, and secondly with the methods of handling waste materials and their various properties and uses. The subject is treated under the four main headings of human food, food for live stock, fertilisers, and alcohols, oils and other industrial products, though in some cases the same raw material can be utilised for several purposes. Wherever possible, analyses are given, and for feeding stuffs the appropriate rations for different animals are frequently indicated. As regards fertilisers, much experimental work has been carried out to test various residues, both as to their actual fertilising value and their relative value when the cost of production is taken into account. Many have proved to be uneconomic on the latter score, but the tests have indicated various sources of potential manures, some of which may profitably be exploited. A comprehensive table of contents and a number of illustrations add their quota to the general usefulness of the volume under review, which should prove a valuable work of reference to all agriculturists and to many of those associated with industry. W. E. B.

*The Evolution of Mathematical Physics: Being the Rouse Ball Lecture for 1924.* By Dr. Horace Lamb. Pp. 48. (Cambridge: At the University Press, 1924.) 2*s*. net.

"THE profound study of Nature is the most fruitful source of mathematical discoveries." In this quotation from Fourier, Prof. Lamb gives the keynote of his lecture on mathematical physics. He traces the history of the subject during the nineteenth century, showing how work initiated on the Continent was brilliantly continued in Britain. The great time of Britain began with Green, who was followed by the Cambridge galaxy, in the enumeration of whom Lamb excludes men still alive and names only Stokes, Kelvin, Maxwell, Rayleigh. Then a time came when Britain went barren and it has remained barren ever since.

What is the cause of this barrenness? Is it that the well of genius has run dry, or is it that in some way Great Britain fails to provide the geniuses with appropriate opportunities? It is a century since Fourier stated the condition of mathematical progress, and in his lecture Prof. Lamb shows how the advances of the nineteenth century in Britain were due to the wide and deep knowledge of both mathematics and physics possessed by the workers. It is necessary to ask to what extent our universities are fulfilling the condition laid down by Fourier and now emphasised by Lamb? The answer is distressing. Not only are mathematics and physics divorced so that a man takes his degree in one or other and not in the two combined, but also the total range of mathematics is being found too great for a man to cover, and the tendency is to give a degree on an increasingly fractional knowledge of pure mathematics. If the present tendency persists, the time will come when each mathematician will have a minute knowledge of his own highly specialised branch and his angle of vision will be so limited as to make any advance impossible for him even in his own branch.

The total range of mathematics and physics as at present treated at Cambridge is too great for any man to cover in a degree course, as is also even the total range of pure mathematics as at present treated. So long as the present treatment of these subjects endures, we shall continue to sink in the slough of uselessness just described, and if the process of subdivision and specialisation is allowed to continue, our sinking will be the more rapid. The health of mathematics in Britain requires that Cambridge should discover a means to reverse this process and should in some way sufficiently condense the essentials of mathematics and physics to enable the individual to attain a real knowledge of both.

*Gas Engineers' Compendium: a Collection of Statistics, Formulæ, Rules and Data for the Everyday Use of Gasworks' Officials and Students.* Compiled by Experts. Pp. 292. (London: Ernest Benn, Ltd., 1924.) 32*s.* 6*d.* net.

A COMPENDIUM should at least be compendious, that is to say it should be comprehensive, complete, and compact; the information it contains should be accurate. This bulky volume fails to justify its title when tested by any of these criteria. General statistics and statutory requirements relating to the gas industry, gas-making coals, retort settings, purifiers, gas-holders, gas producers, by-products, flow of gases in pipes, and data relating to gas distribution generally, the mechanical characteristics of steel beams, etc. of various cross sections are amongst the subjects upon which information and useful particulars are given. We have failed to find tables referring to values of the elastic moduli of materials (and these are required in connexion with certain formulæ contained in the book), data referring to viscosities of gases, coefficients of expansion of substances, vapour pressures and numerous other physical data with which the gas engineer is intimately concerned. Room could be found for these if the thirteen blank pages, blank parts of pages, and wide marginal spaces characterising the volume were utilised; Kaye and Laby's Tables would serve as an example of the type and format of a volume much needed by the gas industry.

The incompleteness of information contained in the present volume is sufficiently illustrated by reference to the inadequacy of the statement on p. 272 relating to the melting point of firebricks—the value for "ordinary" firebricks alone is given. In like manner, one value only is given for the melting point of an electric lamp filament (unspecified). Inaccuracy of some of the information contained in the volume may be exemplified by reference to the tabulated melting points of magnesium, tantalum, and other substances given on the same page. Values of the specific heats of gases, etc. (p. 273), are given only at ordinary temperatures, and these in some cases are incorrect, and certainly in the cases of air and steam are not the generally accepted values. The mathematical section containing the elements of trigonometry, tables of squares, square roots, cubes, cube roots, logarithms, antilogarithms, and trigonometrical tables is possibly both the least and most useful part of the volume. The information contained in the useful part consisting of 16 pages of this section can be obtained elsewhere at a cost of one penny. This volume contains 292 pages (not all filled) and costs 32*s.* 6*d.* *Verb. sap.* J. S. G. T.

*The Rock Tombs of Meir.* By Dr. Aylward M. Blackman. Part 4: The Tomb-Chapel of Pepi'onkh the Middle Son of Sebkḥotpe and Pekhernefert (D, No. 2). (Archæological Survey of Egypt, Memoir 25.) Pp. viii + 61 + 27 plates. (London: Egypt Exploration Society, 1924.) 42*s.*

THIS is a welcome continuation of Dr. Blackman's work, interrupted for nine years. Another large tomb, full of inscriptions, is here recorded, which had been opened by authorised native diggers, and left to destruction without adequate publication. These tombs of local princes give a detailed view of society some four thousand years ago. The great period of the pyramid builders was ageing to its fall, and pluralities and sinecures were the perquisite of high office. Forty-four titles belonged to the prince Pepionkh; some were the equivalent of modern degrees and honours which we express by initials, but others imply too much work for one man, such as Vizier, Chief Justice, Treasurer, Royal Deputy, Head of the Record Office, Keeper of the Granaries, and so forth. No doubt most of these duties were done by deputy, as he had sixty-four officials under him, all named in his tomb, and duly listed here. Beside these there are fifty relatives, who all had offices, and a hundred and ten dependants who also were thought worth mention. Thus more than two hundred persons all swelled the bureaucracy of this noble and lived on the estates. The good old man lived to a hundred, having "grown old very happily" and "never gone to bed vexed." The king under whom he thus flourished also lived to a hundred, in the peaceful and fat autumn of that civilisation, soon to be scourged by a Syrian occupation.

The facsimile copies of all the sculptures and paintings are carefully executed, and are fully described; the inscriptions and translations have been discussed before publication, with various authorities. This may therefore be accepted as a final record, a kind of work which no nationality has done but our own, though sometimes executed for foreign patrons.

W. M. F. P.

*Excavations in Malta.* By M. A. Murray. Part 1. With a Chapter by G. Caton Thompson. Pp. iii+49+21 plates. (London: Bernard Quaritch, 1923.) 7*s.* 6*d.*

THIS record of excavations in Malta covers the work done by Miss Murray and her party in the years 1921–22. The most important site attacked was the cave of Ghar Dalam, in which Mr. G. Despott in the course of his excavation in 1916–17 discovered two teeth, since identified as belonging to Neanderthal man. An area of 40 feet by 60 feet was excavated down to rock, but beyond bones of the hippopotamus, some from a stratum which had hitherto proved sterile, no result of particularly noteworthy importance was obtained. Of the three remaining sites excavated, the most considerable was that of Borg en Nadur—remains on the slope of a spur running up from the bay of San Giorgio, at the top of which is the tower from which the site takes its name. The remains, which are well known to archæologists, include a dolmen flanked by an upright stone. In the area west of this dolmen, to which excavations were confined, a small apsidal building was brought to light which exhibits several points of interest and part of the wall of a forecourt. Miss Murray also examined the chamber behind the dolmen. No satisfactory evidence of stratification was obtained. The objects found included pillars, and pillar blocks, Bethel stones, hammer and polishing stones, a number of small chert implements and three fragments of bronze. The pottery, mostly fragmentary, Miss Murray, following Dr. Zammit, classifies as neolithic and bronze age, assigning a polished gray or black ware to the former, and the red with black decoration to the latter. It has been pointed out, however, that the attribution of the second type to the bronze age rests upon no very certain basis. If Miss Murray's results do not lead to any very decisive conclusions, she has produced a very careful, and therefore valuable, record of a considerable amount of work done in a limited time and at a trying season of the year.

*Handbook to the Exhibition of Pure Science.* [*British Empire Exhibition.*] Arranged by the Royal Society. Pp. 228. (London: A. and F. Denny, Ltd., 163a Strand, W.C.2, 1924.) 1*s.* net.

UNLIKE most Exhibition literature, which usually has a mercenary motive, patent or concealed, this publication is educational in the best sense of the word. The contributors to it are all investigators in the front rank, and their contributions summarise clearly and concisely all the recent advances in physical and biological science. Part I. contains articles concerning the structure of matter by "J. J.," Bragg, Rutherford, and Aston; relativity and astronomy are dealt with by the Astronomer Royal and Eddington; "wireless" topics by Glazebrook and Fleming; spectra by Fowler; meteorology by Napier Shaw and others; origin of man by Smith Woodward; physiology by Starling, Harris, Hill, Cathcart; and this list is not exhaustive. Part II. comprises a descriptive catalogue of the exhibits in the Exhibition of Pure Science at Wembley, together with introductory remarks by eminent specialists. In every case it has been sought to trace the development of a discovery or invention from the beginning to the latest application, and to show how the applications originated in research undertaken without any utilitarian motive. The handbook will be greatly appreciated, not only by those who visit the Exhibition, but also by all who are interested in modern science; and those concerned would do well to see it placed in the hands of all senior science pupils in the schools of the Empire.

*An Essay concerning Human Understanding.* By John Locke. Abridged and edited by A. S. Pringle-Pattison. Pp. xlviii+380. (Oxford: At the Clarendon Press; London: Oxford University Press, 1924.) 8*s.* 6*d.* net.

IT is possible to appreciate the reason for this abridged edition of Locke's great Essay and at the same time to regret its appearance. If it had to be done, no living philosopher is so qualified to do it well as Prof. Pringle-Pattison. It is issued for academic reasons and appeals to academic purposes. Every teacher of philosophy knows that it is useless and undesirable to expect the student to read the whole work intensively as he must read, say, Spinoza's "Ethics" or Kant's "Critique of Pure Reason" if he would understand those philosophers. Locke is prolix and also a large part of the Essay has lost the interest and influence it had. On the other hand, nothing is easier than to direct the student as to what is important and what comparatively negligible. Abridgments are unwise. However well-informed, it is certain, for it is human nature, that the reader will suspect that something of importance has escaped or been suppressed.

*The Electrolytic Rectifier: for Electrical Engineers, Physicists, and Wireless Amateurs.* By N. A. de Bruyne. Pp. vii+75. (London: Sir Isaac Pitman and Sons, Ltd., 1924.) 3*s.* 6*d.* net.

THIS is a useful little book and will be helpful to electrical engineers, physicists, and radio amateurs. The electrical engineer will appreciate the theory and the method described of using a rectifier to charge accumulators directly from alternating current supply mains. The book will also enable him to understand better the action of electrolytic lightning arresters. The physicist will find the author's experiments on the use of neon lamps with rectifiers suggestive. His experiments seem worth following up. The thousands of radio amateurs who have learnt by experience that hot cathode and mechanical rectifiers are fragile and costly to use for charging accumulators from the mains will learn that there are cheaper and no less efficient methods of charging them. The references given will be helpful to the serious student, and the description of the gas layer theory shows that it is in fair accord with experiment.

## Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

**Five- (and Six)-Point Support: "Right as a Trivet."**

THE earliest mention of the mathematical principle of Geometrical Fit, in five- and six-point contact, is found in the first edition, 1867, of Thomson and Tait's "Natural Philosophy," p. 131, § 198: "As an additional degree of freedom is lost by each successive limitation of a point in the body to a smooth surface, *six* such conditions determine completely the position of the body.

"Thus if six points properly chosen on the barrel and stock of a rifle be made to rest on six convex portions of the surface of a fixed rigid body, the rifle may be replaced any number of times in precisely the same position, for the purpose of testing its accuracy."

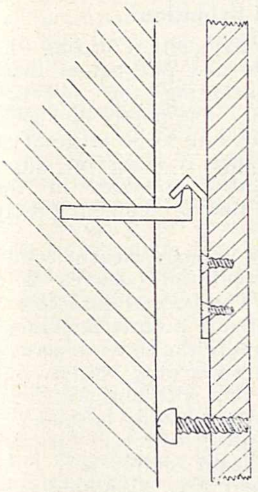

FIG. 1.—Five-point support for pictures on a wall.

This message has not yet received the attention it deserves in the design of mechanical apparatus, for example, the Six-Point Rifle Rest. It is ideal in repetition work such as rifle small arm manufacture, where the parts require to be assembled at random. In Geometrical Fit there is no need for machining of the parts; the fitter's occupation is gone; and "Right as a Trivet" is an exact proverbial description of a perfect mechanical theorem embodying the Axioms of Geometrical Fit.

In the five-point support we proceed to describe, one contact is suppressed, allowing the body one degree of freedom, as we see in the trivet on the bars of a grate, free for a sidelong displacement, but always coming to a steady bearing. The sixth point is encountered by sliding the body up against a stop.

A length of electric conduit tube round a room will serve in the same way for the support of pictures, the tube resting in brackets fastened to the wall at dado height. Hooks on the back of the frame will hold the picture up at an appropriate height, leaving it free to be displaced sideways to any desired position; the cant from the vertical is settled by a round-headed screw in the back lower bar of the frame. The same method can be applied to bracketing out a piece of apparatus from the wall, leaving it free to be lifted off and replaced, and yet quite firm and steady in position.

The wall of a modern laboratory, for appearance and cleanliness, should be not the rough brick surface as at the Cavendish Laboratory, but of glazed brick with a dado some way up from the floor; a mop passed over it will wipe off the dust. A nail cannot be driven into this surface; and so the architect should give instructions for an iron plate to be built into a course of the bricks, at an appropriate level of dado, with a cornice lip projecting slightly; and no more is required for the support of apparatus or blackboard, wherever desired, or however heavy, as in Fig. 1.

If a nail must be driven, a board should be kept for the purpose, and then the board is hung up where required as a blank blackboard.

The method is ideal for a picture gallery, a Royal Academy exhibition. The Academician will stake out his claim and settle the height of his picture, and of the hooks in the back of the frame; and if dissatisfied there is no difficulty in his removal to another site on the wall.

In the oldest Academy of Art, the Pinacotheka on the Acropolis of Athens, the walls are still smooth marble, with no sign of a nail driven, and the professor, our guide, was puzzled how the pictures were hung, until I directed his attention to the groove in a horizontal course, giving the support described above.

Applied to the ballistic pendulum (Fig. 2) the five-point principle requires a suspension of five wires in appropriate spacing, to allow a block or sleeper to recoil parallel to itself; and no consideration is required of centre of percussion or oscillation; the point of impact is practically immaterial. The block moves all together, as in Euclid's definition of a solid body.

The suspension is made from a bracket held up

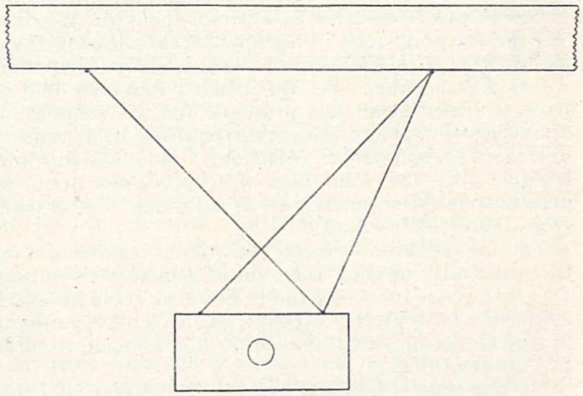

FIG. 2.—Ballistic pendulum.

against the wall in the manner described above; not from the roof, for which the architect never makes provision, and inaccessible at that, especially in a fire with the roof full of smoke. The electric chronograph has replaced the ballistic pendulum for careful velocity measurement, but there are still many applications where the pendulum can prove useful, economical, and accurate.

The psychology of the recruit must be considered at the first introduction to the use of his rifle, so as not to waste confidence in himself by throwing away his first shots. Ordered to lie down on the ground behind a rifle rest designed on this six-point principle, with the rifle in it trained on the target, say at 500 yards, he will be directed what to see on looking through the sights, and instructed in simple snapping practice under the careful eye of his instructor to see there is no flinch or wink on pulling the trigger, going through all the preliminary motions of opening the breech and inserting a cartridge, and ejecting the empty cartridge case by working the bolt. A live cartridge is then inserted without notice, and on pulling the trigger the unsuspecting recruit feels the kick, how it is not formidable with a proper hold. After this he can continue with his allowance of drill rounds, and find all shots in the bull's-eye. He will have acquired confidence in his weapon and himself, and realise that he can continue this standard of marksmanship; if only he holds the rifle straight and himself steady, the weapon and ammunition will do the rest. He is not discouraged at the outset by the depressing experience of finding all his first series of shots going he knows not where.

In Geometrical Fit there is no need for machining the parts. The parts of a rifle can be stamped out in drop forging, and assembled at random, the natural skin left untouched to avoid rust. The only surface to require machining is a sliding contact, as of the bore of the rifle for the passage of the bullet, and the bolt action of the breech mechanism. When a rifle is assembled and tested by the proof rounds, the opportunity can be utilised of adjusting the sighting at the same time. The rifle is placed in the six-point rest, and the proof rounds fired, without aiming, at a card in the line of fire. The centre of mean impact is then marked on the card, and another workman follows to place the foresight in line on the muzzle, to be brazed on there afterwards. The operation of proving and sighting is thus carried on simultaneously from the same six-point rest.

These principles were too simple to appeal to the Enfield tradition; the complication of the bolt action was adduced as a triumphant refutation when I attempted to explain the theory.

Lord Kelvin had occasion to complain of the dogged opposition of his workmen, and was compelled to put it to them as a personal favour to carry out the six-point idea in his apparatus, allowing them the liberty of classing him as a fool, and paying their wages all the same. At Woolwich I was once just in time to recommend the principle for the suspension of a series of coat and hat racks, requiring to be removable and replaced on occasion. But we did not reckon with the smartness of the sapper artificer, careful to make a mechanical fit sideways, obliterating that degree of freedom.

The use of these brackets was made conditional on the possibility of their removal at a moment's notice. But, as a consequence of the R.E. science, the brackets could not be replaced without an intolerable amount of trial and error, calculable on the algebraical principle of Permutations.

At Finsbury Technical College the advice of Prof. James Thomson was enlisted by Perry for the design of a blackboard, in accordance with his idea of the requirements, and the following description is quoted from "Technical School and College Building," p. 152, by E. C. Robins, 1887.

Prof. James Thomson's blackboard, shown in plate 5 there, is so sensitive to movement, it may be moved up and down with the little finger, although the blackboard itself measures 14 feet wide by 6 feet 6 inches high.

According to Prof. Perry, "It is absolutely necessary the lecturer should not rub out a mathematical formula until the end of the lesson, and this requires a very long blackboard, the longer the better. As one who has to teach mathematics I say a blackboard should not be less than 30 feet long. A long blackboard is usually fixed to the wall. You can write perhaps at 6 feet from the ground to 3 feet, but it saves much needless moving to be able to write all formulas at about 5 feet from the ground.

"It is of importance then to move the whole of the blackboard up and down with a touch of the finger, as Prof. James Thomson's arrangement enables you to do.

"Instead of hanging the blackboard by two chains over four pulleys, and having a very heavy balanced weight for the whole board, involving a tremendous amount of friction, we hang the ends of a well-framed board by two chains from the long arms of two levers; the shorter arms carry a heavy balance weight, and the only place where friction can occur is at the fulcrum of the levers.

"This allows a very large motion of the board for a small motion of the balance weight, a great convenience. When these fulcrums are well oiled, a touch of the chalk at any point of the board is sufficient to lift the blackboard."

Vertical grooves give sliding contact, arranged on scientific principles, to render jamming impossible, by the use of only three contacts. But Perry here had the same experience and difficulty as Thomson with the workmen. He complained how after he had been transferred to Kensington, he returned to find the blackboard had been put right by a skilled workman, quite sure the number of supports was insufficient, adding a fourth sliding contact. The result of making what he called a workman-like job was for the blackboard to jam.

However, in a recent visit to Finsbury Technical College, I found the blackboard had been restored again to its original Thomson design, and was in proper working order, easy up and down.

G. GREENHILL.

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### Mendelism and Evolution.

MEMBERS of the British Association during the recent Toronto meeting have had put before them the available evidence concerning the so-called "White Indians" of Panama. The purely biological interest of the discovery turns out to be as great as the anthropological; and, since it bears on correspondence which has recently appeared in the columns of NATURE, I should like to comment briefly upon it.

In the first place, then, it appears clearly established that the "white" condition behaves as a simple Mendelian recessive. The normal dark colour is completely dominant; there are no intermediates; all the "whites" show essentially the same deviation from normal; white × white gives only whites, but whites may be produced (together with normals) from the mating of two persons phenotypically normal.

The condition has been described as "partial albinism." If by this is meant simply any condition in which normal pigmentation is reduced, the term is applicable; but it should be noted that these people possess yellow hair and hazel eyes.

All the authorities who have examined them are agreed that the condition has no racial significance: the racial type has not been altered save in the one respect of pigmentation, nor can the condition possibly be interpreted as resulting from previous crosses with Europeans. In any case, the discovery that the condition depends on a single-gene Mendelian difference from the normal implies both these results.

Now, however, for the biological and evolutionary significance. Not only are these "mutants" (as they clearly appear to be) perfectly capable of healthy existence and reproduction, but they are coming to form a community of their own. The normally-coloured members of the tribe have a feeling against marrying "whites," with the result that the mutants mate almost wholly with others like themselves, and thus in course of time have formed a nearly closed, self-reproducing community of several hundred souls.

Mutation: consequent preferential mating: consequent establishment of a definite intra-specific unit: with the future consequence that any further mutation occurring within this unit will remain confined to it, and the difference between mutated and type stock thus become accentuated. Here, in man himself, is a case showing with almost diagrammatic clarity how evolutionary change may originate in single mutations of considerable magnitude. JULIAN S. HUXLEY.

The Marine Biological Laboratory,
Woods Hole, Mass., U.S.A.

## Agricultural Research.

THE address delivered by Sir John Russell, as president of Section M (Agriculture), at the recent meeting of the British Association at Toronto, may be characterised as a somewhat despondent survey of present day activities in agricultural research, with particular reference to those branches of the subject allotted to the Rothamsted Station and the special problems upon which the workers there have been engaged. It may be worth while to give consideration to some of the more general aspects of applied research to which Sir John Russell's remarks inevitably direct attention.

When philosophers, as they then called themselves, first turned their attention to the problems presented by the life of the plant, they were not long in finding that the pioneer science of chemistry enabled them to throw an immediate light on what we may now regard as the crude fact, that plant life is dependent for food upon an adequate supply of certain elements, such as carbon, nitrogen, phosphorus, and potassium. It was an easy step to supply some of these elements by "artificial" means. The result was that, dating from the forties of the last century, the practice of applying "artificial" manures received an immense impetus: so much so that farming practice was almost revolutionised. It became possible not only to raise the level of food production from a given area of land, but also to maintain that level indefinitely.

The material consequences of these early discoveries were so great that they created a belief in the efficiency of scientific research as applied to husbandry which has been held to justify the expenditure by the State, as well as by other agencies, of larger sums than have hitherto been devoted to research of any other description. But during the last eighty years science has presented only one other gift of an economic importance equal to that just indicated. Mendel and his belated disciples have taught us to regard the plant as a plastic organisation which can be systematically moulded in desired directions. Sir John Russell has catalogued the remarkable results of the work of Biffen and others.

Yet it cannot be denied that the agricultural sciences have made great advances in other directions in these long years. Our knowledge of the factors concerned in the growth of animals and plants is almost inconceivably greater than it was eighty years ago. Why is it then, that, as judged by economic tests, farming practice has been so little modified that even Virgil's "Georgics" may still be read as a textbook? One reason may be suggested. The growth of a plant or animal is affected by a number of environmental causes beyond human control. A severe hailstorm, a rainy season, may render nugatory all the efforts of the most skilful and scientific husbandman. He earns his living really by virtue of the law of averages. If old tradition is right, he rings a cycle of changes in a lunar period of nineteen years. It is a fair inference, therefore, that he is not likely to be much moved by scientific evidence that a certain course of action will produce a better result *of the order of difference* that he associates with a normal seasonal variation. If, for example, the supposition is made that the yield of any crop on a particular field will vary normally by 10 per cent. from year to year, a scientific improvement, which, if adopted, increases yield by 10 per cent. in any one year, is scarcely likely to interest the husbandman. It may be, therefore, that science has failed to produce discoveries of sufficient magnitude. "Artificial" manuring, it is true, may be said to have been a discovery of the order of 100 per cent.; and the science of plant-breeding may be said to have involved differences of the same order.

In Sir John Russell's address, consequently, one detects a feeling of disappointment. We have passed through, he says, a "pioneer period with . . . the disadvantages of certain lack of perspective, failure to follow up important issues, and some narrowness of outlook." He suggests that steps should be taken to secure the co-operation of a team of workers in every science bearing on agriculture—the members to be drawn from all parts of the British Empire. The proposal is scarcely in the region of practical politics. After all, the epoch-making discoveries of science have not come from team work—nor from what is sometimes termed "directed" research.

The Member of Parliament and the Treasury official are apt to think of research as if it functioned like a penny-in-the-slot machine—a mechanism which unfailingly gives "results" for the inserted coin. Such and such an industry should form a Research Association, accept a grant, and forthwith grind out results good for the industry concerned. The whole history of scientific effort, however, is a record of individual successes in so-called "pure" science, and, with due respect to the Director of Rothamsted, what appears to be wrong with agricultural science is that it is too agricultural. If, as he says, the "co-operation of a plant physiologist" is needed, let us take care that the worker is not tied to the study of agricultural plants, and if, in consequence, he is a worker in "pure" botany, let us see that he gets as liberal a grant as his brother working in agricultural botany. At the present juncture, research in pure botany is languishing in all our universities, and yet, on Sir John Russell's admission, the advances made by one branch of the science, that of plant-breeding, have far outdistanced any discoveries in the sciences with which he is directly concerned.

The lesson one may venture to extract from the address of the Director of Rothamsted is that it is high time that the State turned its attention to the need for fostering scientific research in pure science. Directed research, that is, research directed to secure definite economic results, is in danger of becoming outworn for lack of draughts from the *pocula sacra* which University research in pure knowledge exists to provide! CANTAB.

## The Vibrations of Air in Organ-Pipes of Unusual Shapes.

IN an interesting letter published in NATURE for August 30, Principal J. A. Aldis discusses the vibrations of air in organ-pipes of unusual shapes, and gives a number of elegant formulæ for calculating the frequencies of the tones in certain cases. The date of the investigations (1867–1868) gives them a special interest, since they were carried out some three or four years before the publication of Rayleigh's well-known paper on "The Theory of Resonance," in which, by the introduction of a quantity which he called the "conductivity" of an orifice, he was enabled to give a simplified treatment of the theory of bottle-resonators and of pipes with restricted mouths.

I was at first somewhat surprised to see that the formula given by Principal Aldis for the frequencies of the tones of bottle-pipes agreed satisfactorily with observations, apparently without any restriction as to the size of the bottle. The formula is obtained by assuming the existence of stationary plane waves in the two parts of the bottle—*i.e.* in the neck (or mouth part) and in the stopped part—and the continuity of the pressures and velocities at the junction of the two parts. The formula is

$$\tan mh \cdot \tan mk = \frac{\text{area of mouth part}}{\text{area of stopped part}}, \quad (1)$$

where $h$ is the length of the mouth part, $k$ is the length of the stopped part, and $m$ is $2\pi/\lambda$ or $2\pi n/a$ ($n$=frequency, $a$=velocity of sound). While this formula might be expected to be satisfactory in the case of bottle-pipes with parts of moderate length, it would, I think, scarcely be expected to hold good if the length of the bottle were much less than a quarter of the wave-length belonging to the fundamental tone of the bottle. In such a case we should expect to get better results by using Rayleigh's formula for the frequency of a Helmholtz resonator, namely—

$$n = \frac{a}{2\pi}\sqrt{\frac{c}{Q}}, \quad . \quad . \quad . \quad . \quad (2)$$

in which, for a bottle-pipe, $c$ would be the hydrodynamical conductance (Rayleigh's "conductivity") of the mouth part and Q the volume of the stopped part. It appears from this, therefore, that for small bottle-pipes the important factor is the *volume* rather than the *length* of the stopped part.

The point to which I wish to direct attention, however, is that, notwithstanding the apparent diversity of equations (1) and (2), Rayleigh's equation (2) can be obtained as a limiting form of (1) when $h$ and $k$ are made small compared with the wave-length. In this case we have approximately $\tan mh = mh$ and $\tan mk = mk$, and if $\sigma_1$ is the area of the mouth part, and $\sigma_2$ the area of the stopped part, we obtain

$$m^2hk = \frac{\sigma_1}{\sigma_2},$$

or

$$n^2 = \left(\frac{a}{2\pi}\right)^2 \cdot \left(\frac{\sigma_1}{h}\right)\Big/\sigma_2 k.$$

Since $\sigma_1/h$ (area divided by length) is the conductance of the mouth part (end-correction being neglected) and $\sigma_2 k$ is the volume of the stopped part, we have

$$n = \frac{a}{2\pi}\sqrt{\left(\frac{\sigma_1}{h}\right)\Big/\sigma_2 k} = \frac{a}{2\pi}\sqrt{\frac{c}{Q}}. \quad . \quad . \quad (3)$$

It appears, therefore, that either of the two forms (1) or (2) may be used for obtaining the approximate frequency of the fundamental tone of a small bottle-pipe. Rayleigh's formula, however, has the disadvantage that it does not help us to discover the frequencies of the overtones.

If in equation (1) we suppose $h$, but not $k$, to be small compared with the wave-length, we have the case of a pipe with a narrow mouth. Equation (1) becomes

$$mh \tan mk = \frac{\sigma_1}{\sigma_2},$$

or if $\sigma_1/h = c$ (the conductance of the mouth),

$$\tan mk = \frac{c}{m\sigma_2}, \quad . \quad . \quad . \quad . \quad (4)$$

an equation which was given by Rayleigh in 1871 ("Scientific Papers," vol. i, p. 46, equation (15); the right-hand side is inadvertently shown with a minus sign).

Again, if $k$ but not $h$ is small compared with the wave-length, we have the case of a long tube connected with a reservoir. Equation (1) becomes

$$\tan mh = \frac{\sigma_1}{m\sigma_2 k} = \frac{\sigma_1}{mQ}, \quad . \quad . \quad . \quad (5)$$

Q being the volume of the reservoir. This equation was also given by Rayleigh. E. T. PARIS.

Signals Experimental Establishment,
Woolwich Common, London, S.E.

## Abney Sectors in Photometry.

THE following may be of value to those interested in photometry.

The instrument known as the "Abney Sectors" used for reducing, for photometric purposes, the intensity of powerful illuminants, such as searchlight projector arcs, by means of a rotating disc fitted with continuously variable sectors, is difficult to construct, and, unless perfectly made, is liable to stick at high speeds.

I have found the following a simple and efficient instrument.

A disc 12 to 18 inches in diameter, in which curved edged V-shaped slots are cut (Fig. 1), is mounted vertically on a board together with a driving motor. Between the illuminant and the disc, close to the latter, but mounted separately, is a screen in which is cut a small rectangular aperture. The beam of

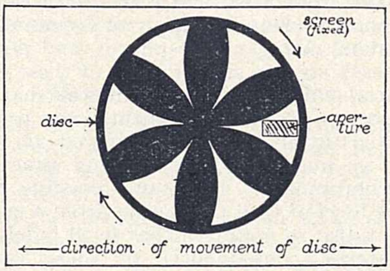


FIG. 1.

light under investigation passes from the source through the aperture and interruptedly through the rotating sectors of the disc to the photometer. The rays are alternately obstructed and allowed to pass by the sectors of the rotating disc, just as in the case of the Abney Sectors. By moving the board on which both disc and driving motor are fixed with respect to the aperture, more or less obscuration as desired may be obtained.

The board may move in a groove graduated to show degrees of obscuration. G. F. WOOD.

Forest Research Institute,
Dehra Dun, July 12.

## Aurora, Potential Gradient and Magnetic Disturbance.

IN view of suggestions which have been made from time to time that a relationship may exist between the intensity of the earth's electric field and the phenomena of the aurora, or of terrestrial magnetism, the available data from Cape Evans—the winter quarters of Capt. Scott's last expedition—have been examined. The original intention to make a comparison between the auroral data and the potential gradient data was formed on the publication of the first meteorological volume. This intention was stimulated by the fact that the time of maximum of the daily variation in potential gradient at that station lay between the time of maximum frequency for auroræ (4 A.M.) and the time of maximum magnetic disturbance (10 A.M.)—in time of the 180th meridian. In addition, Dr. Simpson had recorded slight anomalies in temperature and in pressure at the time of day when the aurora was most frequently observed. By the courtesy of Dr. Simpson, copies of the original data for potential gradient were made available, but it was found that the hours during which conditions were favourable both for observations of aurora and for potential gradient measurement (wind less than 10 miles per hour) were not sufficiently numerous to repay investigation.

On the other hand, it is known that the activity of the aurora is related to magnetic disturbance, and data exhibiting this relationship have been published in reports of the Expedition (" Terrestrial Magnetism" and " Observations on the Aurora"). In these circumstances, Dr. Chree kindly lent his original figures for hourly character number (representing magnetic disturbance), and these were used for making a comparison with the figures for potential gradient during winds up to 5 miles per hour, for the period March 1911 to February 1912.

For the purpose of this comparison, the potential gradients corresponding to Dr. Chree's magnetic character numbers (0 = slight and 2 = great magnetic disturbance) have been meaned for all hours during which the wind was not greater than 5 m.p.h. Generally speaking, the mean gradients corresponding to these character numbers vary during the course of the day similarly to the curves shown on p. 315 of " Meteorology," vol. i. The mean value for the year corresponding to

Character number 0 is 89 volts/metre.
,, ,, 1 is 90 ,,
,, ,, 2 is 96 ,,

Taking, however, means for each hour of the day, and allowing equal weight to each hour, the corresponding numbers are 88, 89, and 91. The evidence seems, therefore, to be against any direct connexion between magnetic disturbance and potential gradient at this station.

Figures have been derived for the mean value of the potential gradient at each hour of the day, for four periods of three months each, and these figures also do not encourage much hope in the reality of such a connexion. The mean values for the four quarters (commencing for convenience in February, and equal weight being allowed to the mean value for each hour of the day) are :—

| Quarter. | Magnetic Character Number. | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| Feb. to Apr. | 82 (82)* volts/metre | 81 (83)* | 88 (88)* volts/metre |
| May to July | 77 (76) ,, | 77 (78) | 78 (78) ,, |
| Aug. to Oct. | 93 (93) ,, | 93 (94) | 93 (96) ,, |
| Nov. to Jan. | 106 (111) ,, | 98 (99) | 107 (107) ,, |

* The figures in brackets represent the corresponding means when each observation during the quarter is given equal weight.

C. S. WRIGHT.

Wey Lodge, Portmore Park,
Weybridge.

### A Substitute for the McLeod Gauge.

THE letter in NATURE of August 23, p. 276, fails to justify an attack on the McLeod gauge. The theory that water is absorbed by glass is a theory only, of which there is no proof, and there is no proof that the McLeod gauge reads incorrectly or even that it is inconsistent. Any variation can be observed only by comparison with another method of measuring low pressure, which is just as likely to vary or be inconsistent as the McLeod gauge. Animal emanation, the glass-blower's breath for example, is very difficult to dislodge from the surface of glass and might easily cause a disturbance in the electric spark phenomena.

A final pressure of 0·001 mm. is mentioned; this means a pressure which will support a column of *mercury* 0·001 mm. high. The McLeod gauge is the only practical means of determining this measurement directly.

In a former letter we were told that the McLeod gauge may have special uses (such as the calibration of other gauges) " under rigidly controlled conditions." This can only mean clean glass, pure mercury, and an efficient drying medium, but it goes to prove my assertion that " there is no substitute for the McLeod gauge, in its perfect measurement of low pressures, expressed in height of mercury column."

HENRY A. FLEUSS.

47 Albert Road,
Caversham, Reading,
September 4.

MR. FLEUSS's letter answers itself. But may we trespass on your space for the last time in order to correct a misunderstanding which others than Mr. Fleuss have shared, and for which our original letter was doubtless responsible ?

We never intended to deny that the McLeod gauge, used rightly, is a thoroughly trustworthy instrument and almost indispensable for the calibration of all other gauges, except possibly the Knudsen. But we deny that, as it is often used, it is trustworthy or convenient. It is still, or was recently, an almost universal practice to attach a McLeod to every pumping system and to take readings on it a few minutes after the apparatus has been exposed to the air, and long before the condensed water is removed from the glass. McLeod gauges used in such circumstances are, we repeat, " cumbrous and misleading devices," " mere relics of the past." They are responsible for the ridiculous underestimating of pressures which is still common in the papers of serious investigators. It is for gauges used in such circumstances that we advocate the Pirani gauge as a substitute. Its increasing use shows that we are not alone in our opinion.

N. R. CAMPBELL.
B. P. DUDDING.
J. W. RYDE.

### Chimæras Dire : Transplantation of Heads of Insects.

I AM sorry that Prof. Przibram (NATURE, September 6, p. 347) should think that I treated Dr. Finkler's statements with unbecoming levity. The object of my letter was simply to direct attention to Dr. Blunck and Dr. Speyer's criticisms of Dr. Finkler's work and not to express agreement with one side or the other. Now that Prof. Przibram has undertaken to reply to these criticisms, the accuracy of my brief summary is perhaps no longer a matter of great importance, although I fail to see that it is in any way seriously misleading. It is true that I ought to have written " thorax " instead of " wing-cases," and also that Dr. Finkler has not yet told us with what he fed his inter-specific monsters ; but I still think that the sentence " a male head led a female body into unwonted perversities " is not an unfair version of what Dr. Finkler has said. To those of us who have only a scanty knowledge of the subject it seems a less extraordinary thing that " the male head kept its usual reaction towards the female . . . when transplanted to a body of opposite sex " than that the body should acquire a new reaction as a result of the operation.

The complaint that Dr. Finkler had refused to submit his specimens for investigation by others was not mine, but was made, as I stated, by his German critics. The specimens which Mr. Boulenger brought to London have been repeatedly exhibited here. I was told that they were not to be submitted to dissection or section-cutting, but I am now informed that no such condition was imposed by Dr. Finkler in handing over the specimens.

W. T. CALMAN.

British Museum (Natural History),
London, S.W.7.

## Biology and Religion.[1]

By Prof. J. S. HALDANE, F.R.S.

FOR religion the world, whether visible or invisible, is the manifestation of God. The real basis of religion lies in our own conscious experience, in our awareness of values which determine the course of our existence and unite us all but cannot be regarded as derived from either individual or collective self-interest. In so far as we realise these values, their objective reality, and their unity, we acknowledge, whether we are aware of it or not, that our universe is a spiritual universe and the manifestation of one God.

The theories of natural science seem to recognise neither objective ethical values nor God. Yet many scientific men have been deeply religious, and in one way or another have, even though often unsatisfactorily, reconciled their science with their religion. With the progress of science in recent times such reconciliation has seemed to become more and more difficult, and the existence of spiritual reality in the sense implied in religion has seemed to become more and more shadowy. During the nineteenth century this process was very marked ; and it was particularly the progress of biology, and only to a minor extent that of historical criticism, that brought the difficulty to a head. I shall endeavour in this paper to indicate what seems to me the cause of the difficulty, and to maintain at the same time that however uncompromising the attitude of biology is, and I hope always will be, towards obsolete details of theological creeds, there is in reality nothing to come between biological science and real religion.

Perhaps we can best realise the cause if we call to mind the argument of a once popular book, Paley's "Natural Religion." Paley argued that, first, the human or animal body is a piece of exquisitely perfect machinery ; and that, secondly, the existence of this wonderful machinery is clear evidence of the existence of a superhuman Designer. His argument was not very original, but it was at any rate put with great clearness. The first step came to be accepted by the great majority of physiologists ; but the second step was invalidated by the discovery of evolution and the theory of natural selection. It is, however, to the first step that I wish to direct attention ; for the essence of the whole matter is there.

Granted that the body is a machine, Paley would have said that the soul is placed within to control its voluntary working. Nevertheless, the more the matter has been investigated the more clearly has the fact seemed to emerge that the conscious control of the machine is dependent on exactly the same sort of material conditions as its ordinary unconscious working. We need only, for example, reduce the oxygen supply, or cut off the supply of some substance supplied by a gland, to produce not only loss of normal conscious control, but also a condition akin to, or identical with idiocy. If, therefore, the body depends upon mechanical conditions, so also does the mind or soul. Moreover, moral and mental characters are just as clearly transmitted by ordinary generation as bodily characteristics. In Paley's time, and indeed for long afterwards, many physiologists believed that there is active in the living body a factor which they called vital force, which is independent of the mechanical conditions. But the observations just quoted are fatal to vitalism also.

Paley's first step, taken in conjunction with the further development of physiology, thus leads us straight towards what is called materialism. Consciousness becomes a mere mysterious accompaniment of mechanical processes ; and spiritual values have ultimately no more meaning than they can have in a purely physical world.

Paley was a product of his time. With his generation, and succeeding generations, he accepted the assumptions about the nature of visible physical reality which had come down to him from Galileo and Newton. These assumptions were that visible reality consists of self-existent bodies separated from one another in self-existent space and time, and acting on one another according to the definite laws of mechanics, physics and chemistry. The human body, as a part of visible reality, must be just as much subject to these laws as inorganic bodies.

But Newton's conclusions about visible reality were based on the observation of inorganic phenomena. They seem to fit these phenomena, or at least seemed until recently to fit them, though Newton himself was far from thinking that he had done more than make a beginning of applying them in detail. But do they fit the phenomena of life ? If they do not, then Paley's first step was a false one, and the materialistic conclusions which have so naturally grown out of it fall to the ground. From the purely scientific point of view of biology itself, the question is fundamental. No one can doubt that the conception of a living organism as a mechanism such as Paley depicted is to a very large extent useful and convenient ; but is such a conception consistent with the characteristic phenomena of life and conscious behaviour ? To this scientific question I have largely devoted myself since my student days.

If we observe the relation between physiological stimulus and response we find that, under standardised or "normal" conditions of environment, the response follows the stimulus as regularly as any physical effect follows its cause. But when the conditions of environment are altered, perhaps to only a very slight degree, this is no longer the case : the response is altered, perhaps totally prevented or "inhibited," to use a physiological term. The exact response of a limb, for example, to a stimulus, say a visual stimulus, acting on the body, depends on a host of stimuli varying in nature with the relative positions of the various parts of the body : depends also on endless other co-existent stimuli, whether visual or of other kinds. It is just the same with chemical stimuli acting on any part of the body whatsoever.

When we regard this phenomenon from a wider point of view, we see that we can with very considerable success predict what happens if we assume that the life of an organism is something which actively asserts and maintains itself, including the organism's relations to its environment, in a manner which is specific or "normal."

[1] From a paper read at the Conference of Modern Churchmen, at Oxford, on August 28.

The responses and their modifications or inhibitions then fall into intelligible order. Apart from this assumption, characteristic physiological responses are nothing but unintelligible chaos: we cannot predict the characteristic manner in which stimuli and responses become associated and effective.

That the parts and activities of a living organism exist relatively to one another is evident. The very nomenclatures of biology presuppose this. Relativity reigns supreme in biology. But not only is this so: the relationships of life also actively assert and maintain themselves. The responses of the nervous system become intelligible from this point of view; but this is still more evident in connexion with the simpler responses within the body to molecular stimuli—the responses connected with respiratory exchange, assimilation and secretion. It is with these responses that my own experimental work has been mainly associated, and the study of them has left no doubt in my mind of the necessity for regarding the already defined conception of life itself as fundamental in biology.

Perhaps this necessity will become more easy to understand if I refer to the basis of practical medicine on its therapeutical side. When the organism is injured by any passing cause, tissues of exquisite delicacy have been destroyed or altered in structure. We have no means of repairing or replacing these structures as we might repair or replace the injured parts of a machine. Nevertheless, the injuries can be healed, and by various means we can facilitate the process or render it certain. It is because life actively maintains and reproduces its normals that recovery is brought about. What a doctor does is merely to aid Nature in the process. Any other view of the matter amounts to the mere quackery which has been repudiated by scientific medicine ever since the time of Hippocrates.

But I can almost hear some well-meaning scientific colleague saying "Your conception of life may be all very well as a sort of heuristic principle, but it is totally unintelligible. The process of healing and reproduction must depend on a series of molecular reactions; and the right way to understand it is to investigate these reactions one by one. Since the living body is material it must be subject to the laws of all material action. In other words, it must be a mechanism, though a very finely balanced and complex molecular mechanism." Let us then suppose for the moment that this is so, and see how the assumption works out.

The living body reproduces itself from generation to generation. In the process of reproduction it grows from a microscopical speck, or rather two microscopical specks, the male and female elements, which have united to form one. Little or none of the assumed molecular machinery can exist in these specks: it must all be gradually built up again in the course of development. This development itself is a very complex process, which on the mechanistic theory would necessitate the existence of extraordinarily complex molecular machinery in the germinal specks, and corresponding machinery in the parent organisms for producing the germinal machinery. The mind recoils from the incredible complications involved.

Specific germinal cells in the bodies of animals can sometimes be followed in their successive divisions from one generation to another, and in this sense there is continuity of the germ-plasm. On the mechanistic theory, therefore, the molecular machinery of reproduction reproduces itself by fission from its like. But how is a delicate piece of machinery to reproduce itself by fission? Imagine the unspeakable confusion in such a process, or in the sexual union of two similar pieces of machinery!

I have perhaps said enough to show why I cannot regard the mechanistic theory of life as tenable. It involves quite impossible assumptions and leads us nowhere in respect of the characteristic phenomena of life. Not only the newspapers, but also scientific men, continue to speak of the mechanism of life and heredity: I confess that such an expression has no meaning whatsoever to me. We cannot dispense with the distinctive conception of life. Let there be no mistake, however, about what this implies. It implies that the old conception of visible reality which Galileo and Newton set forth has broken down; and that there is no use in appealing to that conception in support of a mechanistic theory of life. Life would be unintelligible on that conception; but it is reality that science has to deal with, and not an ideal world of mechanism. The ideal mechanical world of Galileo and Newton corresponds sufficiently well for most practical purposes with our experience of inorganic phenomena, but does not correspond with our experience of biological phenomena. The supposed self-existent bodies and separable reactions of the ideal mechanical world have turned out to be not really self-existent and separable; and we have to modify our fundamental conception of visible reality accordingly, though for many practical purposes the merely mechanical conception may suffice.

It may be many years before the significance of the phenomena of life for our conceptions of visible reality is generally understood; but assuredly this general understanding will in time be reached.

So far I have only discussed life in such a form as we seem to meet with in plants, or in the activities of parts of our own bodies which we assume to be unconscious. I now come to conscious activity. We know what conscious action is in ourselves, and we can easily infer its presence or apparent absence in other persons. We can also form some judgment as to its presence in even lowly organised animals.

Conscious is distinguished from unconscious experience or activity by the fact that a conscious experience or action carries with it an ordered reference to both past and anticipated experiences, as well as to other present experiences. It was Kant who first pointed out this fundamental fact clearly in relation to perception. A conscious experience not carrying in itself ordered relations to past and anticipated experience is a purely imaginary figment. This discovery constitutes the great advance which Kant made beyond Berkeley and Hume. We cannot derive our conceptions of the spatial and temporal orderliness of our world from separate experiences of it: the orderliness is already given in any experience, and belongs to it. An ordered universe existing apart from conscious experience of it would be nothing to us. It was to a world of relativity that Kant's analysis of perception led.

At first sight Kant's idealism seems to lead us into impossible or practically unmeaning conclusions; but let us follow the same line of reasoning further than

Kant followed it. He belonged to his own time. The order which he found to be implied in conscious experience was simply the order of the physical world as pictured by Galileo and Newton; and indeed his idealistic philosophy became a sort of buttress to their ideas of visible reality. Whether visible reality was self-existent, or relative, or ideal did not seem to matter much in practice, although with relativity physics Kant's reasoning has now come into prominence among physicists themselves.

When we examine our own conscious experiences and actions we find that they hang together in another manner besides those pointed out by Kant. They hang together or are essentially related in the manner already described in connexion with the phenomena of life. Whether we will or no, they influence and inhibit one another in a manner which cannot be predicted or understood on merely physical principles, and which only becomes more or less predictable or intelligible in the light of the conception of life. What Locke called the secondary qualities in experience come under this category, together with various natural appetites and instincts, repulsions and attractions. Into all our conscious perceptions and actions this element of relatedness enters, and not merely the relatedness in a physical sense, to which Kant directed attention. Both in connexion with ourselves and with other organisms is this true. It is only by a process of artificial abstraction that we can neglect the biological aspect of our conscious experience, and the neglect of this aspect has led to endless intellectual confusion.

We must not make the mistake of supposing that the conception of life stops short at the body-surface of an organism. A living organism cannot be separated in thought from its environment. In life the physiological relation to environment is maintained just as clearly as the physiological relation between the parts of the body. An organism belongs to its environment just as much as its parts belong to one another. Different individual organisms are also organically related to one another, by parenthood, sex relations, and mutual association of various kinds. The normal limits in duration of individual life are also an apparent evidence of this relationship.

In consciousness of the biological aspect of experience, and in corresponding conscious action, our lives have for us a past and future which is inseparable from the present. Our perceptions and actions are thus those of conscious interest, as distinguished from the blind immediacy of what we regard as mere biological phenomena. Our world is a world of interests and values, and our actions have a corresponding responsibility attached to them.

The existence of biological phenomena showed us that a mere mechanical conception of visible reality is fundamentally inadequate, however useful practically for some purposes. The progress of philosophical investigation since Descartes has also shown us that in whatever way we may for temporary practical purposes represent to ourselves the visible universe, it cannot be in reality anything but a universe of conscious existence. Berkeley, Hume, Kant, and their lineal successors have been in agreement about this, however short they may have stopped in the further development of their conclusion. Putting together this conclusion with the previous one, we find that our universe is a universe of perceived interests and values, and of responsible conduct.

Let us now examine further the nature of the interests and values which present themselves in perception and conscious behaviour. We can think of them in the first place as the interests of an individual human organism. In the life of a conscious organism, what is required for the maintenance of its normal organic life and structure is foreseen and provided for in the light of past experience, since conscious experience and action reach out, as Kant showed, into both the past and the future. In this process the environment is as much concerned as the body of the organism itself, since life, when we investigate it, involves, and indeed manifests itself in, a normal relation between living organic structure and environment. This fact is to some extent masked in higher organisms, which, as Claude Bernard first indicated, possess, in the form of their blood, an internal environment which by various means is kept amazingly constant in its character, and acts as a sort of buffer between the living tissues and the variations in the external environment; but now that physiologists have become aware of this, the true relations between organisms and environment are standing out ever more clearly. It is a relationship which can only be comprehended as an organic one: a merely physical interpretation of it is not possible. Even from the point of view of our merely individual lives, our environment is in no mere physical relationship to us: it is bone of our bone and flesh of our flesh.

An isolated individual human organism is, however, only a scientific abstraction: for without at least a mother or nurse no human infant could survive. In the perception more particularly of human relationships and corresponding actions, we become aware of wider interests than those centred round our individual organisms. The wider interests centre round family, countrymen, the human race, and extend also to animals, plants, and country. They extend also to both the past and future. In the experiencing of them it is just reality itself that is being revealed to us; and spiritual reality, not merely ideal scientific abstractions. We are, in fact, no mere self-centred beings, complete in ourselves; and those who set before themselves, and endeavour to act on, the idea that they are entirely self-centred are only doing violence to their own nature.

This latter conclusion seems to me equally clear even if we simply regard human behaviour from an abstract biological point of view. A higher organism is an assemblage of countless individual cells; but the behaviour of not one of them is intelligible biologically apart from its relations to the rest, and to the environment generally. In exactly the same way the biological behaviour of individual human organisms is unintelligible apart from their relations to other human organisms and the rest of their environment. Their very being in the biological sense manifests itself in this relationship. We belong in the most intimate sense to our environment.

The wider interests which reveal themselves in human society have a compelling power which dominates what we regard as mere individual interests. In these wider interests we meet with something which we can in this sense describe as "not ourselves," though in another sense it is the reality of ourselves. It binds us together in spirit, so that what others feel and see we also feel and see. We thus attain to what we regard as objective perception, a perception that others share in, and that unites all men: also to corresponding objective standards of behaviour.

This perception and behaviour is not just the collective or average perception and behaviour of a number of individuals, but something which only shows itself in fellowship with others, and in the contemplation of our relationship with Nature. It is the manifestation of the spiritual Reality of our universe—the Reality which men call God.

We are so accustomed to regard reality as physical reality in the sense of Galileo and Newton that any more adequate conception of reality seems to us far away and unreal—mere mysticism. We are the children of a materialistic age. We look for a soul consisting, if not of ordinary matter in the mechanical sense, yet of something which is only a thinly veiled imitation of it. We look, also, for a similarly constituted God. Such entities can never be found. God is with us, in us, and everywhere around us, as Jesus taught. We must learn to see spiritual reality, and not the mere appearances of matter. We must learn, also, that the voice of God is not a voice threatening us from outside with material punishments or coaxing us with the hope of material rewards, but a voice which, when we hear it, transforms our most hidden motives and thoughts.

Let me return to the relations of biology and other branches of natural science to religion. Perhaps it might seem that what I have been saying attributes to natural science the responsibility of blinding us to spiritual reality. Are not, for example, Galileo and Newton, and the great biologists who have treated the living body as if it were a piece of mechanism, responsible in this respect? To point out that theologians are equally responsible does not answer this question. I wish to consider it directly.

When we examine the original contributions of great men of science we always find, first, that on the data before them their conclusions were justified, and, secondly, that these conclusions were calculated to be of great practical use to their fellow men. If it is true that the reality of our universe is spiritual, it is no less true that we are constantly struggling with illusion and imperfection, and that it is only in that struggle that spiritual reality manifests itself to us. We cannot separate faith from works. The motive of science has always been the discovery of what, in one way or another, will be of use; and at every turn we make use of scientific discovery in practical affairs. It does not matter how limited in scope the discovery may be, we can always make use of it. To take examples, the discoveries by Kepler of the mechanism by which images are focussed on the retina, or by Harvey of a mechanical process by which blood is circulated through the body, were limited in scope, but of immense practical service. The eye cannot be regarded as a mere mechanical structure, nor the circulation as a mere mechanical process, so there is a reality beyond these discoveries. This does not, however, detract from their value, any more than the discoveries of Einstein have detracted from the value of Newton's discoveries.

Scientific investigation is just part of the struggle in which spiritual reality manifests itself; and the realisation of this brings science, particularly pure science, very near to religion. It is only when science becomes dogmatic that it assumes an attitude which seems to deny the existence of spiritual reality. We find very little of this dogmatism in the writings of great men of science, but much more of it in the desiccated science of systematic text-books and popular expositions. For example, the idea is spread abroad in such writings that natural science, unlike philosophy, advances by a steady process of addition. We have only to look back on the history of natural science to see how utterly misleading this idea is. The progress of science is just as much strown with the remnants of discarded theories as is the progress of philosophy; but, in spite of this, continuity of development is evident in the histories of both of these subjects. Surely it must be the same with theology.

During most of my life I have been struggling more or less with scientific dogmatism, but I have never before addressed an audience mainly clerical. I wish to take the opportunity, therefore, of adding my voice to those of others who are engaged in struggling with the shackles of theological dogmatism. There are very many who, like myself, are kept away from existing churches by creeds and church services which they cannot honestly countenance, and perhaps a still larger number who are actively hostile because they regard churches as hotbeds of superstition. If I thought that my country could get on equally well without churches I should not care what was taught in them. But I do not think so. We need to be constantly reminded of that spiritual reality which manifests itself in willing service of every kind, and without the perception of which our country would relapse into chaos.

The churches cannot afford to be hampered by unintelligible beliefs which are mainly materialistic accretions of Christianity and greatly weaken its influence on those who are worth influencing. Religion itself stands on ground which cannot be assailed: it has no use for rickety defences. The story of Jesus and His teaching appeals to all men, and influences them practically, because it touches what is deepest and most real in them. Many, however, feel forced to conclude that that teaching was based only on emotional illusion. Hence adequate philosophical or theological support is needed for it. This support should be based on the widest philosophical and scientific knowledge. Any shirking of the questions involved, or cowardly sheltering behind mere traditional authority, is fatal. The true function of a church is to help men to see reality as a whole, and to guide their actions accordingly, thus preventing social chaos, intellectual confusion, and artistic decay.

You are members of the national Church of England, and we are meeting near the spot where one of the greatest leaders of that Church, a man of English yeoman stock, met his end. It is to Latimer that my mind goes back when I appeal for intellectual freedom in the English Church. He stood, not only for social justice and humanity in his country, but also for intellectual freedom. It was not of his own sufferings, or his own soul, that he spoke as he was dying, but of the England he had served so fearlessly, so lovingly, so faithfully, thus finding oneness with God.

The candle which was lighted in England as Latimer and Ridley perished is still burning.

## The Forces which lift Aeroplanes.[1]

By Prof. V. K. F. BJERKNES, Geophysical Institute, Bergen.

THE forces which carry aeroplanes are now subject to intensive experimental and theoretical investigation. In one respect, however, these investigations have led to a surprising result, namely, that the force which makes flying possible belongs to a group of forces discovered long ago, before the period of aviation. Their existence had been predicted mathematically, and these predictions had been verified by experiments.

### THE DIRECT GEOMETRIC AND THE INVERSE DYNAMIC ANALOGY BETWEEN HYDRODYNAMIC AND ELECTROMAGNETIC FIELDS.

This old theory, and these old experiments, relate to what is called *hydrodynamic actions-at-a-distance*. The period when the doctrine of action-at-a-distance was absolutely predominant lasted, at least on the Continent, until about thirty years ago. The researches which I am about to describe, date from that period. My father, C. A. Bjerknes, could not reconcile himself with this doctrine at the time when he was a student at the University of Christiania, about eighty years ago. Ten years later he had the opportunity of acquainting himself with recent results of research in theoretical hydrodynamics. These had just led to a surprising fact: a spherical body could move through a frictionless fluid without experiencing any resistance. This paradox was in his eyes an important fact in discussing action-at-a-distance. The doctrine of Newtonianists had been that space was empty. They believed that a medium filling it would ultimately stop every motion. But this argument now turned out to be erroneous. The supposition that space was filled with a medium was not contradictory to the first axiom of dynamics, the principle of inertia. This made another idea occur to him: Should not the same medium be able also to propagate actions from body to body, thus giving rise to apparent action-at-a-distance? And would not the answer be found by solving the problem of simultaneous motion of two or more bodies in the fluid—for mathematical simplicity of spherical or cylindrical form?

The conditions under which my father worked were not favourable. But he never gave up his point of view, and twenty-five years later he was in possession of the full solution of the problem, and had verified the results by a series of striking experiments.

The result was that a very remarkable analogy became evident between the field of motion in a fluid and the electric or magnetic field of force: the bodies produced fields of motion of precisely the same geometric structure as static or stationary electric or magnetic fields. Moreover, they exert apparent actions-at-a-distance upon each other, equal to, but—most curiously—opposite to the actions-at-a-distance between the corresponding bodies in the electric or magnetic fields.

### GENERAL STATEMENT OF THE ANALOGY.

In one respect, however, my father's theory was special: he had proved this analogy to exist only for bodies of spherical or cylindrical form. By slightly changing the problem, I succeeded some twenty years ago in giving an absolutely general proof of the analogy. I retained in my theory the idea that the main fluid was homogeneous and incompressible. But for the solid spheres and cylinders I substituted *fluid* bodies of any shape. These bodies may differ from the surrounding fluid in four respects: (1) In density: this gives the body a reaction against acceleration, different from that of the surrounding fluid; (2) in compressibility: the bodies may perform motions of expansion and contraction; (3) the motion considered was allowed to be vortical inside the bodies, while it was always irrotational in the surrounding fluid; (4) external force may act upon the elements of the bodies but not on those of the surrounding fluid.

The advantage of considering the entire system as fluid is that its dynamics are then determined completely by the hydrodynamic equations. Therefore the analogy to the electric or magnetic field may be demonstrated by a simple—in reality very simple—transformation of these equations. The leading idea of this transformation is to consider the actual fluid field of motion as made up by two partial fields: the *impressed field*, which is that produced by external force, including the hydrodynamic actions-at-a-distance; and the *induced* or *free field*, which is due to fluid pressure, setting aside that part of the pressure which produces the hydrodynamic actions-at-a-distance. The impressed field exists only inside the bodies, while the induced or free field pervades all space, including that inside the bodies, and when added to the impressed field in this inside space, it gives the actual fields of motion of the bodies.

This system can be compared with an electric or magnetic one. Specific volume will then correspond to magnetic permeability or specific inductive capacity; velocity will correspond to magnetic induction or electric displacement. The product of velocity into density, that is, specific momentum, will correspond to magnetic or electric intensity. Impressed field within the fluid bodies will correspond to impressed field in the interior of a permanent magnet or a pyro-electric crystal, and induced hydrodynamical field will correspond to induced magnetic or electric field in external as well as in internal space. Velocity of expansion or of contraction will correspond to magnetic or electric charge, positive or negative; and vorticity, specially defined here to be the curl of induced specific momentum, will correspond to electric current density.

This correspondence between the quantities used for describing the two kinds of fields being agreed upon, the analogy between the two kinds of fields may be stated thus:

*At any moment the field of motion of the fluid system is identical in geometrical structure with a certain static or stationary magnetic or electric field; and in this hydrodynamic field there are apparent actions-at-a-distance which, element for element, are equal but opposite to those of the corresponding forces of the magnetic or electric field.*

Having obtained this theoretical result we can easily apply it to solid bodies; for the external force which we have introduced is subject to no restriction. We can

[1] From a discourse delivered at the Royal Institution on Friday, May 9.

therefore let this force, or a certain part of it, control the motion of a body in such a way that it moves as if it were rigid, or solidly elastic. This result is attained by imagining reciprocal actions between the particles of the body which have no resultant for the entire body. The only thing to be taken into account will be the impressed fields produced by these reciprocal actions between the particles. But as these fields are characterised by small motions in all possible directions, they will in general give rise only to insignificant reactions with the exterior field.

By substituting solid bodies for the fluid bodies we can obtain experimental demonstrations. But, it may be argued, where solid bodies are moving in a fluid we do not in general observe any striking analogy with the phenomena of the electric or magnetic fields. The reason for this is twofold. First, to recognise the analogy we must divide the field into its impressed and induced parts. The distinction between these two partial fields will not in general be visible to the eye. It must be found by a dynamical analysis. Secondly, the hydrodynamic system is a moving system which is always changing its configuration, and the direction and intensity of motion of its different parts. During each new phase of its motion we must therefore compare it with a new electromagnetic system: this gives a fugitive character to the analogy. But in two cases it must crystallise into a concrete and strikingly visible form: first, when the motion is permanent, and secondly, when it consists of small synchronous oscillations about an invariable average configuration. In both cases we have to compare it with a constant electric or magnetic field. In both cases the induced hydrodynamic field is hidden as a more or less invisible field, while that part of the impressed field which is due to the hydrodynamic actions-at-a-distance produces strikingly visible effects.

This result is, however, obtained in both cases at the expense of a certain reduction of the extent of the analogy. As vortices cannot be oscillatory in a frictionless fluid, they must be zero. In the oscillating case, therefore, the analogy with the electric currents fails. On the other hand, as displacement of the boundary surface would violate the permanence of the motion, all phenomena due to change of volume or of place of the bodies drop out; and we retain only the phenomena depending upon permanent circulation, corresponding to those of electric currents.

## The Instruments.

A general auxiliary instrument is a generator for producing vibrating motion. A little electric motor drives a spindle having two eccentrics, each of which works a little pump. Each pump is double-acting and consists simply of cylinder and piston but has no valves. Through the outlet tubes communicating with the ends of the cylinders a few cubic centimetres of air is thus alternately driven out and in, in opposite phases from the two ends of the same cylinder. A cock allows us to regulate the amplitude of that oscillating air current which is conveyed to the main instruments. When a unidirectional air current is desired, a simple valve arrangement may easily be inserted.

A practical peculiarity of the instrument is that the cylinders, not the pistons, are connected with the eccentrics, and that the pistons react against the motion only by their inertia. This proves useful in connexion with the regulation of the amplitudes. Cylinder and piston are carefully polished but *never* oiled. Another peculiarity of construction is an elaborate symmetry of the moving masses and of their motions, in order to eliminate all vibration of the instrument by compensation.

The alternating air currents from the generator are used to produce two kinds of vibration: first, pulsations, or periodic changes of volume, and secondly, oscillations or periodic changes of place. The pulsating body is a drum having metallic membranes (by their durability preferable to indiarubber membranes) and fixed on the end of a metal tube (Fig. 1, I, II). The membranes are alternately blown out and sucked together by the alternating air current. Loading one membrane of such a pulsator, and connecting the other membrane with a spherical shell, which is mounted on a tube and surrounds the pulsator, we get an oscillator (Fig. 1, III): the outer shell and the inner load make opposite oscillations. The desirable case when these become equal amplitudes is attained when the weight of the load equals the sum of the weight of the spherical shell and the half of the mass of water displaced by it. In this event the pulsator will, by the principle of the conservation of the centre of gravity, remain at rest, and the outer shell will oscillate undisturbed both when the projecting tube of the pulsator is taken in the hand and when it is inserted in a rigid clamp. It will not transfer disturbing oscillations to sensitive balances in which it is inserted for the experiments.

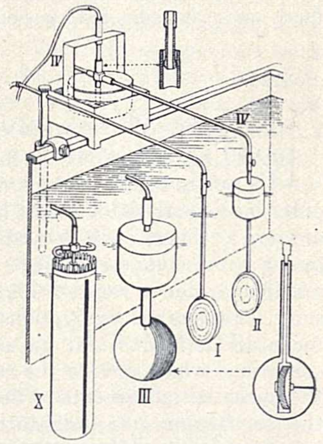

Fig. 1.—Balance arrangement with pulsators (I, II), oscillator (III), rotating cylinder (X).

Different arrangements can be made for giving such a pulsator or oscillator the degree of mobility required for examining the forces or couples exerted upon them. It is generally convenient to let it float with a buoy. If then the tube conveying the air from the generator is sufficiently flexible, we have at once both translatory and rotatory mobility. To reduce the mobility to a pure translational one, we may give the system of tubes which convey the air from the generator the form of a torsion balance. The weight of this balance is conveniently carried by a floating buoy, swimming in the tank used for the experiments, or in an extra vessel outside it, to reserve the main tank exclusively for the bodies under experiment. We may also do away with the torsion tube of this balance, and let the air go directly from a fixed tube through a loose joint into the balance with really very little loss of air (Fig. 1, IV). This has the advantage that the equilibrium is always indifferent. One of these balance arrangements may be used for demonstrating the attractions, repulsions, or lateral displacements exerted upon a pulsating or an oscillating body. The latter may be inserted in the balance in two principal ways: for longitudinal mobility, so that its direction of mobility coincides with its axis of oscillations; or for transverse mobility, so that the direction of its mobility is normal to its axis of oscillation. Rotational mobility of an oscillator is obtained either by suspending it by a rubber tube, or by letting the air pass direct into the floating oscillator through a loose joint.

As bodies having no vibrating motion of their own, we use a heavy sphere suspended from a float, a light sphere held under water by a load and suspended from a float, a light and heavy cylinder suspended in the same way.

Finally, for studying the field of motion set up in the fluid we may use a simple arrangement, namely, a light spherical body attached to an elastic wire. This sphere will be set into induced oscillations by the surrounding fluid, and, choosing that period which gives resonance, we can magnify the minute water oscillations and make them visible. The sphere may also carry a light rod which projects above the surface of the water, and carries a pencil which inscribes its oscillations automatically with ink upon a glass plate placed above the water.

These instruments serve for experiments with vibrating bodies. Permanent motions can be produced by the rotation of cylindrical bodies. By a simple valve arrangement inserted in the tubes conveying the air current from the generator, the alternating current may be changed into a unidirectional one. This current can then be used to drive a turbine attached to a cylinder which is thus set into rotation (Fig. 1, X). To examine the forces exerted upon such a cylinder the latter is placed in the balance just as the pulsator or oscillator was, while another cylinder driven in the same way is mounted on a handle which may be taken in the hand or fixed in a support.

(*To be continued.*)

## Obituary.

### SIR WILLIAM BAYLISS, F.R.S.

"BAYLISS'S book is by far his greatest contribution to science—much more important than any of his individual discoveries is his statement of his point of view." These were substantially the words used to me by a very competent critic. At the time I wondered whether or not it were so, and I have often wondered since. Bayliss's investigations into the electric phenomena of the heart [1] and the salivary glands,[2] into the conditions which govern the cerebral circulation,[3] into the muscular movements of the alimentary canal,[4] into the mechanism of vaso-dilatation,[5] into the correlation of vaso-motor reflexes;[6] his establishment of the existence of antidromic fibres in the mammal,[7] his researches on the application of surface phenomena to physiological action,[8] and the discovery of secretin [9]—these were his principal discoveries.

When all allowance has been made for the fact that most of this work was carried out in collaboration, it remains an extraordinary tribute to a man's point of view to say that the statement of it transcends such researches. Yet in support of my friend's statement I reflect that in another continent there are "Bayliss Clubs"; these do not exist for the study of the specific subjects enumerated, but for the joint discussion by physiologists and chemists of so much of science as they have in common. The association of Bayliss's name with such societies is a tribute precisely to Bayliss's statement of his point of view. It is not merely that when one asked why the clubs were so called one received the answer, "We discuss the sort of thing which is in Bayliss's book," but that when one comes to think the matter out, one finds it not a little surprising that such societies were not associated with other names; for it cannot be claimed that Bayliss was a pioneer in the investigation of biochemistry. His interest in the subject—so far as may be gleand from his published works—dated from about the come mencement of this century—before which date the pioneer work in Great Britain had been done. Hardy had launched colloid chemistry in the 'nineties; Hopkins, before the eighteen hundreds were complete, was well forward with that series of isolations which adorn both organic chemistry and physiological science; and Halliburton had done the major portion of his work.

Bayliss's great contribution was that he discussed the whole subject of biochemistry as a continuous whole, thinking out each point *ab initio*, and committing the record to paper, so that what he thought for himself he thought also for others. His method of approaching a subject was one which lent itself admirably to this procedure. The quality of genius differs from individual to individual, probably even more than its quantity. Among scientific men, the genius of some is of the artistic type; though possessing great certainty of touch their inspiration comes they know not whence. To the onlooker it appears almost to be an accident; that it is not so is proved by the fact that it crops out too often in the life of the same person. In others genius is of the mathematical type; with them the premises are grouped in a particular way and to their vision the conclusion flashes out.

Bayliss's genius was not precisely of either type—at least if my own appreciation of it may be trusted. He took nothing for granted, he was not in a hurry, he inquired with meticulous care into every step of an argument; if he found something which was not perfectly clear to him, he spared no pains to discover whether the thread of the argument was really broken or whether he had merely failed to follow it. In the end his mind became clear on the subject; to his own satisfaction he was able to pronounce either that he understood the matter and that it was thus, or that he failed to understand it because the thread, to the best of his judgment, was not continuous.

Such a method is eminently calculated to exclude all forms of obscurantism, and indeed nothing was more

[1] *Journ. of Physiol.* 12. xx, 1891, and 13. lviii. 1891.
[2] *Journ. of Physiol.* 7. 217, 1886.
[3] *Journ. of Physiol.* 18. 334, 1895.
[4] *Journ. of Physiol.* 24. 99, 1899.
[5] *Journ. of Physiol.* 16. 10, 1894, and 24. 173, 1901.
[6] *Journ. of Physiol.* 37. 264, 1908.
[7] *Journ. of Physiol.* 28. 276, 1902.
[8] Proc. Roy. Soc. B, 84. 229, 1911, and 91. 196, 1920.
[9] *Journ. of Physiol.* 28. 325, 1902, and 29. 174, 1903.

foreign to Bayliss's philosophy than vague talk about "vital force" or the like. Either a phenomenon was understood, in which case the explanation could be written down and placed on record in his book, or it remained for investigation. In the latter case it might fall into one of two categories, (*a*) that of being capable of explanation on the basis of current knowledge of the properties of matter, (*b*) that which awaited further discoveries into the fundamental conditions which govern material things. It was Bayliss's good fortune to be at the zenith of his intellectual powers at a time when important additions were made to the knowledge of several departments of chemistry and physics, such, for example, as of adsorption, of catalytic action, of interfacial phenomena, and of radiant energy. Each successive addition afforded to Bayliss a prospect of the removal of phenomena from category (*b*) (above) to category (*a*), and of their final elimination from the region of the unexplained. That was Bayliss's point of view—as I understand the matter; it was a point of view extremely stimulating to the student, not only because it led so directly to experimental investigation, but also because it led along a road which seemed so straight and so easy to follow.

Could Bayliss have been given the choice as between a spectacular form of genius on one hand and a form which was readily intelligible on the other, I feel sure he would have chosen the latter. The spectacular had little attraction for him; simplicity was characteristic no less of his intellectual outlook than of his personal habits.

I gladly concede to rising generations that to them Bayliss's statement of his point of view is his most important work, but to myself Bayliss—of course in conjunction with Starling—was pre-eminently the discoverer of secretin. The moment when the first drop of pancreatic juice was elicited by the injection of duodenal extract must, I think, have been the most dramatic in his scientific career. Possibly I take this view, because I was at a peculiarly impressionable age at the time, possibly it is accentuated because of a trifling incident which stamps it upon my mind. I had the good fortune to witness, not indeed the first successful experiment on the subject, but I think the second—that in which the first was to be either confirmed or refuted. The physiological laboratory at University College, London, was in those days peculiarly open to young physiologists—I imagine that it is not less so now. Some errand took me round there: the door of Bayliss and Starling's room was open: an experiment was in progress. Bayliss held a flask in one hand, and with the other was in the act of introducing a tissue extract into the circulation from a burette, Starling was on his haunches, his eye on the level of a canula which projected from the animal: the extract went in: the blood pressure fell for the nonce: there was a pause and then—drop, drop, drop from the canula. There was no secrecy—all was explained without reserve, to a youngster who had published perhaps a couple of papers, who hailed from another laboratory, whose very presence might have been accounted an intrusion, and who had no possible claim on either the confidence or the genius of those who had made so great a discovery. Thus can generosity and understanding attract youth within the charmed circle of genius.

Indeed, Bayliss loved the company of the young. I can see him now discussing some topic with a circle of young, and, it may be, obscure physiologists, at the meeting of some society, and by his simplicity and sympathy wiping out the disparity in age and status, or lunching off porridge in a popular restaurant surrounded by young researchers and wishing for no more elaborate fare and no more exalted company.

Bayliss took a considerable interest in public affairs—scientific, sociological, and political—probably in that order. Under this heading mention should first be made of his work in connexion with the Medical Research Council; for the following information I am indebted to Sir Walter Fletcher. From the historical point of view the Medical Research Council came into being at a time when the practise of medicine in Great Britain had much to gain from a closer liaison with physiological discovery—a fact which was greatly emphasised by the War, and one which afforded to Bayliss a field of peculiar usefulness in connexion with the work of the Council. The most conspicuous work which Bayliss did during the War will always associate his name with the subject of surgical shock, for the fuller understanding of which the Council appointed a very strong committee over which Bayliss presided; his own contribution was principally on the side of treatment. His introduction of intravenous injections of gum saline not only was regarded by many competent authorities as being of great use, but also it paved the way for a renewed interest in blood transfusion and a much improved technique for the purpose.

After the War, Bayliss assisted the Medical Research Council by presiding over a Committee for the investigation of the biological action of light, the object of "which is to analyse, explain, and extend all our valuable but still quite empirical knowledge of the action of light on the body, as in increasing its defence against tuberculosis, raising the bacteriological power of the blood, and in replacing and facilitating the action of vitamin A." Bayliss greatly assisted in suggesting precise laboratory observations. This work is still in progress, and in its concluding phases his loss will be greatly felt.

Much of Bayliss's work was of a surgical type; and, probably rather by accident, he was singled out at one time as the special target of those who disapproved of animal experimentation—a rather singular irony, because he was always on the side of the weak, the struggling, and the oppressed in all movements designed to better their condition. In politics he was a Liberal and presided over a local organisation of the Liberal party.

Bayliss's sociological interests became more evident towards the end of his life. The last man to derive any satisfaction from seeing his name in print, he was a frequent contributor to the press in the form of letters on such subjects as he thought might be helpful. This was part of his "statement of his point of view," though in a minor sphere; where he found difficulties he recorded them and gave the record to all and sundry who might be helped by it. On scientific matters he was a frequent contributor to NATURE, whilst his sociological writings embraced subjects so widely separated as the importation of cocaine, the methods of killing meat for food, and the desirability of birth control. Indeed, he was a vice-president of the Society for Constructive Birth Control and Racial Progress.

Bayliss received the honour of knighthood in 1922. He held the following degrees and distinctions: M.A. and D.Sc. (Oxon.), Hon. LL.D. (Aberdeen and St. Andrews), F.R.S., Hon. Fellow of Wadham College, Oxford, Hon. member of the Danish Academy of Science, Corresponding Member of the Société de Biologie (Paris) and of the Royal Academy of Belgium, Professor of General Physiology, University College, London, member of the Council of the Royal Society, 1913–1915, secretary and afterwards treasurer of the Physiological Society, Joint Editor of *Physiological Abstracts* and of the *Biochemical Journal*. Bayliss delivered the Croonian Lecture to the Royal Society in 1904 and received the Royal Medal in 1911, the Copley Medal in 1919, and the Baly Medal of the Royal College of Physicians in 1917. He delivered the Oliver-Sharpey Lectures in 1918, the Sylvanus Thompson Lectures in 1919, and the Herter Lectures in 1922.

JOSEPH BARCROFT.

AN appreciative account of the scientific career and work of Dr. T. C. Mendenhall, who died on March 22, is contributed to *Science* of July 11 by Mr. G. R. Putnam, and we are indebted to it for the following particulars: Dr. Mendenhall was born on October 4, 1841, and after preliminary training as a teacher, became the first professor of physics in the Ohio State University. He went to Japan in 1878 as professor of physics in the Imperial University at Tokyo, and three years later returned to Ohio. He was president for several years of the Rose Polytechnic Institute, and for seven years of the Worcester Polytechnic Institute, from which he retired in 1901. Dr. Mendenhall took a leading part in many activities connected with science and engineering in the United States. He was for five years superintendent of the Coast and Geodetic Survey, and served as president of the American Association for the Advancement of Science, and the American Metrological Society. He carried out some notable investigations in terrestrial gravity, seismology, atmospheric electricity, and related subjects.

WE regret to announce the following deaths:

Mr. F. H. Bradley, O.M., fellow of Merton College, Oxford, and author of "Appearance and Reality," "Principles of Logic," and other authoritative works on problems of philosophy, on September 18, aged seventy-eight.

Prof. Alexander Darroch, professor of education in the University of Edinburgh, aged sixty-one.

Dr. Franz Doflein, emeritus professor of zoology and comparative anatomy in the University of Breslau, on August 26, aged fifty-one.

Dr. J. Elliott Gilpin, professor of chemistry at Johns Hopkins University, known for his work on the action of chlorides of phosphorus on amides and on fractionation by capillary diffusion of crude petroleum, aged fifty-seven.

Dr. Sidney Martin, F.R.S., physician to University College Hospital, London, and distinguished for researches in chemical physiology and pathology, on September 22, aged sixty-four.

## Current Topics and Events.

A FINE, seated statue of Lord Lister, in academic robes, the work of Mr. G. H. Paulin, was unveiled in Kelvingrove Park, Glasgow, adjoining the University, on September 17, by Sir Hector C. Cameron, Dean of Faculties. The Lord Provost presided, and speeches setting forth Lord Lister's unique service to humanity in the domain of scientific surgery were made by Sir Hector, Sir Donald MacAlister, Bt., principal of the University and president of the General Medical Council, and Prof. J. H. Teacher, of the Royal Infirmary Department of Pathology, who is the custodian of the Lister relics there preserved. It was in the Kelvingrove Park, near his house, that Lister meditated the principles of his antiseptic method of wound treatment, during his tenure of the University chair of surgery from 1860 until 1869. It was in the Royal Infirmary, near the old College, that he applied these principles to practice, and thereby demonstrated their efficacy in the prevention of suppuration and of septic poisoning in operative wounds. The ceremony was preceded by a luncheon in the Civic Chambers, attended by a large number of distinguished surgeons and citizens of Glasgow, and by Mr. J. J. Lister, fellow of St. John's College, Cambridge, and nephew of Lord Lister. The latter spoke of his uncle's early researches, and of his private life, in response to the toast of the Lister family, proposed by Sir Donald MacAlister, who narrated some picturesque incidents of his friendship with Lord Lister during thirty years. The statue completes the effort begun by the Glasgow Lister Memorial Committee in 1912, but interrupted by the War. Generous contributions have been made by it, not only to the Glasgow monument, but also to the international fund for establishing a Lister Oration and Prize for research in surgery, to the memorial in Westminster Abbey, and to the Lister collections displayed in the Glasgow Royal Infirmary in commemoration of the great surgeon's association with the institution.

THE announcement in the daily press regarding the decision of the Government to provide a "further" sum of 500,000*l*. for agricultural education and research deserves, perhaps, some elucidation. It may be recalled that the Development Commissioners hold two funds—the old and the new. From the old come such charges as the grants to the various Agricultural Research Institutes established before the War and the salaries and expenses of the advisory officers attached to University Agricultural Departments. The old fund, also, has to meet the cost of what may be termed the miscellaneous statutory activities of the Commissioners in relation to fishery, harbours, etc. To the new fund, on the other hand, being the creation of the Corn Production (Repeal)

Act, is debited the cost (in England and Wales only) of certain schemes which escaped the fall of the Geddes axe. As to finance, it would appear that the old fund is kept alive by annual doles from the Treasury, whereas the new fund, starting with 850,000*l*. in 1921, has now received a windfall of a further sum of 500,000*l*. In a communiqué recently issued by the Ministry, it is announced that the new money will probably be allocated in part to the schemes relating to research on foot and mouth disease; economic research; marketing investigations; veterinary education and research; soil surveys; and the National Institute of Agricultural Botany. It is also announced that, in relation to the new money, no definite allocation of funds as between Scotland and England has been made. From this explanation it would appear that the Corn Production "New" Fund of 850,000*l*. is earmarked for expenditure in England and Wales only.

ANNOUNCEMENT has been made of the retirement on September 30 of Dr. Crichton Mitchell from the service of the Meteorological Office, in which he has acted for some years as general superintendent of the activities of the office in Scotland. He was originally appointed from May 16, 1916, to be Superintendent of the Observatory at Eskdalemuir, on the recommendation of the Gassiot Committee of the Royal Society. That committee is responsible for the administration of the Gassiot Trust Fund, the most notable of the few private endowments for geophysical subjects in Great Britain, and on the transfer of the administration in 1910 of the Observatories at Richmond and at Eskdalemuir from the National Physical Laboratory to the Meteorological Committee, it accepted the responsibility also of nominating superintendents of the three observatories attached to the Meteorological Office at which geophysical work was undertaken, namely, Kew, Eskdalemuir, Valencia. At the termination of his first year, Dr. Crichton Mitchell was reappointed for the duration of the War or longer if it were necessary. The appointment so begun has continued for eight years and a half with great advantage to the observatories and considerable enlargement of their scope. The work now includes the climatological work taken over from the Scottish Meteorological Society in 1913 and the expansion of the meteorological station at Lerwick into a geophysical observatory, when certain buildings became available there after the War, as well as the work on daily weather at Scottish stations for the Air Ministry. Dr. Mitchell brought to his task the enthusiasm for physical science engendered in the University of Edinburgh in the time of Tait, Crum Brown, and Chrystal, the practical experience of managing an observatory at Trivandrum, and the administrative experience of the educational department of Travancore. That he should have been available for developing his special gifts of organisation in Scotland just in the dark days of the War must be regarded as an example of good fortune for the geophysical sciences, which otherwise labour under considerable disadvantages.

THE *Morning Post* has discussed recently the question of why "science does not pay." It is true that in many cases technically trained men fail to make much direct use of the knowledge they acquire at college in their subsequent life. But we know that the scientific training they have undergone has indirectly often been of the greatest value to them. We are not impressed by the fact that sometimes a municipality offers a beggarly salary for a technically trained assistant. Unless the prospects are good, there is little chance of a suitable man being obtained. Young men like posts where there is a chance, even if only remote, of ultimately getting a lucrative and influential position. For this reason they are content to receive a less salary than a mechanic of the same age would be allowed by his Trade Union to accept. Even a Covent Garden porter demands a guaranteed minimum of 4*l*. 5*s*. per week, whilst many technically trained men accept readily initial salaries less than this. A junior engineer in works, even although he has had works experience, often begins on a less salary than the minimum given in the Burnham scale for secondary school teachers. But capable men have good chances of promotion to better posts, and if they are enthusiastic for their profession, they do not grumble even when promotion seems remote. The remedy for unemployment is the development of national resources, and this calls, as Prof. J. A. Fleming says in a letter to our contemporary, for new ideas, initiative, and invention. Many manufacturers are fully alive to this fact, and we think that nowadays they all hold science in high esteem. In the engineering profession, there is a demand both for young men of the public school type, that is, men who get on well with manual workers, and for thoughtful men who love research and invention. A young honours graduate in science with works experience has little difficulty in getting a post in the electrical engineering profession. We think that the chances of promotion compare very favourably with other professions. It has been suggested that the Engineering Institutions look after the remuneration of their members and are simply glorified Trade Unions. This is not the case. They were founded for the advancement of science and its applications, and only enforce regulations on those engaged in any advisory or consultative capacity.

CERTAIN of the delegates attending the International Congress for the Protection of Nature held in Paris at the end of June 1923, felt that the object desired could be better effected by means of a smaller and more permanent organisation. An informal conference was therefore held at the Natural History Museum on November 2, at which it was decided that the Society for the Promotion of Nature Reserves should summon a meeting of organisations in Great Britain interested in the protection of animal and plant life, the promotion of Nature reserves, and kindred objects. The meeting was held at the Natural History Museum on January 14, under the chairmanship of Viscount Ullswater, and as the outcome the Central Correlating Committee for the Protection of Nature was set up, and it is believed that similar committees will be formed in other countries. The constituent organisations of the British Committee and their representatives are as follows: The Trustees of the British Museum, Lord Rothschild (chairman); British Ornithologists' Union, Maj. A. G. L. Sladen; Entomological Society, Mr. W. G. Sheldon; International Committee for the Protection of Wild Birds, Mr. Hugh Gladstone; Linnean Society, Sir Sidney Harmer; National Trust for Places of Historic Interest and Natural Beauty, Mr. E. G. B. Meade-Waldo; Royal Society for the Protection of Birds, Mr. F. E. Lemon; Society for the Preservation of the Fauna of the Empire, Maj. Stevenson Hamilton; Society for the Promotion of Nature Reserves, Earl Buxton; Zoological Society of London, Dr. P. Chalmers Mitchell. Dr. G. F. Herbert Smith, Natural History Museum, S.W.7, is the Honorary Secretary-treasurer.

THE new Anglo-Dutch telephone cable which connects Domburg, Walcheren, on the Dutch coast, with Aldeburgh has been successfully laid. The length of the cable is 86 nautical miles. Pupin coils are not used, but each of the sixteen conductors is continuously "loaded" with iron wire. The British Post Office and the Dutch Telegraph Administration are to be congratulated on having such well-founded faith in mathematical theory. Through such a long length of cable, speech would be hopelessly distorted were it not for the loading. Another novelty is the use of paper instead of gutta-percha or ballata for the dielectric. This reduces the leakage and lowers the electrostatic capacity, both highly desirable results As strong tides and currents prevail in the Channel and North Sea, substantial armouring in addition to two lead sheaths are employed. To obviate the necessity of having to make numerous joints, the cable was constructed in ten-mile lengths, and the s.s. *Faraday* was fortunate in having calm weather during the process of laying the cable. The weight of the cable exceeds 2000 tons, and Messrs. Siemens Brothers and Co. had to build a special shop and erect new machines in order to make it. The tests show that the cross-talk between the core circuits and between a physical and its associated "phantom" circuit were less than the minimum specified. It is hoped that a good telephone service between Britain and continental countries will foster trade and promote better political relations.

THE electrical transmission of photographs has been an accomplished fact for some time past, and the principle involved is simple. A very small pencil of light passes through the surface of a cylinder and impinges upon a photo-electric cell at its axis. The negative to be transmitted is wrapped round the cylinder, and as the latter revolves with a fine screw-like movement, every part of the negative passes in turn between the light pencil and the photo-electric cell and regulates the current according to its density. The receiver at the other end of the wire consists of a cylinder that revolves synchronously with the sending cylinder, and is covered with a sensitive photographic film upon which impinges a very fine pencil of light after it has passed through a "light-valve" which allows light to pass through it of an intensity that is regulated by the transmitted current. It is but a step from the sending of a simple photograph to the transmission of the three colour-records of a colour photograph. This we learn from the Colour Supplement of the *British Journal of Photography* for September has recently been successfully done at the instigation of Mr. S. H. Horgan over a line about a thousand miles long, namely, from Chicago to New York. Mr. Horgan made a three-colour lantern slide from the records as received, and says that the Western Electric Company were "amazed at the beautiful and faithful colours shown in the slide."

IN connexion with the British Empire Exhibition, the British Dyestuffs Corporation, Ltd., has published an illustrated booklet which tells the story of the discovery in 1856 of the first artificial dyestuff by W. H. Perkin, who was then but eighteen years old, and of the subsequent vicissitudes and successes of the dyestuffs industry in Great Britain. Within twenty years of that chance discovery, Germany had taken the lead among the dye-producing nations, and Great Britain was importing 80 per cent. of her requirements from continental sources. The decline and fall of British initial supremacy in this field has been attributed to many causes, but the author of this pamphlet is convinced that neglect of research was the most potent. The renascence of the industry during the War, the energy and resourcefulness of the firms that had survived foreign competition, the establishment of the Corporation about five years ago, and the reversal of the 4 : 1 ratio of imports to home manufactures, are events and achievements too recent to have been forgotten by the scientific world, but their reiteration from time to time to those who can with difficulty understand the fundamental importance of a vigorous organic chemical industry is both useful and necessary. It is interesting to note that since its inception the Corporation has expended 450,000*l*. on research; that it now employs 125 chemists, 83 per cent. of whom possess high university degrees, 30 colourists, about 30 engineers, and approximately 3000 workpeople. The five factories owned by it occupy 600 acres of land, and consume annually 80,000 tons of coal, 30 million units of electricity, and 2000 million gallons of water. Facts like these speak for themselves.

DURING recent years the Government of Great Britain has been increasingly active in instituting measures for dealing with the diseases and pests of cultivated plants and crops, and J. C. F. Fryer and G. H. Pethybridge (*Journ. Min. Agric.*, July 1924) have drawn up a useful historical summary and résumé of the present position of the phytopathological service of England and Wales. In the early years, after the passing of the Privy Council orders against the Colorado potato beetle in 1877, all research and advisory work was dependent upon the efforts of individual scientific workers. No official service was organised until the passing of the Development and

Road Improvement Funds Act, 1909, which provided resources for a definite scheme of research investigation and advisory work in agricultural and horticultural plant pathology. This service has developed into two distinct, but co-ordinated, organisations, one consisting of a body of Government officials under the direct control of the Ministry of Agriculture, and the other of a number of scientific workers in the various universities, agricultural colleges, and research institutes, financed from Government funds, but free from the detailed instructions of the Ministry and subject only to a certain amount of supervision to secure efficiency. The résumé indicates the subdivision of the work among the various units of these two sections. Diagnosis of diseases and pests in the field is the function of a corps of advisors, and investigations into fundamental problems such as those relating to the physiological action of insecticides and the nature of immunity and resistance to disease are carried on by the research workers in various institutions. The official body deals with the collection and distribution of information, the practical work of administering existing legislation with regard to diseases and pests, and the control of plants coming into or exported from Great Britain. Although each part of the service is independent, an increasing degree of co-operation exists in dealing with problems of all types, thus enabling more rapid and efficient progress to be made.

A PERIOD of frequent rainfall, which has prevailed over the British Isles since the commencement of April, is dealt with in the *Meteorological Magazine* for September by Mr. C. E. P. Brooks, of the Meteorological Office. The rainfall is given for the period of five months, April to August. The percentage of the average rainfall, 1881–1915, is given for different parts of the British Isles. The excess is least in Scotland, where for the five months it amounts to 126 per cent. of the average. In Ireland it is 131 per cent., in England and Wales 146 per cent., and for the British Isles generally, 138 per cent. of the average. For the south-east of England the fall is 161 per cent. of the average, and in each month with the exception of June the percentage of the average rainfall is greater in the south-east of England than in any of the larger divisions of the British Isles. The five months in question are said to have proved a decidedly rainy period, although not excessively so; the rains were chiefly cyclonic. Details are given showing the influence of travelling Atlantic depressions on the weather of the British Isles, an inquiry which some day may yield data to assist in long-period forecasting.

THE Chinese floods are somewhat explained in the *Meteorological Magazine* for September. The floods are referred to as unparalleled in the present century. It is stated that in the province of Chih-li 25,000 square miles are under water, and it is estimated that nearly five million people are homeless. The water is 3 feet higher than in the flood of 1917, when the material damage was estimated at 25,000,000*l*. Between Tientsin and the Shansi Mountains is the meeting ground of five rivers, and a great quantity of silt is brought down from the mountains; this raises the level of the river bed. The waters are greatly restrained by embankments, and if a gap is broken a river may flood a wide area of the country. The average rainfall is about 20 inches a year, which falls almost entirely in the three summer months July-September. This summer the rainfall has been abnormally heavy; at Pekin, the fall in July was 26 inches, and at Tientsin 32 inches fell in three weeks. These heavy rains have broken numerous gaps in the banks, causing disastrous floods over all the low-lying country. The meteorological situation favouring floods in North China is dealt with, and reference is made to an article in the *Times* of September 2, which alludes to definite plans having been prepared after the disaster of 1917 to avert the danger of similar floods.

IT is announced in the *Observatory* that Prof. H. Kopff, of the Heidelberg Observatory, has been appointed professor of theoretical astronomy in the University of Berlin and Director of the Astronomischen Recheninstituts.

A DIRECTOR of the Norfolk Agricultural Station is required. Candidates for the position must possess a university degree or diploma, a modern scientific training in agriculture, first-hand experience of arable agriculture, organising ability and facility in lecturing. The latest date for the receipt of applications, which should be sent to the Secretary, Norfolk Agricultural Station, 11 Bridewell Alley, Norwich, is October 11.

AN assistant is required in the British Museum Laboratory for research in connexion with the cleaning and restoration of museum exhibits. Candidates must be honours graduates in chemistry, with research experience and a wide general knowledge of chemistry, with, if possible, training in mycology and an interest in archæology. Applications for the post should be sent, upon a prescribed form, not later than October 11 to the Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1.

APPLICATIONS are invited for positions under the Ceylon Government of a mycologist and a systematic botanist. The first named, if a senior officer with tropical experience, will be placed in charge of the mycological division; the second will be required to take charge of the systematic work in the Botanic Gardens of the Colony, to make researches into the flora of Ceylon, and to study especially the ecology of Ceylon plants. The posts will become vacant about July next. Applications must be made upon a special form obtainable from the Private Secretary (Appointments), Colonial Office, S.W.1.

THE Secretary of State for the Colonies has appointed a committee to advise him on matters relating to the recruitment and training of officers for the agricultural departments of the non-self-governing dependencies. The committee will be constituted as follows: Lord Milner (chairman), Lord Lovat (vice-chairman), Sir Arthur Shipley, Sir Daniel Hall, Prof. J. B. Farmer, Dr. A. W. Hill, Mr. F. B. Smith, Major R. D. Furse, with Mr. P. A. Clutterbuck, of the Colonial Office, as secretary.

A GENERAL discussion on the physical chemistry of igneous rock formation is to be held in the rooms of the Geological Society, Burlington House, London, on Wednesday, October 22, beginning at 3 P.M. The meeting is being organised under the joint auspices of the Faraday Society, the Geological Society, and the Mineralogical Society. A general introduction will be contributed by Dr. J. S. Flett, and papers are expected from Prof. C. H. Desch, Dr. J. W. Evans, Prof. J. W. Gregory, Mr. A. F. Hallimond, Prof. Paul Niggli, Dr. A. Richardson, Dr. A. Scott, Mr. G. W. Tyrrell, and Dr. W. E. S. Turner. Further particulars relating to the meeting may be obtained from Mr. F. S. Spiers, 90 Great Russell Street, London, W.C.1.

THE Educational Number of the *British Medical Journal* (September 6) contains an article by Dr. Andrew Balfour on the teaching of public health, in which he reviews approvingly the provisions of the new regulations for the Diploma of Public Health, introduced by the General Medical Council on January 1 this year. The medical practitioner can now obtain the Diploma only after he has been qualified for two years and the period of study extends over one year. Dr. Balfour also details the provisional scheme of lectures and practical work of the new London School of Hygiene and Tropical Medicine, of which he is the first Director. The London School of Tropical Medicine has just been incorporated in this new School, the buildings for which will be ready in about two years' time and are being built and equipped by the generous gift of two million dollars by the Rockefeller Foundation. An account of the circumstances of the foundation of the School appeared in NATURE of July 28, 1923, p. 149.

## Our Astronomical Column.

NEW COMET, 1924 *c*.—A comet of the eighth magnitude, with a tail, was discovered by Mr. Finsler at Bonn on September 15. The following positions have been received, the first two being approximate only:

| G.M.T. | R.A. | N. Decl. | Place. |
|---|---|---|---|
| Sept. 15·27 | $13^h\ 13^m\ 0^s$ | 19° 0′ | Bonn. |
| 17·27 | 13 35 0 | 16 0 | Bonn. |
| 19·276 | 13 52 8 | 12 7 | Babelsberg. |

From these the following orbit has been deduced, but as the observations are not exact, it may be considerably in error:

$$T = 1924,\ \text{Sept. } 4{\cdot}15\ \text{G.M.T.}$$
$$\omega = 67^\circ\ 9'.$$
$$\Omega = 87^\circ\ 46'.$$
$$i = 114^\circ\ 48'.$$
$$\log q = 9{\cdot}5940.$$

The following positions are calculated from these elements, for Greenwich midnight:

| | R.A. | S. Decl. | log *r*. | log Δ. |
|---|---|---|---|---|
| Sept. 28. | $14^h\ 50^m\ 44^s$ | 1° 13′ | 9·8660 | 0·0801 |
| Oct. 2. | 15 7 36 | 5 33 | 9·9095 | 0·1190 |

SOLAR PHYSICS AT CAMBRIDGE.—The eleventh annual report of the Director of the Solar Physics Observatory at Cambridge, covering the period April 1, 1923–March 31, 1924, has just been published. The bulk of the work accomplished falls under the three headings—stellar work, solar work, meteorological physics. Under the first heading come the very valuable theoretical investigations of Messrs. E. A. Milne and R. H. Fowler, by means of which they have given more precision to the method devised by Prof. M. N. Saha of calculating stellar temperatures and pressures from the degree of ionisation of atoms in the atmospheres of the stars. Furthermore, stellar data, in the light of modern theory, have now been made available for the solution of certain physical problems. On the experimental side, Mr. Baxandall has identified certain absorption bands in the spectra of S-type stars with bands of zirconium oxide—an identification which has since been confirmed by Mr. Merrill at Mount Wilson. The chief solar work of the year, other than routine observations, has been the systematic examination of flocculi by Mr. Butler, and the study, by the Director and Mrs. Beech, of areas and proper motions of sun-spots in the light of the Mount Wilson discovery that the true sun-spot cycle covers a period of 22 instead of 11 years. Mr. Moss has examined the daily records obtained at Kodaikanal of the distribution of prominences at the sun's limb for the years 1904–1922, and has obtained interesting indications of loci on the sun's surface specially favoured by prominences. The correlation of the phenomena of sun-spots, flocculi, and prominences has thus been the outstanding solar work of the observatory. On the meteorological side, Mr. C. T. R. Wilson has continued his investigations of ionising radiations by the "cloud" method, while Dr. E. V. Appleton has been investigating the changes of potential gradient due to very distant lightning discharges, which are regarded as the sources of the disturbances known as "atmospherics" in wireless telegraphy.

RADIATION AND MASSES OF STARS.—Prof. H. Vogt describes an investigation into the relation between the masses of a number of double stars in the *Zeitschrift für Physik* of August 8; he deals with 85 double stars from the Lick Observatory Bulletin, No. 343, and others which have been considered by Eddington. The masses were calculated from the absolute brightness and the temperature as determined from the spectrum, using Eddington's formula, and thus the mean ratio between the masses of the brighter and fainter components was determined for different spectral classes (bright component).

The following table shows the result, M*b*/M*f* being the ratio of the mass of the bright to that of the faint component, S the spectral class of the bright component, and *n* the number of stars considered:

| Giants. | | | Dwarfs. | | |
|---|---|---|---|---|---|
| S | M*b*/M*f* | *n* | S | M*b*/M*f* | *n* |
| M | 18·4 | 2 | A | 1·6 | 9 |
| K | 2·7 | 6 | F | 1·3 | 23 |
| G | 1·9 | 9 | G | 1·25 | 18 |
| F | 3·0 | 5 | K | 1·23 | 11 |
| B | 4·6 | 8 | M | 1·19 | 2 |

If one double star is left out from the five F giants, M*b*/M*f* for this class becomes 1·7, and then, with the exception of the B giants, the ratio diminishes towards unity as the state of development of the stars progresses, as would be the case if the mass diminished with the radiation. Assuming that when a brighter component is in the A (dwarf) class, its mass is 2·5 and the mass ratio M*b*/M*f* is 1·6, and that both components diminish in proportion to the radiation output, then if M*b* has the values given below, in passing through the later spectral classes, the values of M*b*/M*f* are as given in the third line, and may be compared with the values of M*b*/M*f* above:

| | A | F | G | K | M |
|---|---|---|---|---|---|
| M*b* . . | 2·5 | 1·5 | 1·0 | 0·7 | 0·4 |
| M*b*/M*f* . | 1·6 | 1·2 | 1·10 | 1·06 | 1·04 |

## Research Items.

ENGLISH GYPSY BURIAL CUSTOMS.—Mr. T. W. Thompson continues his interesting study of gypsy burial customs in the Journal of the Gypsy Lore Society, Third Series, Vol. III., Pt. 2. Although burials in unconsecrated ground are recorded, the evidence does not on the whole support the view held by some that this was, at one time, the normal practice. In the Heron family, however, only one burial appears in parish registers between 1650 and 1830. The most characteristic funeral rite of the English gypsies was the sacrifice of all the belongings of the deceased which were not buried with the body. The tent and surplus clothes were burnt, possessions which could not be burnt were buried, and the horses and donkeys were sold to gorgios or, in earlier days, were killed. In some cases the living wagon was burnt, even when the deceased was not the owner but only a member of the family, or a child. The reason would appear to be fear that the dead would be restless and jealous at others using their property rather than a dread of pollution, though this may not be entirely absent. In like manner the objects buried with the dead and the offerings made at the grave, though possibly in some degree intended for his service, were primarily to protect the living by making him happy and contented. This dread of the return of the dead is also shown by the avoidance of the names of near relatives no longer living. If another relative or friend bears the same name, a fresh name or nickname is used. Although to swear by a dead relative is the most solemn oath a gypsy can use, a descriptive phrase is substituted for the name. Gypsies also avoid camping places used by the deceased, and, more commonly, abstain by vow or otherwise from his favourite drink, food, or amusement.

IRON WORKING IN THE CAMEROONS.—In *Man* for September, Mr. L. W. G. Malcolm gives an account of iron-working in the Bagam area of the Cameroons. Trades are here under the direct control of the head chief and are specialised, a tradesman being a privileged person and exempt from all work other than his own. Each trade is a guild to which a limited number of apprentices is allocated. No stranger is allowed to enter an iron-smelting hut without a ceremony which includes aspersion of the stranger and the sacrifice and eating by the workers of a fowl purchased by him. The furnace, which is housed in a low hut, differs from the usual West African type in being built in a pit with a sloping approach. It appears to be a development of the Kordofan type, but is much larger. It is square in horizontal section with a back of the natural ground, the sides and front being of clay mixed with chopped grass. The charging hole is on the top between the two sets of bellows, which are arranged on the solid earth at the back, and the gas escape tube. Each bellows has a tuyère, of which the lower end rests on the fire-bed inside the furnace. When the furnace has been lit and charged, which is done gradually, it is kept in full blast by relays of blowers for twenty-four hours. The amount of metal produced at each reduction is about sixty pounds.

THE ANCESTORS OF MAN.—In a popular article contributed by Prof. Henry Fairfield Osborn to the June number of *Asia*, he emphasises his belief that the Tertiary ancestors of man will be discovered in the high plateau region of central Asia. He therefore looks forward with eager anticipation to the results of the new expedition which has been sent by the American Museum of Natural History to collect fossils in Mongolia. Prof. Osborn asserts that "the arboreal theory of man's origin has been given up," and adds that "his ancestors, if tree-living, left their trees in the middle period of the Age of Mammals." He considers that man was driven to live in caves in western Europe by the advance of the ice sheet and the consequent cold conditions during part of the glacial period. It was an episode "of vast importance in the mental and spiritual development of the race, just as the previous period of life in the open was one conducive to its physical and moral development." He thinks that man lived in the open for a comparatively long period, the oldest known race being represented by the flint implements and fireplaces discovered in the Pliocene Crag of Foxhall, Suffolk. Prof. Osborn's article is written to counteract the influence of Mr. W. J. Bryan, who has lately published many attacks on the doctrine of organic evolution, and seems to have a large following in the United States of America.

THE STIFLING OF SILKWORM COCOONS.—In the Bulletin de la Société d'Encouragement pour l'Industrie Nationale for June, M. G. Bertrand describes how extremely sensitive the chrysalides of the silkworm are to the vapour of chloropicrin. The shell in which the chrysalides are naturally enclosed does not protect them appreciably from attack by the vapour, which ensures a complete and rapid stifling of the cocoon. One gram of this agent per 1000 gm. of cocoons acting for one hour at 20° C. will effect the desired result, even if double cocoons are present. On exposure to air, the cocoons lose practically all odour of chloropicrin and dry readily. The stifling produced in this way, which is equal and sometimes even superior to that secured in the usual "dry and humid heat" industrial processes, does not affect the silky envelope, the colour and other original qualities of the cocoons being retained. Neither do the spinning qualities decline. The tenacity and elasticity of the fibres obtained by the new and old processes are found to be the same. The author emphasises the fact that the new method is, both from the academical and industrial points of view, economical, and requires less supervision, since the margin of safety, without fear of damage to the silk, is very considerable. It is claimed that the chloropicrin process is convenient and certain, has no objectionable action on the silk, and requires no complicated or costly installation.

PROTOZOAN PARASITES OF OLIGOCHÆTE WORMS.—The freshwater Oligochætes have long been known to harbour a variety of interesting protozoan parasites. The study of these has lately been taken up by Dr. Doris L. Mackinnon and Miss D. Ines Adam, who contribute two important papers on the subject to the *Quarterly Journal of Microscopical Science* (vol. 68, Part II.). The first of these deals with the life-history of the remarkable genus Triactinomyxon, a genus so complex in its structure and development that it has been doubted whether it is really a Protozoon at all. The peculiar triradiate "spores," with their thread-capsules, so similar to those of the Cœlenterata, are described and figured, and an admirably clear and straightforward account of the life-history is given, with copious illustrations. Most of the known species of the genus occur in the common Thames worm, Tubifex, and the authors' account is based chiefly upon a new species, to which they have given the name *Triactinomyxon legeri*. The second memoir deals with four astomatous Ciliates parasitic in the genera Tubifex, Nais, and Lumbriculus. The authors remark that if a really satisfactory classification of the astomatous Ciliates is ever to be made, it is necessary that many more of the earliest recorded forms should be re-investigated and re-identified, and their work forms a noteworthy contribution to the subject.

ALKALOIDS FROM DATURA.—The Bulletin of the Imperial Institute (vol. 22, p. 134) contains the results of analyses of *Datura metel*. It appears that if the flowers of this plant are removed during cultivation so that no fruits appear, the yield of alkaloids is increased from 0·24 to 0·36 per cent., the former figure being obtained for normal fruiting plants. Further, the alkaloid present consists almost entirely of scopolamine in deflowered specimens, while in normal plants only about one-fifth of the alkaloid is scopolamine, the remainder being hyoscyamine.

NORTH AMERICAN SPECIES OF ARISTIDA.—Mr. A. S. Hitchcock has described (Contrib. U.S. Nat. Herbarium, 22, 1924, p. 517) the North American needle-grasses of the genus Aristida. These grasses, although widely distributed throughout the world in steppes and prairies, and of considerable economic importance, are only to be distinguished with difficulty and have not always been adequately described. This paper represents a large amount of work and it removes many difficulties. Seven new species are described, together with a number of new combinations.

VARIABILITY IN FUNGI.—Mr. H. R. Briton-Jones records the results of cultural work on *Rhizoctonia Solani* Kühn in the Transactions of the British Mycological Society, vol. 9, p. 200. This fungus is responsible for the "sore-shin" disease of cotton seedlings. A number of forms from Egyptian cotton, from Missouri, U.S.A., India, and also from English peas and potatoes, were examined and induced to produce the fertile stage, *Corticium vagum*, under culture. The various strains remained more or less distinct throughout the experiments, even when allowed to infect a common host plant. They showed, moreover, different physiological properties. Thus the foreign strains, unlike those from Great Britain, were unable to grow at temperatures of 5-8° C. The fungus grows best at the surface of moist, not dry, jellies, just as in Nature it attacks its host plants at the ground level where comparable conditions obtain.

AMERICAN CAMBRIAN GEOLOGY AND PALÆONTOLOGY.—The veteran American palæontologist, Charles Doolittle Walcott, although past the allotted span of life, is, we are glad to see, still ably carrying on the work begun in 1908 of describing the primary fossils of America, and has just brought out Part 9 of vol. iv. of his "Cambrian Geology and Paleontology" (Smithsonian Miscell. Publicat., lxvii.). The present part deals with the Cambrian and Ozarkian Brachiopoda, as well as two new species of Cephalopoda and a new genus, Ozomia, of the family Technophoridæ, formerly considered to be Pelecypods, but now referred to Sars's order Notostraca. The Brachiopoda come principally from Alberta and British Columbia, with a few from various localities in the United States, and a small collection from Novaya Zemlya. These are fully set forth and systematically described, and include fifty new species and a new variety. There are twenty most excellent plates of figures based for the most part on photographs.

MIOCENE FORAMINIFERA.—The mere mention of Foraminifera at once recalls to mind the great triumvirate of Parker, Jones, and Brady, who laid the foundations of our present knowledge of the order, while Jones's pupil, C. Davies Sherborn, compiled a "Bibliography" and an "Index" unsurpassed at the time. Later, the work was carried on by F. Chapman, now in Australia, but the historiographers in this century of these fascinating but most puzzling little animals have been Heron-Allen and Earland, whose joint works are familiar and indispensable to all students. These authors have just published (Journ. R. Micro. Soc., 1924) an elaborate paper on the "Miocene Foraminifera of the 'Filter Quarry,' Hoorabool River, Victoria, Australia," which is to be regarded as a supplement to Chapman's "Study of the Batesford Limestone," that writer being unable to carry it on further. The material dealt with consisted of about half a pint of white organic deposit from the Filter Quarry, which its Foraminiferal contents show must have been laid down in a tropical sea at a depth of from 50 to 150 fathoms under conditions very similar to those existing at the present day round the northern coasts of Australia. A sample from the overlying marl, taken by Dr. T. S. Hall, indicated that, although laid down in about the same depth, it must have been deposited within the continental mud line. Altogether the authors fully describe two hundred and seventy species and varieties, nineteen of which are held to be new. The new and a few previously named species are amply figured on eight plates containing 118 figures.

KNOLL-REEFS AND THE CRAVEN FAULTS.—In their paper on "The Lower Carboniferous Succession in the Settle District" (Quart. Jour. Geol. Soc., vol. lxxx. pp. 184-273, 1924), Prof. E. J. Garwood and Miss Edith Goodyear discuss a number of outstanding problems that have hitherto awaited a satisfactory solution. It is shown that the whole of the succession north of the North Craven Fault belongs to the North-Western Province, and that in general the Middle Craven Fault may be taken as the southern limit of this province. To the south the beds show almost everywhere an abrupt change to the southern type of development. Structurally, however, the change is complicated by the occurrence between the faults of knoll-reefs which belong to the Southern facies, and by the presence of Yoredale rocks south of the Middle Fault. The knoll-reef limestone of the High Hills is of $D_3$ age and therefore cannot pass laterally into the $D_1$ limestone against which it abuts on the north. Although there is no other evidence of thrusting, it is suggested that the beds have been brought together by movement from the fractured southern area against the rigid and undisturbed northern block. Thrusting seems also to explain the abrupt change from Southern to North-Western facies. With regard to the origin of the knoll-reef structure, Marr's contention that limestones of any kind can be folded into knoll-like domes is fully substantiated. It is also shown that the typical knoll-reefs of the southern succession owe their form partly, as suggested by Tiddeman, to the original deposition of rich accumulations of organic remains, and partly to the accentuation of the quaquaversal structure by subsequent movements.

DISTRIBUTION OF PHILIPPINE EARTHQUAKES.—In the recently issued Bulletin for May 1922 of the Manila Weather Bureau, the Rev. M. Saderra Masó considers the distribution of earthquakes in the neighbourhood of Butuan (northern Mindanao), basing his conclusions on the records of six years. The average monthly number of earthquakes registered by a Wiechert seismograph at Butuan (1916-1921) is 90. The earthquakes originate in four principal seismic zones. In the first (30-50 km. from Butuan), the earthquakes come chiefly from a shallow centre in Butuan Bay. The second and most important zone (80-160 km.) includes the whole central and deepest part of the Philippine Deep; the third (270-320 km.) contains the central and southern extension of the Agusan valley (a zone responsible for the great earthquakes of 1893, 1894, and 1911); and the fourth (380-500 km.) the unstable north-east portion of the Celebes Sea. The zone of minimum frequency (60-80 km.) embraces most of the eastern and central cordilleras, in the latter of which no sensible earthquake, so far as known, has ever originated.

SURVEYS IN SPITSBERGEN.—An article by Mr. R. A. Frazer in the *Geographical Journal* for September gives an account of some explorations carried out by him, in conjunction with Messrs. N. E. Odell and G. Milling and the late Mr. A. C. Irvine, in Central Spitsbergen in August 1923. Their object was to amplify and extend the preliminary survey made in that region in 1921. Landing at Duym Point in Hinlopen Strait, they crossed the island via the Chydenius range and Mount Chernichev to the head of Klaas Billen Bay. The area traversed, which lies to the south of the New Friesland ice-sheet, proves to be a region of complex topography from which the glaciers drain mainly to the east. A provisional map of this small area is published. It is based on photogrammetric work, but it must await the precise positions of the northern beacons of the Russo-Swedish Arc of Meridian surveys before a final version can be prepared. Only the approximate positions of these beacons have so far been published.

DISINTEGRATION OF RADIUM-C.—The September issue of the *Philosophical Magazine* contains an account of the experiments which have been made by Sir Ernest Rutherford and Dr. J. Chadwick to determine the origin and nature of the long range particles which appear from a source of radium-C. They find that the particles of range 9·3 cm. appear in equal amounts in vacuum, helium, oxygen, carbon dioxide and zenon, in whatever way the source is prepared and whether it is covered by a sheet of mica or silica or left uncovered. The paths of the particles as determined by a shadow method and as deflected by a magnetic field lead to the conclusion that the particles are $\alpha$-particles arising from the disintegration of the radium-C, and are not due to the disintegration of the gas through which the $\alpha$-particles pass. The same conclusion appears to be probable with regard to the particles of range 11·2 cm., and the two groups probably represent new types of disintegration of radium-C.

THE MEASUREMENT OF FEEBLE RADIOACTIVITY.—A method of measuring weak radioactivity by means of a photographic record of the drift of an electrometer, charged by the ionisation current produced by $\beta$- and $\gamma$-radiation, is described by Dr. G. Hoffmann in the *Zeitschrift für Physik* of July 12. The ionisation chamber consists of a very open wire cage, the potential of which is kept at 240 volts, and containing an electrode connected to the electrometer. The cage is cleaned with acid and is contained in a brass box, from which the air can be pumped and replaced by carbon dioxide from a steel cylinder. The carbon dioxide, when fresh, contains no emanation. The whole apparatus is surrounded by thick lead cylinders, and the substance to be examined is powdered on a sheet of tinfoil covered with a thin layer of shellac, and placed in a holder round the inner surface of the brass box. All $\alpha$-rays are absorbed by the carbon dioxide before they reach the cage, and so do not cause rushes of ionisation and irregularities in the photographic record. Among other experiments made with the apparatus, the radioactivity of sodium and cæsium has been studied; taking that of potassium as unity, sodium gives less than 0·002, and cæsium from polluxite, which contains no rubidium, shows no trace of radioactivity.

THE CRYSTALLINE STRUCTURE OF GRAPHITE.—In the *Zeitschrift für Physik* of August 4, Messrs. O. Hassel and H. Mark describe an investigation designed to clear up the discrepancy between the results of Debye and Scherrer and those of Hull; single crystals, natural and artificial, and polycrystalline material were employed, and great care was taken to avoid distorting the soft material, which, when in the form of powder, was not pressed into rods, but fastened with collodium to a thin wool thread, stretched in the axis of the camera. Different characteristic X-radiations were employed, and the rotation diagram method, the Laue method, Bragg's reflection method, and the Debye-Scherrer method were all made use of, the intensity relations of the reflections being determined. Consideration of the whole of the diagrams in detail showed that, if all the carbon atoms have the same valency, there is no space group which gives the observed interferences. It is necessary to assume a $c$-edge-centred lattice, with particles having the reflecting power $R_1$, shifted a certain amount with respect to a lattice with reflecting power $R_2$ and with the particles in the positions for closest packing; the smallest possible orthohexagonal cell measures $a=2{\cdot}47$ Å, $b=4{\cdot}25$ Å, $c=6{\cdot}70$ Å, and contains eight atoms; a figure in the original paper shows the relations between the particles. The measurements of Ewald, Debye, Scherrer, and Hull agree with the structure determined.

GLASS TECHNOLOGY.—The Experimental Researches and Reports published by the Department of Glass Technology of Sheffield contains in volume 6, 1923, among other papers, one on natural sillimanite as a refractory material, by S. English, and one on heat-resisting glasses by Prof. Turner. The first paper gives an account of some trials of natural sillimanite, which melts at 1816°, in place of clay as a refractory. Mixtures with clay were used. The mixture with 9 per cent. of clay showed a very small shrinkage on drying, and on burning at 1400° the further contraction was negligible. The porosity was rather less than standard pot clay, and the action of molten glass was much less than that on clay. Prof. Turner's paper gives an interesting account of the developments in the manufacture of heat-resisting glasses, beginning with the systematic work of Schott at Jena in 1892, and including "Pyrex" glass containing 80·62 per cent. of silica, 11·9 of boric anhydride, 2 per cent. of alumina, 3·83 per cent. of soda, and small quantities of other constituents. In America, tea and coffee pots, tea-cups, and cooking ware are made from refractory glass.

SODIUM TUNGSTATES.—We have received a reprint of a paper on sodium tungstates by Dr. E. F. Smith, published as a contribution from the John Harrison Laboratory of Chemistry, University of Pennsylvania. The sodium tungstates described in the literature were re-examined, and the conditions for preparing 5:12 sodium tungstate determined. With normal sodium tungstate (1:1) and meta-sodium tungstate (1:4) as opposites in basic and acid character, the intermediates 3:7, 5:12, and 4:10 were found as products of their union. The 1:2 and 1:3 salts do not exist, probably because of their very ready hydrolysis. The suggestion that paratungstates exist in two modifications, namely, 3:7 and 5:12, was not confirmed. Carbon tetrachloride as a new reagent was extensively employed.

## The Japanese Earthquake of 1923.

SOON after the earthquake of September 1, 1923, the Imperial Earthquake Investigation Committee appointed a number of sub-committees to investigate the earthquake from different points of view, dealing with observations on seismology, geology, hydrography, and geodesy, and, on the practical side, with problems of architecture and civil engineering. The complete reports of the various sub-committees will, it is expected, be published before many months are over. In the meantime, Prof. A. Imamura, who has succeeded Prof. Omori as the head of the Investigation Committee, has written a valuable report which appears in No. 6 of the " Seismological Notes " of the Committee.

As Prof. Imamura points out, the earthquake was by no means the most severe that has visited the Japanese Empire—it was inferior, for example, to the Tokyo earthquake of 1855—though, in the destruction of life and property, it is probably without a rival. After five minutes, the motion had so far subsided that Prof. Imamura was able to visit the observatory of the Seismological Institute. Here he found that nearly all the instruments were wrecked. Only one component of one seismograph kept working all through the earthquake, but, within five minutes, four seismographs (recording actual size or up to twice that size) were readjusted or repaired, other more sensitive instruments being added after a day or two. These repairs were impeded by the outbreak of fire in the University, and it was not until 10 P.M.—the earthquake occurred just before noon—that the Institute and its observatory could be regarded as safe. The office of the Investigation Committee was burnt with its important papers.

From the direction and duration of the preliminary tremors, it is estimated that the epicentre was 92 km. from Tokyo in the direction S. 26° W., that is, under Sagami Bay, in lat. 34° 58·6′ N., long. 139° 21·8′ E. The angle of emergence at Tokyo was 10°, giving a depth of about 15 km. for the focus. The curve representing the relation between the focal distance and the time of transit of the first tremors is practically a straight line, from which it is found that the time at the origin was 11 h. 58 m. 32 s., and the velocity of the first tremors 7·5 km. per sec. for the neighbourhood of the epicentre. The total duration of the record of the great shock was 2 h. 20 m.

From the initial direction of the movement at different places within a radius of 170 km., Prof. Imamura concludes that " the seismic action might have been applied in such a manner that the compression along a deep stratum was directed towards the north and west."

The greater part of the coast of Sagami and Tokyo Bays was elevated, the maximum amount of uplift being a little more than 2 metres. Such changes are slight compared with the displacements in the bed of Sagami Bay. The total area of depression is estimated at 700 sq. km. and that of elevation at 240 sq. km., the total volume depressed at 50 c. km., and the volume elevated at 20 c. km. This implies that the average depression was 39 fathoms and the average elevation 45 fathoms.

The tsunami, or seismic sea-waves, were greatest along the shores of Sagami Bay, where they reached a height of 8 metres at Ito and Aziro, 9 metres at Ainohama, and 12 metres at Atami. From the directions in which the sea-waves advanced, it follows that the most prominent waves came from neighbouring areas of elevation. The enormous depressions gave rise to only minor waves.

The cause of the earthquake is still unknown. Possibly there may have been a great fault-movement in the heart of Sagami Bay, but so far no trace of it has been discovered. On land, two minor faults have been observed, one near Nagasawa in the Miura peninsula, the other near Nago in the Bo-so peninsula. Both are about 2 km. in length, and have a maximum vertical displacement of one metre.

Four slight shocks, with epicentres in or near Sagami Bay, were registered at Tokyo during the preceding month, the last one eight days before the earthquake. Otherwise, the great shock came suddenly and without warning. The study of the after-shocks is complicated by the great size of the focal area, and by the occurrence of another destructive earthquake, belonging to the same zone, and of nearly equal strength, at 2 h. 47 m. on September 2, the after-shocks of which mingled with those of the first earthquake. The after-shocks originated in three areas, the first including the Bay and Province of Sagami, the second the Bo-so peninsula and sea-bed to the east, and the third the drainage-area of the River Tone to the north of Tokyo. Of the 1256 after-shocks recorded at Tokyo during September, 46 (including the majority of the strong after-shocks) occurred in the first zone, 71 in the second, and 25 in the third, while the epicentres of more than a thousand (nearly all slight and none strong) are unknown.

The latest statistics show that the total number of lives lost was 99,331 (59,065 in Tokyo and 23,440 in Yokohama), 103,733 were wounded, and 43,476 missing. The number of houses completely collapsed was 128,266, while 126,233 half collapsed, 447,128 were burnt, and 868 washed away. A second table gives the number of houses collapsed in the places most severely damaged, and the percentage of such with regard to the number of pre-existing houses. In Yokohama the percentage was as low as 12·4, but in Kamakura it rose to 84·4, and in six places it exceeded 90. In one of these (Simosoga) it was 97·8.

A recent issue of the Bulletin of the Seismological Society of America (vol. 13, 1923, pp. 124-146) contains an interesting article on the Japanese earthquake by Dr. T. A. Jaggar, the well-known vulcanologist and founder of the Volcano Observatory on Hawaii. Dr. Jaggar spent October in the meizoseismal area, and he has added many details to our knowledge of the earthquake. He estimates the value of property destroyed at between four and five thousand million dollars, and states that some well-informed Japanese put the loss of life at about four hundred thousand. The volcano of Oshima showed no unusual phenomena at the time of the earthquake. Dr. Jaggar describes the changes of level of the floor of Sagami Bay and along the coast-line. These are summarised above and in NATURE, vol. 113, pp. 473-474. He considers that the belt of maximum depression was the epicentral tract. " As the shoreline belts all about were lifted or lowered only one to eight feet, the depression mechanism was of a different order from the margin mechanism. It appears to have been a collapse of blocks into a pit or rift in the bottom of the bay aligned with the island volcano chain, which extends hundreds of miles south-south-east." The after-shocks were of two kinds, the slow prolonged type (resembling the first shock) and the abrupt short type preceded by a booming noise. Dr. Jaggar quotes at length the accounts of several careful observers in Tokyo, Yokohama, etc. With regard to the place of the earthquake among other great shocks, he concludes that it was not more intense than the Mino-Owari (Japan) earthquake of 1891, and probably much weaker than the Yakutat Bay (Alaska) earthquakes of 1899. C. D.

## Standardisation of Scientific Glassware.

THE Joint Committee for the Standardisation of Scientific Glassware, which was promoted by the Institute of Chemistry (30 Russell Square, W.C.1), and includes thirty-seven members representing mainly users and manufacturers, has published its first report, entitled "Units of Volume," in which is recorded the unanimous recommendation to discard the cubic centimetre as the standard unit for scientific glassware and to institute therefor the litre and the millilitre. Since, however, some chemists still prefer to use the Mohr unit, the Committee has added two further recommendations to obviate confusion between the two systems, although it hopes that in time the litre and the millilitre will be adopted exclusively. Vessels graduated on the Mohr system, it is recommended, should be marked "G.W.A." (grammes of water in air), and the numerical relation between the units shall be 1000 G.W.A. = 1002 ml. The National Physical Laboratory will test vessels of both kinds, but those graduated on the Mohr system will be marked differently from the others.

Whereas the volume of a body of simple geometrical form is readily calculated from its linear dimensions, the volume of a hollow vessel designed to hold a fluid is determined more easily and more accurately by finding the weight of water required to fill it. But the use of two distinct types of units has many disadvantages, especially if there is no simple numerical relation between them. To establish such a relation, the originators of the metric system defined the kilogram as the mass of water which occupies one cubic decimetre at its temperature of maximum density; so that the unit of volume, the litre, could be defined either as a cubic decimetre or as the space occupied by a kilogram of water at the specified temperature. A cubic decimetre of water was, however, not a practical standard weight, and the kilogram was therefore re-defined as the mass of a particular standard weight (*kilogramme des Archives*). In accordance with this change, the litre was re-defined as the volume occupied by one kilogram of pure water at its temperature of maximum density and under normal atmospheric pressure. Thus the litre became independent of the metric unit of length, and the cubic centimetre lost its relation to the volume of a mass of water. The precise relation between the litre and the cubic centimetre was found experimentally to be 1 litre = 1000·027 c.c. (±0·001), a difference so small as to be negligible for ordinary volumetric glassware.

The introduction of the Mohr system caused confusion, inasmuch as by it the unit volume was defined in terms of the apparent weight in air of a mass of water at room temperature. By this system a "litre" flask contains 1000 gm. of water (weighed in air against brass weights) at 17·5° C., which is the equivalent of 1002 c.c. as defined above; but the followers of Mohr designated the volume occupied by the 1000 gm. of water one litre, and the thousandth part of it one cubic centimetre. The exact relation between the Mohr unit and the millilitre is given by the fact that the amount of water which weighs 1000 gm. in air of density 0·0012 gm./ml., when weighed against brass weights of density 8·4 gm./ml., occupies a volume of 1002·021 ml. at 60° F. The difference between this figure and 1002, namely, 2 parts in 100,000, is negligible in practice, and hence the Committee recommends the adoption of the round number, thus facilitating inter-conversion of "G.W.A." and millilitres.

The Committee has also considered the accuracy of volumetric glassware, and recommends the adoption of only two grades, namely, Class A, or Standard Apparatus, which must pass the N.P.L. or other approved test, and the Class B, or Commercial Grade Apparatus, of cheaper quality and for general use, which must, however, be guaranteed by the manufacturer to comply with certain minimum requirements. The Class A Tests and the Class B Tests of the National Physical Laboratory (as revised in a recent pamphlet to be obtained from The Director, N.P.L., Teddington, Middlesex) are approved, and confidence is expressed that manufacturers will be able to supply guaranteed Class B apparatus at reasonable prices. Finally, the Committee urges strongly that volumetric glassware should never be ordered without specifying the limits of accuracy required.

## Cod and Cod Fishery.

THE three papers included in No. 7, vol. vi., series ii., Fishery Investigations, Ministry of Agriculture and Fisheries (H.M.S.O., price 3*s*.), record an investigation undertaken as part of the general programme of research on the cod which was initiated by the International Council for the Exploration of the Sea in 1921.

The first, under the initials of Mr. W. C. Smith, deals with the Irish Sea cod fishery. This fishery is of importance only during the winter months, and it is carried on chiefly by Manx long-line fishermen and a few Fleetwood steam-liners. With the approach of winter and the decreasing temperature of the water, large mature cod move into the Irish Sea from the north to spawn. The return movement begins in April and is usually completed by the end of that month. Spawning takes place during February, March, and April in the waters around the Isle of Man and off the Cumberland coast. The young immature fish remain in these waters throughout the year.

The second paper, by Prof. Jas. Johnstone, gives an account of the cod as a food fish. It contains a summary of most of the results of analyses of cod and cod products, which may be found in König's big volume and in the work by Atwater. The results obtained from Irish Sea cod are also included. The results show that the cod is a "fat-poor" fish. Less than about half of the total weight of the entire fish is edible. In the edible substance, about 81 per cent. to 84 per cent. is water, and there is practically no fat; about 1 per cent. is ash, and the rest (about 14 to 17 per cent.) is protein.

The third paper, by Prof. Johnstone and Mr. A. Scott, summarises information on the parasites and diseases of the cod. Ectoparasites and endoparasites are set out under orders and families, and a note on the occurrence of each is given. Both are less numerous in the cod than in many other species of fishes. The whiting and haddock, for example, are much more affected than is the cod. Cases of sarcomatous and other tumours, lupus and ulceration of the body, "columnar disease" in the muscle, diseased liver, stone in the urinary bladder, and ovarian degeneration are on record. Humpbacked cod in which the head is fairly normal in shape, while the trunk and tail regions are shortened and the backbone is thrown into a gently spiral form, are occasionally seen. One-eyed cod suggestive of irregular development rather than of injury are also recorded. References to literature on hermaphroditism are given in the concluding section of this instructive paper.

## University and Educational Intelligence.

ABERDEEN.—Prof. Alex. Findlay has accepted an invitation to visit Stanford University, California, as acting-professor of chemistry for the three-quarters of the academic year, January to August, 1925.

LEEDS.—The University and the Philosophical and Literary Society have arranged a joint programme of lectures and music for the autumn term. The lectures include one by Prof. L. Bairstow on some aspects of modern aerodynamics, one by Mr. J. S. Huxley on recent progress in developmental physiology, and three by Prof. A. Gilligan on the geology of Yorkshire, all of which are free. Prof. S. Brodetsky and Mr. S. Stoneley are giving a popular course of six lectures on astronomy and Prof. P. F. Kendall three lectures on man and the ice age.

LONDON.—The two following courses of free public lectures at King's College are announced:—On Wednesday, October 8, and seven successive Wednesdays, at 4.30, "The Histology of the Nervous System," by Dr. C. da Fano; on Wednesday, October 8, and four following Wednesdays, at 5.30, "The Human Body and its Function," by Prof. R. J. S. McDowall.

On Friday, October 3, at 5.30 P.M., Prof. T. Percy Nunn will deliver a free public lecture at University College on "The Scientific Interpretation of Nature." This lecture is introductory to the new course for the M.Sc. on the principles, history, and method of science.

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APPLICATIONS are invited for the headship of the chemistry department of the Borough Polytechnic Institute. Particulars and a form of application are to be obtained from the principal of the Institute, Borough Road, S.E.1.

IT is stated in the *Times* that schools of forestry are to be established at the University Colleges of Auckland and Canterbury by the New Zealand Government, which will make a grant of 1000*l.* a year, with an additional 600*l.* towards the cost of initial equipment.

INDIAN education in 1922–23 is reviewed by the Educational Commissioner with the Government of India in a report recently published at Calcutta. Commenting on the reorganisation of the University of Allahabad, the report states that some dissatisfaction has been expressed with the arrangement by which a residential teaching university is combined with affiliated colleges, some of which are situated at places very far distant from the university centre. This has led to movements for the establishment of universities at Agra and in Rajputana.

WE have received a "London University Guide and University Correspondence College Calendar, 1924–25," issued by University Correspondence College, Burlington House, Cambridge. This is a handy little volume of 200 pages, giving in convenient form regulations, syllabuses, and advice as to appropriate text-books for preparation for the matriculation and external degree examinations of the University of London. It is issued gratis. It was formerly published annually, but its issue has been suspended since 1915.

THE London County Council recently opened an education publicity campaign by issuing an excellent little pamphlet entitled "The Londoner's Education." This has now been followed by a sixpenny "Guide to Continued Education in London," this being No. 1 of a "Privileges of Citizenship" series. In addition to giving a concise account of the provision made for continuation education of all types—commercial, technical, trade, domestic, literary—and of the facilities available for all classes of students for improving their knowledge and using profitably their leisure hours, the booklet gives lists of numerous pamphlets, obtainable, most of them gratuitously, at the Council's offices, which contain more detailed information. It gives also a convenient list of several hundreds of institutions offering evening classes.

THE Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland are inviting applications for a limited number of agricultural scholarships, of a maximum annual value of 200*l.*, which are open to students proposing to take up posts as agricultural organisers, teachers or lecturers in agriculture, etc. Candidates should usually be graduates of a university. The scholarships are tenable for two years, and are intended to give students an opportunity of broadening their knowledge of agriculture both at home and abroad. Their value will vary according to the scholars' means, and to the cost of living prevailing in the country visited; laboratory fees and travelling expenses will be defrayed. Particulars may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1, in the case of English and Welsh students, and from the Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, in the case of Scottish students. The latest date for receiving applications is October 31.

THE Industrial Fellowship scheme of the Mellon Institute of the University of Pittsburgh has been in operation for thirteen years. A recent report of the director shows that at the close of the year 1923–24 no fewer than 83 research chemists and engineers were employed at the Institute, and that the sum of 412,132 dollars had been contributed for sustaining this work by the industrial fellowship donors. The total amount of money given by industrial firms to the Institute since 1911 is 2,719,103 dollars. The history and research system of this unique institution are described in an illustrated booklet, which also contains one of the forms of agreement under which fellowship foundations are accepted. The salient features of the system are as follows: A firm or an association of manufacturers having a problem or group of problems that needs investigation, provides a sum of money (about 5000 dollars for each investigator to be employed for a whole year) sufficient to cover salaries of investigators, operating charges, and purchase of necessary equipment; the Institute selects the fellow or fellows, and furnishes laboratory, library, consultative facilities, the use of its permanent research equipment, direction to the progress of the work, and an environment that stimulates productive investigation; all results are the property of the donor, to whom in the meanwhile monthly progress reports are regularly submitted. Although primarily an industrial experiment station, the Institute recognises the need of fundamental scientific research as a background and source of stimulus for industrial research, and has funds which are devoted to the prosecution of investigations not suggested by industry but planned by the permanent staff, four of whom were engaged in purely scientific research of this type during the year. Co-operation between the fellows is stimulated by a social club, in the activities of which all are expected to take part.

## Early Science at the Royal Society.

**September 27, 1662.** The president communicated a letter sent by his majesty to the duke of Ormonde, lord-lieutenant of Ireland, recommending the Royal Society for a liberal contribution from the adventurers and officers of Ireland for the better encouragement of the said society in their designs. Whereupon it was ordered that a copy of the said letter should be taken; and the humble thanks of the society be returned to his majesty by Sir Robert Moray, for this great testimony of his royal favour.—The president was desired to return likewise the thanks of the society to Mr. Secretary Nicholas and Mr. Williamson, for their readiness to assist the society in the king's letters to Ireland without taking fees.

**September 28, 1664.** There was read a letter of Dr. Wallis to Mr. Oldenburg, giving an account of his having performed the task imposed upon him concerning Mr. Horrox's astronomical papers, by comparing the copies with the originals, and digesting all the several pieces into one body, and prefixing to it an epistle addressed to the president of the Society.—The secretary informed the Society that at Rome observations of Jupiter had lately been made with the new glasses of Campani, by means of which, six belts had been discovered in that planet, four of which had appeared more obscure, and two more clear than the rest of his body.—The secretary having also formerly written to his correspondents in France, to inquire into the truth of the odd experiment delivered by the jesuit Casati, in his book, intituled, "Terra machinis motu," and received an answer thereto by a person who had consulted the author of the book himself concerning the same, he communicated it to the Society; the substance of which was that the said Casati had not tried the experiment himself, but had seen it tried by a gentleman, named Don Innocenzo Conti, viz., that the liquor extracted out of a certain bismutum, and well rectified, when sealed up hermetically, and exposed to the moon, rose in the full, and fell in the new moon.

**September 30, 1663.** Mr. Palmer presented the Society, from Mr. Edward Diggs [Digges] with two sorts of silk, one coarse, the other fine, sent from Virginia, and made there; together with some written observations of Mr. Diggs' concerning silk-worms, and the making of silk, contrary to the received opinion thereof. Mr. Palmer was desired to return the Society's thanks to the presenter, and to let him know, how much they were pleased with his care and concern for improving of this manufacture; and how glad they should be to receive information, from time to time of the progress of it. Mr. Hill was desired to get the parcel of the coarser silk to be put into a stuff for a cover for the mace.

1674. Mr. Hooke reported, that upon his making the proposal of the council to Mons. Papin of twenty pounds a year certain for writing all letters for the Society, he had accepted the same.

**October 1, 1662.** Dr. Wren presented some cuts done by himself in a new way of etching; whereby, he said, he could almost as soon do a piece on a plate of brass, as another should draw it with a crayon on paper.—Dr. Merret read his paper concerning the planting and preserving of timber; together with his collection of those statutes, that have been formerly made by the parliament of England.

**October 3, 1666.** The lord bishop of Exeter being requested to communicate the observations of Jupiter's satellites made by Mr. Laurence Rooke in order to the calculating of tables of their motion, his lordship desired, that he might be put in mind of it by Mr. Hooke, and that he would purposely come to his library in Gresham College to look them out.

## Societies and Academies.

LONDON.

**The Institute of Metals** (Autumn Meeting), September 9.—**R. J. Anderson** and **E. G. Fahlman**: A method for measuring internal stress in brass tubes. The method for measuring longitudinal internal stress is called the strip method, and is carried out by slitting a narrow strip longitudinally in a piece of tubing; for example, a strip 2·75 inches long and 0·10 inch wide in a 3·25 inch tube length; and then releasing one end of such a slit strip by cutting. Stress is indicated by the springing out of the freed end, and can be calculated from the modulus of elasticity of the material and the distance in movement of the freed end.—D. H. **Andrews** and J. **Johnston**: The application of the ideal solubility curve to the interpretation of equilibrium diagrams in metal systems. The method of plotting here discussed has not been applied previously to metal systems. In many systems the simple theory fits the observations better than had been anticipated, and may at least be used as a guide in criticising and simplifying experimental work.—Guy D. **Bengough** and R. **May**: Seventh report to the corrosion research committee of the Institute of Metals. The problem of corrosion is considered largely from the point of view of the "scale" of corrosion products which forms on the surfaces of such metals as copper, zinc, and brass immersed in sea-water. A large proportion of tube failures in modern condensers is due to local impingement of aerated sea-water; the rapid corrosion is due to the local removal of protective scale by the impinging stream. Certain types of preformed scales may be very resistant to this type of action. The occurrence of "dezincification" is due, not to bad mixing of copper and zinc in the manufacture of brass, but to the absence of arsenic from tubes. The electrolytic method of protection of condenser tubes generally gives negative results, but occasionally good results have been reported; these seem to be due to chance secondary effects particularly of the anode products. Corrosion of brass may be due to metal-ion concentration cells or oxygen-distribution cells. With high-speed water streams the metal-ion concentration cell may become the more powerful and render the metal anodic and severely corroded; deposits of sand, porous masses of corrosion products, etc., may cause oxygen distribution cells to become active and set up local corrosion, but the most rapid cases of corrosion seem to belong mainly to the former type. Sometimes the two types of action reinforce one another.—E. H. **Dix**, Jr., and A. J. **Lyon**: Comparative results on copper-silicon-aluminium and other aluminium alloys as obtained on separately cast specimens and specimens cut from a crankcase casting. Copper-silicon-aluminium alloy is particularly well adapted for complicated castings which do not require a large amount of machining. The casting properties of Alpax are similar, but it has a very low proportional limit and is inferior in this respect. Lynite 195 has uniform and desirable physical properties. The proportional limit is considerably above any of the alloys tested. The foundry practice, however, is more difficult for this type of an alloy. 8 per cent. copper-aluminium alloy is suitable for the general run of castings and can be cast in sections $\frac{1}{16}$ in. or more in thickness without much difficulty.—R. **Genders**: The extrusion of brass rod by the inverted process. Precautions are necessary to secure good surface, the method adopted for the present being the avoidance of entrance of the skin of the billet into the region of flow. The structure of the extruded rod does not show the concentric zones of material varying in crystal size and physical properties often produced by the peculiar nature of the flow which obtains in the ordinary process. The rear portion of the rod is variable in structure and hardness from centre to outside, but in a continuous gradient. All possibility of "core" defect is excluded, and, if defects are allowed to arise, they will be visible on the surface of the rod.—D. **Hanson** and Grace W. **Ford**: Investigation of the effects of impurities on copper. Part II.—The effect of iron on copper. Solid copper will dissolve about 4 per cent. of iron at 1100° C., but the solubility at lower temperatures is much less. Within the limits of solid solubility, the electrical resistivity increases rapidly as the iron content is raised: hence iron is extremely deleterious in copper for electrical purposes. The tensile strength is raised by 2 per cent. of iron from 14·5 tons per sq. in. to about 20 tons per sq. in. The effect of heat-treatment is relatively small. Iron has no great embrittling effect.—Sir Thomas K. **Rose** and J. H. **Watson**: Experiments on the working of nickel for coinage. The experiments were made in order to determine the conditions in which nickel for coinage could be cold-rolled in the existing rolls at the Royal Mint. It was found impossible to prepare coins containing 99 per cent. nickel with 1 per cent. of manganese, magnesium, carbon, iron, silicon, etc., such as are manufactured with the aid of hot-rolling. By the addition of 2 per cent. manganese, however, castings can be prepared suitable for cold-rolling and conversion into coin. The coins consist of a solid solution, and accordingly resist tarnishing and corrosion equally well with those containing 99 per cent. or more of nickel, such as are in circulation abroad.

## Official Publications Received.

Transactions of the Leicester Literary and Philosophical Society; together with Report of the Council for 1923–1924 and Annual Reports of the Sections. Vol. 25, 1924. Pp. 55. (Leicester.)

Far Eastern Association of Tropical Medicine. Transactions of the Fifth Biennial Congress held at Singapore, 1923. Edited by the Hon. Dr. A. L. Hoops and Dr. J. W. Scharff. Pp. 974+86 plates. (London: J. Bale, Sons and Danielsson, Ltd.) 40*s*. net.

Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 2: The Prakrit Dhātv-ādeśas according to the Western and the Eastern Schools of Prakrit Grammarians. By Sir George Abraham Grierson. Pp. 77-170. (Calcutta.) 3.15 rupees.

The Rockefeller Foundation: International Health Board. Tenth Annual Report, January 1, 1923–December 31, 1923. Pp. xvii+158. (New York: 61 Broadway.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 76: Studies in the Dermaptera and Orthoptera of Ecuador. By Morgan Hebard. Pp. 109-248+plates 5-10. (Philadelphia.)

Government of India. Department of Industries and Labour: Public Works Branch. Irrigation in India: Review for 1922–1923. Pp. iv+39. (Simla: Government of India Press.) 12 annas.

Forest Bulletin No. 58: General Volume Table for *Chir* (*Pinus longifolia*). Classified by Diameter (and Girth) and Height. By S. H. Howard. Pp. 14+3 plates. (Calcutta: Central Publication Branch.) 8 annas.

Report on the Danish Oceanographical Expeditions 1908–10 to the Mediterranean and Adjacent Seas. Vol. 2: Biology. H. 1: Medusæ. By P. L. Kramp. Pp. 67. (Copenhagen: Andr. Fred. Høst and Søn.)

The Hundred and Second Report of the Commissioners of His Majesty's Woods, Forests, and Land Revenues. Pp. 50. (London: H.M. Stationery Office.) 6*s*. 6*d*. net.

Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1924–25. Pp. 229. (Manchester.)

Meddelanden från Statens Skogsförsöksanstalt. Häfte 21, Nr. 4: Några Norrländska Skogsföryngringsproblem II; Quelques problèmes relatifs à la régénération dans la Suède septentrionale II. Av Gunnar Schotte. Pp. 149-180. Häfte 21, Nr. 5: Tallens och granens Kolsyreassimilation och dess Ekologiska Betingelser; Untersuchungen zur Ökologie der Kohlensäureassimilation der Nadelbäume. Av M. G. Stålfelt. Pp. 181-258. Häfte 21, Nr. 6: Skogsinsekternas Skadegörelse under åren 1919–1921; Die Schädigungen der Forstinsekten in den Jahren 1919–1921. Av Ivar Trägårdh. Pp. 259-294. (Stockholm: Centraltryckeriet.)

Loughborough College, Leicestershire. Calendar, Session 1924–25. Pp. xiv+214+53 plates. (Loughborough.) 3*s*. 6*d*. net.

Transactions of the Institution of Chemical Engineers. Vol. 1, 1923. Pp. xv+120. (London: Abbey House, Westminster.)

Manchester Astronomical Society. Journal of the Sessions 1922–1924. Pp. 60. (Manchester.) 4*s*.

Growth in Trees and Massive Organs of Plants. Dendrographic Measurements, by D. T. MacDougal; The Growth Record in Trees, by Forrest Shreve. (Publication 350.) Pp. 116. (Washington: Carnegie Institution.) 1.50 dollars.

Department of Marine Biology of the Carnegie Institution of Washington. Vol. 20: American Samoa. Part 1: Vegetation of Tutuila Island; Part 2: Ethnobotany of the Samoans; Part 3: Vegetation of Rose Atoll. By Prof. William Albert Setchell. (Publication 341.) Pp. vi+275+37 plates. (Washington: Carnegie Institution.) 3.50 dollars.

The Vesuvius Eruption of 1906: Study of a Volcanic Cycle. By Frank A. Perret. (Publication 339.) Pp. 151+24 plates. (Washington: Carnegie Institution.) 4 dollars.

Natal Museum. Mammals, Series 1. 10 pictorial post cards and leaflet. Mammals, Series 2. 10 pictorial postcards and leaflet. (Pietermaritzburg.)

Year Book of the Michigan College of Mines, 1923–1924, Houghton, Michigan. Announcement of Courses, 1924–1925. Pp. 123. (Houghton, Mich.)

Department of Commerce: Bureau of Standards. Technologic Papers of the Bureau of Standards, No. 259: Saturation Relations in Mixtures of Sucrose, Dextrose, and Levulose. By Richard F. Jackson and Clara Gillis Silsbee. Pp. 277-304. (Washington: Government Printing Office.) 10 cents.

Bulletin of the American Museum of Natural History. Vol. 49, Art. 3: The Dermaptera of the American Museum Congo Expedition; with a Catalogue of the Belgian Congo Species. By James A. G. Rehn. Pp. 349-413. Vol. 49, Art. 4: Size-Variation in Pyrenestes, a Genus of Weaver-Finches. By James P. Chapin. Pp. 415-441. Vol. 49, Art. 5: Observations on *Colobus* Fetuses. By Adolph H. Schultz. Pp. 443-457. (New York.)

Marine Structures: their Deterioration and Preservation. Report of the Committee on Marine Piling Investigations of the Division of Engineering and Industrial Research of the National Research Council. By William G. Atwood and A. A. Johnson; with the Collaboration of William F. Clapp, of Robert C. Miller, and of H. W. Walker, H. S. McQuaid and Marjorie S. Allen. Pp. vi+534+14 plates. (Washington: National Research Council.) 10 dollars.

## Diary of Societies.

*SATURDAY*, SEPTEMBER 27.

SCHOOL NATURE STUDY UNION (Anniversary Meeting) (at London Day Training College), at 3.—G. H. Gater: Address.

*TUESDAY*, SEPTEMBER 30.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—J. Lamb: Marine Oil Engines, Practical Notes on Bearing Adjustment.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. G. H. Rodman: A Talk about Orchids.

*WEDNESDAY*, OCTOBER 1.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—G. D. Elsdon and P. Smith: The Determination of Coconut Oil and Butter Fat in Margarine.—F. Knowles and J. C. Urquhart: A Preliminary Note on the Composition of the Fat of Goat's Butter.—Miss W. N. Nicholson and D. Rhind: The Quantitative Estimation of the Degree of Hydrolysis of Gallotannin by Tannase.—Miss M. B. Richards and W. Godden: The Pemberton-Neumann Method for the Estimation of Phosphorus.—W. S. Shaw: Application of "Formal Titration" to the Kjeldahl Method of Estimating Nitrogen.

*THURSDAY*, OCTOBER 2.

INSTITUTION OF MINING ENGINEERS (Annual General Meeting) (at British Empire Exhibition), at 11 A.M.—Dr. J. S. Haldane: The Values for which the Institution stands (Presidential Address).—Sir Josiah Court: Salt Treatment for Miners' Fatigue.—Prof. K. Neville Moss: (*a*) The Food Requirements of Coal Miners; (*b*) The Mechanical Efficiency of the Human Body during Work in High Air Temperatures; (*c*) The Physiological Standardisation of the Kata-Thermometer.—J. T. Storrow and J. Ivon Graham: The Application of Gas Analysis to the Detection of Gobfires.

ROYAL AERONAUTICAL SOCIETY, at 5.30.—Lt.-Col. H. T. Tizard: Common Sense and Aeronautics.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss Ida C. Ward: Speech Defects.

*FRIDAY*, OCTOBER 3.

INSTITUTION OF MINING ENGINEERS (Annual General Meeting) (at British Empire Exhibition), at 10.30 A.M.—E. Williams: Economics of the Coal-mining Industry.—R. L. A. Dron: The Valuation of Mines and Minerals, and the Relation of Income Tax to such Valuations.—Prof. D. Hay and R. Clive: The Ventilation of Mines.—E. L. Hann: The Rhymney Valley Compressed-air Installation.—S. Mavor: Problems of Mechanical Coal-mining.—F. S. Sinnatt and H. E. Mitton: The Preparation of Coal for the Market.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Display of Exhibition Slides.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Prof. A. W. Bickerton: Explosions, Terrestrial and Celestial.

### PUBLIC LECTURES.

*THURSDAY*, OCTOBER 2.

UNIVERSITY COLLEGE, at 2.30.—Sir Flinders Petrie: The Official Classes of Ancient Egypt.

*FRIDAY*, OCTOBER 3.

BEDFORD COLLEGE FOR WOMEN, at 11 A.M.—Miss Hosgood: The Netherlands.

UNIVERSITY COLLEGE, at 5.30.—Prof. T. Percy Nunn: The Scientific Interpretation of Nature.