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Broadcasting and the School.

EDUCATION has a conservative and a progressive meaning. There are some who regard it mainly as a means for preserving civilisation, and there are others who would emphasise its function in preparing each generation to understand and to solve the problems of a more abundant and complicated world. The attainment of both aims is facilitated by the provision of apparatus, materials, and methods. Books, pictures, museums, laboratories, and workshops are available on a more lavish scale than ever before, and new devices for acquiring knowledge or skill are continually tested and applied.

Probably the most important educational experiment of the last ten years has been that of broadcasts to schools, and none has created more divergent opinions. On one hand, it has been hailed with enthusiasm as a means of widening the outlook and stimulating the interest of the pupils. On the other, it has been condemned as an unsuitable medium possessing no advantage over, and generally inferior to, personal instruction by a teacher. Both of these contain an element of truth. They are opinions which are based on objective and subjective facts. Objectively, the matter transmitted may be unsuitable, the speaker's method of delivery may be defective, reception may leave much to be desired. Subjectively, the teacher may belong to the group which welcomes external aid, or to the group which resents it.

The precise value and the limitations of the new medium in schools could only be ascertained by an investigation on scientific lines. A grant from the Carnegie United Kingdom Trust enabled such an investigation to be undertaken in Kent in 1927, and the report [1] which has now been issued is a remarkably interesting document. The schools were all elementary schools, and were selected in such a way as to represent a wide variety of conditions. They included boys', girls', and mixed schools, small rural, semi-rural, and large town schools. In regard to secondary schools and adult education, the experiments were only tentative, and are being continued.

The experiments were carefully planned. Each set lasted for a term. Three conferences were held, and these were attended by representatives of the teachers, of the Kent Education Committee, and of the B.B.C., and by H.M. Inspectors for the area. A 'Report Form' was sent out at the end of the

[1] "Educational Broadcasting," published by the Carnegie United Kingdom Trustees, Dunfermline, 1928.

first term ; a ' 1st questionaire ' at the end of the second term, and a ' 2nd questionaire ' at the end of the third term. The questions varied with the course, and those in the second questionaire were varied slightly, as the result of experience or in view of the stage of the experiment, from those in the first. The answers were given in the form of ' Yes,' ' No,' or ' No information,' ' No opinion.' Great care was taken to avoid the answers ' Yes ' or ' No ' upon inadequate evidence or absence of conviction.

The chief positive value of the investigation lies in the gradual elimination of the objective imperfections which occur both at the transmission and reception ends. Much attention was devoted to the choice of subject, method of presentation, and voice and delivery of the lecturer, and it was found that a knowledge of school conditions and some experience in teaching were most desirable. No child will listen patiently to a speaker merely because he has attained distinction in some (to the child) remote sphere of intellectual activity. The lecturer must be an expert only in the sense that he can convey information or stimulate interest that cannot be obtained or aroused in the same degree by the ordinary methods in school. This means that he must know his subject, but it is more important that he should possess a transmittable voice and personality than that he should have made additions to knowledge. That is the blunt truth where young people are concerned. Older people will suffer much to feel themselves in touch with greatness. Young people will not; and the report wisely remarks that :

" A professor of mediaeval literature is called an expert : so is the driver of an express train. Sam Weller's knowledge of London was extensive and peculiar ; he, too, was an expert."

At the receiving end it was found that possession of a good set was insufficient unless it was properly maintained. At the end of the first term, only 29 sets out of 44 were yielding good results. The B.B.C. then appointed two resident engineers at Maidstone and Canterbury, and made arrangements for technical assistance in other districts. At the beginning of the third term, 37 sets out of 55 were working satisfactorily, but by the end of the term only three were defective. It is interesting to note that in 17 out of the 18 sets not working properly at the beginning of the term, the fault lay in neglected batteries.

The subjective factor can never be eliminated entirely. However sympathetic a teacher may be towards wireless instruction, his interest in subjects is neither uniform nor universal. But by spreading the experiments over a number of subjects and a number of schools the differences probably cancel out ; and by avoiding a ' forced ' opinion for or against, the Committee obtained judgments which may be regarded as sufficiently detached to be of real value. The actual results upon the pupils are not measurable on any scale, and are rarely capable of expression in exact terms. They are opinions based on careful observation, and they are put forward in the report with so much moderation that they command respect.

The objective imperfections were so far reduced during the year that, in the case of some talks, the favourable opinion was almost unanimous. The general opinion of the teachers was

" That the Broadcast lessons (*a*) imparted a knowledge of facts ; (*b*) stimulated interest in ways which could be definitely observed ; (*c*) created impressions as durable as those produced by their ordinary lessons ; (*d*) did not encourage inattention ; (*e*) were particularly stimulating to clever children ; (*f*) supplied views and information which the teachers themselves could not have supplied ; (*g*) gave them fresh ideas for lessons ; (*h*) interested some parents in the work that their children did in school."

On the other hand, " all the courses were not uniformly successful." The teacher should " have some knowledge of the subjects treated," and success depends very largely on " co-operation between the teacher and lecturer."

There is one aspect of school broadcasts that seems scarcely to have received sufficient attention. That is the influence on the teacher, and, through him, on the pupils. If the lecturer " supplied views and information which the teachers themselves could not have supplied," and if " he gave them fresh ideas for lessons," he is surely rendering a very direct service to formal education. It is relatively easy for the specialist teacher in a large urban school with a public library close at hand, to say contemptuously that he is in no need of external aid. But the case of a village school of forty children with two women teachers is different, and the danger that the teaching may become stereotyped and dull is greater. For this and other reasons we take the view that the greater part of the value of the radio lesson is indirect : that it operates, through the teacher, at times when the lecturer is silent and the voice of the loud speaker is stilled.

It will be obvious that the report is entirely favourable to school broadcasting, providing certain conditions are fulfilled. The practice has come into use, and it has come to stay. By August 1926,

before these experiments began, "nearly 2000 schools had notified the B.B.C. that they were making use of the school broadcasts." This total has been reached in less than three years. The foreword to the report, which bears the signature of the director of education for the County of Kent, begins with these words:

"Every Monday afternoon at half-past two the Director-General of the British Broadcasting Corporation, after the manner of the well-known French Minister of Education, can take out his watch and say: 'At this moment 70,000 children are taking a wireless History lesson; Music on Tuesday, English on Wednesday, and so on through the week.' Two years ago he could have claimed 20,000 pupils. Two years hence he may be dealing with 200,000. In ten years, who can say how many boys and girls will have come under his influence?"

While declining the invitation to tread the perilous path of prophecy, we desire to congratulate those who undertook, or assisted in, the investigation on the accomplishment of a valuable piece of work.

The Structure of Mongolia.

Geology of Mongolia: a Reconnaissance Report based on the Investigations of the Years 1922-23. By Prof. Charles P. Berkey and Frederick K. Morris. (Central Asiatic Expeditions: Natural History of Central Asia, Vol. 2.) Pp. xxxi + 475 + 44 plates + 6 maps. (New York: American Museum of Natural History; G. P. Putnam's Sons, Ltd.; London: G. P. Putnam's Sons, Ltd., 1927.) 10 dollars.

A GOBI, which according to Howorth is the Mongol word for the stony or sandy desert, is explained by the authors of this monograph as an open plain on the floor of a basin. The geology of the Gobis, in that sense, is rarely on first appearance attractive; but they often yield fossils of exceptional interest, because the remains of extinct land animals have been buried in the deposits on their floors. Prof. H. F. Osborn made the sound prediction that north central Asia would be found to have been an important centre in the evolution of the higher vertebrates, and an expedition on a grand scale was organised by Mr. Roy Andrews to collect the fossils which would be expected on this hypothesis. The expedition, as is well known, obtained a rich haul of fossil vertebrates—its most sensational discovery being the nests with the eggs of dinosaurs.

This large and richly illustrated volume by Prof. Berkey and Mr. F. K. Morris reports the results of the expedition in the field of stratigraphical geology. The palæontological collections are to be described in later volumes. The geological results are important, as they reveal the structure of a little-known part of east central Asia. The area explored is north-west of Peking from Kalgan across central Mongolia to Urga and to the south-west of that town. Most of the volume is occupied by the geological descriptions and sections of the long routes traversed by the expedition. These details are followed by general discussions of the geological results, of the geographical processes observed, and of the relations of the work to the geology of northern Asia.

Prof. Berkey and Mr. Morris have proved that the whole area rests on a platform of pre-Palæozoic rocks, which are divided into the three usual types: the lowest is a fundamental series of coarse gneisses, schists, and crystalline limestones, which in other parts of China is called the Tai Shan system; next is a series of quartzites, schists, phyllites, and limestones, similar to the rocks that in central China Bailey Willis called the Wu Tai system; the third division, the Nankou system of Richthofen and the Sinian of Grabau, includes slates, graywackes, and sandstones. This foundation was invaded by a great mass of granite. Then followed a long gap, as the Lower and Middle Palæozoic, which are well represented in southern China and Yunnan, are absent. The Carboniferous and Permian Systems are represented by marine deposits, which were followed, after long interval, by a thick series of continental Jurassic deposits, which, like the older rocks, have been folded. Then, after another gap, occurs a long succession of Cretaceous and Kainozoic beds, which are all thin, are richly fossiliferous, and are nearly horizontal. Many of the fossils show that during their existence there was an easy land passage between eastern Asia and western America.

The pre-Palæozoic platform is seamed with dykes, but the later stages of central Mongolia contain only little evidence of volcanic activity. Wide sheets of basalt on its borders range in time from the Lower Oligocene to the late Pliocene, and Mushketov has described a volcanic cone with a still preserved crater. Messrs. Berkey and Morris discovered some lavas and an interesting series of fused rocks near Mount Tuerin, which they describe as volcanic vents made by the fusion of the overlying sediments by superheated volcanic gases. They describe these rocks as the most striking experience of vulcanism seen in the Gobi region

(p. 78). The fusion of surface clays would appear to require more intense heat than can be provided by a volcanic gas; and it may be due, like the pseudo-obsidians of India, to the burning at the surface of producer gas formed by the action of superheated water upon underground beds containing coal or bituminous material. The heat in this case may be due to dykes that fed the lava flows five miles from the locality.

The authors saw no local evidence of glacial action, and an interesting map (p. 383), that shows the very restricted range in Asia of the Pleistocene glaciation, forms a useful corrective to such views as that recently expressed in "Magic Ladakh," that a continuous ice cap spread from India to the North Pole.

The expedition found abundant evidence of striking earth movements. The numerous *talas* are described as warped basins. The Khingan Mountains, which form the eastern front of the plateau, are due to the subsidence of the land to the east, either by a down-fault or a down-fold along a monocline; and on the mountain types of this region fault action has been a powerful influence.

The authors classify the tectonic mountains of northern and central Asia into five series, and consider that the forces which raised them have acted in general along the same lines, and are due to one constant influence which has always been working in the same direction and in the main on the same mass of land. This view requires some qualification when applied to the Asiatic borderlands, but it appears to be true in the main for the interior of the continent; and the stress which the authors have laid on this conclusion should be very useful.

The basins, which are the characteristic features of Mongolia, are attributed to wind action, which lifts out of them the loose material; but the authors conclude that the wind has usually little power of direct erosion on rock. This conclusion is no doubt true where the process has proceeded so far that the country is smothered by a protective sheet of drift, as appears to be the case in central Mongolia; but where hard rock stands up in the way of the wind, other areas show that the wind may be a powerful agent of erosion. The authors remark that in Mongolia the cliffs are rarely undercut by the wind, and that their foot is generally protected by banks of earth. They therefore attribute the wide 'peneplanes,' for which they adopt that spelling, to the action of running water. The agency of the wind in the transport of material they recognise as of great importance; but the material carried they consider due to the disintegration of rock by weathering, and its destruction and scattering by running water.

One interesting chapter summarises the evidence of the changes of climate in Mongolia throughout geological time. The pre-Palæozoic rocks give no definite information, which is first afforded by the Permian marine rocks; they, by the absence of reef-yielding corals, denote a temperate climate. The evidence of the long succession of subsequent continental deposits indicates that the conditions have been generally those of a semi-arid land, which in consequence of its distance from the sea had a low rainfall. Some of the beds, such as the water-rolled conglomerates, required for their formation more powerful water action than the sub-aerial sands; but such different deposits may have been formed contemporaneously in the same region, one in river deltas, and the other on open plains. The only marked evidence of a change of climate appears to be in the Pleistocene, when during the glaciation of some parts of the world there must have been a heavier rainfall and more humid conditions, probably owing to the displacement of the track of the storms.

The volume is accompanied by a full bibliography. The work of the Russian explorers is illustrated by a map of their routes, which has been so much reduced that it is difficult to read. The illustrations are excellent, and on a most generous scale; they include some beautiful coloured plates of scenery after sketches by Mr. Morris. This work is the first issued volume of a series which will doubtless prove one of the standard authorities on the geology and natural history of Asia.

J. W. G.

Riddles in Evolution.

The Species Problem: an Introduction to the Study of Evolutionary Divergence in Natural Populations. By G. C. Robson. (Biological Monographs and Manuals, No. 8.) Pp. vii + 283. (Edinburgh and London: Oliver and Boyd, 1928.) 15*s*. net.

"We shall at least be freed from the vain search for the undiscovered and undiscoverable essence of the term species . . . a grand and almost untrodden field of enquiry will be opened, on the causes and laws of variation, on correlation, on the effects of use and disuse, on the direct action of external conditions. . . . A new variety reared by man will be a more important and interesting subject for study than one more species added to the infinitude of already recorded species." —Darwin, "Origin of Species"; 1884; chap. xv.

THESE passages from the master's eloquent recapitulation came irresistibly to mind on closing this book by the eminent authority on

mollusca of the British Museum. For in this excellent conspectus of "specialist and other data" on evolution we see how far we have trod the field these seventy years since Darwin.

The book has two parts; the first deals with the differences between species groups and the bearing of species recognition on evolutionary problems; the second mainly examines the existing 'orthodox' theories on evolutionary divergence. The point of view (Chap. i.) is that, despite all modern work on morphological, genetical, physiological, and ecological criteria, no essence of the term distils; further, that evolution does not imply the "production of standardised groups or units"; hence the title is a concession to the "time-honoured . . . convention that the initial stages of species-divergence are better studied in the form of taxonomic species," the latter having become the reference point at which most information concerning divergence is assembled. Chapter ii., on the constitution of species and natural populations, concerns species recognition, its difficulties, and the systematist's attitude. Physiological differentiation (Chap. iii.), though less canalised and more capricious in incidence and pace, "marches in a broad sense" with structural differences.

In Chap. iv., on allied species and their distribution, a new general principle, "Opportunity Dispersal," is briefly cited—a new species "as it arises may be compelled by competition to occupy a less-favoured or an unoccupied 'niche' . . . because other habitats are already occupied." In Chap. v. "Isolation" is lengthily treated, a special feature being a short review, very good, on sexual isolation. The importance of sterility is emphasised. Being restricted to promoting divergence, isolation is really of secondary importance, as it does not induce variation or promote the spread of variants.

Part 2 faces three problems: the origin of variant characters, their spread, and the origin of groups. The rôles of the germinal tissue, environment, and natural selection are ably reviewed, and careful attention is focused on correlation. The review gives us pause, for from all the post-Darwinian inquiry, unequivocal researches are rare. For example, concerning heritable variation, almost the only case is the melanism induced in moths by special feeding (Harrison and Garrett). Struck by the fewness of the individuals first responding to treatment, the author comments that coincidental conditions in the germ cells, *e.g.* physiological, may contribute to the changes invoked. Kammerer's early salamander work (Appendix) is not neglected, though it is regarded as showing only an accommodation or 'threshold' effect. Again, on the numerical increase of variants, we know little beyond the two cases of 'massive transformation' shown by Weldon's crabs and industrial melanism in lepidoptera; touching their spread, we know practically nothing. Natural selection, it is acknowledged, provides a logical explanation but is difficult to prove, though mimicry in lepidoptera appears a good example of its incidence. But of the many others usually educed (p. 212), only Weldon's experiments indicate that the death-rate works selectively so that the survivors are different from the eliminated.

Other difficulties, centred around the thorny problem of adaptation, are adumbrated and, incidentally, it is significant "that the selective value of slight differences between species and races has never been systematically explored." The special difficulties encountered in applying the orthodox evolutionary hypotheses in cases where groups are differentiated from each other in several characters highly correlated are stressed, the author feeling their importance because characters do tend to 'hang together' and because races and species are recognisable by this very tendency. Moreover, it is impossible to decide whether the production of non-serviceable differences between species has been due to correlation with serviceable ones because the evidence is deficient.

The book's format is good, but notice should be taken of a fair number of slips, *e.g.* Nuttal (pp. 66, 104, 105) for Nuttall, *Tephrosa* (p. 267) for *Tephrosia*, *menas* (p. 234) for *mœnas*; several cross-references require correction—Lutz, 1909 (p. 28), is dated 1908 in the bibliography, and Viets, 1923 (p. 196), 1924, Bateson, 1912 (p. 78) is not given, and Myers and Gale (p. 187) reads Myers and Salt.

Whatever views one may hold on this or that theory of evolution—exponents of natural selection, for example, will not agree to the author's caution regarding its sweep—one must congratulate the writer on his informative, well-ordered presentation and its reasoning and reasonableness. The appeal of the book is to the worker in biology. It will be especially useful to promising senior students and 'improvers' for its point of view—that of an experienced worker impressed by the magnitude of the many problems and the smallness of the progress made. Such readers, too, will find a sane corrective to easy acceptance of 'royal road' theories and, no less, an incentive to work

in evolutionary problems, for the book is one long list of desiderata in this regard. It is a stock-taking that provokes heart-searching: Are our individual researches vested with sufficient universality?

We have a lurking doubt as to whether the biologist of to-day, despite the reaction towards studies in function, is intimate enough with living things. We suggest 'back to Darwin,' whereby, in one person or team, extensive field work, keen systematics, careful breeding, and inspired experiment are all laid under contribution in attacking the fundamental evolutionary problems appropriate to an organism or a group. Fortunately, to cite a few examples from Mr. Robson's book, important work on these broad lines is being wrought; Lotsy in Holland, Sumner in America, and Harrison in England are all engaged on 'new varieties reared by man' and fulfilling Darwin's prediction. But very many more such are needed, and more facts, and, above all, more time. After all, say for the spread of variants, what are the seventy post-Darwinian years compared with the ages available to Nature? A. D. P.

Historical Optics and the Microscope.

Origin and Development of the Microscope: as Illustrated by Catalogues of the Instruments and Accessories, in the Collections of the Royal Microscopical Society, together with Bibliographies of Original Authorities. Edited by Alfred N. Disney, in collaboration with Cyril F. Hill and Wilfred E. Watson Baker. Preceded by An Historical Survey on the early Progress of Optical Science, by the Editor. Pp. xi + 303 + 30 plates. (London: Royal Microscopical Society, 1928.) 17*s.* 6*d.*

FEW individuals possess all the qualifications necessary for the study of the history of any science. They must read with facility the Latin in which the ideas of the early writers were expressed. Failing actual possession, they must have ready access to the original works. Above all they must have the requisite leisure. These essential conditions are rarely found combined in one individual, and it is not surprising that familiarity with the scientific literature of the past is so limited. An impressive exhibit of ancient books at the recent Optical Convention attracted the casual attention of only a small proportion of the members, some of whom no doubt were interested more in the quaintness of the illustrations than in the matter. The collections of the various societies are rarely consulted, and private libraries are dispersed in the sale-rooms as no home of permanent usefulness can be found for them.

The three authors of this book combine all the qualifications requisite for the production of the historical work they have so successfully undertaken on behalf of the Royal Microscopical Society, of which they are fellows and honorary officers. Their work has been done in the most favourable surroundings directly within the valuable library and museum of the Society. Mr. Disney, the principal editor, states in the concluding paragraph of his preface that the work represents the labour of seven years. Anyone who has attempted to read one single work, such as the Thesaurus of Alhazen, will appreciate how much labour must have been involved in the concentration of twenty centuries within the limits of one concise volume.

Part I. contains four chapters of history and a bibliography, which in itself is a valuable contribution, comprising, as it does, many important extracts and interesting explanatory notes.

Chapter i. covers the period from the earliest times of Ptolemy, Euclid, Archimedes, and Hero to about the year 1590, when Baptista Porta was particularly active. In a future edition some rechecking of proofs will be required, particularly as regards the dates, which differ in the headings and text, due, in some cases, to the interchange of 0 and 6.

That optical instruments are erroneously attributed to the ancients forms the thesis of Chapter ii. Prominence is given to a very valuable discussion of this subject by Prof. Henri Martin, of the University of Rennes, in a paper which appears to be little known in Great Britain. While the authors have, in general, presented the views of the ancient writers they quote without any attempt to direct the opinion of the reader, they seemingly adopt the conclusion of Prof. Martin that the accomplishments of the past have been exaggerated. With that conclusion most people will agree, possibly with some regret that, in the case of Friar Bacon, his wonderful description of what might be performed by refracted vision was unaccompanied by an explanatory diagram. It should not be forgotten, however, that the mathematical demonstration may lag a century behind the discovery. The conclusion also involves acceptance of the view that no ancient magnifying glasses exist, because such segments of spheres of glass as have been found are probably merely ornaments.

Chapter iii. deals with the age of progress from Kepler to Hevelius, and that debatable question, which Borellus tried to answer, namely, Who was the true inventor of the telescope? forms the subject of the fourth chapter.

Optical history in general occupies the first half of the book. The second half is termed a "Description and Illustrated Catalogue," a designation which conveys little indication of the interest with which the material has been invested. The microscopes described are those possessed by the Society. They have been divided into two groups A and B, with accessories in a third group C. The year 1850, by which time a fairly rational type of instrument had been evolved, has been selected as the boundary between the first and second periods.

The authors are to be congratulated on the successful conclusion of their labours, and the thanks of all concerned with the history of optics and the microscope are due to the Royal Microscopical Society for the publication of this valuable work. JAMES WEIR FRENCH.

Modern Investigations in Materials.

Applied Elasticity. By S. Timoshenko and J. M. Lessells. Pp. xxi+544. (London: Constable and Co., Ltd., n.d.) 25*s*. net.

THE importance of the strength and elasticity of the materials employed in engineering construction is well reflected in the frequency with which treatises on the subject appear. Prescott's book, with the same title as the volume at present under notice, was a specially notable contribution made a few years ago; but rather more abstract and mathematical than is perhaps desired by the majority of engineers. The volume here considered does not refrain from mathematical discussion, nor does it make any strenuous endeavour to simplify such methods, but it deals throughout with problems of definite practical moment, and its matter is in all respects up-to-date.

Mr. Timoshenko—well known for his original studies in elasticity—is responsible for the analytical Part I. of the volume, in which he incorporates much of his own original work. His chapter headings are of a very ordinary type, but a closer examination reveals that within each of these chapters there are many special developments quite unusual in treatises of this class. Chapter vi., on the bending of bars on elastic foundations, is, in its applications, a notable example of the author's powers; as are also Chapter viii. in which multi-throw crankshafts are treated, and Chapter ix. on curved bars. Chapter xi., on stresses produced by dynamical causes, is ambitious in its scope but, probably hampered by space considerations, it fails to do full justice to the modern technical problems of vibration.

Part II., on the experimental side of the subject, is by Mr. Lessells, who has conducted many researches on materials. His treatment is wide in range, and well defined in sectional detail. The important modern lines of fatigue, impact, and hardness testing are very clearly reviewed and presented; although the section on the effects of high temperature might have been extended with advantage. The separate chapter on theory of strengths is a welcome innovation in works of this kind.

The book is, in its general scheme, of an advanced order, mainly suited to senior students of the subject and to engineers who have to deal with the difficult details of modern design, but its wealth of treatment, summary, and reference on the outstanding modern problems and investigations of this important subject, give it a very high place in the rather lengthy list of works on the same subject.

Our Bookshelf.

Die neueren Milchindustrien. Von Dr. L. Eberlein. (Technische Fortschrittsberichte: Fortschritte der chem. Technologie in Einzeldarstellungen, herausgegeben von Prof. Dr. B. Rassow, Band 14.) Pp. xi+119. (Dresden und Leipzig: Theodor Steinkopff, 1927.) 5 gold marks.

THIS volume deals with the industrial aspect of milk production. After a brief account of the composition of milk and a description of the chief chemical and bacteriological methods which are used in its examination, the production and supply of clean milk are considered. Attention is directed to the milking machine, the cleaning of the vessels in which milk is transported, and the bacterial content of milk. The supply of milk to towns is an important chapter, and whilst it is agreed that fresh raw milk is the ideal food for children and adults, provided it can be obtained of low bacterial content and free from dirt, it is held to be impossible, on account of the cost, in present circumstances to provide such milk for the main body of the population. Pasteurisation and the three main systems are described, and two methods, other than by heat, for the removal of bacteria are described.

The preparation of condensed milk and the apparatus used for the purpose are described, and the succeeding chapter deals with dried milk and its preparation. The use of dried milk for infant feeding is mentioned.

In view of the difficulty which is often experienced in disposing of surplus milk at the 'flush'

time of the year, the manufacture of casein has been found in some countries, *e.g.* the United States, New Zealand, Argentine, and France, to be of greater profit than was at first expected; separated milk is used, the fat being employed for butter-making. The uses of casein are manifold, and it now finds application in a number of trades.

Another milk by-product which often proves a great embarrassment to the cheese-maker is whey, the milk sugar of which is valuable. The commercial manufacture of milk sugar is given, together with details of the necessary plant.

The information and the technical details given in this volume are likely to be very valuable to those engaged in the milk industry, especially to the manager of a factory where the condensing or drying of milk is practised.

Handbuch der allgemeinen Chemie. Herausgegeben von Prof. Paul Walden und Prof. Carl Drücker. Band 5: *Mechanische Eigenschaften flüssiger Stoffe; Volumen, Dichte, Kompressibilität, Oberflächenspannung, Innere Reibung.* Von Prof. R. Kremann. Pp. xii + 598. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 46·50 gold marks.

A NOTEWORTHY development in physical chemistry during the last twenty years is the increasing amount of attention paid to those properties of liquids which are primarily due to the cohesive forces between molecules. Compressibility, surface properties, and viscosity have attracted the interest of many investigators, both in Europe and in America, and the new knowledge gained of the behaviour of liquids has found many important applications in industry. Prof. Kremann's book on the mechanical properties of liquids is therefore a welcome contribution to physico-chemical literature and provides a valuable work of reference for students and investigators in this field.

The book is divided into three parts dealing with volume relations, viscosity, and surface tension (including interfacial tension). Each section opens with a useful survey of the experimental methods available for measuring the property studied, followed by a discussion of the influence of temperature and pressure. The effect of chemical composition is next considered, and here one must pay tribute to the skilful manner in which the author has collected and correlated a large number of empirical relations, laying due stress upon those of greatest generality and theoretical significance. Finally comes an account of the behaviour of binary mixtures and solutions.

The book is written avowedly from the experimental viewpoint, so that a critical discussion of the molecular theory of liquids could scarcely be expected. At the same time, it seems unfortunate that such a discussion was not attempted, even if it only served to emphasise our ignorance of the laws of force between molecules. This, however, would involve a consideration of vapour pressure and latent heat with which Prof. Kremann deals only incidentally, although they, too, may be classed as mechanical properties of liquids. S. S.

Grass Land: its Management and Improvement. By Prof. R. G. Stapledon and Dr. J. A. Hanley. Pp. 159. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 5*s.* net.

DURING recent years increasing attention has been paid to the improvement of grassland from various aspects, including methods of cultivation, manuring, and the types of grass used for sowing down. Progress has been rapid, and is still continuing, and in this volume Messrs. Stapledon and Hanley have sought to epitomise the present position, though at the same time they fully acknowledge that many of the recommendations put forward are tentative in nature and may need modifying in the light of future experimental results. Their aim is to provide the most precise information possible to enable an intelligent farmer to apply new methods in his management of grassland, wherever such improvement offers prospects of increased revenue. It is pointed out that one of the chief difficulties in estimating the financial value of improvements to date is the lack of adequate information in the form of farmers' costings accounts.

Grassland may be divided broadly into two types, natural and semi-natural, embracing respectively the large un-enclosed areas of moorland, heath, downs and saltings, and fenced-in land associated with the homesteads. The latter naturally offers the greatest opportunities for improvement, the appropriate methods of treatment varying widely according to local conditions.

In many cases manurial applications, to be effective, must be preceded by adequate mechanical treatment, or by the amelioration of soil acidity by the judicious use of lime, notably in very smoky districts. The necessary difference in grazing and meadow treatment is indicated, and information is given with regard to the various methods of renovating grassland and to the production of permanent and temporary leys. A bibliography of selected literature concludes a most useful summary of grassland treatment.

Principles of Soil Microbiology. By Prof. Selman A. Waksman. Pp. xxviii + 897 + 19 plates. (London: Baillière, Tindall and Cox, 1927.) 45*s.* net.

THE demonstration of Schloesing and Muntz in 1877 that in sewage beds ammonia is converted into nitrate by biological agencies, and the further demonstration by Warington that two species of bacteria are involved, followed by their isolation by Winogradsky, turned the thoughts of soil investigators towards the biological aspect of soil fertility.

Naturally, the earlier work was confined to the bacterial population of the soil, and, in text-books published round about 1910, nitrification, nitrogen fixation, and denitrification were the main topics of discussion. Since that date, the subject has gradually assumed a broader aspect, and it has been realised that not only bacteria, but also protozoa, algæ, and fungi are playing a part in the various soil reactions.

In the voluminous treatise prepared by Waks-

man, soil microbiology is treated under three main divisions, the first two dealing with the occurrence, isolation, identification, and cultivation of soil organisms, and the third where their chemical activities are discussed. Throughout, the treatment is very complete, and in this perhaps lies one of the faults of the book; for without a wide knowledge of the subject there is a danger of not seeing the wood for the trees. Also, the author would have been well advised to show more critical judgment in discussing the work of others: as the book stands, students will have difficulty in differentiating the really good pieces of research from the mediocre or even bad. Apart, however, from these blemishes, Waksman has done good service to soil microbiology in producing so compendious a volume, the citation of more than 2500 references being a service in itself. His book is essential to all those interested in the micro-organisms of the soil.

Money and Monetary Policy in Early Times. By A. R. Burns. (The History of Civilisation Series.) Pp. xiii + 517 + 16 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 25*s.* net.

IN a conclusion which sums up the lines of argument of his valuable study of money as an element in the growth of early civilisation, Mr. Burns enumerates the deficiencies in the evidence, for, as he says, it is as well to keep in mind the things we do not know, as well as those we do. This is wise, for the gaps in our evidence are great and the theories of numismatists and archæologists have not always been marked by restraint. For example, throughout the whole period with which the author deals, there is no evidence of the legal weight of coins, nor is it known what were the practical conditions of monetary law and the circulation of currency. How did the State decide what was the quantity of coins to be circulated? This is a point of peculiar importance for Mr. Burns's study, of which the originality lies particularly in his investigation of the use of monetary issues in relation to political supremacy. As a result he shows how, broadly, a distinction can be drawn between the policy of the great eastern empires and that of the Greek States.

In regard to the early stages of a currency, Mr. Burns shows himself sceptical as to the existence of a primitive state of exchange which is unorganised barter. This he regards as only a logical postulate for purposes of exposition. Nor does he think that the ox, though the first unit of value, recognised over a wide area, was ever in general use as a means of exchange. The author is to be congratulated on a sound piece of work which cannot fail to stimulate further research.

The Working of Aluminium. By Edgar T. Painton. Pp. ix + 214 + 20 plates. (London: Chapman and Hall, Ltd., 1927.) 13*s.* 6*d.* net.

THE scope of this book is not exactly indicated by its title, as the making of alloys and of castings is included as well as the mechanical working, heat treatment, welding, finishing, and testing of aluminium and the light alloys. On all these matters the author is informative, and his account of them shows practical familiarity with the workshop. Aluminium presents difficulties in machining and finishing to those who are accustomed to other metals, and many useful hints may be gathered from the instructions here given, and from the descriptions of actual operations, mainly in connexion with the motor industry. Theoretical discussions are deliberately excluded, and there are no photomicrographs, but the brief notes on age-hardening and on the 'modification' of the alloys of aluminium and silicon are accurate so far as they go.

In the account of heat treatment and melting, some mention might have been made of electric furnaces, which are now so widely used for these purposes in America, but are also used in Great Britain, and in the chapter on testing reference might have been made to the use of diamond pyramid indentation instruments, which are already displacing the scleroscope in some laboratories, on account of their greater accuracy when used with thin sheets. Among processes for the protection of aluminium surfaces, the excellent method of anodic oxidation, is described, with its further development, the application of dyes to the oxidised surface. Electroplating with cadmium is mentioned, but not the now extensively used process of plating with zinc. The illustrations are numerous and good, but the publishers have used an excessively loaded paper, which makes the book inconveniently heavy and throws an undue strain on the binding.

Ergebnisse der Biologie. Herausgegeben von K. v. Frisch, R. Goldschmidt, W. Ruhland und H. Winterstein. Zweiter Band. Pp. vi + 729. (Berlin: Julius Springer, 1927.) 56 gold marks.

THE price of this, a volume of essays by specialists, is too much. £2 : 16*s.* for a book, which from an English publisher would cost £1, or at most £1 : 10*s.*, is not justifiable. Recently two correspondents in NATURE directed attention to the cost of other Julius Springer publications, and we cannot advise the reader to purchase this volume at the price asked for it by the publisher.

The volume contains three essays on tropisms in plants—by P. Stark, L. Brauner, and W. Zimmermann. So far as the reviewer is able to judge, these sections are comprehensive, and they all have extensive bibliographies. There is then a chapter on urea, which the reviewer has been informed is good. This is written by A. Kiesel, of Moscow. In the section following, F. von Wettstein discusses heteroploidy at length. The Golgi apparatus is the subject of another chapter by W. Jacobs. This part is quite good and comprehensive.

Following this is a biochemical chapter on striated muscle fibre, by Bierdermann. This will be found useful to physiologists interested in muscle contraction, etc. An article on the spleen, by E. v. Skramlik, is followed by a section by Richard Goldschmidt on intersexuality, etc. This, as one might expect, is a valuable and interesting review of the subject. J. BRONTË GATENBY.

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.*]

Progressive Lightning.

IN NATURE of Nov. 20, 1926, p. 749, I showed how, by the use of a pair of photographic lenses carried on a rapidly revolving disc, information should be obtained as to the time any part of a flash of lightning lasts, how long it takes to get from any one part to any other part, where it begins and where it finishes, and how, if at all, succeeding flashes in a multiple flash differ in these respects from the pioneer flash which, so to speak, blazes the trail and has more to do to find a way which the others have merely to follow.

I had made this apparatus and carried it about for twenty-six years without obtaining a photograph when I wrote the article above mentioned. Since that time Dr. G. C. Simpson has kindly taken charge of it, but he had not so far been more successful than I in obtaining a suitable flash. At the end of June last he let me have the machine again to bring to this laboratory, where, as the guest of Mr. Alfred Loomis, I am exceptionally well placed for observations of this kind. The laboratory is at the top of a granite hill at an elevation of about 900 feet, and similar dome-shaped hills thickly clad with forest extend in all directions as far as the eye can see.

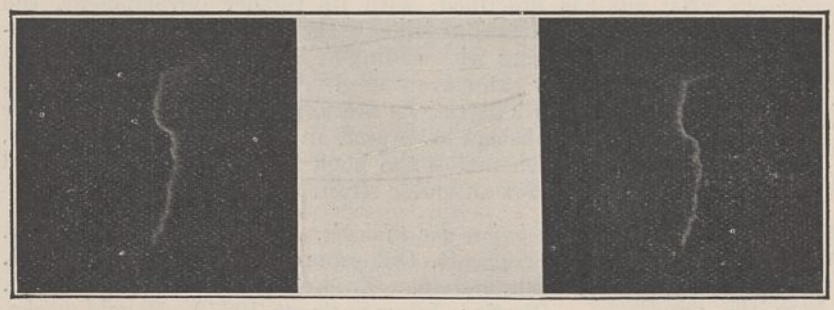

FIG. 1.

In the last month there have been two unusually severe heat spells accompanied by innumerable thunderstorms, but not until midnight, Aug. 5, did I see any clean flashes following one another in approximately the same direction. By clean I mean not obscured by intervening rain. I was fortunate to get one of these on to the plate with the lenses revolving in 4-inch circles at a speed of about 12 turns per second. For a preliminary picture I felt it safer to employ a low speed. This may be taken to be about 12 feet per second or 3600 mm./sec. The focal length of the lenses is 6 inches or 150 mm. The length of the image of the flash is 22 mm. which would make the length of the flash, or at least the visible portion of it, about $\frac{1}{7}$ of its distance. I judged this to be about 10 miles or 16 kilometres.

It so happened that the two images of the flash made by the two lenses were in line with one another, so that any aberration due to the motion of the lenses would displace the later portions of the flash sideways and in opposite directions. In order to obtain a measure of this displacement I scribed a straight line on the negative right through the two images. Measurement against this line would then show distortion with certainty and considerable accuracy. Stereoscopic examination, however, is more convenient, especially if the flash did not begin at one end and leave off at the other.

For this purpose a print is cut in two, and the two images are mounted side by side with the scribed lines parallel and square to the line joining the eyes. The two prints were so placed on the card that the two images were being carried towards one another all the time that the flash lasted. This is made evident by the sharp edges of the two images being remote from another while they showed the fading away of the light on the sides nearest to one another. If, then, any part of the flash had been later in time than any other, the images of this part would be nearer together, so that, seen in a stereoscope with the scribed line apparently upright, this part would appear nearer than other parts.

Actually, on looking at the mounted pair of images reproduced herewith (Fig. 1), the middle nearly vertical part with a small kink in it appears nearest, while the part bent to the left below seems to come from behind. Similarly, the sharp bend to the left above also seems to come from behind, but not so far behind, and the nearly vertical part from this up into the cloud appears again nearly vertical. The interpretation of these appearances then is as follows. The flash started at the ground, and almost immediately after started also in the length next the cloud. The flash then travelled from both these parts and finished in the middle upright portion about 1/7000 second later.

This was a single weak little flash with no overflow for succeeding flashes, so that it is not surprising that any part of it lasted no more than about 1/3600 second, the image being about 1 mm. wide before the very rapid fading away of the light. If it should be thought that the width of the image is due to mere imperfection of focus, the answer is that 4 mm. from the lower end and to the right there is a small branch flash on each image which is so sharp and thin as to be barely visible on the print. In each image this emanates from the leading edge. In the stereoscope this appears to come from behind, so it may have been the trigger of the whole discharge.

It may perhaps be well to state that the stereoscopic effects described above can have no relation to any stereoscopic effect which the two lenses as stationary lenses could have produced, because one of these effects is at right angles to the other. Besides, in a distance of several miles, a four-inch separation of the lenses would be inadequate. If they were separated 20 or perhaps 100 metres, then a very striking real stereoscopic view would be obtained.

It will be evident that as the linear displacement in the images due to time lag in the lightning depends only on the lag and on the linear speed of the lenses, the distortion of shape will be greater as the images are smaller, so that distance in the lightning, for example, not nearer than three miles, and short focus lenses, will make the stereoscopic effect more conspicuous. With much increase of size of the lens disc, the photographic plate might become inconveniently bulky and expensive. In such cases the obvious equivalent of two fixed lenses one above the

other, and with films travelling horizontally in opposite directions, might be preferred. Kinematograph lenses and films would then be suitable.

While I attach no importance to the rough numerical results obtained from this first experiment, I do maintain that it indicates that the method of oppositely moving images is capable of giving useful and certain information, and that a meteorological observatory might well be equipped with a special camera designed for higher speeds than my modest pioneer apparatus. Information as to fact can do no harm.

C. V. BOYS.

The Loomis Laboratory,
Tuxedo Park,
New York, Aug. 11.

On Co-ordinated Biological Research.

IF researches dealing with the relation of organisms to the environment are to approach in precision and completeness those dealing with matter and its physical attributes, it is essential that problems like that outlined below should be attacked by a team of workers, working simultaneously and in co-operation. Biological work of this kind may be accurate, valuable, and interesting, and yet fail in completeness for lack of contemporary data, as a review of recent work would readily show.

During recent years I have studied the general biology of oyster populations (*O. edulis*) in mass and in individuals in relation to general environmental conditions throughout successive seasons in different localities. From these studies it is clear that populations vary in their biological manifestations directly with the environment; for example, the incidence of general shell-growth, spawning, sex-change, and fattening can be predicted approximately from a knowledge of the environmental conditions, of which temperature range and rate of temperature change are the most important; the incidences vary in different localities.

It has also been demonstrated that *O. edulis* changes from femaleness to maleness automatically at, or a few hours after, the instant of egg-spawning (*Jour. M.B.A.*, **14**, p. 967; 1927), and it is clear from the studies mentioned above that the main change in the population from maleness or neuter to obvious femaleness occurs just before and during the breeding season: further, the amount of change in the population to femaleness at the beginning of the breeding season depends upon the nature of the environment. There are indeed good presumptive grounds for concluding that certain oysters, which are —or have recently been—male, will begin to produce eggs—whether they still retain sperm or not—provided (*a*) that the food-reserves have attained a certain concentration, (*b*) that the temperature of the medium is above a certain level: hence the occurrence of hermaphrodites. These conditions are not inconsistent with the possibility that certain substances may have hormonic value.

The problem to be solved is, therefore, How much of the sex-change is due to internal or to external factors acting separately? or alternatively, What combination of internal and external factors will maintain maleness or cause the assumption of femaleness? I have stated elsewhere that anything can be a male, but that some more than ordinary attribute is required to make a female. Broadly applied, this statement is true of the oyster, and the obvious preliminary requirement for a functioning female is abundance of food-reserves. Therefore, to obtain *conclusive* evidence of the factors controlling sex in *O. edulis*, it will be necessary in the first place to obtain seasonal chemical analyses of individuals the recent sexual history of which, as well as actual sexual condition at the instant of examination, is known. It can perhaps be predicted that the total rate of metabolism in debutante females will be higher than in the declining and perhaps fully ripe males, but for the clear establishment of the cause of sex it will be necessary to obtain accurate information on this matter correlated with conditions as regards food-reserves. When the results of these researches are known, it is possible that a basis may exist for critical experimental work.

To understand variations in the rate of metabolism and correlate the results in a direct manner with the environment, it will be necessary to know the seasonal variations in the plankton over the natural oyster beds. The seasonal variations in plankton are undoubtedly controlled in part by the supply of limiting food-factors, *e.g.* phosphates, nitrates, and in part by the biological characters of the constituents; it is therefore necessary to know the variations in the limiting food-factors in the area of investigations.

It has been shown that the growth of shell-material occurs at about the periods of the year when the storing of food-reserves especially occurs (*J.M.B.A.*, **15**; (1928), so that the interrelationship of these two processes is also bound up with sex. Shell-growth, however, is a problem which itself demands—besides biological information regarding internal condition—full knowledge also of the physical conditions prevailing over the beds, *e.g.* variations in salinity, temperature, alkalinity, and even general illumination. The experimental analysis of the factors concerned in producing that kind of shell-growth which may occur when oysters are disturbed during the non-growing season (loc. cit., 1928) would be most satisfactorily performed when known natural conditions on the beds can be used as a control. The possibility of predicting the beginning of shell-growth to within a period of one or two weeks (loc. cit., 1928) also offers an excellent opportunity for the study of calcium metabolism, and significant determinations of the seasonal variations in the metallic constituents of the blood.

It is obvious that one person alone cannot investigate all these matters as they should be investigated, that is, simultaneously. For this reason I came to the conclusion, and reported last year, "that a definite scheme of co-ordinated research might now be formulated to attack simultaneously in the future the factors underlying shell-growth, sex and sex-change, spawning and fattening in the oyster, and the more exact relation of these to the environmental—and experimentally controlled—conditions."

A scheme of this kind, it is true, need not be confined to the oyster, but might also be applied to the herring, the plaice, the haddock, the salmon, or other organisms, but it is doubtful if the results from any of these piscine biological subjects would be as valuable from the point of view of fundamental biology as those which might be obtained from a sedentary sex-changing organism like *O. edulis*. There are other species of oyster similar in biological characters to *O. edulis*, and a scheme like that outlined above might be carried to fruition in almost any country, but everywhere great difficulties will have to be overcome. In England there would seem to be little chance of the adoption of such a programme of co-ordinated research, unless there were universal approval and the various bodies interested in fundamental research combined to provide the costs and the personnel.

J. H. ORTON.

Marine Biological Laboratory,
The Hoe, Plymouth,
Aug. 7.

Displacement of Liquids in Capillaries.

THE phenomenon to which this communication refers is so striking, and its probability of occurrence in any chemical laboratory so great, that the absence of mention of it in the literature was very surprising to me.

If one places in a glass tubing, 5 mm. in diameter or less, drops of two immiscible liquids, end to end, so as to form a liquid-liquid interface, the continuous bubble these two liquids make will begin to move in the direction of the liquid of greater surface tension, and continue so indefinitely depending on the length of the tube. By raising the end of the tube toward which the bubble is moving to a certain height from the horizontal, the motion of the bubble is stopped; when it is raised still higher it slides back, and when lowered below the stationary height it

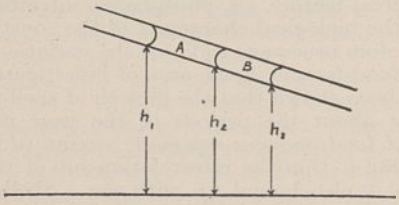

FIG. 1.

will move up again. It is evident from Fig. 1 that at equilibrium

$$(1) \qquad P=[(h_1-h_2)\rho_A+(h_2-h_3)\rho_B]g$$

where P is the pressure, ρ_A and ρ_B the densities of the liquids, and g the acceleration constant. The force $\pi r^2 P$ exerting this pressure is the resultant of the forces acting at the three interfaces, and therefore

$$(2) \quad \pi r^2 P = -2\pi r\sigma_A \cos\theta_A + 2\pi r\sigma_{AB}\cos\theta_{AB} + 2\pi r\sigma_B \cos\theta_B$$

where r is the radius of the capillary, σ is the surface tension, and θ the angle of contact.

The resultant pressures become quite measurable when we make use of small capillaries, as is shown in equation (2), written in the form

$$(3) \qquad P=\frac{2}{r}\left(-\sigma_A\cos\theta_A+\sigma_{AB}\cos\theta_{AB}+\sigma_B\cos\theta_B\right).$$

By modifying the conditions the liquid column can be made to move in the opposite direction; that is, if we construct a capillary as illustrated in Fig. 2,

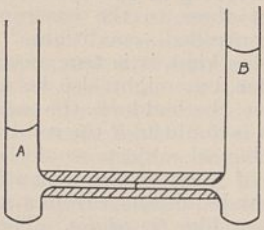

FIG. 2.

where the ends of the liquid column extend into the tubes of a cross-section where capillarity is not displayed, the liquid-liquid interface will move in the direction of the liquid of smaller surface tension.

The pressure developed under this condition is given by

$$(4) \qquad P=\frac{2\sigma_{AB}\cos\theta_{AB}}{r}.$$

Bartell and Osterhof,[1] in their work on 'wettability' of solids, measured such pressures in compressed powders, and arrive at the same relationship as in equation (4), but in a complicated manner.

This manifestation of surface phenomena is being utilised in my laboratory in measuring interfacial tensions, angles of contact, and adhesion tension of various liquids against glass.

J. L. SHERESHEFSKY.
Gulf Oil Companies' Fellowship,
Mellon Institute of Industrial Research,
Pittsburgh, Pa., July 9.

[1] "Colloid Symposium Monograph," vol. 4, p. 240; 1926.

Wave-length Shifts in Scattered Light.

RAMAN and Krishnan have recently described a new type of radiation emitted by organic liquids when illuminated with the light of a mercury arc, or with selected lines from such an arc. Lines are found in the spectrum of the scattered light at wave-lengths which are not present in the illuminating source. In the case of benzene the wave numbers of the shifted lines differ from those of the incident lines by amounts which are equal to the wave numbers of certain infra-red absorption maxima of the molecule. Raman and Krishnan state that these lines represent the scattered light of modified wave-length predicted by Kramers and Heisenberg in their correspondence principle treatment of dispersion. I believe this interpretation is correct. However, the evidence that these lines do not constitute a fluorescent emission, following the absorption process after a finite interval, is qualitative. First, Raman states that the radiation scattered with modified frequency from a cloud of carbon dioxide brightens up in the same way as the ordinary scattered light when the cloud is formed. Further, the shifted radiation is polarised nearly as strongly as that which suffers no change of frequency.

These facts indicate that this radiation is coherent, which would presumably not be the case if it were due to absorption followed by emission after a finite time. Of course, the absorption coefficient of benzene is rather small in the region studied, but it may readily be large enough to account for the retention of an amount of energy sufficient to give rise to the very weak modified scattering. In the present state of our knowledge about the mechanism of general absorption in liquids, the possibility cannot be dismissed offhand.

The purpose of this communication is to direct attention to an alternative method of settling this interesting question, independent of assumptions about the coherence properties of the radiation. It consists in determining whether there is a time lag between the reception of the incident light and the emission of the scattered radiation of modified wave-length. Several methods for determining such lags have been described by R. W. Wood (*Proc. Roy. Soc.*, **99**, 362; 1921). In regard to time resolving power, the most efficient of these is the method of Abraham and Lemoine, involving the use of a Kerr cell as a very rapid electromagnetic shutter. Gottling (*Phys. Rev.*, **22**, 566; 1923) has used this method to show that the phosphorescence of barium cyanoplatinite does not commence until 2×10^{-7} seconds after the illumination has commenced. For rhodamine the interval is 2×10^{-8} seconds. It is appreciated that the principal difficulty in applying this method to modified scattering is the small intensity of the light. However, since the modified light can be observed with the aid of colour filters, it is very likely that such observations can be made successfully.

In 1925, Foote and Ruark discussed in *Science* (vol. 61, p. 263) the existence of the scattered wave-lengths of Kramers and Heisenberg in the spectra

from metallic vapours in the arc or spark, illuminated by their own monochromatic radiations of very short wave-length. The conclusion was that such lines have not been observed in the spectra of the alkaline earths. An extension of this line of investigation, using very long exposures, is much to be desired.

In the spectra obtained by Raman and Krishnan with water and methyl alcohol, the modified radiation consists of broad bands. Such is not the case with benzene, toluene, pentane, and ethyl ether. It may be that the breadth of the band in the case of methyl alcohol and water is due to some specific property of the OH group, but I believe it more probable that the breadth is due to the associated character of these two liquids. It is natural to expect that the vibration frequencies of molecules would be altered by association.

ARTHUR EDWARD RUARK.
Gulf Oil Companies' Fellowship,
Mellon Institute of Industrial Research,
University of Pittsburgh,
Pennsylvania,
July 20.

The Nierenstein Reaction.

IN their test experiment with benzoyl chloride, Bradley and Robinson (*Jour. Chem. Soc.*, p. 1316; 1928) have modified the original method described by Clibbens and Nierenstein (*Jour. Chem. Soc.*, **107**, 1491; 1915) as follows:

(1) They added the benzoyl chloride to the diazomethane instead of using the reverse procedure prescribed by us.

(2) They carried out the reaction at a temperature "maintained at $-5°$ to 0°," whereas this is not stated by us, since we work at laboratory temperature.

(3) They attempted the separation of the ω-chloroacetophenone with light petroleum, and not by means of vacuum distillation as stated by us.

The effect of (1) was emphasised in my previous letter (NATURE, June 16, p. 940), and furthermore, by reversing their method of mixing the reactants, Bradley and Robinson (NATURE, July 28, p. 130) are now able to record a yield of 9 per cent of ω-chloroacetophenone instead of a trace, detectable "by the powerful lachrymatory properties and characteristic odour of the compound." This yield is still much lower than that recorded by Clibbens and Nierenstein, and since this can be attributed only to difference in technique, points (2) and (3) have been investigated by me, in collaboration with Dr. T. Malkin, with the result that it is found:

(*a*) That by working at a low temperature very little ω-chloroacetophenone is produced.

(*b*) That by fractional crystallisation from light petroleum, which is a most unsatisfactory procedure, the yield is reduced to 50 per cent of pure ω-chloroacetophenone.

In view of these results I briefly repeat the general technique of the reaction:—Diazomethane prepared in form of a gas according to Staudinger, or in ethereal solution according to Pechmann, is slowly passed or distilled into an ethereal solution of the acyl chloride at room temperature; for example, in the experiment under discussion, diazomethane from 17 c.c. nitrosomethylurethane is distilled with ether over a period of 1 hour into a solution of 10 gm. benzoyl chloride, dissolved in 75 c.c. dry ether (Grignard), the temperature being 19°. To the ethereal solution (350 c.c. in the case of the experiment with benzoyl chloride) is added about 1–1·5 c.c. glacial acetic acid, and the ether evaporated off, during which process any excess of diazomethane and ω-diazoketone is destroyed. The residues left are worked up according to the details given in each case (in the experiment with benzoyl chloride the residue is distilled *in vacuo*).

I hope that by keeping to these conditions Dr. Bradley and Prof. Robinson will now be able to corroborate our results. Failing this, Dr. Malkin or I will be glad to demonstrate the reaction to them or any other of their colleagues they should choose to send down to Bristol. The experiment with benzoyl chloride can be carried out in one afternoon.

M. NIERENSTEIN.
The University, Bristol.

The NH Band and the Dissociation Energy of Nitrogen.

THE so-called ammonia band at 3360-70 A., photographed first by Eder in 1892, has since been studied and measured by many authors. Fowler and Gregory (*Phil. Trans. Roy. Soc.*, **218**, 351; 1919) have published beautiful photographs of it. Lately this band has been attributed by Barrat (*Proc. Roy. Soc.*, A, **98**, 40; 1920), Hulthen and Nakamura (NATURE, **119**, 235; 1927), and others to the NH molecule. Using R. W. Wood's arrangement for the optical excitation of mercury vapour (*Phil. Mag.*, Oct. 1925, Sept. 1927), I have observed the appearance of it when about 4 mm. nitrogen and very little hydrogen—perhaps a few thousands of mm.—are admitted to the quartz tube containing the mercury vapour which is being excited by the light of a water-cooled, magnetically deflected mercury arc.

The NH band appears as a result of photosensitised fluorescence; then it disappears as soon as the line 2537 of the arc is absorbed or self-reversed. With the help of the wire-gauze method (see R. W. Wood, NATURE, **120**, 725; 1927) it has been determined that the intensity of the band in our case is proportional to the square of the intensity of the exciting light. The problem is to find an explanation for the appearance of the band with this intensity relation. Now, the little hydrogen present in the tube is probably completely dissociated by the excited mercury, so that we have practically a constant density of atomic hydrogen. The combination of nitrogen and hydrogen as a gas reaction will furnish sufficient energy for the emission of the band 3360-70. Its intensity will be then proportional to the product of the concentrations of atomic hydrogen and nitrogen, and since the first is practically constant, the concentration of atomic nitrogen must be proportional to the square of the intensity of the arc or, what amounts to the same thing, to the square of the number of excited mercury atoms. This relation can be interpreted if we assume that the atomic nitrogen is formed by three-body collisions of N_2 molecules with two excited mercury atoms:

$$N_2 + 2\,Hg' \longrightarrow 2\,N + 2\,Hg.$$

The only excited atoms which come into consideration are the 2^3P_1 atoms with 4·9 volts and the metastable atoms with 4·68 volts energy. The maximum of energy available in the best case for the dissociation of N_2 is then 9·8 volts; two metastable atoms would give only 9·36 volts, which is 1·5 to 2 volts less than the assumed value of 11·4 volts. We could have some more energy available if we suppose that the reaction $N_2 + 2\,Hg' \longrightarrow N + HgN + Hg$ takes place. The combination energy of HgN would then help to dissociate the N_2 molecule. An explosive black deposit of HgN should then be expected, but has never been observed in the tube in spite of running it uninterrupted for several days. This reaction seems, then, not to take place in our case.

It thus appears probable that the dissociation

energy of nitrogen is less than, or about, 9·8 volts, and not 11·4 volts as was calculated by Sponer and Birge. The matter will be discussed in more detail in another place in connexion with a study of the photosensitised fluorescence of several other molecules.

E. GAVIOLA.

Johns Hopkins University,
Baltimore, July 12.

The Instability of a Single Vortex-Row.

DR. HAROLD JEFFREYS, in his letter appearing in NATURE of Aug. 11, p. 206, mentions some interesting practical effects for which the principle to which it refers is responsible. To those which he mentioned may be added a physiological consequence for the circulation of the blood. As the blood-stream races past the cusps of the valves at the orifices of the heart, some of the eddies, to quote his words, "enter the dead water, where they produce a circulation with a reverse current" behind each valve. This disposition prevents extreme eversion of the valve, and facilitates closure of the valve without delay or hindrance so soon as the diastolic check of the stream current ensues, at end of the active beat. The anatomical channel is actually bayed out (sinus of Valsalva) in the case of the two largest blood-vessels, in order to favour development of what in the letter is termed the second row of vortices.

C. S. SHERRINGTON.

Oxford, Aug. 19.

X-Ray Studies on the Nitrides of Iron.

IN the preliminary report under the above title, published in NATURE of May 26, p. 826, the conclusion is drawn that the cubic γ-phase is a solid solution of nitrogen in γ-Fe. A further study of the photograms, however, makes a correction of this assumption necessary, for there are in the photograms two very weak lines which indicate that the nitrogen atoms have definite places in the lattice.

As was said in the preliminary report, the lines of the γ-phase are fixed, showing that the phase probably has a very limited homogeneity range. As to its limits, it was pointed out that the upper limit was probably between 5·7 and 6·1 per cent nitrogen.

The iron atoms certainly still form a face-centred cubic lattice ($a = 3{\cdot}789$ A.) and nothing in the photograms indicates that the elementary dimensions must be increased. If the nitride contains about 6 per cent nitrogen, it is most likely that there is one nitrogen atom per one unit cell, that is, per 4 iron atoms. The formula of the nitride then becomes Fe_4N with 5·9 per cent nitrogen.

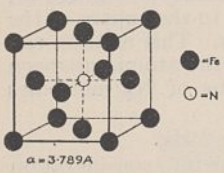

FIG. 1.

One possible position of the nitrogen atom is in the middle of the cell, as is shown in Fig. 1, that is, with the co-ordinates $\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$. Another possible position has the co-ordinates $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$. The positions and intensities of all lines calculated on these assumptions in both cases agree very well with the observed ones.

To judge between the two structures is hard, as they give almost the same intensities of the lines. It must, however, be pointed out that the iron atoms of the first structure are not equivalent.

GUNNAR HÄGG.

Institute of Metallography,
Institute of General and Inorganic
Chemistry of the University,
Stockholm,
July 14.

The Crystal Structure of Solid Mercury.

As yet only two attempts[1] seem to have been made to determine the crystal structure of solid mercury with the aid of X-rays. The results of these investigations, however, were wholly contradictory.

I have tried to settle the question with the aid of a special spectrograph designed by Prof. Coster for crystal analysis at low or high temperatures. I have succeeded in obtaining with an exposure of one hour very good Debye-Scherrer diagrams by which the results of McKeehan and Cioffi, who found a simple rhombohedral structure, are fully confirmed. The main difficulty met with in my investigations was getting a preparation with sufficiently fine grain to be suitable for a Debye-Scherrer analysis. This was finally obtained by reducing mercuro-oxide by formic acid held in gelatine. The preparation contained very densely packed mercury globules of about 10 μ diameter.

These small globules showed the effect of undercooling in a very striking way. At the temperature of solid carbon dioxide ($-80°$), by far the greater part of them remained in the liquid state, as was clearly shown by the X-ray photograph obtained, in which the amorphous band of liquid mercury was predominant.[2] Only by hammering the preparation at a temperature below the freezing point of mercury was it possible to obtain mercury crystals in such abundance that very strong Debye-Scherrer lines were obtained. These conclusively support the views of McKeehan and Cioffi. As these authors worked at a temperature of $-115°$, no transition point seems to exist between $-115°$ and $-80°$.

A fuller account of method and results will be published elsewhere.

M. WOLF.

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Continued Self-Pollination in Cotton.

COTTON, though included among self-pollinated plants, is subject to crossing, and the extent of natural cross-pollination under favourable conditions is so great that it is regarded by some as obligatory for keeping up the health and vigour of cultivated races.

Kumpta cotton (*G. herbacium*) yielded in the year 1915 one pure strain, which has been continued since then by the use of selfed seed. The pure line has thus been subjected to continued selfing for twelve years. During the last season the strain was thoroughly examined in the following characters: 1, height of the plant; 2, total length of limbs; 3, sterility of the anthers; 4, shedding of flowers; 5, number of bolls per plant; 6, yield of seed cotton per plant; 7, ginning percentage; 8, staple length; and 9, seed weight.

The results clearly showed that there was no deterioration in any of the above characters. From this it appears that twelve years' selfing has no injurious effect in cotton.

Sometimes a variety yields more than its pure line which is selected for yield. The cause of this is to be found not in the deterioration of the selection due to selfing, but in the hybrid vigour of the F_1 plants appearing in the open pollinated seed of the variety.

G. L. KOTTUR
(Cotton Breeder).

Agricultural Station,
Dharwar, India.

[1] L. W. McKeehan and P. P. Cioffi, *Physical Review*, **19**, 444; 1922. G. Aminoff and N. Alsén, *Geol. Fören. Förhandl.*, vol. 44, January 1922.
[2] J. A. Prins, *Physica*, **6**, 315; 1926.

Some Recent Work on the Light of the Night Sky.[1]

By LORD RAYLEIGH, F.R.S.

IT is now well known that the light of the night sky has little in common with the day sky. When the sun is 18° below the horizon, and the moon also below the horizon, night conditions may be considered to be established. A clear sky is of course necessary for the study of the luminosity. Unlike the day sky, it is found to exhibit very little polarisation. The intensity is considerably below the threshold of colour vision, and subjective impressions about its colour, which is sometimes described by imaginative writers as blue, have no basis in reality.

The chromatic constitution of the light of the night sky can be investigated by experiments with coloured glasses. We may select a red and a blue glass, and look through them at the night sky. The blue one will almost certainly be the brighter, owing to the Purkinje effect. We may superpose neutral glasses on the blue one until the intensities are matched, and we shall then have a test by means of which the night sky can be compared qualitatively with other sources as regards the blueness or redness of the light. It is only necessary to reduce the intensity below the threshold of colour vision, and to note which glass gives the brighter field.

It is found in this way that the day sky is much bluer than the night sky, which is nearly of the general colour of a piece of white paper illuminated by a half watt lamp at normal incandescence. In this comparison, the brightness of the paper may be suitably reduced by placing the lamp a long way off.

SPECTRUM OF THE NIGHT SKY.

Spectroscopy of the night sky is a difficult problem, and the most that can be made out by visual methods is that the green auroral line is present on a background of apparently continuous spectrum. Some writers have recorded that they can always see the green line. I myself can only see it when the brightness as revealed by the photometric method presently to be described is above the average. Many experienced spectroscopists have been unable to see it at all. The main instrumental condition is to use a wide slit and a high dispersion. Lenses may advantageously be dispensed with.

Photographic methods are necessary for a more detailed study of the spectrum. In a single night's exposure it is scarcely possible to do more than photograph the green line, using a one prism spectrograph with spectrum ratio not less than $f/2$ and an orthochromatic plate. I have constructed small spectrographs with an aperture ratio $f/0{\cdot}9$, and with these it has been possible with an exposure of many nights to photograph the apparently continuous background of the spectrum, along with two emission lines or bands at wavelengths very roughly estimated as 4210 A. and 4430 A. The broad absorption lines G, H, and K of the solar spectrum are seen in absorption. These are probably to be attributed to starlight, which is superposed on the light proper to the night sky. The relative amount of starlight has not been determined. I believe it is largest in the blue region of the spectrum, and relatively unimportant in the yellow and red regions.

An exposure of many nights on an Ilford panchromatic plate failed to show anything in the red region of the spectrum.

It is noteworthy that the negative bands of nitrogen, which are the most important feature in photographs of the auroral spectrum, are not present in the night sky.

PHOTOMETRIC METHODS OF OBSERVATION.

For some years past I have been making systematic photometric observations on the light of the night sky. As we have seen, the spectrum consists partly of the green auroral line, and partly of apparently continuous background. It is desirable to treat these separately. The light is, however, too feeble to allow of spectrophotometry in the ordinary sense. The method adopted in this work is to analyse the light with colour filters. Three filters were used, one designed to isolate the green auroral line as nearly as possible, and the others designed to transmit the region (a) on the red side, and (b) on the blue side of the line, excluding the line itself in each case. These are called the red, auroral, and blue filters.

The standard comparison light consists in each case of crystals of potassium-uranyl sulphate, which are self luminous, owing to the radioactivity of the contained uranium which stimulates the fluorescence of the salt. There is reason to believe that when in a sealed vessel the source may be regarded as independent of external conditions, and constant, at all events for very many years.

The type of photometer chiefly used consists of a Lummer cube, with the field divided into two vertical strips. The right hand (transparent) is backed by the uranium salt; the left-hand part, silvered, reflects the sky with a colour filter interposed. Choice from a series of neutral glasses allows the filtered sky light to be matched with the standard.

The densities ($\log_{10}$ opacity) of the set of neutral glasses had the values

0·1 0·2 0·3 . . . . . 0·7, etc.

The scale used for recording and discussing the results is a magnitude scale, that is, one in which each step is a constant multiple of its predecessor. The zero reading is that which gives a match without one of the neutral glasses. For example, a reading of -3 means that the third neutral glass has to be used *over the sky*. A reading is recorded as -3 if the

[1] This paper was sent in for publication to Prof. S. Chapman, F.R.S., chairman of the Committee of the International Research Council on Solar and Terrestrial Relationships, and received by him (as he confirms to me) on Monday, June 18.

same glass has to be used *over the uranium source*. Intermediate interpolated values are entered; for example, 3·5. The zeros for the three separate regions of the spectrum, red, auroral, blue, are related in an arbitrary manner, though the factor involved in passing from one neutral glass to the next is, of course, the same for each, so far as the glasses deserve the same neutral. Within the practical limits of experimental error they do deserve it.

It is to be noticed that the comparisons are not at all prejudiced by a difference in colour between the two lights. At these low intensities the eye sees everything in monochrome, just as the photographic plate does at all intensities.

If the intensities are to be compared at different places and at the same time, it is necessary to duplicate the instruments and to adopt one as a master standard. The others can be compared with it by means of an 'artificial sky' consisting of a diffusing screen of which the brightness can be controlled and measured by varying the voltage across the terminals of a small electric lamp used to illuminate it. The details are here passed over. Each local observer takes the readings with his own instrument as described. They are reduced to the standard scale at headquarters by applying a subtractive correction, which gives the result which would be obtained under the same conditions on the master standard instrument, with the filters belonging to the latter. The scale numbers thus adopted are those of the neutral glasses, thus the intensity is multiplied by passing up one unit by the anti-logarithm of 0·1 or 1·259. Three steps on the scale are equivalent to a factor of $(1{\cdot}259)^3$, or to approximately a doubled intensity. This is a convenient rule to remember.

Photometric Observers and Results.

For observations in various parts of the world, I have been able to rely on the kindness of scientific friends who either undertook the work themselves or were able to find other capable observers who were so kind as to undertake it.

The stations and observers were as follow: Hawaii (United States Magnetic Observatory, Ewa, Oaku—Mr. H. E. McComb); Victoria, British Columbia (Dominion Observatory—Dr. J. S. Plaskett, Mr. Harper, Mr. H. H. Plaskett, Mr. Pearce); Mt. Wilson, California (Mr. Humason, as arranged for by Mr. H. D. Babcock); Pomona College, Claremont, California (Prof. Brackett); Pinehurst, N. California (Prof. J. C. McLennan); Kingston, Ontario (observations received through Prof. J. C. McLennan); Arequipa, Peru (Dr. J. S. Paraskevapoulos, as arranged by Prof. Harlow Shapley); Lerwick Observatory, Shetland Islands (Mr. A. W. Lee, arranged by Dr. G. C. Simpson); England (Terling, Essex, and near Hexham, Northumberland, during part of the autumn—Lord Rayleigh); Cape of Good Hope (Dr. H. Spencer Jones); Gilgil, Kenya Colony, E. Africa (Mrs. G. Cole); Kodaikanal Observatory, India (Dr. Royds, Mr. A. A. Narazana Ayer, Mr. P. R. Chidambara Ayer, Mr. S. S. Ramaswamy Ayyangar); Canberra, Australia (Commonwealth Solar Observatory—Dr. W. C. Duffield and Mr. A. L. Kennedy); Christ-

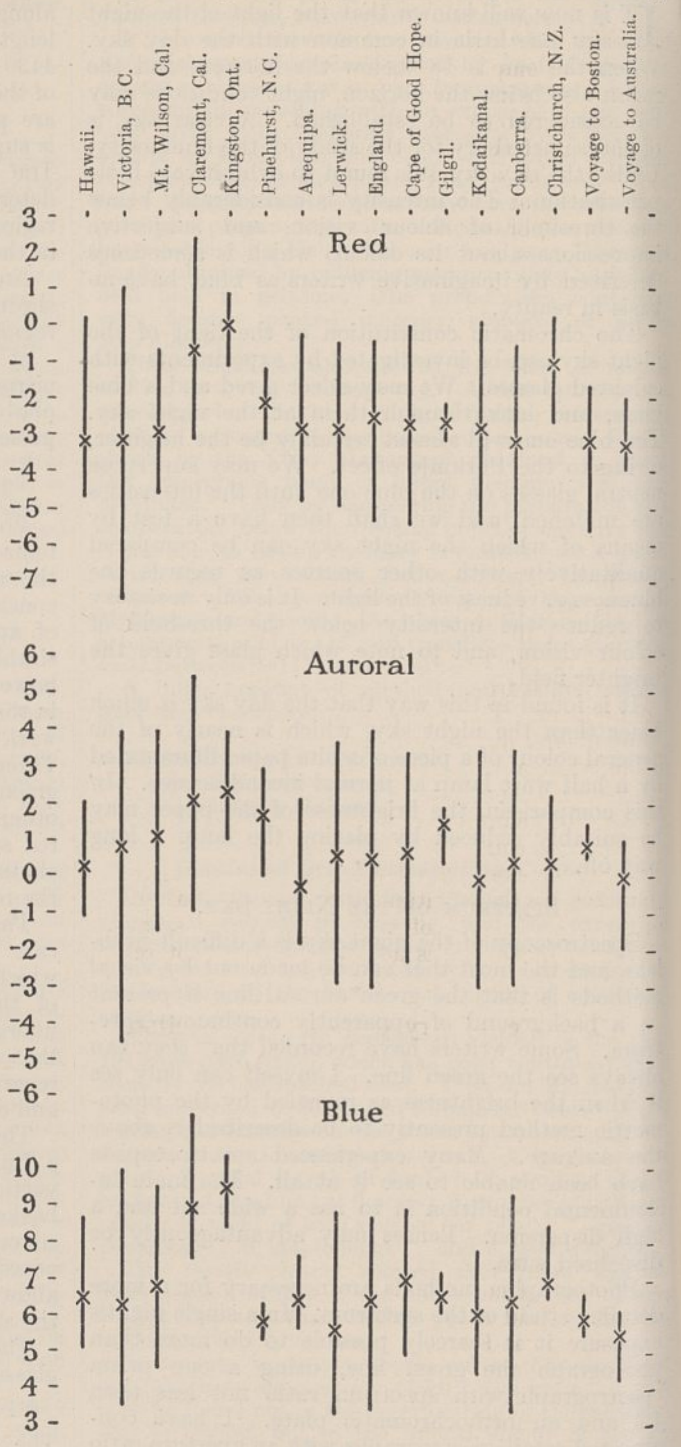

Fig. 1.

church, New Zealand (Mr. P. W. Glover); Voyage from Marseilles to Boston (Mr. H. D. Babcock); voyage from England to Melbourne (Miss Natalie Allen).

MEAN VALUES AND RANGE OF VARIATION.

The accompanying diagram (Fig. 1) gives the mean results in each component. It must be emphasised that though the red component, for example, is measured throughout on a consistent scale, this scale has an arbitrary difference (representing an arbitrary but constant intensity ratio to) from the scale used for either of the other components. The mean values are marked by crosses, and the extreme range in each component by the vertical lines.

The general conclusions to be drawn from this diagram appear to be as follows: First, fairly normal values can be stated for the intensity of each component at any part of the world. These values are somewhat as follows, on the various arbitrary scales:

Red	−2·5
Auroral	+0·8
Blue	+6·5

The few cases which apparently lie outside these limits are believed to be due to observational causes. Full discussion is given in a paper presented to the Royal Society. The usual range of variation is from three to four fold in any given component. There is a strong correlation between the red and auroral intensities on any given occasions, and a rather less strong but still marked correlation between these and the blue. It is, however, definitely established that this correlation is not complete. A simple test for this is to match, for example, a red glass directly against a blue one by the addition of suitable neutral glasses, discarding the use of the self-luminous standard. It is found that this adjustment does not remain good for all succeeding nights, though it may be necessary to wait for some time before a marked change is observed.

ARE THE VARIATIONS AT DIFFERENT STATIONS CORRELATED?

The variations of intensity which form the subject of this investigation do not occur uniformly all over the world. They are conditioned, in large part at any rate, by local circumstances. To illustrate this, some striking illustrative cases will be given before discussing the subject by statistical methods.

Date.	Place.	Red.	Auroral.	Blue.
Jan. 16, 1926	England	−4·4	−1·4	+5·8
	Cape	−1·9	+2·0	+9·0
Mar. 2, 1926 .	England	−3·6	−0·2	+6·4
	Cape	−0·4	+2·0	+7·7
April 15, 1926	England	−3·6	−0·8	+6·4
	Cape	−2·4	+2·4	+8·3
Sept. 19, 1925	England (Northumberland)	−3·6	+1·7	+6·4
	Shetland (Lerwick)	−4·4	−2·8	+3·4
June 7, 1926 .	Hawaii	−4·7	−0·9	+5·1
	Canberra	−2·4	+2·1	+7·9

These cases have been chosen to show contrast. The mean values at the two places are in each case very nearly the same. Yet we see that occasion may be found where the intensity at one is double or more than double that at the other.

On calculating the correlation coefficients for approximately simultaneous observations at the pairs of stations mentioned, no significant coefficients were found. It will be seen immediately that there probably are long period variations which imply a correlation, but these are swamped by local irregular variations.

(To be continued.)

The Centenary of James B. Neilson's Invention of Hot-Blast in Iron Smelting.

By Prof. WILLIAM A. BONE, F.R.S.

IT may be considered singularly fortunate and appropriate that the forthcoming meeting of the British Association in Glasgow exactly coincides with the centenary of James Beaumont Neilson's epoch-making invention of the use of hot-blast in iron smelting, which was first conceived and demonstrated in that city. For it inaugurated a century of continuous advance in scientific fuel economy, and may be said to have done for iron-smelting what Richard Arkwright's inventions had previously done for cotton-spinning.

In 'praising famous men,' it is well to appreciate their personalities and upbringings as well as their achievements; and in many ways the case of James B. Neilson is of peculiar interest. He was born on June 22, 1792, in the village of Shettleston, near Glasgow, the son of Walter Neilson, a colliery engine-wright; his mother has been described as "a woman of capacity and an excellent housewife." After a village-school education up to the age of fourteen years, he first helped his father for a while, and afterwards became apprenticed to his elder brother John, an engineman at Oakbank, near Glasgow, who is said to have designed and constructed the first iron steamer that put to sea.

In the year 1814, Neilson took employment as a colliery engine-wright at Irvine, where a year later he married Barbara Montgomerie; in 1817 the failure of the colliery compelled them to move into Glasgow, where Neilson was appointed foreman (and five years later, manager and engineer) to the newly established gas-works, where he remained for the next thirty years.

This proved to be the turning-point in Neilson's life; for, besides ensuring him steady and congenial employment, his settlement in Glasgow brought educational opportunities of which he fully availed himself at the Andersonian College, where he studied physics and chemistry with conspicuous zeal and success. Not only did he thus improve

his own intellectual position, but afterwards he also succeeded in inducing his work-people—mostly illiterate Highlanders and Irishmen—to follow his example; and he established an institute, with lecture-room, library, laboratory and workshop for their instruction, thus becoming a pioneer in technical education. The results of his work and inspiration were soon seen in the improvements which were introduced into gas manufacture at the Glasgow works under his direction; for, among other things, he introduced the use of fire-clay instead of cast-iron retorts in carbonising coal, and of sulphate of iron in the purification of the gas thereby produced. Undoubtedly he was a most alert and progressive gas-manager and engineer.

Neilson's crowning achievement, however, for which his name will ever stand high in the list of scientific inventors, was in connexion with iron smelting, an industry with which, until about the year 1828, he had had little or no experience; and it affords a conspicuous example of how a scientifically minded outsider may sometimes see his way along simple lines to a new great advance in a manufacturing process which those in daily contact with it have entirely missed.

In certain experiments with coal-gas, Neilson had observed how its flame luminosity could be materially increased merely by supplying it with pre-heated air through a tube surrounding the burner. This simple experiment set him thinking, and was the starting-point of all that followed. He next found that the temperature of a smith's hearth could be raised by blowing it with hot instead of cold air. To-day this may seem so obvious as scarcely to be called a 'discovery'; but to the 'practical man' of a century ago it seemed new and even surprising, so little were the thermal aspects of combustion understood, outside of a few laboratories, such as at the Royal Institution in London, where ten years earlier Humphry Davy had discovered so many new things about flame.

When Neilson first propounded to the Scottish ironmasters of his day the idea that much fuel could be economised in the smelting furnace by the simple expedient of pre-heating the ingoing blast, they pooh-poohed it. It was (they said) common experience that the furnaces made a better quality and quantity of metal in winter than in summer, which result they ascribed to lower blast temperature. Neilson, on the other hand, thought it more probably due to increased moisture in the air in summer-time, thereby anticipating to some extent the ideas about 'dry blast' put forward and proved eighty years later by James Gayley in the United States. Fortunately for the world, he was not overborne by the wisdom of the ironmasters, but persisted in his own idea until its essential truth had been triumphantly demonstrated.

Neilson's basic English patent for the invention was filed on September 11, 1828, so that the forthcoming British Association meeting will exactly coincide with its centenary; the corresponding Scottish and Irish patents date from October 1, 1828. All were entitled "Improved Application of Air to produce Heat in Fires, Forges, and Furnaces, where Bellows or other Blowing Apparatus are required," and (after referring to the generation of the blast by these known methods), the material part of the specification ran as follows:

"The blast or current of air so produced is to be passed from the bellows or blowing apparatus into an air vessel or receptacle, made sufficiently strong to endure the blast, and through and from that vessel by means of a tube, pipe, or aperture, into the fire, forge, or furnace. . . . For an ordinary smith's fire or forge, an air-vessel or receptacle capable of containing 1200 inches will be of proper dimension, and for a cupola of the usual size for cast-iron foundries, an air-vessel capable of containing 10,000 cubic inches will be of proper size. For fires, forges, and furnaces upon a greater scale, such as blast furnaces for smelting iron, and large cast-iron founder's cupolas, air-vessels of proportionately increased dimensions and number are to be employed. . . . The air-vessel may generally be conveniently heated by a fire distinct from the fire effected by the blast or current of air. . . . The manner of applying the heat to the air-vessel is, however, immaterial to the effect if it be kept at a proper temperature," the latter being described as 'considerable,' and preferably, but not necessarily, that of 'red-heat or nearly so.'

From this it is evident that what Neilson claimed was, not some particular device or apparatus, but the principle of pre-heating air in combustion as a means of economising fuel, which until then had been unthought of. In regard to iron smelting, where its greatest success was to be, it should be realised that, a century ago, the invention meant that the expenditure of a small quantity of fuel (small coal) *outside* the furnace, for the purpose of pre-heating the ingoing blast, would save many times more fuel (coke) *inside* the furnace. To-day it means even more, because the blast is now pre-heated by the combustion of part of the furnace gases, which in those days were entirely wasted.

The first trials of the invention as applied to iron smelting, which were made at the Clyde Ironworks, near Glasgow, early in 1829, were immediately successful beyond the most sanguine anticipation. For, with blast pre-heated to 300° F. only, the total coal consumption fell from 8 tons 1¼ cwt. per ton of iron with 'cold blast' to 5 tons 3¼ cwt.; and in 1833, with blast pre-heated to 615° F., it was further reduced to 2 tons 5¼ cwt. only. Indeed, it was said that, as the outcome of these experiments, the same amount of fuel produced three times as much iron, and that a given volume of blast did twice as much work, as formerly with cold blast. Actually the average furnace output had increased from 36 tons 18 cwt. per week with cold blast in 1829 to 61 tons 1 cwt. per week with blast at 615° F. in 1833. Although, as now seems probable, some part of the great economy so achieved may have been due to the simultaneous adoption of less wasteful coking methods, as well as to some concurrent reduction in the boiler coal consumption per ton of iron consequential on the greater furnace

output resulting from the change from 'cold' to 'hot' blast, no less an authority than Sir Lowthian Bell, after an impartial survey of the facts of the case as known fifty years later, concluded that, leaving out of account the two factors referred to, the actual *direct* saving in fuel due to the introduction of hot blast by Neilson at the Clyde Ironworks between 1828 and 1833, must have amounted to *at least* 20 cwt. of coke (or say nearly $1\frac{3}{4}$ tons of coal) per ton of iron produced, a result achieved merely by imparting to the ingoing blast an amount of heat developed by the combustion of between 2 and 3 cwt. of small coal *outside* the furnace, which he characterised as being in itself "sufficiently astounding."

This was, however, by no means all; for in Scotland it was through Neilson's invention that the blackband ironstone discovered by David Mushet in 1802 first became available for iron smelting, having previously been useless for the purpose. Also, it enabled Scottish ironmasters to substitute raw coal for coke in their smelting operations. So great, indeed, were the combined advantages resulting from the invention that the Scottish output of pig-iron rose from 37,500 tons per annum in 1830 to 196,960 tons per annum in 1839, while the enhanced profits were admittedly £54,000 per annum. In South Wales the invention enabled the use for the first time of anthracite as blast-furnace fuel, the successful adoption of which in America in the year 1840 (entirely due, *as was acknowledged*, to "this simple discovery—the substitution of what is called the hot blast for the cold blast") undoubtedly founded the great Pennsylvanian iron industry, which to-day has attained to such enormous dimensions.

As time progressed, and the means of further increasing blast temperature improved, the advantages of hot blast continually increased for at least sixty years after it was first employed. Indeed, it may be said that the impetus of the pioneering work of Neilson went on until it was completed by the supplementary inventions of regenerative hot-blast stoves by E. H. Cowper and Thomas Whitwell during the years 1860–65, by which time it had revolutionised iron smelting and made possible the huge furnace outputs of the present day. It is interesting to know that Neilson was present and spoke at the meeting of Mechanical Engineers in London in 1860 when E. A. Cowper described his new regenerative stove for pre-heating the blast to 1300° F., which (as Neilson said) completed his own invention of 1828. When it is remembered that, with the exception of comparatively small amounts of 'cold-blast' iron which are still produced for special purposes, practically the whole of the world's present annual output of about 80 million tons of iron is produced in furnaces run with blast pre-heated to 1200° F. or higher, with coke consumptions ranging from about 18 to 30 cwt. per ton, according to the richness and porosity of the ore smelted, and with outputs running up to 1000 tons per furnace per diem, the enormous value of Neilson's invention to humanity can scarcely be exaggerated, and its centenary is an occasion for international celebration befitting its wide-world use and importance.

The question as to *why* the use of hot blast has effected such colossal fuel economies and furnace outputs in iron smelting during the past century has provoked much scientific research and controversy, and is perhaps even yet not fully understood, so much have we still to learn about the chemistry and thermodynamics of iron smelting. But it is scarcely too much to say that the far-reaching implications of Neilson's work were behind much of Lowthian Bell's classical investigation upon the chemical phenomena of iron smelting fifty years later, and still urge us on to further inquiries.

With the view of developing the business side of his invention, Neilson entered into partnership (in 1828) with Charles Macintosh (the inventor of 'water-proofing') and John Wilson; he needed strong support, because while the ironmasters of his day eagerly adopted his process, they did not always acknowledge his rights in it. It was said that some entered into agreements with him about it, but repudiated their obligations when the time came for paying. Be that as it may, however, in common with many other pioneers, Neilson seems to have been scurvily treated by most of those who profited largely by his inventions, and the story is a sad and unedifying one. For years he is said to have received nothing from them; indeed, an association of Scottish ironmasters was formed in 1840 for the express purpose of resisting any practical acknowledgment of the validity of Neilson's patent, thereby admitting its great technical success. Eventually, Neilson and his partners succeeded in establishing their rights after long and costly litigation against infringers, which became historic in the annals of patent law. So far as the English patent was concerned, they finally succeeded in the case of 'Neilson *v.* Hartford,' which was fought out in the Court of Exchequer in May and June 1841; but in Scotland, it was not until 1843 that the *cause célèbre* of 'Neilson *v.* Baird'—the trial of which in Edinburgh lasted nine days, and is said to have cost £40,000—finally vindicated the patent of 1828. During this action defendants admitted having made £260,000 profit by the use of hot blast, but denied the validity of the patent on grounds of verbal ambiguities; but it is satisfying to know that the Court ruled out this plea and finally decided the issue in Neilson's favour, although awarding him £11,876 only, instead of the £20,000 which he had claimed.

Neilson had joined the Institution of Civil Engineers in 1832, and in 1846 he was elected a fellow of the Royal Society. But he took fame very quietly, and in 1847 retired to a cottage which had been built in 1827 for Edmund Kean, the great tragedian, who there found it "glorious through the loop-holes of retreat to peep on such a world." In 1851 he moved to an estate which he had acquired in the Stewartry of Kirkcudbright, where he died on January 18, 1865.

The Glasgow Meeting of the British Association.

THE meeting of the British Association which opens in Glasgow next week will be the fifth to be held in that city. The first Glasgow meeting in 1840, presided over by the Marquis of Breadalbane, was attended by 1353 members, and resulted in grants being distributed for scientific purposes to the amount of £1546 16*s.* 4*d.* The general proceedings of that meeting were very similar to those of British Association meetings of later years; perhaps the most conspicuous difference being the opening of the meeting with an address not by its president but by Murchison on behalf of himself and his co-secretary, Sabine, in which the activities of the Association during the preceding year were reviewed. In addition to giving an interesting summary of such activities, the secretaries in their address stressed particularly the importance of the Association as a channel for impressing upon Government the opinions and claims of science, and it is of equal interest to note in the address indications of cordial co-operation in this respect between the British Association and the Royal Society. In 1840 the Association met in seven sections, A-G; section E, now devoted to geography, represented in those days medical science; D represented biology as a whole, and the younger sections H to M, representing various specialised subdivisions of biological science, are in the 1840 report conspicuous by their absence. Amongst the sectional officers of this first Glasgow meeting were: J. D. Forbes, Airy, Whewell, Graham, Lyell, Buckland, De la Beche, Smith, W. J. Hooker, Edward Forbes—assuredly an impressive list!

In 1855 the Association again met in Glasgow under the presidency of the Duke of Argyll, who in his opening address urged forcibly the claims of science to an important place in the school curriculum. Again there was a distinguished list of sectional officers—Section C standing out in particular with Sir Roderick Murchison as president, and Lyell, Darwin, Sedgwick, Hugh Miller, and Ramsay as vice-presidents.

The 1876 meeting, presided over by Thomas Andrews, was again one of much interest: the presidents of sections included William Thomson, W. H. Perkin, and Russel Wallace, while amongst other office-bearers were Clerk Maxwell, Stokes, Tait, Crookes, Haeckel, and Hooker. One of the two evening discourses, by Wyville Thomson, was devoted to the *Challenger* expedition, which had just returned from its great voyage of exploration.

The Glasgow meeting of 1901, under the presidency of Sir Arthur Rücker, still lingers in the memory of the older members of the Association as one of special interest and success. The members numbered 1912, and £945 was distributed in the form of scientific grants. Of the distinguished men who then presided over sections, Major MacMahon, Prof. J. Cossar Ewart, and Dr. H. R. Mill are expected to be present at this year's meeting. In addition to Sir Arthur Keith, who vacates the presidential chair in favour of Sir William Bragg, at least three other past presidents of the Association are expected to be present: Prof. Horace Lamb, Sir Oliver Lodge, and Sir Charles Parsons.

As will have been gathered from the summary in our last week's issue, the sectional programmes at Glasgow promise to be of great and varied interest. An outstanding feature of the meeting will be the numerous discussions upon problems of the day, some relating to pure science, others to its relations with industry, economics, or education: discussions in which many distinguished men of science will take part. Such discussions probably contribute more to the advancement of science than does the ordinary type of paper conveying to specialists the news of some original discovery in specialised research.

Important items of Association business which will come up for discussion by the General Committee at Glasgow will have to do with arrangements as to future meetings. Next year's is to be held in South Africa, and it is expected that a deputation will be present in Glasgow to discuss final arrangements. The place of the centenary meeting in 1930 will also have to be discussed, there being obvious practical difficulties in the way of holding that meeting in the city in which all would desire that it should be held, namely, York, where the Association held its first meeting in 1830.

In looking forward to a doubtless successful and interesting meeting at Glasgow, the thought suggests itself that the time approaches when the British Association may well prove itself to be an instrument of still greater national importance than in the past. Our civilisation has come to be entirely dependent upon science in many of its practical details: public health, food-supply, transport—of materials and ideas—industry, and the many other factors which make civilised existence what it is; but yet we find government and administration carried on practically entirely by men of literary training without any grounding in science. If our civilisation is to continue, there is need for such changes in our educational system as will ensure that not only our governors and administrators but also the mass of the people shall be given such a grounding. There are those who believe that the British Association is in an unequalled position for accelerating the advent of such educational reform, which has been long delayed but is becoming every year more urgent.

Visitors from Abroad.

An exceptionally large number of distinguished men of science from abroad will be present at the meeting. Notable among them will be the following:

Prof. M. J. Bonn, of the Commercial High School at Berlin, a well-known economist, especially on the economic history of Europe; Prof. Robert Broom,

of the American Museum of Natural History, New York. He was until lately professor of geology and zoology at Stellenbosch, South Africa, and keeper of fossil vertebrates in the South African Museum, Cape Town.

Prof. Dr. Viktor Christian, keeper of the Natural History Museum at Vienna : a distinguished authority on anthropology.

Dr. C. J. Davisson, of the Bell Telephone Laboratories, New York. He is notable for his work on thermionics and electron physics ; Dr. George A. Dorsey, of New York, an authority on physical anthropology and ethnology, and curator of anthropology in the Field Museum of Natural History in New York.

Prof. A. von Eiselsberg, professor of physiology at the University of Vienna. He attends the meeting as representing Gesellschaft Deutscher Naturforscher und Aerzte, which is the German counterpart of the British Association.

Prof. Dr. W. J. de Haas, Natuurkundig Laboratorium, Rijks-Universiteit, Leyden, Holland, well known for his work on electric conductivity ; Dr. Jul. Hartman, of Copenhagen, one of the leading younger Danish physicists ; Prof. Olaf Holtedahl, Geolog.-Palæontol. Inst., at the University of Oslo, Norway, one of the leading authorities in Scandanavia on the palæontological side of geology.

Dr. John af Klercker, of Skanor, Sweden, a generous and public-spirited Swede of high scientific attainments, the foremost authority on the ethnology of Sweden ; Prof. Douglas W. Johnson, of Columbia University, New York, a distinguished geographer, working mainly on the physiographical side, surface movements, relief, coastal changes, etc. ; Dr. H. Spencer Jones, H.M. Astronomer, Royal Observatory, Cape Town.

Prof. A. E. Kennelly, professor of electrical engineering in Harvard University. He is attending the meeting as representing the American Association for the Advancement of Science.

Dr. A. Loir, conservator of the Museum of Natural History at Le Havre. He is attending the meeting as representing l'Association Française pour l'Avancement des Sciences ; Prof. V. I. Lubimenko, of Leningrad.

Prof. C. E. McClung, professor of zoology at the University of Pennsylvania, Philadelphia, who is widely known for his work on chromosomes, and as the organiser of the service of *Biological Abstracts* designed to assist biologists in keeping abreast of new work ; Dean S. Lailer Mathews, of the Divinity School, Chicago, one of the most eminent ecclesiastics in America with a European reputation ; Prof. N. Maximow, of Leningrad, whose work on fungi and applied botany ranks high in scientific circles ; Prof. Th. Mortensen, of the Zoological Museum, Copenhagen.

Prof. Y. Ogura, of Tokyo, distinguished by his work on fossil plants.

Prof. J. Reinke, emeritus professor of botany in the University of Kiel.

Prof. Johannes Schmidt, of the Carlsberg Museum, Copenhagen, whose researches on the life history of the eel are known to all biologists ; Prof. O. Stern, of the Institut für physikalische Chemie, Hamburg, who has done important work in various branches of physical chemistry ; Dr. F. L. Stevens, of the Department of Botany, University of Illinois, a distinguished economic botanist and an authority in plant pathology, diseases of food-plants, with special application to agriculture. He attends the meeting as representing the American Association for the Advancement of Science ; Prof. F. E. Suess, of the Geological Institute, University of Vienna, famous for his work on tectonics, carrying on that of his father, the late Prof. Edouard Suess, whose work on " The Face of the Earth " is a standard classic.

Prof. Vuylsteke, of Brussels, who was formerly a professor at the University of Louvain. He became an honorary corresponding member of the British Association in 1886, having attended the meeting at Aberdeen in 1885.

Prof. P. Zeeman, of Amsterdam, whose work on magneto optics and related subjects is familiar to all students of physical science.

Obituary.

DR. CHARLES CHREE, F.R.S.

CHARLES CHREE was the second son of the Rev. Charles Chree, D.D., minister of Lintrathen in Forfarshire, a country parish a few miles from Kirriemuir—Barrie's ' Thrums.' He was educated at the Grammar School, Old Aberdeen, and at the University of Aberdeen, where he was awarded the gold medal as the most distinguished graduate in arts of his year. Like many other Aberdeen students, he decided to complete his studies at Cambridge, but his scholarship was so wide that he had difficulty in making up his mind whether to pursue the study of mathematics and physics or to become a classical scholar, as he had taken a high place in classics at Aberdeen. He once told the present writer that what finally decided him was the fact that his mathematical rivals seemed less formidable than the classical ones.

Chree gained a mathematical scholarship at King's College, Cambridge, and rapidly came to the front as a leading mathematical physicist. His degree of sixth wrangler in 1883, distinguished though it was, scarcely represented his ability. A serious illness originating in disease of the bone and necessitating amputation of a thumb prevented him from working for many months, and delayed his taking the Tripos as he had originally intended in the preceding year. He also took a first class in Part 2 of the Natural Sciences Tripos, taking geology as a subsidiary subject. His election to a fellowship at King's College followed in 1885, and in 1890 he was re-elected to a research fellowship.

During his stay at King's, Chree wrote many important papers, most of them on the somewhat abstruse subject of mathematical elasticity. The excellent work he did can be seen by looking up the many references to his name in Love's standard treatise on elasticity. He did good work at the Cavendish Laboratory, but at that time there were not many openings for research physicists, and the theory of elastic solids was not a subject which appealed to those who appointed university professors.

In 1893, Chree was elected Superintendent of Kew Observatory, and until he retired from this post in 1925, he devoted himself to the study of terrestrial magnetism, atmospheric electricity, and allied subjects. Under his direction Kew attained the leading position amongst the magnetic observatories of the world. Until the National Physical Laboratory took over the work, Chree was responsible for the testing of thousands of chronometers, watches, clinical thermometers, and similar instruments.

During recent years Chree was president of the Section for Terrestrial Magnetism and Atmospheric Electricity of the International Commission for Geodesy and Geophysics. The immense amount of work involved in studying the vast records of observations made for more than a hundred years can only be appreciated by few. Yet Chree never spared himself in his unfaltering and unflinching search for truth. He always weighed evidence fairly, and never attempted to neglect those portions of it which failed to support the current theory. No one appreciated more than he did the vital importance of the researches now being made into the constitution of matter, and no one recognised more fully the futility of hoping ever to attain finality.

In his presidential address to the Physical Society in 1908, Chree mentioned the great practical utility of eminent men of science formulating theories on matters of general interest. For example, he mentioned Kelvin's theories of the internal heat of the earth and the age of the sun's heat. But he regarded these theories as scientific poetry, just as, in a somewhat similar way, Kelvin himself regarded Fourier's 'Theory of Heat' as a mathematical poem. It is the privilege of the young to dream dreams, and Lord Kelvin and many other scientists were always young.

In 1916, Chree gave the seventh Kelvin Lecture to the Institution of Electrical Engineers, taking as his subject "Terrestrial Magnetism"; atmospheric electricity had been discussed fully by Lodge in a preceding Kelvin lecture. Amongst other matters he discussed Maunder's recently enunciated 27-day period. He came to the conclusion that we are justified in saying that if a certain day is disturbed, then the days from 25 to 30 days later have more than the usual chance of being disturbed. The 27th day is that one on which the probability of disturbance is a maximum. A great deal has yet to be done in unravelling the exact nature of the relation between sunspots and magnetic phenomena; as he says in his monograph on "Terrestrial Magnetism" (1912): "We may perhaps at present be in the same position as medical science would be in if no distinction were recognised between small-pox, chicken-pox, and measles. In such circumstances the death-rate from eruptive diseases might well appear arbitrary. Astronomers presently may find it possible to recognise different types of sun-spots, and a magnetic relationship may then become conspicuous."

Chree was elected a fellow of the Royal Society in 1897. He received the degree of Sc.D. from Cambridge in 1895 and the Hon. LL.D. of Aberdeen in 1898. He was awarded the Hughes Medal of the Royal Society and a Watt Medal by the Institution of Civil Engineers. He was a past president of the Royal Meteorological Society and devoted a great amount of time to the various scientific societies to which he belonged. He was by far the most conscientious referee the present writer ever knew; no matter how long or how difficult the paper, he would referee it thoroughly.

To the staff at Kew Chree was *persona grata*; one of them, R. S. Whipple, who was with him for twelve years, was the son of Chree's predecessor, as was also his successor, F. J. W. Whipple. It would take many pages to make even a brief résumé of Chree's scientific work, which includes about a hundred and fifty valuable papers communicated to the *Philosophical Transactions* and *Proceedings of the Royal Society*, the *Philosophical Magazine*, the journals of many societies, etc.

In his domestic life Chree was happy, his sister presiding over his house in Richmond, and his brother, Dr. William Chree, K.C., a well-known member of the Scottish bar, accompanying them on holidays. At Cambridge Chree was a good tennis player, and he was fond of cycling and golf. He and his brother were trout fishers from their earliest days and had spent holidays fishing in Norway. When the last summons came early this year, Chree was in full bodily and mental vigour, and after finishing so far as possible the work on which he was engaged, he patiently and most bravely waited for the end, which came on Aug. 12. His work lives and will continue to live, and will make the path easier for coming generations. A. R.

Baron Anatole von Hügel.

Baron Anatole von Hügel was born at Florence on Sept. 29, 1854; he was the second son of Charles, Baron von Hügel, his mother being the daughter of General Farquharson. His father was a distinguished soldier, diplomat, and man of science, who was awarded the Patron's Medal of the Royal Geographical Society in 1849 for his travels in Kashmir; he was also a horticulturalist of European fame. Thus inheritance, example, and environment shaped Anatole's future life.

In 1874 Anatole von Hügel was sent by his doctor on a voyage to Australia, and while in Australia, New Zealand, and other islands he collected natural history specimens, and in 1875 went to Fiji to collect birds. Against advice he penetrated into the interior of Viti Levu, and though the natives were in a state of great unrest, he made friends with them and became much interested in what they did and made, winning their confidence and affection by his sweet, simple disposition. Sir Arthur Gordon (later Lord Stanmore) had just been appointed the first Governor of Fiji, and Alfred Maudslay was also there at that time. All three

began enthusiastically to make ethnographical collections, which later were united to form the unrivalled collection now displayed in the Museum of Archæology and Ethnology at Cambridge. Von Hügel wrote voluminous notes on the natives, and he soon came to be an acknowledged authority on Fiji. For this reason he was appointed at the end of 1883 the curator of the newly established Museum of General and Local Archæology, which then consisted of the collections given to the University by the Cambridge Antiquarian Society. The collections were greatly increased in all departments of archæology, and particularly by local Saxon grave-finds, in the excavating of which the curator took an active part.

Under the fostering care and through the discriminating knowledge of von Hügel, the ethnographical collections became of such importance that the title of the museum was changed to that it now bears. The collections were greatly enriched by numerous valuable gifts from the curator, the Baroness, their family, and personal friends. For many years von Hügel worked unremittingly and single-handed for a pittance under most cramped and unhealthy conditions, which must have weakened a constitution that was never robust. It fell to him to undertake the arduous and repellent duty of collecting money for a new museum. He was himself repeatedly a generous donor, as were various members of his family. In time, sufficient money was raised to begin the new building, the details of which involved von Hügel in much work and worry. The foundation stone of the first block was laid by Eliza Margaret, Baroness Anatole von Hügel, on May 14, 1910. The weary work of raising new funds for the erection of the other blocks had to be renewed. The removal of the specimens from the old to the new building was an arduous and anxious task, as was their installation in their new quarters.

His sensitive temperament, conscientiousness, and continual ill-health made life very hard for von Hügel. In the autumn of 1920 he quite broke down, and in June 1921 he felt obliged to send in his resignation as from Dec. 31, 1921. As health permitted he continued to work in the Museum, and had the satisfaction of completing the installation of the Fijian collections. The end came after a long illness on Aug. 15 last.

The above-mentioned circumstances, combined with a difficulty in expressing himself in writing, and a natural diffidence, were the probable reasons why von Hügel has little published work to his credit, and helps to explain why his long-projected and much-looked-for monograph on Fiji has never been finished. After being appointed curator he was made an honorary M.A. of the University, and then he joined Trinity College. In May 1922 he was given the degree of Sc.D. *honoris causa* for his distinction as an ethnologist and for the great work he had done for the University.

No account of von Hügel can be complete without reference to the devotion of the Baroness, his happy home life, and his love for his garden. He and the Baroness were always unobtrusively doing kind actions. He was a sincerely religious man, and he exerted a profound influence on Roman Catholicism in Cambridge. A. C. HADDON.

PROF. F. S. CAREY.

THE sudden death on July 26 of Prof. Frank Stanton Carey, who for thirty-seven years was professor of mathematics at Liverpool, first in University College and then in the University, removes one who did much valuable pioneer-work in the building up of a new university.

Born in Somersetshire in 1860, F. S. Carey received his early education at Bristol Grammar School, and then proceeded to Trinity College, Cambridge. He was third wrangler in 1882, placed in Div. 1 of Part II. of the Math. Tripos in the same year, and elected to a fellowship of Trinity in 1884.

In 1886, Carey was appointed to the chair of mathematics at Liverpool, which had been founded three years earlier, and already occupied by A. R. Forsyth and R. A. Herman. In this chair his life's work was carried out. A born teacher, he was exceptionally able to impart knowledge to the dullest of his pupils, and at the same time to inspire the most brilliant of them. Both types of men continuously sought his advice long after they had left the University, and they were always amply rewarded. He himself never ceased to be an enthusiastic student of pure mathematics, always keeping a youthful outlook and fully appreciating the modern ideas in that subject, vastly different as they are from all that he was taught at Cambridge.

Carey's original contributions to mathematics are not large; they consist of isolated papers on geometry, theory of numbers and groups. His text-books are better known, and have been used by a large number of students; they are "Solid Geometry," "Infinitesimal Calculus," and "The Elements of Mechanics" (of which he was joint author). His latest publication (also a joint one) was "Four-place Tables with Forced Decimals." But of his writings perhaps that which shows him at his best is his chapter on mathematics in the volume on "Modern France" published in 1922 by the Cambridge University Press. In this there occurs a sentence which reveals an admirable spirit for a university teacher: "Perhaps the new ways were invisible except to the eyes of youth." His culture was a wide one, and he appears to have been able to enter intimately into the spirit of the scientific pioneers of the seventeenth and eighteenth centuries.

In the administration of his University, Carey took a prominent part, and on council, senate, and faculties he always judiciously upheld the claims of science and scholarship. He rendered vital help in the establishment of the Tidal Institute. The library, Teachers' Training College, finance committee, and athletic club all benefited by his active sympathy and sound judgment. His death will be deeply regretted by a wide circle of friends and former pupils, many of the latter being teachers and engineers. J. P.

News and Views.

THE choice by the British Association of Sir William Bragg as its president for the Glasgow meeting is a particularly happy one. His genial personality, simple yet charming style of exposition—an especially important qualification in view of the great tradition behind the inaugural address—and his connexion with one of the greatest advances of scientific knowledge in our time, fit him pre-eminently for the presidential chair. Those who had the privilege of hearing his first Friday evening discourse at the Royal Institution after his return from occupying (1886–1908) a chair at the University of Adelaide, and while Cavendish professor at the University of Leeds (1909–1915), when physicists were still struggling to understand the true nature of X-rays and inclining rather to a corpuscular than to the electromagnetic undulatory explanation, will remember how clearly the position was set forth (as afterwards in 1912 in his book "Studies in Radioactivity"), and how the advent of some great impending discovery was foreshadowed which would clear up the mystery. It was not long in coming. For in the same year, 1912, that the book was published, occurred the famous discussion in the rooms of Dr. von Laue at Munich—where the University at that time included in its scientific coterie Röntgen, Groth, Sommerfeld, and Ewald—which resulted in the epoch-making experiment being tried by the two assistants, Friedrich and Knipping, of passing X-rays through a crystal and receiving the issuing rays on a photographic plate. Not only did this successful experiment fulfil the suggestion of Dr. von Laue, that the differently orientated parallel series of planes of atoms composing a crystal should act as a space-grating towards X-rays, which latter on reflection should afford some indication of the crystal symmetry, but also at once decided that the X-rays were of an undulatory nature, with wave-lengths of the same order as the dimensions of the chemical atoms.

THE time was indeed ripe for this pioneer experiment, the forerunner of all the subsequent immense work on the X-ray analysis of crystals. For crystallographers had settled in detail the types of symmetry possible to crystals, together with their space-lattices and point-systems (regarding the atoms as points), and had even got so far in the cases of definitely related (isomorphous) compounds, as to determine the relative volumes and dimensions of the unit cells of these three-dimensional lattices. Immediately after the publication of the first results of the Laue method, Sir William Bragg, then our leading authority on X-rays, took up the investigation, and, by devising a new spectrometric method in which the photographic plate was replaced by an ionising chamber mounted like the telescope of a goniometer, converted the qualitative results into actual measurement of the spacing of the parallel planes of atoms corresponding to each of the chief crystal faces, thereby fixing the absolute dimensions of the lattice-cells and the distances separating contiguous atoms, from centre to centre. The location of the atoms in the structure, and the number of molecules, if more than one, contained in each cell, followed naturally.

DURING his tenure (1915–23) of the Quain chair of physics in the University of London, Sir William Bragg published a brilliant series of papers in which the structure of a large number of crystallised substances was unravelled, at first mostly simple binary compounds, but afterwards more complicated substances, including several organic compounds. Still more recently, at the Davy-Faraday Laboratory of the Royal Institution, after Sir William had succeeded Sir James Dewar as Fullerian professor (1923), the list has been considerably extended, with the aid of an able school of research workers which he has gathered around him. Moreover, it is especially interesting that his distinguished son, Prof. W. L. Bragg, should also be carrying on the good work in the Department of Physics at the University of Manchester, after having assisted in numerous papers in clearing up the theory of this remarkable action of X-rays with regard to crystals. The joint book of father and son, "X-rays and Crystal Structure," now in its fifth edition, is a worthy record of the combined results achieved.

SEPT. 3 is the bicentenary of the birth of the well-known British manufacturer, Matthew Boulton, the partner of Watt and one of the leading industrialists of the eighteenth century. Boulton was born in Birmingham, and at the age of twenty-one years he became a partner in his father's business of trinket making, which ten years later he inherited. His marriage in 1762 with Ann Robinson, of Lichfield, brought him a fortune of £28,000, and the same year he began the building of the historic Soho iron works. By 1767 his turnover was no less than £30,000 per annum. He had by then become acquainted with Watt, and from that acquaintanceship sprang the partnership which made Boulton and Watt the great pioneer firm of steam-engine makers and mechanical engineers. Soho Foundry became the training ground for the new profession. The two men were strangely unlike in temperament, and nowhere could Watt have found another better fitted to further his efforts and support him in bringing the new steam engine into use. With an optimistic outlook on life, endless tact and perseverance, a sound judgment of men and unusual powers of organisation, Boulton possessed a wide knowledge of the world and its industries. The partnership began in 1775. In the next ten years Boulton had raised and expended no less than £40,000 before the steam-engine business began to pay, and Watt himself afterwards wrote "that to his friendly encouragement, to his partiality for scientific improvements and his ready application of them to the processes of art, to his intimate knowledge of business and manufactures and to his extended views and liberal spirit of enterprise, must in a great measure be ascribed whatever success may have attended my exertions." Boulton himself made great improvements in the art of coining, while his scientific attainments led to his election to the Royal Societies of

London and Edinburgh. He died in 1809, ten years before Watt, and his grave is, like Watt's, in Handsworth Church.

UNDER the auspices of the University of Berlin, a 'Ferienkursus für Ausländer' was held in the Physical Institute on July 2–21, the object being to bring before research workers outside Germany the latest results and—to some extent—the speculations of theoretical physics. How greatly this idea was appreciated may be gauged by the fact that an audience of seventy-five, representing fifteen different nationalities, listened to the lectures which had been arranged. The visitors were welcomed at the opening session by the Rector of the University and by Prof. Max Planck. Very unfortunately, Prof. Einstein was ill, and therefore unable to deliver his promised lectures. The speakers and their subjects were as follows:—Prof. v. Laue, theoretical optics and X-rays; Dr. Reichenbach, space-time theory; Prof. Schrödinger, wave-mechanics; Dr. Ladenburg, dispersion; Prof. Hettner, radiometer: breadth of spectral lines; Dr. v. Mises, probability: aerodynamics; Dr. Becker, electron theory of metals; Dr. v. d. Pahlen; stellar statistics; Dr. Bothe, radiology; and Dr. Czerny, infra-red research.

OPPORTUNITIES were afforded during the meeting for seeing something of the original work in progress in laboratories of the University of Berlin, under the guidance of Profs. Nernst, Wehnelt, Pringsheim, and Dr. Lange, whilst a large party availed themselves of the invitation to visit the Reichsanstalt and to listen to an interesting account of its history by Prof. Paschen. This constituted the first course of its kind ever attempted in Berlin, and was regarded in some respects as an experiment. It is difficult to imagine that it could have been more successful either in its scientific value or in the organisation for the comfort and convenience of those who came from considerable distances to hear the words of wisdom. Perhaps in future years similar courses may be arranged in other branches of knowledge. Meanwhile, all who had the chance of being present at the first 'Ferienkursus' this summer departed under a deep debt of gratitude to their hosts for such an opportunity of hearing from the authors themselves of the latest advances which they have made in theoretical physics.

As an effort towards the co-ordination of the extensive new information regarding the geology of Asia, a discussion has been arranged during the British Association meeting in Glasgow on Tuesday, Sept. 11, upon the structure of Asia. The first paper, by Prof. F. E. Suess, of Vienna, "The European Altaids and their Correlation with the Asiatic Structure," will explain some modifications which he regards as necessary in his father's synthesis of Asia. Prof. D. I. Mushketov, director of the Russian Geological Survey, will contribute an account of the recent work of Russian geologists in Eastern Turkestan. The remarkable results obtained in Persia and Mesopotamia by the staff of the Anglo-Persian Oil Co. will be announced in a paper, "A Contribution to the Stratigraphy and Tectonics of the Iranian Ranges," by Dr. H. de Böckh, Dr. G. M. Lees, and Mr. F. D. S. Richardson. Prof. G. B. Barbour, of the University of Peking, will give an account of the work by himself, the Chinese Geological Survey, and of the American geologists, Prof. Berkey and Mr. Morris, during the recent Mongolian expedition, dealing with the mountain structure of north-eastern Asia. Prof. J. W. Gregory will summarise recent work in south-eastern Asia. It is hoped that Prof. Brouwer will speak on the mountain structure of the East Indies, Prof. Boswell on some recent views regarding the cause of the Asiatic movements, and Sir Thomas Holland and Mr. W. D. West on work by the Indian Geological Survey on the structure of the Himalaya.

MANY interesting facts are brought out in the Registrar-General's Statistical Review, 1927, Part I. (Medical Tables), dealing with vital statistics of Great Britain, which has recently been issued (London: H.M. Stationery Office, price 15*s*.). The birth-rate for the year 1927 was 16·6; this is the lowest birth-rate recorded since the establishment of civil registration in the country, the lowest rates previously being those for 1918 (the last year of the War), and 1926, which were 17·7 and 17·8 per 1000 population respectively. The death-rate was 12·3 per 1000 population, which is slightly higher than for any year since 1922. The rise affects the two sexes almost equally, and was due to a severe epidemic of influenza in the March quarter. The deaths of infants less than one year of age were equal to 70 per 1000 births, being the same as for the previous year. Thus the two years 1926 and 1927 have the lowest infant mortality rate on record except only that for 1923, which was 69. The mortality from the infectious diseases differed little from that for the previous year, except that the deaths from influenza numbered 22,263 and were equal to a rate of 567 per million living, which is the highest recorded since the great epidemic of 1918–19. The death-rate from cancer was 1376 per million population, or 14 per million higher than in 1926, and was the highest crude death-rate yet recorded. Increasing use is being made of lysol and coal gas as means of self-destruction; whereas the registered deaths by lysol and coal gas poisoning in 1919 were 7 and 213, in 1927 they increased to 361 and 994 respectively.

THE bird sanctuaries in the Royal Parks in and about London have now been established for nearly six years, and during that time they have been effective in increasing the numbers of nesting birds in certain much-frequented places, and in focusing the interest of many people upon the varied bird life of a great city. The Annual Report of the Committee on Bird Sanctuaries, Royal Parks, England, for 1927, shows that the Committee is not neglecting the condition of the shrubberies, a vital matter if the nesting and sheltering of the birds are to be kept at a high frequency. This and the replacement of worn-out nesting boxes completes the active efforts of the Committee as here recorded. The remainder of the report consists of separate accounts of the bird life of each of the great parks, by various observers. Many of the observations can only be regarded as

trivial, but on the whole they indicate that both summer visitors and nesting birds were scarcer in the sanctuaries in 1927 than in previous years. A word may be said about the format of the report. It is duplicated by a type-writing process on paper of foolscap size, so that instead of being kept for reference it is more likely to be thrown into the waste-paper basket when read. Many visitors to the parks would appreciate this guide to the bird inhabitants, were it printed in a size suitable for library shelves, for one of the chief interests of the annual reports must always be the comparison of one year's results with those of its predecessors. The cost of printing might well be lessened by the reduction of some of the special reports, and the bird sanctuaries should afford opportunities for very attractive illustrations.

AN apposite illustration of a reference to the connexion between twins and the sky among primitive people in our Calendar of Customs and Festivals under date Aug. 18 (see NATURE, Aug. 11, p. 224) is contained in a dispatch from the *Times* correspondent at Buluwayo which appears in the issue of Aug. 17. Two cases were before the Courts on the previous day in which natives were tried for the murder of twins in accordance with native law. It was stated that the native belief was that to kill twins was to secure a good rainfall. The accused were not the parents but the grandparents and a mother-in-law; but in one case the mother acquiesced, nor had she fed the children since their birth as it was against native law. Sentence of death was passed, but the judge stated that it was not likely to be carried out. It may be remembered that a case of human sacrifice during a drought to secure rain occurred a few years ago in one of the South African tribes, when the son of a chief was killed. The present case differs in some respects. It was customary among most African tribes that one or both of twins should be killed at birth, especially if they were girls. This, however, was a rain charm in the sense that it was intended to *avert* the misfortune, especially drought, which their birth entailed. The Rev. H. Junod records that among the Bathonga, a tribe of north-east Rhodesia, twins, who were called the Children of Heaven, though no longer killed, required that not only the mother but also the community should be protected from the evil effects. Twins being specially connected with heaven, their birth prevented rain from falling. It was therefore essential that they should be buried in wet ground. In time of drought, water was poured on their graves, and if they had been buried in dry ground the Bathonga even went so far as to dig up the bodies and rebury them near the river.

THE monthly review edited by the Verband Deutscher Elektrotechniker and two other German institutions, the English edition of which is called *Engineering Progress*, gives in the March issue an excellent description of the huge Klingenberg electric power station near Berlin. The entire number of the journal is devoted to a description of the station, the object being, it is stated, to emphasise the importance of high-class engineering work in the sphere of electric power supply. The power station is situated on the Rummelsburg lake on the outskirts of Berlin and covers an area of fifty acres. It borders on the River Spree, from which even during a hot summer ample cooling water can be obtained. The thermal efficiency of condensing turbines increases with the degree of superheating and in a less degree with the pressure of the steam. On the other hand, the durability of the materials is affected by very high temperatures. A temperature of 400° C. (570° F.) has been chosen at the turbine, the temperature at the boiler outlet being 410° C. The pressure in the boiler is about 500 lb. per sq. inch and in the turbine about 460 lb. By preheating the air before it enters the furnace, it is calculated that an annual saving of about £10,000 per machine is effected. Pulverised coal firing is adopted. An interesting novelty is the drying of the coal by steam, each dryer being sufficient for 25 tons of coal per hour. The pulverised coal is conveyed by means of pipes to the boiler-house, the longest pipe being 1150 feet. Each steam turbine has a capacity of 80,000 kilowatts. The electric energy is generated at 6 kilovolts, is converted to 30 kilovolts and supplied to the networks of greater Berlin. A striking feature of the station is a very lofty building containing the administration offices. It has ten storeys, and on the top of the building are three large water tanks capable of supplying the station with water. In this building are recreation rooms for the station staff, a lecture hall, and a telephone exchange.

BY an Order of the Committee of Privy Council, Prof. Robert Muir, Sir John Herbert Parsons, and the Right Hon. Sir Charles Philips Trevelyan, Bart., M.P., have been appointed members of the Medical Research Council into the vacancies caused by the retirement of Prof. Georges Dreyer, Sir Archibald Garrod, and the Right Hon. William Graham, M.P. The new appointments become effective on Oct. 1.

THE one hundred and ninth annual session of the Swiss Society of Natural Sciences is being held at Lausanne on Aug. 30–Sept. 2. The programme includes general lectures by Prof. E. Bosshard (Zurich) on the past and future of the wholesale chemical industry; Prof. P. Termier (Paris) on recent impressions of travel; Prof. M. Askanazy (Geneva) on achievements and aims in the study of tumours; and Prof. A. Reymond (Lausanne) on the occult sciences in antiquity, a methodological study.

THE Council of the National Institute of Agricultural Botany has awarded the Snell Memorial Medal for the year 1927 to Prof. Paul A. Murphy, professor of plant pathology at University College, Dublin. The medal is given annually to mark eminent work in the sphere of potato husbandry, and it has been awarded to Prof. Murphy in recognition of his valuable contributions to the study of the virus diseases of the potato.

WE have received from Messrs. H. K. Lewis and Co., Ltd., of Gower Street and Gower Place, London, W.C.1, a selection from the "Catalogue of Medical Works" published by them; also a pamphlet entitled

"Eighty-Four Years, 1844–1928," reviewing the activities of the firm since its foundation. These include the publication of many works of medical and scientific interest by well-known authors; a bookselling department, which includes an agency for the supply of standard American and continental works; and a second-hand book department, which contains one of the largest collections in Great Britain of standard and recent works in medicine, surgery, technology, and general science, scarce books when not in stock being advertised for without charge. Finally, there is the circulating library, which contains about 30,000 volumes in all branches of medicine and the allied sciences, as well as books of general scientific or philosophic interest. Attached to the library is a reading and writing room for the convenience of subscribers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A forestry inspector, Department of Lands and Agriculture, Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (Sept. 4). A full-time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 7). A lecturer in engineering science for automobile engineers at the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1 (Sept. 7). An assistant lecturer and demonstrator in electrical engineering in the University of Sheffield—The Registrar, The University, Sheffield (Sept. 14). A pathologist and lecturer in pathology in the St. George's Hospital Medical School—The Dean of the Medical School, St. George's Hospital. S.W.1 (Sept. 15). A professor of physiology in the Patna Medical College—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 19). A professor of mechanical engineering in the Bengal Engineering College, Sibpur—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Sept. 19). The Radcliffe Crocker Travelling Scholarship in Dermatology of University College Hospital Medical School—The Dean, University College Hospital Medical School, Gower Street, W.C.1 (Sept. 30). The William Julius Mickle Fellowship of the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (Sept. 30). A permanent physicist to the Cancer Research Committee of the University of Sydney—The Registrar, The University of Sydney, Sydney, N.S.W. (Nov. 15). A professor of tropical medicine at the Calcutta School of Tropical Medicine and Hygiene—The Director, School of Tropical Medicine and Hygiene, Central Avenue, Calcutta. A pathologist and bacteriologist under the Kensington Board of Guardians—The Clerk to the Board, Guardians' Offices, Marloes Road, Kensington, W.8. Civilian education officers in the Royal Air Force Educational Service, preferably with practical qualifications for teaching engineering subjects—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1.

Our Astronomical Column.

WHAT BECOMES OF THE STARLIGHT?—This is the title of an interesting article by Prof. H. N. Russell in the *Scientific American* for August. Prof. Russell points out that, on the old conception of boundless space, by far the larger portion of the energy poured forth from the stars would seem to be dissipated in the form of ever-widening and ever-weakening waves. On the conception of re-entrant space, the waves would, after making the circuit of space, go over the same ground again. The question is examined whether the wave energy, which is now considered to come from the annihilation of matter, may possibly be built up into matter again. It is shown that this involves some difficult conceptions. The energy required to form a hydrogen atom would be spread through some 400 cubic feet of space. A reference is made to Dr. Millikan's suggestion that the cosmic rays investigated by him result from the union of 28 hydrogen atoms to form a silicon atom; "it is not easy to see how the 28 electrons and 28 protons can all get to the same place at the same time." But it must be remembered that knowledge of the structure of the atom is only a quarter of a century old, and it is to be hoped that the future may reveal solutions of these difficult but fascinating problems.

DOUBLE STARS MEASURED AT JOHANNESBURG.—Vol. 14, part 4, of the *Annals* of Leyden Observatory contains the measures of double stars made with the new 26½-inch refractor and the 9-inch refractor at the Union Observatory at Johannesburg, by W. H. Van Den Bos, between the dates 1925.6 and 1928.2. The search was a systematic one, the sky south of decl. −19°, being swept over, and all stars examined down to the limiting magnitude 9·0 of C.P.D. The result for the region at present covered shows that one star in 16 is double within Aitken's limit of distance, which is 5″ between magnitudes 6 and 9. The power used in sweeping was 420, and the observer notes that he was able to detect the duplicity of stars too close to divide with this power by the blurred character of the diffraction image. The sweeps were made without previous consultation of double-star catalogues, so that the search is quite unbiased, but some known objects might be missed through being near periastron. Several cases of wrong identification in previous catalogues are noted, and it is suggested that in such cases the first to give the right identification has the claim to the discovery.

There are a large number of very close pairs in the catalogue, and many of these are likely to show orbital motion within a few years. Close pairs with equal magnitudes need continuous watching, otherwise there is danger of confusing the quadrants. It is stated that Doberck and Dawson have done this in the case of γ Centauri, and that the period is only half that given by Dawson.

A very interesting triple system is C.P.D. −30° 181; the wider pair has moved through 110° since its discovery by Burnham; the brighter star has a closer companion, discovered by Dawson, the period of which is stated to be less than five years, which is probably the shortest of all visually discovered binaries. The present catalogue contains 141 pages, there being about 11 pairs on each. They are mainly between −19° and −30°, but there are several outside these limits, Castor being included.

Research Items.

AFRICAN HOE CULTURE.—Dr. Hermann Baumann publishes in *Africa* for July a contribution to the study of primitive economics in the form of an analysis of the division of work according to sex in the use of the hoe in African methods of cultivation. It was for long held that the exclusive use of hoe culture by women was proof that agriculture and the settled life were the invention of the woman, who thereby acquired legal and social ascendancy, while man only took part in the tilling of the soil with the introduction of the plough. Now, however, a higher form of hoe culture is recognised in which the man takes a part. It is still associated with matriarchy, but operates in the larger family. In Africa there are two large groups of hoe cultivators. One in the Sudan, Central East Africa, and the highlands of Angola, shows men's work to a greater or less extent, with intensive cultivation; the other, mainly on the west coast, with branches extending to the east coast, in which, except for clearing the ground, the work is left exclusively to the women, and the cultivation is non-intensive. In nearly all cases where cultivation is by men and intensive, it is associated with the older form of patriarchy, the older kinds of African grains are used, government is associated with the ownership of farms, and inheritance is the right of the elder brothers. Cultivation by both sexes, with a preponderance of male labour, is characterised by the fact that the men who mainly grow grain still retain in their processes of hoe culture much of the older root cultivation methods of the women. The rough work, digging, making beds and mounds, is the work of the men; weeding is done by the men when the hoe is exclusively the man's tool. In sowing, the man makes the hole for the seed, the woman puts it in, while at harvest the men dig up the roots, and the women carry or cart the corn. Each sex has its special crop. The evidence from Africa thus tends to confirm the theory that the culture of root crops associated with female labour is the most ancient, and that female labour is associated with matriarchy.

SLAB-BUILT GRAVES IN THE MALAY PENINSULA.—A grave built of granite slabs, with which three carnelian beads were associated, was found in Perak in 1895. A subsequent examination by Mr. H. C. Robinson produced a cross-hatched stone bark-cloth beater, some fragments of bronze, pottery, and an iron tool. Three additional graves of this type discovered at Sungkai in 1927 have been excavated by Mr. I. H. N. Evans, who publishes a report on them in vol. 12, pt. 5, of the *Journal of the Federated Malay States Museums*. In their essentials the graves are comparable to the dolmen, though outside these cists the only megalithic monuments discovered in the Peninsula are those at Pengkalan Kempas, Negri Sembilan. No human remains have been found, and it is not, therefore, possible to arrive at any conclusions as to the race by whom they were constructed, except that they are the work of a race, possibly of tinworkers, who occupied at least part of the peninsula. The graves are of considerable size, three metres in length or just under, and as no granite occurs nearby, their use must have involved considerable labour. The iron tools which were in use were of a peculiar type, some having very small sockets for the insertion of a handle in the same plane as the blade. Stone quoits, though not found in the graves, were probably contemporaneous with the cross-hatched cloth-beaters. A number of bronze implements were also found. Pottery was rough in type and hand-made. Patterns were not common; but both inside and out, the pottery was covered with some glaze-producing material. On the authority of Dr. P. V. van Stein Callenfels, it is stated that cists and graves of the dolmen type are not uncommon in Java, extending from the neolithic to the iron age.

TOBACCO SMOKING IN GREAT BRITAIN.—The smoking habits of the people of Great Britain have undergone considerable changes during the past two decades, according to a report of the Imperial Economic Committee (Ninth Report, Tobacco, Cmd. 3168. London: H.M. Stationery Office). There has been a considerable increase in the consumption of tobacco, which has risen from 2·4 lb. *per caput* in 1914 to 3·4 lb. in 1927. The increased consumption would appear to be due "to the extension of the cigarette habit and to smoking on the part of women." Only in a few countries is the average consumption greater than in Great Britain (Belgium 6·6 lb. a head, U.S.A. 6·02 lb., and Germany 4 lb.). Another interesting feature has been the change over from pipes to cigarettes. In 1907 only 24 per cent of the tobacco consumed in Britain was smoked in the form of cigarettes, but by 1924 the percentage had risen to 58. There has been a marked increase in the demand for Empire tobacco, and considerable improvements in its quality have been effected. In 1924 the Empire supplied only 3·3 per cent of the leaf tobacco imported into Britain, but by 1927 the figure had risen to 18·4 per cent. It is estimated that 37 per cent of the pipe tobacco consumed in the United Kingdom consisted of Empire leaf, but that only 1 per cent of cigarette tobacco was Empire grown. The greatest field for expansion in Empire tobacco marketing is therefore in cigarette tobaccos. It is essential, however, that attention should be paid to type and quality. Distinctive types of tobacco tend to retain their aroma even under marked changes of environment, and to that extent flavour may be regarded as heritable. Nevertheless, the soil and climatic peculiarities have a great influence. Efforts should be made to adapt the flavour of Empire tobaccos to the established taste of the public, and for this purpose the Committee recommends research into the nature of aroma.

EFFECT OF DROUGHT UPON BIRD LIFE.—The long-continued and disastrous drought experienced by central-western Queensland during the past few years has had notable repercussions upon bird-life. During the past three years the total rainfall has been 17½ inches, whereas a forty years' average would indicate 4 feet. Consequently insects, seeds, and berries have been scarce, and birds have suffered from lack of food. Some of the results described by F. L. Berney (*Mem. Queensland Mus.*, vol. 9, pt. 2, 1928) are unexpected. For example, it was discovered that all birds ceased to nest: "from the middle of February 1925 to the latter part of June 1926, a matter of nearly seventeen months, I saw absolutely no evidence of any bird nesting. Even the Corvidæ, birds that one would think would rather revel in hard times with so many dead animals about, were not nesting, but that is perhaps to their credit, indicating that they require not carrion but a variety of insects on which to rear their nestlings," a suggestion which indicates either remarkable instinct or foresight on the part of the crows. Following upon two inches of rain in May 1926, the author noted about a dozen nests belonging to seven species of birds. The high fencing of the country added to the distress, for it prevented the possibility of the migration of emus to more favourable

localities, so that on many holdings these fine birds have been exterminated. The bird population has thus been seriously affected not only by actual deaths, but also by the absence of potential broods.

A NEW AQUARIUM MICROSCOPE.—With the view of observing aquatic microscopic organisms under conditions approaching as nearly as possible to their natural surroundings, Mr. D. J. Scourfield has devised a new type of aquarium microscope (*Jour. R. Micr. Soc.*, June 1928). At the lower end of the body tube of this instrument is a water-tight casing, containing a right-angled prism, to which is attached another casing also containing a right-angled prism, and this second casing serves as the carrier of the low- and medium-power water immersion objectives employed. The combinations of movements possible with the two casings, together with the raising and lowering of the tube and the traverses in two directions in a horizontal plane, enable the objectives to be turned in any direction in the aquarium. Mr. Scourfield points out the probable interest of observations from below or from the side on organisms which make use of the surface film.

SUBTERRANEAN CRUSTACEA.—This formed the subject of the presidential address to the Quekett Microscopical Club (*Jour. Q.M.C.*, vol. 16, 1928) by Dr. W. T. Calman. He urged the amateur microscopist to be on the watch for well-shrimps and other subterranean crustacea, for the amateur who is content to wait but is able to take advantage of the opportunity when it arrives, may obtain results which the professional worker sighs for in vain. The well-shrimps, *Niphargus*, seem to be confined to the southern counties of England, but the common species, *Niphargus aquilex*, occurs as far north as Norfolk. It is not clear how many species of *Niphargus* occur in England, nor has their distribution been exactly ascertained. No subterranean isopod has hitherto been recorded in England, but about two years ago Miss Lucas found in a well at Ringwood, in the New Forest, a blind isopod, *Asellus cavaticus*, which is known from several localities on the Continent.

DIPTERA FROM THE MALAY PENINSULA.—Flies of the sub-order Nematocera other than mosquitoes have hitherto been almost entirely neglected by collectors in the Malay Peninsula. In the *Journal of the Federated Malay States Museums*, vol. 14, part 1, 1928, Mr. F. W. Edwards contributes a lengthy paper on the Malayan Nematocera, which serves to give an idea of some of the genera and species that occur in that region. The material which he studied had recently been acquired by the Malay States Museums and was submitted by the late Director of that institution. At least half the species of all the families, other than mosquitoes, appear to be new to science, and were almost all collected by Mr. H. M. Pendlebury, entomologist on the staff of the museum. Among the fungus gnats, or Mycetophilidæ, only a single species was previously recorded from this region, and in the present paper 59 are recorded, 45 of which belong to the subfamily Sciarinæ, which is evidently strongly represented. The mosquitoes are tolerably well known and number 198 species, which is almost the same total as that recorded from the Indian Empire with Ceylon. There are, however, very evident differences in the Malayan and Indian mosquitoes, and less than seventy of the Malayan forms have been found in the Indian region, whereas nearly all the known Bornean mosquitoes also occur in Malaya. The Crane flies, or Tipulidæ, are also abundantly represented, and the 160 species in the present collection bring the total known forms to 175. As with the mosquitoes, the crane flies exhibit a much stronger facies with those of Borneo, Java, and Sumatra, than with the Indian forms. The Chironomidæ or midges are not included in this paper, while certain of the gall-midges or Cecidomyidæ have already been described by Mr. H. F. Barnes (*Jour. F.M.S. Mus.*, vol. 13; 1927).

EFFECT OF SULPHURIC ACID ON COTTON SEEDS.—The process of treating cotton seeds with sulphuric acid for the purpose of delinting has involved a number of questions, including the effect of the treatment on germination and the sterilising effects on the seeds. Prof. V. H. Blackman undertook to investigate the treatment for the Cotton Growing Corporation, and his report is published in a recent issue of the *Empire Cotton Growing Review* (vol. 5, No. 3). The germinating power of seeds soaked in concentrated sulphuric acid and in dilute acid has been compared with that of controls soaked in water only, and the results are based on the examination of 11,000 seeds. After treatment for 20 to 30 minutes in strong acid, there was no clear evidence of definite increase or decrease in germinating capacity and no evidence of any injurious action. In the case of both the acid-treated seeds and the controls, germination was as complete after four days as after six. With acid treatment there was, however, earlier germination, the second-day results being higher after acid treatment. An exposure to strong acid for so long a period as six hours had no injurious effect on the sample tested, and complete delinting was attained in four hours. The method of wetting the seeds thoroughly with weak acid and then allowing them to dry, thus concentrating the acid remaining on the seeds, was found to be unsatisfactory. The seeds were not delinted, besides suffering a serious reduction in their germinating capacity. It seemed possible that if treatment with strong acid had any detrimental effect on the viability of seeds, it might be due to rise in temperature associated with the treatment. The rise in temperature when the acid comes in contact with the small quantity of water in the seed coat was, however, found to be slight. It is suggested that during the process of washing, local heating of individual seeds may occur as the result of combination of water with acid absorbed by the seeds.

LAND SHELLS OF THE GALAPAGOS ISLANDS.—Numerous collections have from time to time been made of the land shells of the Galapagos Islands, and a record of these was given by Dr. Dall in his admirable paper on "Insular Landshell Faunas" (*Proc. Acad. Nat. Sci. Philad.*, 1896), but the most extensive collection yet appears to have been that made during the expedition sent out by the California Academy of Sciences in 1905–6. Owing to delay in publication some preliminary descriptions of the new species were issued by Dr. Dall in 1917 (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 2). The complete report, however, by Dr. Dall and W. H. Ochsner (both, alas, no longer with us) has now appeared and forms a most valuable communication (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 17). The authors give a summary of the environmental conditions and the habits of the land shells, followed by a scheme of the groups or sections, some of them new, of the Bulimuli, as well as a check list and insular distribution of all the known Galapagos land shells, totalling 78, in alphabetical order. The remainder of the paper is devoted to the descriptions of 59 of these, mostly belonging to the genus *Bulimulus* and none of them new, whilst the more important are figured on two good photo plates. The whole is a noteworthy contribution to the fauna in question and likely long to remain a standard work of reference.

ORGANIC CONSTITUENTS OF OIL SHALES AND RELATED ROCKS.—The latest contribution to this theme comes from Miss Jennie Livingstone of the University of Colorado, published in vol. 16, No. 2, of the *Studies* of that institution. Her work covers microscopical investigations and chemical experiments, reinforced with the usual sketch of shale industrial history and a résumé of the researches of different international workers. The photomicrographs are, however, very good, and the drawings of Green River shale and Kentucky cannel, especially the sporangium covering in the former, are reproduced in colour and are accordingly most instructive. The results of the work support the general theory of organic origin of oil shales, differing specifically in the nature of the original vegetable matter entombed in the sediments, and in the subsequent modifications which such matter has undergone. The environment of accumulation is pictured as swamp, marsh, or lagoon, and bacterial action is indicated by the predominance of humic material in most of the thin sections examined. Further, specific types of organic constituents probably control the nature of the distillates furnished by various types of oil shale, hence recognition and differentiation of such constituents might be expected to form the best basis of philosophical classification of these pyrobituminous rocks. This is, as a matter of fact, so far as most current researches get, but it is the next step which is the most difficult of all. It is not enough to arrive at a classification which, after all, is merely an aid to description; what we would like to know is the mechanism of the complex change whereby the organic matter is converted into 'kerogen,' exactly what principal factors control the destiny of that 'kerogen' when subjected to destructive distillation, and precisely why it is that different ranges of products are produced not only according to the varied shales used but also in response to different conditions of distillation.

THE DAILY VARIATION OF TERRESTRIAL MAGNETISM.—The July issue of the *Physical Review* contains a paper by Mr. Ross Gunn, of the Naval Research Laboratory of the United States, in which it is pointed out that the properties of the conducting layer of the atmosphere are not such as to lead to the large electric currents originally suggested by Balfour Stewart and utilised by Schuster and by Chapman in their examinations of the origin of the daily variation of terrestrial magnetism. Mr. Gunn shows that at the altitude of this conducting layer, where the free paths of the ions and electrons are long, the conductivity is anisotropic and is zero in the direction of the impressed electric field, and the resulting currents in the direction of the field are small. The ions and electrons move spirally about the lines of the magnetic field and produce a diamagnetic region in the higher atmosphere facing the sun, the effect of which is shown to be of the order of the observed diurnal variation. The semi-diurnal and lunar variations and the existence of disturbed days are also explained in a general way by the new theory.

HISTORY OF THE DYNAMO.—In connexion with the fiftieth anniversary of the "world's first tests of the dynamo," interesting reminiscences are given in the *Journal of the Franklin Institute* for July by C. F. Brush, the inventor of the arc light dynamo, and Elihu Thomson. Brush relates how he first tested his dynamo in a sawmill, using a team of horses to get the required power. He excited his dynamo with a single battery, and he relates his joy when the machine suddenly began to develop electric power and the horses were nearly brought to a stop. It is interesting to remember that even in those days Deschanel's "Natural Philosophy" was regarded as a standard authority on electricity. In 1880 the Brush system of electric lighting was exploited in Great Britain and throughout Europe, a factory being equipped in London. The unit of electric current was then called the 'weber.' It was not until the International Conference in Paris in 1881 that the 'ampere' was officially adopted. In the early days, Brush made all the requisite working drawings himself, and also all his special testing appliances. It was a 'one man' laboratory. He wrote all his own patent specifications and tested and personally adjusted all his lamps and dynamos. Elihu Thomson carried out the tests on dynamo machines for the Franklin Institute in 1878. The lack of instruments made it necessary to improvise all kinds of methods of making measurements. He relates that the Committee of the Senate in 1900 which advised the establishment of the Bureau of Standards at Washington, took into consideration papers by Lord Kelvin and Prof. Snyder in arriving at their decision. So far back as 1881, Elihu Thomson had observed curious high frequency phenomena, and in 1889 he constructed a high frequency alternator.

THE PHOSPHORESCENT COMBUSTION OF SULPHUR.—At a temperature just below the ignition point, which varies with conditions from 285° to 325°, the oxidation of sulphur is accompanied by a bluish-white luminescence so long as heat is supplied. The reaction taking place at this point has been investigated by H. J. Emeléus with a view to search for any oxide of sulphur more volatile than sulphur dioxide, and his results are given in the *Journal of the Chemical Society* for July. The reaction products were condensed by cooling with liquid air and then carefully fractionated. No evidence of the formation of sulphur monoxide was obtained, and it was concluded that the reaction during the phosphorescent combustion of sulphur is the same as that in the normal flame. The formation of ozone in the glow, reported by Bloch, could not be detected. The slow luminous oxidation of sulphur appears to be a gas reaction and is sensitive to the presence of sulphur dioxide and various organic vapours. It is suggested that inhibition of the phosphorescence is the cause of the rise in the ignition point of sulphur produced by the presence of these substances.

CATALYSIS BY WATER.—During the course of an investigation of the fluorescence of mercury vapour, which is described in the issue of the *Philosophical Magazine* for August (p. 271), Prof. R. W. Wood and Dr. Gaviola have been able to show the precise part played by water in a chemical reaction catalysed by it. The reaction in question was the photochemical formation of mercury oxide from its elements at low pressure, under the influence of the ultra-violet light from a mercury arc. In the presence of a trace of water vapour, this proceeded with such rapidity that it could probably have been used to measure the rate of evaporation of mercury from a liquid surface, but when water was absent the oxidation did not occur. Nitrogen acted in the same way as water, but was less efficient. Simultaneously, water or nitrogen was found to change a large number of the optically excited mercury atoms from the 2^3P_1 state into the metastable 2^3P_0 state, in which they would accumulate. The conclusion reached was that for oxidation to take place, the mercury had to be excited to this particular metastable level, and that the energy of the metastable atoms was probably the real catalyser of the reaction. The method used by the authors to detect the presence of mercury atoms in their various states was characteristically neat, consisting in an interferometric examination of the appropriate lines from a mercury arc for reversal of their cores after passage through the reaction vessel.

Timber Research.

THE reception by Lord Balfour on July 31 of a large and representative gathering at the Forest Products Research Laboratory marks a definite stage in the development of timber investigations under the Department of Scientific and Industrial Research. Previously accommodated in temporary premises at the Royal Aircraft Establishment, Farnborough, the Laboratory is now in full working order in admirably equipped and well situated buildings at Princes Risborough, Bucks. A photograph of the timber mechanics hall is reproduced in Fig. 1, which gives an idea of the kind of equipment installed in one of the buildings.

Particularly during the War, and following on the demands of aircraft manufacture, the dearth of scientific knowledge of timbers was very manifest. Valuable information was obtained by the Materials Section, under Prof. Jenkin, of the Technical Department of the Aircraft Production Department of the Ministry of Munitions. The threat of a world timber shortage after the War called for urgent action, not only to increase supplies by fresh plantings, but also to promote the utmost reduction of avoidable waste in the uses to which timber is put. It is with the second objective that the Forest Products Research Laboratory is mainly concerned.

For the Laboratory to function effectively, the problem has to be studied intensively from many aspects—pathology, timber physics, wood chemistry, wood technology, seasoning, timber mechanics, wood preservation, wood working—and arrangements made for bringing the results home to the using industries and for encouraging their general application. In a sense, the successful meeting at the Laboratory on July 31 may be regarded as an important piece of 'utilisation work,' since the visitors were given opportunities of visiting the various laboratories, and the clear placarding and labelling of the exhibits enabled them to gain fair impressions of the general organisation and of the investigations in progress.

FIG. 1.—Timber Mechanics Hall Forest Products Research Institute, Princes Risborough.

Mention has already been made of the various sections in which the programme of the Laboratory's work naturally falls. The general research work covers the study of decay caused by fungi and attacks by insects; the analysis of wood and its derivatives; effects due to seasoning, wood preservation, etc.; the examination of the relations of water and heat to wood. Then come problems such as the basic principles of seasoning; the evolution of appropriate mechanical tests and the interpretation of the results; antiseptic treatments against decay; which are subsidiary to full scale work on kiln design, strength comparisons, and wood preservation. In certain of these sections the Laboratory works in close association with the Forestry Commission, the Imperial Forestry Institute at Oxford, and with recognised authorities on particular subjects at the Imperial College of Science and Technology, University of St. Andrews, and the Imperial Institute.

Progress has already been made on a number of specific lines of investigation, and a description of some of them may be of interest.

An examination has been made of the decay occurring in Sitka Spruce timber. Several wood-destroying fungi have been isolated, and the principal one responsible for most of the decay has been identified as *Trametes serialis*. This fungus has been grown in pure culture and its life history studied. The method of attack on timber and the character of rot produced have been carefully observed. A full study of the physiology of the fungus, including the water relationships, is proceeding; in addition, it is proposed to determine the effects of the fungus on the mechanical strength of the wood after varying intervals of time.

Another interesting and important problem which has been attacked relates to furniture-destroying insects, notably *Lyctus* beetles. An investigation has been made into the losses caused by these beetles on timber in store. The work has reached a stage at which practical methods can be given for ridding the timber of this pest by a steam sterilisation treatment in the kiln. It has been shown that sterilisation is effected when the timber is maintained in the kiln for 1½ to 2 hours at an overall temperature of 130° F. and humidity 100 per cent. Apparently there exists a definite relationship between the diameter of the pores of a wood and its susceptibility to *Lyctus* infestation; when the diameter of the vessels of a wood are less than that of the *Lyctus* egg, it is not attacked by this insect. The moisture content of the wood is also a determining factor, and results to date indicate that infestation does not occur when the moisture content falls below 8 per cent. The experiments are being continued in order to ascertain whether lower conditions of temperature and humidity, combined with longer periods of treatment in sterilising kilns, cannot be used to kill *Lyctus* in all its stages. The next problem is to secure immunity for the timber from further attack. Any method, to be practicable, must not spoil the colour

of the timber, must be cheap and easily applied. Preliminary work on this aspect of the investigation is in hand.

An allied 'project' is concerned with the losses caused by Anobiid beetles on timber in buildings and in furniture. Two insects are being specially investigated—*Anobium punctatum* (Common Furniture beetle) and *Xestobium rufo-villosum* (Death Watch beetle). Detailed studies of the biology of both insects are in progress, and the mode of egg-laying and the rate of development of the larvæ are being determined. Later it is proposed to study the effect of varying temperatures and humidities on the length of the life-cycle of both species, and to ascertain whether preferences are exhibited by the insects for different species of timbers. It may be, also, that there exists some relationship between fungal infection of timber and progress of Anobiid attack.

Standard tests are being developed of antiseptics for use in wood preservation generally and in particular for preservation against insect and fungal attack. Timbers treated with various antiseptics at different concentrations are being exposed, and records of results will be kept over long periods.

Microscopic examination is being made systematically of wood structure. Much work is being carried out on the structure and identification of British hardwoods. The variation in structure of home-grown timbers is being studied as a necessary preliminary in forest products research problems. Work has been begun on elm, ash, and oak.

Another main line of experimental investigation concerns the factors influencing and controlling the movement of moisture and heat in timber, with special reference to their bearing on timber seasoning. Several methods of determining heat movement have been tested, and attention is at present being directed to thermal diffusivity as distinct from conductivity. As a result of the experiments carried out to date, considerable information has been obtained as to the rôles that temperature, vapour pressure, and rate of air circulation play in influencing the moisture movement in wood and in its drying. Two 'Technical Papers' on the subject have been published. The original intention was to proceed to estimate the effect of such factors as structure and density, in order to assess the seasoning qualities of different species of wood and to obtain data for optimum seasoning conditions. Recent experience is showing, however, that the problems of case-hardening, shrinkage, and collapse with related warping are of greater importance than was at first realised. Experiments are also in progress to determine the degree of hygroscopicity of different timber, with the view of ascertaining means of reducing the troubles arising therefrom.

An incidental problem is the determination of the most suitable moisture content for timber to be used in the manufacture of various kinds of furniture and in decorative work. Seasonal variations of moisture content in timber are under close observation.

The testing of the mechanical and physical properties of timbers naturally occupies an important part of the working programme of the Laboratory. Mention may specially be made of tests of small clear specimens designed to give a measure of the inherent fibre strength of the species and to provide a basis for comparing one species with another, for determining the influence of defects in larger samples, and for computing the effect of rate of growth, density, and moisture content. Fourteen consignments of home-grown timber have been collected, nine of which have been tested in the green condition, and four, air dry. More than 18,000 tests have been made.

Tests have been made of the seasoning and mechanical properties of timber used, or proposed for use, as pit props; it has been shown generally that home-grown species bear favourable comparison for the purpose to imported timbers. Mechanical tests have also been made of plywoods. In connexion with tests on structural timbers, preliminary data are being obtained for beams and joists; it is hoped in due course to evolve tables for structural grading, etc., which will be of great utility in specifications for building work.

Investigations are being made into the kiln seasoning properties of the commoner commercial timbers. Those into Corsican pine are completed; those into oak, beech, and common elm are proceeding. Parallel mechanical tests are also being made on kiln-seasoned material as compared with control samples.

Data relating to heat quantities and air circulation figures are being collected whenever possible, and observations are being made on the behaviour of the existing kilns, with a view to the construction of a special kiln for the study of factors influencing kiln design. A model experimental chamber is in operation. A report has already been issued regarding the essential principles of kiln seasoning of timber.

An interesting investigation has been carried out on the briquetting of charcoal manufactured in portable and semi-portable kilns, with the object of enabling the more profitable utilisation of waste timber in factories, etc. Following the production of satisfactory charcoal in the portable kilns operated at the Laboratory, arrangements have been made for briquetting trials on a commercial scale.

The above notes will serve to indicate the scope of the general programme of work of the Forest Products Research Laboratory. It should, however, be emphasised again that the scientific and technical work of the Laboratory is being linked as closely as possible with practice, and that continuous efforts are made not only to spread information as it becomes available, but also to arouse and maintain the active interest of the industry in new ideas and new operative methods for the economical utilisation of timber.

The Scott Polar Research Institute.[1]

By Dr. H. R. MILL.

IN welcoming visitors from all the countries represented at the Congress to the temporary premises of the Polar Institute at Lensfield House, the committee of management trusts that the extreme youth of the Institute will be held to excuse the greater prominence given to hopes for the future rather than to memories of the past.

The Scott Polar Research Institute is neither a teaching body nor a society seeking a numerous membership. Its aims are to encourage polar research by supplying information and advice to intending explorers, affording opportunities for study and assisting in the organisation of expeditions, and for this purpose to concentrate in one place all existing knowledge of the polar regions and subject it to expert criticism and cataloguing; above all, to maintain communication with all polar explorers, investigators, and students without any restriction or qualification.

[1] Substance of address at a reception given by the Scott Polar Research Institute of the University of Cambridge to members of the International Geographical Congress on July 21.

It appeared to many of us that the period of polar martyrdom should have been closed long ago, and that a stand should be made against the absurd appraisement of the greatness of explorers by the magnitude of the sufferings they endured. It seemed to us that experience already sufficed to indicate ways of carrying on research in the polar regions with comparatively little risk and practically no suffering if only it were possible to collect such experience and subject it to critical analysis and to show how it could be applied practically. Many of us had deplored the haphazard management of successive polar expeditions and the absence of continuity between them, each expedition being created with infinite labour, carried out at great expense, and allowed to melt away.

The opportunity of remedying this unfortunate state of things arose out of the tragedy of Scott's last Antarctic expedition. The scientific staff which sailed on the *Terra Nova* had a cohesion lacking in previous expeditions. Coming when it did, the appeal of Scott's struggle to reach the pole, and his heroic persistence to the end in his fight against the unexampled difficulties of the way back, were irresistible, and a great wave of hero-worship raised a very large fund to provide for a worthy memorial of those who fell and for the needs of their dependents. The chief memorial was the working up and publication of the scientific results of the expedition, and when this was complete the Committee, composed of the president of the Royal Society, the president of the Royal Geographical Society, and the Lord Mayor of London, found themselves in possession of a balance of £12,000. Mr. Priestley and Mr. Debenham, of the *Terra Nova*, and Mr. Wordie, of the *Endurance*, all settled in Cambridge, persuaded the memorial committee to devote this sum to the establishment of the Scott Polar Research Institute, which came into existence in 1926, the University of Cambridge undertaking to administer the funds, of which £6000 was earmarked as a building fund and £6000 as a general fund, the interest of which is at present the sole income of the Institute. Mr. Debenham has been appointed director of the Institute, with Miss Drake as part-time assistant. To them we owe the admirable arrangement of the rooms which contain the collections now on view.

These consist of an Arctic room and an Antarctic room, each containing the nucleus of a library, with maps and relics of expeditions, other rooms with a good representation of the equipment for polar travellers and a fine series of photographs. These have been contributed by many friends, including the widows of Admiral Sir Albert Markham and of Capt. Scott. A special feature is made of MS. records and diaries of explorers, and anyone desirous of finding a permanent abiding-place for papers of this kind, or any other mementoes of polar expeditions, is assured of the grateful acceptance and careful custody of such treasures. In some cases the promise of handsome bequests has been made, and the steady growth of the library and photograph collection is assured.

An important aid in this direction is the possession of the whole stock of the reports of the *Terra Nova* expedition dealing with the geographical, geological, meteorological, and geophysical work. These volumes may be sold or given in exchange for the reports of other expeditions. A feature is made of the complete cataloguing of the collections.

The only condition imposed by the Scott Memorial Committee is that a suitable memorial building shall be erected before 1936, and in view of the present cost of building it is to be hoped that wealthy friends of geographical discovery will supplement the sum available, so as to make it possible to house the collections in a manner worthy alike of the memory of the great leader whose name it bears and of all he stands for as the best type of the naval explorer, worthy also of the University and of the spirit of research which makes scientific truth its only care.

The Institute, as yet, is in its days of small things, but its promoters dream great dreams of rapid growth and continual adaptation to the changing conditions of modern research. In particular, we cherish the ambition of attaining completeness in the library by securing all published works on the polar regions or transcripts of the relevant portions of such works as have become bibliographical curiosities of fictitious value in their original editions. As many works of exploration have been published without indexes, an effort must be made to supply an index for every published polar book, and a great general index which will embrace all polar literature. Similar completeness cannot be sought for the collection of gear and apparatus, in which models of ships and aircraft must necessarily take the place of the real things. The museum also would only aim at being an index collection with the leading types and full reference to the great museums in which a complete representation of species and specimens are to be found.

University and Educational Intelligence.

CAMBRIDGE.—Mr. R. B. Braithwaite, King's College, has been appointed University lecturer in moral science. Mr. T. R. B. Sanders, Corpus Christi College, has been appointed University demonstrator in engineering. D. R. P. Murray, Pembroke College, has been elected to the Benn W. Levy studentship in biochemistry. Miss W. L. P. Sargent, Newnham College, and G. R. Gedge, Trinity Hall, have been awarded senior studentships of the Goldsmiths' Company.

The readerships in the morphology of vertebrates and in estate management, vacant through the death of Dr. Gadow and the retirement of Mr. F. B. Smith, respectively, are not being renewed. The following teaching officers retire on Sept. 30 next: A. Berry, King's College, and H. W. Richmond, King's College, University lecturers in mathematics; T. K. W. Fair, Jesus College, University demonstrator in chemical physiology; and A. Hopkinson, Emmanuel College, University demonstrator in anatomy.

VOLUME 13 of the *Journal of the College of Technology, Manchester*, has 240 pages and 9 plates, 183 pages and the plates being devoted to original articles by the members of the staff, and the remainder to abstracts of papers which have been contributed by the staff to scientific and technological periodicals, mainly during the years 1925–1927, but a few in earlier years. Of the 13 original articles, 3 deal with mechanical, 1 with electrical, and 1 with civil engineering, 2 with textiles, 2 with mathematics, 3 with applied physics, and 1 with industrial administration. The abstracts number 64, and deal with subjects of the same type. With one exception the papers were set up and the whole journal was printed in the College, and reflects great credit on the printing department. The original articles and the abstracts show that the staff is making valuable contributions to the solution of the scientific and technological problems which arise in industry, and that the Manchester College of Technology retains its position in this respect as one of the best in Great Britain.

Calendar of Customs and Festivals.

August 30. ADDENDUM.

ST. FIACRE, hermit at Breuil, France (seventh century), venerated widely in France, Tuscany, Ireland, and Scotland. Born in Ireland of illustrious parentage, he early adopted a solitary life and, leaving Ireland, settled in the wood Broilum or Brodolium (now St. Brié) in the diocese of Meaux, where he healed the sick by the laying on of hands. He also devoted himself to gardening and became the patron saint of gardeners, who perform an annual procession in his honour on Aug. 30, both at Breuil and at St. Vaugirard in Paris, when both the churches are elaborately decorated with flowers. Few saints in France are more highly honoured, and pilgrimages are made to a large number of places at which his relics are reputed to rest. The deaths of both the Black Prince and King Henry V. are referred to interference with his relics, the latter dying of fistula, a disease with which the saint was especially associated. He was also concerned especially with the cure of gangrene, ulcers and tumours, and polypus. He is to be regarded as one of the most important of 'medical' saints. In Scotland he becomes St. Musset or Muffet by addition of the honorific "Mo."

THE "GREAT FEAST" OF ISLAM AND MUHARRAM.—The Moslem year begins with the month of Muharram, the holy month, corresponding to our month of August. It is closely connected with the Great Feast which is held in the preceding month. This feast, completing the year, is intended to remove the old evils of the preceding period. Preparations for the sacrifice are made by purification of the people. This is effected by various means, shaving the head, bathing, the use of henna, pilgrimages to shrines, the giving of alms, etc. Then follows the purification of the sacrificial victim, usually a sheep, but failing that, a goat, or even a bullock or small camel. The fact that in Morocco and Moslem North Africa the skin of the victim is often worn by a man suggests that the sacrifice symbolises the death of the old year, the victim being a scapegoat for the people, and the resurrection of the new year in the victim's skin. The next group of customs is concerned with the utilisation of the sacred character of the victim in various ways in divination and magic, and finally come the purificatory rites to remove from the people any spiritual influence pertaining to the sacrifice which might be harmful when they enter upon the new year.

Although all the month of Muharram is holy—any of the numerous magical practices connected with it is held to be efficacious throughout the whole year—the tenth day is particularly sacred and, rather than the first, may be regarded as New Year's Day. It is especially associated with the peculiarly Shī'iah rite of mourning for Hosein and Husain, the sons of Ali, who died on this day. The similar cult of Bâba 'Aišōr in Morocco, a purely mythical being who personifies the old year, affords a reasonable presumption that the mourning for the sons of Ali is an Islamised version of rites connected with the death of the Old Year. At Fez, in a performance given nightly, a cardboard toy house resembles the "Tomb of Al-Husain" of the Shī'iah mysteries.

THE POLA CATTLE FESTIVAL.—The chief cattle festival of the Deccan and other parts of Bombay Presidency is held on the new moon of the month Sāvan or Bhādon (July–September). In the Ahmadnagar District it is held in August, when the Kumbis cover the cowsheds with tinsel paper or vermilion, tie tassels of fibre on the horns of the bullocks and decorate them with flowers, feed them with sugar, bow at their feet, rub them with sandalwood paste, and lay boiled rice before them. In the morning the herd is driven to the temple of the ape-god Hanuman and made to rush round it, the herdsman leading the way. In the Central Provinces an old ox leads the procession, carrying a wooden frame over which torches are fixed. A rope of maize leaves stretches across the way, which the ox has to break with its horns, when all stampede back to the stalls. In Berar, the cattle pass under the Toran or sacred rope dedicated to the ape-god, which is made of twisted grass covered with maize leaves. This rope is a prototype of the Toran, the wreath of maize leaves hung on the door of a bride and touched by the sword of the bridegroom when he comes.

September.

'RIDING THE FRINGES.'—A curious custom is recorded in Dublin, where it was known as 'riding the fringes' (? franchises), and in Cork, where it took place triennially at the beginning of September. In Dublin the Mayor and Corporation rode the bounds inland, and on reaching the sea-shore near Bullough, hurled a dart into the sea. This fixed the limit of maritime jurisdiction. At Cork the Mayor and Corporation put out to sea as far as an imaginary line between Poor Head and Cork Head, supposed to be the maritime boundary of the city. Then the Mayor in his official robes, attended by mace and sword bearer and other officials, went to the prow of the vessel and launched a javelin into the water. Regarded as an assertion of authority, the rite points to the worship of a sea deity—presumably Lir, the Celtic sea god, or possibly his son, Manannan.

THE ASHANTI YAM CEREMONY.—At the beginning of September a festival is held in Ashanti, known erroneously to Europeans as 'the Yam custom,' on account of the Yam harvest. It is a feast in which first fruits indeed appear, but as part of a propitiation of past kings of Ashanti and of the dead—a cleansing of the nation, and a purification of shrines of ancestral spirits, of the gods, and of lesser non-human spirits. Preparations for the feast began on a Monday eleven days before the actual festival. On the following Thursday week all sub-kings, chiefs, and office-holders began to assemble. The king and his retinue, preceded by the Golden Stool, informed the ancestral ghosts, gods, and spirits that the ceremony was about to take place by visiting the houses of all state dignitaries. He poured libations and made sacrifices before their doors, and at the shrines at the cross-roads and elsewhere in order. The festival lasted for several days, with a prescribed ritual for each day. On the afternoon of the Sunday, yams were placed by the king on the great fetish *Odwira Suman* and wine poured over it. In the evening the king went to a certain quarter of Coomassie and threw new yams to the spirits who had answered when called upon. On the Monday, the king, by striking an ox, before it was sacrificed, with the golden state sword, deliberately broke a solemn taboo and defiled a sacred shrine—an evil which was repaired the following day by the sacrifice of a sheep over the golden sword. On the following Friday the country was solemnly purified, beginning with the Golden Stool. But only after new yams had been sent to the shrines of ancestral ghosts, of gods and of non-human spirits, could the king, the chiefs, and the nation partake of the new yams of the harvest.

Societies and Academies.

PARIS.

Academy of Sciences, July 17.—Charles Moureu, Charles Dufraisse, and Marius Badoche: Autoxidation and antioxygen action. The catalytic properties of phosphorus compounds. Details of the antioxygen action of various compounds of phosphorus towards benzaldehyde, furfuraldehyde, and styrolene. Phosphoric acid and the phosphate slow down some oxidations in a very marked manner.—S. Winogradsky: The agronomic application of a microbiological test. A modification of the azobacter test is described, which indicates the lime and phosphoric acid requirements within 48 hours.—S. Drzewiecki: A theoretical interpretation of the experimental ballistic curve $F(v)/v^2$.—Jean J. Trillat: A new method of X-ray spectrography. Application to the study of the orientation of the fatty acids by mercury.—C. Marie and Mlle. M. L. Claudel: The influence of the pH in the electrolytic deposit of copper in the presence of gelatine. It is known that when copper solutions containing gelatine in solution are electrolysed, the weight of the deposit is greater than that calculated from Faraday's law. This increase depends on the pH of the solution and is at a maximum for pH about 3·2.—A. Blanc: The photoelectric current as a function of the field and fatigue.—A. Morel, P. Preceptis, and A. Galy: The action of picric acid upon glycyl-glycine. This compound has been obtained in definite crystals, possessing the composition of a monoglycylglycine monopicrate. The crystallographic characters are given.—J. O. Haas and C. R. Hoffmann: Tertiary movements in the plain of Northern Alsace.—G. Nadson and N. Krassilnikov: Schizophytes of the cæcum of the guinea-pig: Anabæniolum.—R. Dieuzeide: The evolutive cycle of *Pemphigella follicularia*.—R. Sazerac and H. Nakamura: The mechanism of the preventive action of bismuth against *Spirochæta icterohemorrhagiæ*.

COPENHAGEN.

Royal Danish Academy of Science and Letters, May 11.—P. K. Prytz: A manometer based on the optical contact between a microscope and a mercury surface. The triple point of water. In determining the height of a mercury surface, a microscope making optical contact with the surface has many advantages over a pointer; and particularly, it allows of much greater precision. A method by which the vapour pressure of water at the triple point can be measured is given.—Niels Bjerrum: Potentiometric determinations of the hydrogen ion activity in mixtures of acids and bases at different salt concentrations and temperatures have been made with the assistance of Miss A. Unmack.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 12).—A. E. Fersman: Chemical constitution of the earth and meteorites. A comparison of average analyses of earth and of meteorites shows their extraordinary resemblance (except in the content of magnesium, calcium, sulphur, manganese, and carbon), which suggest the existence of some general laws of cosmic chemistry. — A. E. Fersman and N. Vlodavec: Phenomena of kaolinisation in the emerald mines of the Ural. An analysis of a green clay-like mineral showed it to approach the formula

$$(Al,Fe''',Cr)_2O_3 \cdot 3SiO_2 \cdot 4H_2O.$$

This mineral constitutes an indication of the possible presence of emeralds.—P. P. Lazarev: A method of determination of the age of a man based on the sensitivity of the eyes. A formula for the determination is given.—S. Kostychev and S. Soldatenkov: Pyruvic acid as an intermediate product of alcoholic fermentation. It has always been found possible to isolate pyruvic acid from the products of fermentation of sugar under the influence of yeast when pure cultures of the latter are used.—M. A. Lavrova: Ancient dunes of the Onega peninsula. Geological and geographical description of the dunes.—S. D. Lvov: The active acidity and buffer properties of grapes and some other fruit. The pH value of the sap of fruit is not accidental, but is correlated with the processes of dissociation of acids of the sap.

VIENNA.

Academy of Sciences, May 18.—G. Koller and E. Krakauer: A synthesis of acridine and acridone.—G. Koller and E. Strang: A synthesis of acridinic acid.—H. V. Graber: Report on geological-petrographical researches in the region of the Hercynian Danube fault.—L. Waldmann: Studies on the metamorphosis in the Moldau-Danube primitive rocks of the Waldviertel.—J. Laimböck: The influence of radium radiation on the piezo-electric behaviour of a quartz plate.—E. Göllnitz: The quaternion functions log x and arctan x.

May 24.—F. Kautsky: The biostratigraphic importance of the pectins of the Lower Austrian Miocene.—E. Gebauer-Fülnegg and F. von Meissner: The question of the preparation of derivatives of the phenol-monosulphonic chlorides.—E. Gebauer-Fülnegg: On aryl-sulpho-phenyl-chlor-amide.—E. Riess and W. Frankfurter: On sulphur-containing derivatives of acetophenone.—B. Karlik and E. Kara-Michailova: The luminescence excited by α-rays and its connexion with the energy of particles.

Official Publications Received.

BRITISH.

Eighth Annual Report of the Scientific and Industrial Research Council of Alberta, 1927. (Report No. 22.) Pp. 48. (Edmonton, Alba.)

The Journal of the Burma Research Society. Vol. 17, Part 2: Geography of South Tenasserim and the Mergui Archipelago. By H. L. Chhibber. Pp. 127-156. (Rangoon.)

Department of Commercial Intelligence and Statistics, India. Agricultural Statistics of India, 1925–26. Vol. 2: Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, and Land Revenue Assessment in certain Indian States. Pp. v+87. (Calcutta: Government of India Central Publication Branch.) 1.4 rupees; 2*s*. 3*d*.

FOREIGN.

Zemkopibas departamenta rakstu krājums, 7 burtnica. Latvijas jūras zvejniecciba 1927 gadā. (Bulletin statistique des Pêches maritimes de Lettonie, année 1927.) Sakopojis V. Miezis. Pp. 53. (Rigā.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1927.) By William Henry Fox. Pp. 77+3 plates. (Brooklyn, N.Y.)

Diary of Societies.

FRIDAY, SEPTEMBER 7.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

SATURDAY, SEPTEMBER 8.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District Meeting) (at Town Hall, Great Yarmouth), at 11.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District Meeting) (at Town Hall, Morpeth), at 2.

CONGRESSES.

AUGUST 30–SEPTEMBER 2.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Lausanne).—Including following Lectures:—Prof. E. Bosshard: Past and Future of the Wholesale Chemical Industry.—Prof. P. Termier: Recent Impressions of Travel.—Prof. M. Askanazy: Successes and Aims in the Study of Tumours.—Prof. A. Reymond: The Occult Sciences in Antiquity: a Methodological Study.

SEPTEMBER 3–10.

INTERNATIONAL CONGRESS OF MATHEMATICS (at Bologna).—In following sections:—Arithmetic, Algebra, Analysis; Geometry; Mechanics,

Astronomy, Geodesy, Geophysics, Physical-mathematics, Theoretical Physics; Statistics, Mathematical Economics, Calculation of the Probabilities, Science of the Actuary; Engineering and Industrial Applications; Elementary Mathematics, Didactical Questions, Mathematical Logic; Philosophy, History of Mathematics.

SEPTEMBER 4–7.

INSTITUTE OF METALS (Autumn Meeting) (at Liverpool).

Sept. 4.

At 8 P.M.—

(In Arts Theatre, University, Brownlow Hill.) F. G. Martin: Non-Ferrous Metals in the Shipping Industry (Seventh Autumn Lecture).

Sept. 5.

At 10 A.M.—

(At Adelphi Hotel.) General Meeting. A selection of Papers will be presented in abstract and discussed.

Sept. 6.

At 10 A.M.—

(At Adelphi Hotel.) General Meeting. A selection of Papers will be presented in abstract and discussed as time permits.

Sept. 7.

At 9.45 A.M.—

Trip to Bettws-y-Coed and Dolgarrog.

Communications.

The following communications are expected to be submitted:—

Dr. C. J. Smithells, S. V. Williams, and J. E. Avery: Laboratory Experiments on High Temperature Resistance Alloys.

U. R. Evans: Corrosion at Discontinuities in Metallic Protective Coatings.

Dr. A. G. C. Gwyer, H. W. L. Phillips, and L. Mann: The Constitution of the Alloys of Aluminium with Copper, Silicon, and Iron.

W. R. D. Jones: The Copper-Magnesium Alloys. Part III.

G. B. Brook and H. J. Simcox: Note on Practical Pyrometry.

R. May: Eighth Report to the Corrosion Research Committee. The Corrosion of Condenser Tubes. 'Impingement Attack,' its Cause and Some Methods of Prevention.

J. E. Malam: The Rockwell Hardness Test.

T. F. Russell, W. E. Goodrich, W. Cross, and (in part) N. P. Allen: Die-Casting Alloys of Low Melting Point.

F. Hargreaves: Work-Softening of Eutectic Alloys.

R. Genders, Dr. R. C. Reader, and V. T. S. Foster: Die-Casting of Copper-Rich Alloys.

Dr. C. S. Smith: The Alpha Phase Boundary of the Copper-Silicon System.

S. L. Archbutt, J. D. Grogan, and Dr. J. W. Jenkin: Properties and Production of Aluminium Die-Castings.

Dr. W. Hume-Rothery: Methods for Investigating Alloys of Reactive Metals.

C. H. M. Jenkins: The Strength of a Cadmium-Zinc and of a Tin-Lead Alloy Solder.

D. R. Tullis: Note on the Treatment of Aluminium and Aluminium Alloys with Chlorine.

SEPTEMBER 5–12.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Glasgow).

Wednesday, Sept. 5.

At 8.30 P.M.—

Inaugural General Meeting (in St. Andrew's Hall, Charing Cross).—Sir William Bragg: Modern Developments of the Physical Sciences and their Relation to National Problems (Presidential Address).

Thursday, Sept. 6.

At 10 A.M.—

Prof. E. C. C. Baly: Fluorescence, Phosphorescence, and Chemical Reaction (Presidential Address to Section B).

Prof. W. Garstang: Larval Forms: Their Origin and Evolutional History (Presidential Address to Section D).

Joint Discussion on Human Distributions in Scotland.

Prof. Dame Helen Gwynne-Vaughan: Sex and Nutrition in the Fungi (Presidential Address to Section K).

Dr. J. S. Gordon: The Livestock Industry and its Development (Presidential Address to Section M).

At 11 A.M.—

Prof. J. Brontë Gatenby, and others: Discussion on Cell Structures.

At 11.15 A.M.—

Dr. G. C. Simpson, and others: Discussion on the Mechanism of Thunderstorms.

Sir William Ellis, Col. Ivor Curtis, and others: Joint Discussion on School, University, and Practical Training in the Education of the Engineer.

At 12 NOON.—

Prof. J. L. Myres: Ancient Geography in Modern Education (Presidential Address to Section E).

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

Dr. Vaughan Cornish, and others: Discussion on the Preservation of Scenic Beauty in Town and Country.

Friday, Sept. 7.

At 10 A.M.—

Dr. R. A. Sampson, and others: Discussion on the Photographic Measurement of Radiation.

Dr. J. Vargas Eyre, and others: Discussion on Fermentation.

Sir William Ellis: The Influence of Engineering on Civilisation (Presidential Address to Section G).

Dr. H. E. Magee, Prof. E. P. Cathcart, Capt. J. Golding, and Dr. N. C. Wright: Joint Discussion on Lactation and Nutritional Factors allied thereto.

Dr. Cyril Norwood: Education: the Next Steps (Presidential Address to Section L).

At 11 A.M.—

Prof. T. H. Pear: The Nature of Skill (Presidential Address to Section J).

Saturday, Sept. 8.

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. E. A. Westermarck: The Study of Popular Sayings (Frazer Lecture in Social Anthropology).

Sunday, Sept. 9.

At 11 A.M.—

Official Service in the Cathedral Church of St. Mungo. Preacher: Rev. Dr. Lachlan Maclean Watt.

Monday, Sept. 10.

At 10 A.M.—

Prof. A. W. Porter: The Volta Effect: Old and New Evidence (Presidential Address to Section A).

E. B. Bailey: The Palæozoic Mountain Systems of Europe and America (Presidential Address to Section C).

Prof. Allyn Young: Increasing Returns and Economic Progress (Presidential Address to Section F).

Sir George Macdonald: The Archæology of Scotland (Presidential Address to Section H).

At 11 A.M.—

Prof. C. Lovatt Evans: The Relation of Physiology to other Sciences (Presidential Address to Section I).

Prof. F. O. Bower, and others: Discussion on the Size Factor in Plant Morphology.

At 11.15 A.M.—

Dr. H. H. Read, Dr. Gertrude Elles, and others: Discussion on Problems of Highland Geology.

At 11.30 A.M.—

Prof. T. H. Pear, Prof. H. Clay, and C. G. Renold: Joint Discussion on the Nature and Present Position of Skill in Industry.

Tuesday, Sept. 11.

At 10 A.M.—

Dr. C. J. Davisson, and others: Discussion on the Scattering of Electrons by Crystals.

Sir William Pope, and others: Discussion on Recent Advances in Stereo-chemistry.

Prof. F. E. Suess, and others: Discussion on the Tectonics of Asia.

J. A. Venn, Dr. J. S. King, and others: Joint Discussion on the Incidence of Taxation in Agriculture.

G. E. Briggs, Dr. F. G. Gregory, and others: Discussion on the Interpretation of Growth Curves.

Aims of, and Developments in, Broadcasting. Papers:—(*a*) Sir John Reith: Wireless in the Service of Education. (*b*) Salter Davis: An Experiment in Educational Broadcasting.—Sir Oliver Lodge, W. A. Brockington: Discussion.

At 12 NOON.—

Prof. T. H. Mortensen, Dr. F. A. Bather, and others: Discussion on Bothriocidaris and the Ancestry of Echinoids.

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

At 2.15 P.M.—

Prof. F. E. Fritsch, R. Gurney, and others: Joint Discussion—A Biological Investigation of British Fresh Waters.

Dr. G. S. Carter: The Conditions of Life in a Tropical Swamp: an Investigation of the Swamps of the Paraguayan Chaco (Lantern Lecture).

At 2.30 P.M.—

Prof. E. Taylor-Jones: Spark Ignition (Lecture).

Dr. J. D. Sutherland, and others: Joint Discussion on the Economic Balance of Agriculture and Forestry.

At 2.45 P.M.—

Discussion on the Position of Geography in Scottish Schools.

At 5 P.M.—

Sir John Stirling-Maxwell, Bart.: Forestry in Scotland: Past, Present, and Future (Lecture).

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. F. G. Donnan: The Mystery of Life (Evening Discourse).

Wednesday, Sept. 12.

At 12 NOON.—

(In Fore Hall, University.) Concluding General Meeting.

SEPTEMBER 6 AND 7.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS (Annual General Meeting) (at Masonic Hall, Edinburgh).—Discussion on Paper by A. M. Simpson: Lands Valuation and Income Tax Charges.—Dr. C. Carpenter: William Young Memorial Lecture.—G. Braidwood: Quality.

SEPTEMBER 10–13.

INTERNATIONAL CONFERENCE ON LIGHT (at Lausanne and Leysin).—Among the subjects to be discussed are the Methods of Measuring the Energy and Biological Activity of Light Rays; Irradiated Foods and Sterols; the Climatic and Light Therapy of Various Forms of Tuberculosis.

SEPTEMBER 12–15.

CONGRESS OF THE GERMAN PHARMACOLOGICAL SOCIETY (at Hamburg).

Sept. 13.

Discussions on the Work of the Heart and Vessels in Honour of William Harvey, with papers by Liljestrand, Jarisch, Straub, Anrep, and Mansfeld.

Sept. 14.

Papers by Flury and Zangger on Modern Industrial Intoxications.

Sept. 15.

Paper by Barger on Ergot Bases.