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Work of the Forestry Commission: Progress and Promise.

II.

In view of the fact that the first ten-years period of the Forestry Commissioners' work was to expire at the end of March 1929 and that a new grant to continue the work would have to be obtained from Parliament, the Commissioners in 1927 discussed with the Government the question of a forest policy for Great Britain under the heads (1) general forest policy, (2) programme for the second decade (being an instalment of policy) which the country was in a position to undertake.

Under the question of a general forest policy the Commissioners held that in order to ensure a supply of home-grown timber (both softwood and hardwood) adequate for the normal well-being of the nation and for safety in time of national emergency, it was necessary to proceed steadily with the afforestation of uncultivated land and the improvement of existing woodlands (almost totally neglected during the first decade). A census of existing woodlands was published by the Commissioners in 1924. An analysis of this most valuable and interesting report showed that the acreage of hardwoods in Great Britain was depreciating, and that the existing woods and the areas which had been felled were in a far from satisfactory position—that, in fact, there was little chance of the private proprietor being able to undertake the work.

In the forecast of the present decade's work, it is stated: "It had been hoped that the first decade would witness the planting up of arrears of fellings accumulated during the War, and the second (decade) improvement of existing woodlands and a large extension of the area under forest. These expectations are very unlikely to be realised." This statement is a most surprising one to find in the report. From 1922 onwards it must have been patent to the Commissioners, several of them important landowners, that the heavy taxation and death duties would make it impossible for the private owner to do much to assist the reafforestation of the areas felled during the War. Further, the Commissioners presumably had at their disposition official statistics showing the position of the country generally *vis-à-vis* taxation, the break-up of estates, and so forth. All that was needed was a broad forestry administrative experience to point the way to efficient handling of a difficult position.

The Commission, however, was tied to a fixed annual coniferous planting programme. This next

decade it is again tying itself down in a similar fashion. There have already been many complaints throughout the country on the neglect to replant hardwood areas throughout the first decade, an insignificant 7000 acres being the total area dealt with by the Commissioners. The latter comment upon the difficulty of dealing with the owners of such areas, touch upon the possibility of asking for powers for compulsory acquisition, etc. But the proposed programme definitely shows preoccupation with the coniferous planting programme and a lukewarm attitude towards the existing forest or, better expressed, woodland areas, throughout the country—whether felled during the War, exploited since 1919, or being exploited (as are many oak woods) at the present time. Owing to the neglect of the areas felled during the War, they have now been lying disforested for at least twelve years; the forest soil has deteriorated by that period of years; the surface is covered with a heavy weed growth, which will be expensive (and is proving so) to remove. The Commission has offered grants to private proprietors to assist in the replanting of such areas, but admit the practical failure of this policy.

The ten-year forecast furnishes no evidence that the Commissioners have advanced any further towards a solution of this important matter. It would appear that they intend to allow the bulk of these areas, possessing a true forest soil, to remain for twenty years unplanted; whilst they purchase elsewhere bare areas of necessarily poorer soil, to grow a coniferous crop, of problematical value at the end of a first rotation. Surely the Commissioners realise that the discovery of a solution of this very urgent problem rests at their door. At present they do not appear to have got further than the suggested possible course of asking Parliament for compulsory powers to acquire such areas. It may be suggested that such a step would not unlikely prove widely unpopular and would do serious damage to the cause of forestry in Britain.

That the value of the Commissioners' work since 1919 is recognised by Parliament is evidenced by the grants made for the next decade. At the instance of the late Conservative administration, Parliament voted a sum of £5,500,000 into the Forestry Fund, commencing from April 1, 1929. This sum was increased by the succeeding Labour Government to £9,000,000. Forest receipts during the decade are estimated at £2,160,000—giving a total sum for expenditure during the period of £11,160,000.

For forestry operations the estimated cost for the decade is slightly more than £8,000,000. Provision is made for the acquisition of plantable land at a uniform rate of 60,000 acres a year. The total planting programme is placed at 353,000 acres, made up of 330,000 acres of afforestation and 23,000 acres of replacements—that is, of replanting existing plantations! It is proposed to continue the system of planting grants, and it is anticipated that between £140,000 and £150,000 may be expended on this work during the decade. On the subject of forest workers' holdings, it is laid down that 3000 will be established during the period, at an average cost of approximately £625 each. Education and research are each to have allotted £100,000, and special services £20,000.

The objects and aims of a forest policy in a country are not necessarily always involved in direct revenue returns in cash. The indirect returns, in so far as they are advantageous to the community at large, may have a higher value. In Britain it is this latter point of view which must govern the forestry question for some time to come. So far as can be judged in these very difficult times, the grants made by Parliament may, through the indirect benefits accruing to the people, be fully justified, and the public may be obtaining a full return for the money expended. Future generations will be able to give the true answer. But it is believed that the advent of the Commissioners and of their work has already proved of benefit to the community on the countryside. The second decade of their activities would be of even greater value to the country as a whole, if the Commissioners would tear up the Acland Report—of admitted value in its day, up to a certain point—and adopt a wider vision and broader principles of forest administration.

Physiographic Evolution of Britain.

The Physiographical Evolution of Britain. By Dr. L. J. Wills. Pp. viii + 376. (London: Edward Arnold and Co., 1929.) 21*s*. net.

IT is one of the primary aims of stratigraphical geology to integrate into a picture or chart the results of the mapping of rocks or deposits and the palæontology of each noteworthy geological period. From the early years of the last century, if no earlier, the pioneers such as Lyell and Trimmer had resorted to this method of portrayal, and the device has been employed by many, perhaps most, of their successors. Some have been content to represent an 'ideal landscape' or a restoration of the assumed distribution of land and water at some specific period of

an area of limited extent; while others, greatly daring, have transgressed narrower limits and attempted to depict regions of continental or even wider extent.

In these exercises, more than in most speculations, an author is giving hostages which he may, to his sorrow after, have to redeem; at the same time, the discipline of a preliminary essay upon a map may, and doubtless often does, disclose incompatibility, quite as often as it opens wider vistas.

The subject of the present work has been dealt with comprehensively by only two previous writers—Hull in 1883 and Jukes-Browne in successive editions in 1888, 1893, and 1911. These works still have a value, especially the last, for the stratigraphical data they furnish, allowance being made for corrections and results that have accrued from later researches; but Dr. Wills's book approaches the subject with a fullness of knowledge to which the earlier writers could make no claim. Though in the preface Dr. Wills modestly defines his aim as "to fill a certain gap in student literature", there is, we venture to say, no geologist, adept or novice, who will fail to benefit by attentive reading, whether for its copious references to British and foreign literature or for the critical faculty which is brought to bear on the strong and weak points of attractive hypotheses.

Part 1 is devoted to the physiographical principles upon which these reconstructions are based, and the subject is illustrated by a large number of well-chosen diagrams, most of which are original, either in their entirety or as the author's amplified interpretation of verbal descriptions of other writers (for example, Fig. 9, *c*. Ring-dykes and cone-sheets). A short discussion of the nature of the geological record completes Part 1; our author then plunges very literally *in medias res*—into, not the restoration of Pre-Cambrian physical geographies, but into the Post-Carboniferous systems! This is because "the newer rocks of the geological column on account of their greater simplicity are better fitted than the more ancient systems for a study of the physiographical phenomena of the past".

In these "newer rocks" the author includes the uppermost Coal Measures and Permian rocks, as they and the Trias, in his judgment, originated under more or less similar conditions on the surface of a new continent that he considers to have begun to emerge first in Coal Measure times. The present reviewer is disposed to antedate the emergence of this land mass, in view of the many signs of continental conditions seen in the Old Red Sandstone and in the Lower Carboniferous beds throughout the greater part of the British area. "It was during the latter part of the Carboniferous period that great earth-movements [the Hercynian] set in, which continued intermittently until its close and for long after."

At the close of the Cretaceous period, a critical condition had again come about which brought with it vast modifications of the European geography, by which the widely extended Chalk Sea was expelled from the greater part of northern Europe, at the same time that the Tethys maintained the character and to some extent the position of the Mediterranean.

In our own region great events transpired; earth-movements began which were accompanied by volcanic activity affecting a tract extending from Cornwall to Greenland. While these momentous changes were in progress in north-west Europe, others still more impressive were developing farther south. The Tethys, which had long sustained the rôle of a great settling vat for the detritus of two continents, now began to yield in a reverse direction, and from a mainly synclinal arrangement became, under compressive stresses, mainly a geanticline nipped between the jaws of the two relatively rigid masses of Hercynian Europe and Africa. The effects of this compression are seen in the overriding of the Alpine foreland by successive 'nappes' and the less pronounced reversals of the African slopes. These features are illustrated by text-figures 72-84.

The Cainozoic system in the Anglo-Parisian 'cuvette', a convenient term introduced by the author to signify "a basin in which sedimentation is going on", is discussed in Chap. xvii.; and the Quaternary Period under the headings "Glaciated Areas" and "Earth-movement and Climatic Changes in the British Extra-Glacial Area", in Chaps. xviii. and xix., is a valuable summary of the results of recent work in glacial geology, in which the author has played an important part, and the noteworthy effects of Pleistocene earth-movements in Britain and especially in Scandinavia.

The author then reverts to the consideration of the Pre-Cambrian and Palæozoic systems which were held in abeyance until the more accessible record of the Post-Carboniferous series had furnished a readily intelligible illustration of the processes involved. Parts 3-8 are therefore devoted to the review of the topics of the Pre-Cambrian

conditions, especially the physiographical processes indicated:

"If . . . we limit our studies to the era after a solid crust with continents and oceans had developed with an atmosphere and hydrosphere not greatly differing from those that have obtained in the Cambrian and more recent periods, it seems logical to assume that the processes of change were similar to those of later times, though they may have differed in degree and in the tempo at which they worked."

The Lower Palæozoic systems, embracing Cambrian, Ordovician, and Silurian, are treated as a study of a geosyncline developing in a marine area with insular or submarine volcanoes. This geosyncline had for its foreland a continental mass, 'Atlantis', of which the portion now visible consists of the Outer Hebrides and the north-west Highlands; the foredeep comprised Scotland, the Lake District, and northern Ireland; a second deep, at times connected with the foredeep, extended from north Wales to south-east Ireland. The sinking of the sea-floor persisted in its main features throughout the Lower Palæozoic systems, and the distribution of the types of deposition is explained by reference to the regions of the sea-floor.

At or near the close of the Silurian period a new restlessness affected the British area, of which some indications had already appeared. The geosyncline began to give way, just as in Tertiary times we have seen that of southern Europe did. It was in fact nipped, as the type was later, between two massive jaws, of which that on the south-east is obscure. The culmination of this movement is placed by the author in the time immediately preceding the Dittonian, or upper part of the Lower Old Red Sandstone; it affected not only the north-west and west of the British Isles but also extended in one direction through the length of Scandinavia, where its course is approximately north-east with overthrusting to the north-west. In its extension through Scotland and Ireland the alignment was changing to a more east-to-west direction in the south of Ireland, where it encounters the Atlantic. Beyond the two apparent termini these Caledonides may with much probability be traced on the north in a majestic curve through Spitsbergen into northern Greenland. In the opposite direction, in the Acadian chain of North America, comparable structures have long been known, the connexion being by an assumed syncline crossing the present floor of the North Atlantic, with a branch passing up Davis Strait and Baffin Bay.

A transgressive series, marine in the south and continental in the north of Britain, brought in a new continental condition indicated by the Old Red Sandstone and Carboniferous series, to the description of which the author devotes some fifty pages. The conditions of deposition of the Lower Carboniferous appear to have been more fully marine in the south and deltaic growths in the north, with occasional periods of balance between deposition and subsidence, leading to the formation of swampy flats upon which peat-beds to form coal seams were accumulated. The clearer waters of the Anglo-Welsh area gave origin to great beds of Carboniferous limestone, the deposition of which was, however, controlled by faulting movements, of which the Craven faults marking off the 'Rigid Block' of Prof. Marr are examples. The researches of Garwood and his school have enabled the mapping of the components of the limestones and of the Yoredale facies to be traced over large areas through the British area.

This phase was brought to a close by the invasion from the north of the great series of coarse grits of mainly deltaic origin with intercalations of marine shales characterised by a succession of goniatites, forms by the aid of which the baffling complication of sandstone beds has been unravelled. A very full discussion of the conditions attending the deposition of the Coal Measures, perhaps the most complete 'restoration' which is possible for any British formation, and the formation and constitution of coal seams brings this section to a close.

A concluding chapter is devoted to the description of the succession of volcanic rocks in the British series.

It remains to say that the book is very fully indexed. P. F. K.

The Problem of Chemical Affinity.

Le problème de l'affinité chimique et l'atomistique: étude du rapprochement actuel de la physique et de la chimie. Par Prof. Charles Brunold. Pp. v + 118. (Paris: Masson et Cie, 1930.) 20 francs.

THE author of this very interesting essay has dealt with the theme of chemical affinity in its relation to physical theories from the early period to the present day. His treatment is historical and critical, and the main conclusion which he reaches is that the problems of chemical combination grouped together under the concept

'affinity' have always proved, and are for some time likely to prove, much too complex and specific to allow of any explanation by prevailing physical theory which will prove at all satisfying to the chemist. He begins his historical account by the statement that "the notion of affinity was introduced into science in 1733 by Boerhaave", whereas it is well known that the name was used by Albertus Magnus, and that very detailed investigations on elective affinity were published by Mayow in 1674, based on earlier quite definite and clearly expressed opinions of Boyle. These ideas, carried further by Stahl (whose results seem to be incorporated, without acknowledgment, by Newton in his "Opticks"), were summarised in the Affinity Tables of Bergman. The first attempt to explain the results on the prevailing physical theory made use of mechanical conceptions, since mechanics was then the senior branch of theoretical physics. Newtonian attractions were introduced, and when the researches of Berthollet had removed the foundation of Bergman's theory, their author could still make appeal to the mechanical attractions between the particles to account for the action of mass.

With Davy and Berzelius another epoch began. The study of electricity had become of predominating interest in physics, and the electrochemical theory sought to subordinate all chemical theories to the laws of electrostatics. This view, in turn, soon proved insufficient, and the study of carbon compounds and substitution turned the thoughts of chemists away from the views of Berzelius. The latter, however, had much in them which has reappeared in modern theory, especially in the views of Kossel, and as M. Brunold says, the explanations which may serve for the compounds of one single element, carbon, need not necessarily apply to the other ninety-one. It has gradually become clear that there are, in fact, two different types of valency at least, 'polar' in ionic salts and 'non-polar' in compounds such as those of carbon. The ordinary valency formulæ, which may express well enough the reactions of carbon compounds, fail completely in the chemistry of other elements. The theory of Werner has filled an important place in this field, and it would have been desirable for M. Brunold to have devoted a little more space to its explanation. With the advent of the theory of energy, a relation between affinity and heat of reaction was introduced, but this in turn proved abortive.

After the new advances in physics leading to the isolation of the electron and the study of the structure of the atom, another attempt to explain the phenomena of chemical combination could be made. The earlier atom models are considered one by one, and the reasons for their abandonment (after they had promised to provide explanations of valency) are explained. In the closing pages of the book it is made clear that the latest atom models are in turn fading from the screen, and that "the mechanics of Bohr seems to-day out-of-date". In this section, the important part played by the Periodic Table, an achievement of pure chemistry, is properly emphasised. "Every time that the theories or methods of physics have, in the study of chemical problems, attacked a case of some slight complexity, they have been compelled to make an appeal to the results of chemistry, that is to say, to renounce at least provisionally a development according to their own proper means."

It will be seen that the opinions of the author, all of which are most carefully reinforced by relevant chemical facts, are not without a certain vigour, and the book is one which both chemists and physicists can read with interest and profit. The molecule with which the chemist operates is to a large extent static, and whatever relation it may have to prevailing physical theory, the 'octet' is something which, according to M. Brunold, 'works'.

Philistine Cities.

(1) *Gerar*. By Sir Flinders Petrie. Pp. vii + 34 + 72 plates. 50*s*.

(2) *Beth-Pelet I*. (*Tell Fara*). By Sir Flinders Petrie; with a Chapter by Olga Tufnell. Pp. vii + 26 + 72 plates. 50*s*.

(3) *Corpus of Dated Palestinian Pottery*. By J. Garrow Duncan. Including Pottery of Gerar and Beth-Pelet dated and arranged by Sir Flinders Petrie, and Beads of Beth-Pelet dated and arranged by J. L. Starkey. Pp. 21 + 83 plates. 30*s*.

(London: British School of Archæology in Egypt; Bernard Quaritch, Ltd., 1928–1930.)

THE British School of Archæology in Egypt has widened the scope of its activities, and since 1926 has conducted excavations in the coast plain of south Palestine. For this change there was the excellent reason that the only period of Egyptian history of which even the outlines are obscure is that of the Hyksos conquest; and for this it was in this quarter, whence those conquerors apparently came, that clues were most likely to be found.

(1) In 1926 and 1927 the selected site was Tell

Gemmeh, identified with the Biblical Gerar, eight miles south of Gaza and from the coast, a natural hill of fifty feet, covered by another fifty feet of debris, scarped by the Wady Ghuzzeh and deeply eroded by wind and rain, so that only a small area of its original platform-top remains. Six successive periods of building were uncovered, within a depth of thirty feet, each ignoring its predecessor, so that there was good evidence for distinguishing the contents of each. They were assignable, respectively, the latest to the Persian conquerors in the sixth century B.C., the earliest to the Egyptian protectorate of Thothmes III. in the fifteenth. Between these there were reoccupations by Rameses III. about 1194 B.C., by Shishak about 930 B.C., by the Jewish Amaziah about 810 B.C., and by Psammetichus I. about 660 B.C.

Among architectural remains, the great military granaries are notable: among the small objects, an interesting series of safety-pins, of local workmanship, and surprisingly early date, according to the excavators; the copious strings of amulets and beads, of the centuries from 1200 to 950 B.C.; the evidence not only for iron-smelting but also for the tempering of swords, about 870 B.C., and the rudely sketched linear designs on limestone incense-burners resembling those of iron age Cyprus. The pottery, especially in the 'Philistine' period, is influenced, as at Lachish and Askalon, by Minoan pot-painting from oversea. The numerous weights give a clue to successive commercial systems which have prevailed along the great corridor between Asia and Egypt, in which Gerar lay.

(2) In 1928 work was begun at Tell Fara, a large site, rather farther inland, and deeply eroded by the Wady Ghuzzeh so that its structure was revealed, with nearly fifty feet of ruins on a natural hill a hundred feet high. Practical difficulties were greater here than at Gerar; the nearest water, for example, being eleven miles off. The position and contents of this site identify it, as its name also suggests, with Beth-Pelet, the home of the Pelethites, King David's royal bodyguard. Besides the contents of the fort and its houses, the cemeteries yielded instructive material. The Hyksos period, with characteristic un-Egyptian pottery, and scarabs imitated from a series of Egyptian models, runs from the days of the XIIth Dynasty to the XVth, which represents the Hyksos conquerors of Egypt, as known from graves at Yehudiyeh: and it is claimed that the sequence of scarab designs at Tell Fara shows that the XIIIth and the XVIth Dynasties were parallel, and began together at the close of the XIIth.

The Egyptian protectorate of the XVIII-XIXth Dynasties is a period of conflicting influences, Egyptian from the south, and Minoan from oversea. Debased Minoan decorations are here dated surprisingly early, and oddly identified. The scarabs seem to be still the basis of chronological sequence. A steel dagger (Pl. xxi. 90) about 1370 B.C. is noteworthy both for form and for material: Tutankhamen's dagger is of the same generation. Flange-hilted daggers of bronze are also early of their kind; and there are some interesting forms among the ear-rings. A terra-cotta horseman (TM 379) is oddly described as "Scythian" though dated "to the age of David and Solomon".

A notable group of tombs is described as "Solomonic". They are stone-lined and roofed with stone-slabs, and contained ornaments of gold, with occasional electrum and silver and fine cornelian beads. The ivory gaming board, 188, is described as "unique" on p. 12, but as "a well-known form" on p. 109. Among the later tombs, the Egyptian lotus-ornament on a vase (17 K7 in text, cf. 17 P5 in Pl. xxxix.) is notable, if it be so early as is said; and the calendar reckoner (Pl. xl. 481) very curious. On the small face-amulets (xl. 493-5) the feather head-dress of the 'sea-raiders' of Ramessid times reappears. Far the finest art works from this site are the silver bowl and bronze ladles, and the jointed bedstead of iron, bronze, and wood, from a fine tomb of about 850 B.C.

The fort itself shows the same characteristic glacis-defences as Hyksos sites at Yehudiyeh and Heliopolis. Its inner arrangements have naturally been much remodelled under Egyptian, Philistine, and Israelite rule; and the site was heavily refortified during Shishak's occupation of Palestine in the tenth century.

(3) Mr. J. Garrow Duncan's "Corpus of Dated Palestinian Pottery" includes the new material from Gerar and Beth-Pelet, and also from the American excavations at Bethshan. The arrangement is by shapes, and consequently fabrics are often mixed, as well as periods and sites; but for ready reference the shapes are most easily recognised; and a convenient notation gives a clue to date and provenance. Decorative designs are also analysed into their component motives, again irrespective of style or fabric; which is much less convenient or instructive. At the end is a similarly constructed key to Palestinian beads. There are some useful notes on the general discrepancies in dating among earlier excavators in Palestine, and on the uselessness of certain well-known pieces of work, through neglect of obvious precautions.

Our Bookshelf.

Leçons de géométrie projective. Par Prof. Federigo Enriques. Traduit de la quatrième édition italienne par Prof. P. Labérenne. Pp. iv + 430. (Paris : Gauthier-Villars et Cie, 1930.) 60 francs.

THE present French translation from the fourth edition of these lessons on projective geometry by the eminent Italian mathematician-philosopher to a certain extent meets a long-felt want. Perhaps the most striking feature of the book is the remarkably clear and consistent way in which the subject is developed from its logical foundations solely by means of graphical methods, based upon five purely geometrical postulates together with a sixth which is the geometrical equivalent of Dedekind's continuity theorem. Although so much stress is laid upon projective constructions, the relations between projective and metrical geometry are expounded in the text whenever occasion arises, whilst the connexions with group theory and algebraic geometry are touched upon in several appendices.

As regards the detailed arrangement of the book, it is sufficient to state that the first five chapters deal with definitions, fundamental propositions and preliminary theorems, the law of duality, the postulate of continuity, and Staudt's theorem. Then follow chapters on projectivities and involutions between forms of the first and second ranks, with applications to conics, their projective and focal properties, and to cones, ruled quadrics, and twisted cubics. A chapter on projectivities between forms of the third rank completes the work. The perusal of this book is sure to afford great pleasure to all interested in the development of projective geometry.

Testing Radio Sets. By J. H. Reyner. Pp. vii + 178 + 8 plates. (London : Chapman and Hall, Ltd., 1930.) 10*s*. 6*d*. net.

THIS book gives a series of suggestions for the tracing of faults in the simpler types of receiving apparatus. It is not likely to be of assistance to qualified radio engineers ; but, as there are few books on the subject, it will be useful to amateurs with a limited amount of technical knowledge. The author's discussion of the effects produced in a high frequency choke coil is correct, provided that it is not in parallel or virtually in parallel with other components of the receiver. The conclusion he draws (p. 59), that it acts like a small capacitance which has the property of allowing direct current to pass through it, is too vague. The advisability of discharging the condensers in an eliminator or mains-driven receiver is pointed out. The way he suggests, however, of placing the metal part of a screwdriver across the terminals of the reservoir condenser, is open to criticism, for such violent discharges have been known to damage the condenser. It would be better to discharge it through a resistance.

The part of the book dealing with ' laboratory testing ' seems to be a brief outline of the measurements that can be made in the author's own laboratory. In places it would be well if the author had been more explicit. On p. 23, for example, we read, " we will assume that this circuit functions, but in a poor manner ". There are many different ' poor manners ' in which a circuit can function. The chapter on American test data will be useful.

Growing Tree and Small Fruits. By H. B. Knapp and E. C. Auchter. (The Wiley Farm Series.) Pp. xiii + 510. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1929.) 15*s*. net.

THE needs of practical fruit-growers and students are here specially catered for by providing them with a text-book which can also be used as a reference volume for points of detail. To this end, an attempt has been made to render the various sections of the book complete and independent, in order that information unnecessary for the individual may be passed over without fear of losing other points germane to the question in hand. Each of the main fruits is dealt with separately, from harvest to harvest, marketing operations being included ; and in addition special chapters are devoted to wider problems of more general application, including, amongst others, orchard establishment, pruning, propagation, thinning fruit, and the control of diseases and pests. Here again, where necessary, the application of the problem to particular fruits is indicated individually and adequately indexed. The scientific names of some species of the common fruits are appended ; and hints for practical work, given at the end of each chapter, increase the usefulness of the volume for students' class work.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 43. Pp. xii + 838 + 40 plates. (London : Institute of Metals, 1930.) 31*s*. 6*d*. net.

STUDIES of the influence of gases on cast metals occupy an important place in this volume. Both hydrogen and sulphur dioxide cause unsoundness in copper and bronze, and removal of them by means of nitrogen or some other insoluble gas, or by melting under reduced pressure, has been found to improve the quality of the ingots or castings. The four papers on this subject all owe their origin to the Non-Ferrous Metals Research Association, whilst the same body is responsible for the work by R. Genders on the increased resistance to corrosion produced by the addition of small quantities of aluminium to brass, this being one of a number of instances now known of the protection of an alloy by an external film consisting mainly of aluminium oxide. A communication by C. F. Elam is interesting as recording the progress of solid diffusion of zinc through brass by the application of X-ray methods. A lengthy paper by T. A. Rickard on the early use of the metals led to a discussion in which archæologists as well as metallurgists took part. The scope of the Institute of Metals is wide, and its journal is an invaluable source of information concerning the progress of metallurgy.

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.*]

The Meaning of Existence.

PROF. MUIRHEAD'S illuminating letter in NATURE of Feb. 7, p. 197, raises innumerable questions which I am not qualified to discuss with him, but I should like to add a comment on the narrower scientific aspect of the problem.

Here are two quotations, forty years apart, from eminent men of science:

(1) Lord Kelvin in 1889—"[The ether] is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether."

(2) Sir Arthur Eddington in 1929—"Among leading scientists of to-day, I think about half assert that the ether exists, and the other half deny its existence; but as a matter of fact both parties mean exactly the same thing and are divided only by words."

We are in the paradoxical position that two scientific workers of to-day who say "Yes" and "No" both mean precisely the same thing, while two scientific workers forty years apart, who both say "Yes", mean diametrically opposite things. The key to the paradox is, I think, to be found in Prof. Muirhead's words: "before there can be any talk of existence you must define the world within which it is affirmed—what the logicians call 'the universe of discourse'".

The physicist of forty years ago did not suspect the need for any such definition. Surrounding and conditioning our world of consciousness, he saw a vast independent universe of concrete machinery, which he unthinkingly and unconsciously accepted as his 'universe of discourse'. On the other hand, the scientific worker of to-day finds his 'universe of discourse' in the phenomenal universe as apprehended by his brain. The crux of the matter seems to me to be that this does not—like the old ocean of machinery—provide a single, clearly defined 'universe of discourse'. It rather gives us a collection of universes of discourse, some greatly overlapping but some almost independent, some objective but some largely subjective.

First there is the universe of the astronomical observatory and the physical laboratory, which is "continuous with the world of the felt, waking body", experience showing that this is identical for all of us, at any rate outside lunatic asylums. I think science now compels us to give an unqualified denial to the existence of an ether in this universe of discourse.

Then there is the mathematical universe of discourse, which deals only with such phenomena as can be reduced to 'pointer-readings'. Those who want an ether in this universe may have it, just as they may have Cartesian or polar co-ordinates if they want them; but it will be a mathematical ether, not 'continuous with the world of the felt, waking body'.

Finally, there is the universe of discourse provided by that world which, in Prof. Muirhead's words, "resolution into mathematical symbols or 'pointer-readings' fails to make intelligible", including—if one must use the word—the world of 'values'. Although I am in almost complete agreement with Prof. Muirhead, I differ from him in thinking that an ether can have any existence in this world, or even any meaning, mainly, I suppose, because 'values' do not enter into clearly defined relations with time and space. In brief, I would contend that in the physical world an ether is non-existent; in the mathematical world it comes into being at the beck and call of the mathematician; in the world of 'values' it is meaningless.

J. H. JEANS.

Validity of the Genus *Sinanthropus*.

PROF. MARCELLIN BOULE, Director of the Museum National d'Histoire Naturelle in Paris, has written to me with reference to my Henderson Lecture, "The Significance of the Peking Man", extracts from which appeared in NATURE of Feb. 7 (p. 202), to direct my attention to the fact that long before Dr. Weinert expressed doubt as to whether the Peking man should be excluded from the genus *Pithecanthropus* he had made the same protest. To quote his own words: "Je crois être le premier à avoir rapproché intimement le *Sinanthropus* du *Pithécanthrope*. Voyez *L'Anthropologie*, t. 39 (1929), pp. 455-460."

In my Edinburgh lecture I purposely refrained from mentioning Prof. Boule's name, because his opinion was expressed before the fuller information was available, which seems to me to be fatal to his view. Dr. Weinert's book was written, however, after this evidence was issued. Hence it was not unfair to quote him as the supporter of an opinion which I think is mistaken.

The question of priority is not a matter of any particular consequence. As a matter of fact, at a meeting of a students' society in this College (the University College and Hospital Anthropological Society), before either Prof. Boule or Dr. Weinert raised this question, Dr. H. S. Harrison, of the Horniman Museum, started a discussion by suggesting that the fossil from China was a representative of the genus *Pithecanthropus*.

I should like to point out that in his preliminary announcement of the discovery of the skull (on Dec. 2, 1929) Prof. Davidson Black directed attention to its resemblance to the calvaria of *Pithecanthropus* but gave cogent reasons for according it generic distinction. The profound contrast of a fossilised human tooth from China to those of *Pithecanthropus* was pointed out so long ago as 1903 by Prof. Max Schlosser (*Abhandl. d. k. Bayerisch. Akademie Wissensch.*, Math. Phys. Klasse, Bd. 22, p. 20); and in his great monograph (*Palæontologia Sinica*, 1927) on the tooth which served as the type of the genus *Sinanthropus*, Prof. Davidson Black still further emphasised the contrast and justified his action in creating the genus, the validity of which is admitted by every palæontologist who has seen the actual specimens. As I have emphasised in my Henderson Lecture, the form of the brain case, the morphology of the individual bones, and even the architecture of the diploe, all corroborate the inferences drawn from the teeth that *Sinanthropus* is a distinct genus. Although the fossil from China definitely approaches more nearly to *Pithecanthropus* than to any other genus, the monograph which Prof. Davidson Black has written for immediate publication in *Palæontologia Sinica* (ser. D, vol. 7, fasc. 2) provides the full evidence, comparative data, and the statistical justification for its generic independence.

While the question of determining what criteria are necessary to justify the creation of a separate genus is one that does not admit of an exact answer, I do not think that anyone who has compared, as I have recently done, the actual Chinese fossils with those of other men and apes and the casts of fossil human skulls, would fail to realise that the inclusion

of the Peking man in the genus *Pithecanthropus* would introduce an undesirable element of confusion into this difficult field of interpretation.

G. ELLIOT SMITH.

Institute of Anatomy,
University College, W.C.1,
Feb. 9.

Raman Lines in X-Ray Spectra.

A VERY interesting and significant phenomenon has been described by Ray [1] and by Majumdar,[2] in which it is shown that a quantum of the radiation energy, say of the wave-length comprising the copper K_α lines, may, on passing through carbon or aluminium, be diminished by an amount sufficient for the ejection of a K electron from a carbon or an aluminium atom, and then pass on in the same or very nearly the same direction with a reduced energy $h\nu'$, and consequently a greater wave-length.

$$\nu' = \nu_{\alpha 1} - \nu_k,$$

where $\nu_{\alpha 1}$ is the frequency of the copper $K_{\alpha 1}$ line, and $h\nu_k$ is the energy required to remove a K electron from the carbon atom.

In the communications mentioned above, photographs are shown in which lines may very plainly be seen corresponding to this part absorption in carbon, nitrogen, and oxygen. It was stated that carbon in the form of soot was used, but nothing was said as to how thick the absorbing layer was, nor regarding the manner of employing nitrogen and oxygen. Since, in every case reported, a line due to at least one of these gases appeared along with the line due to carbon, it is evident that the three substances were all used at the same time. In discussing the work of Ray, Bhargava [3] says the X-rays passed through air; and Ray, in his later paper,[4] makes no comment on this point, but mentions that a Siegbahn vacuum spectrograph was used.

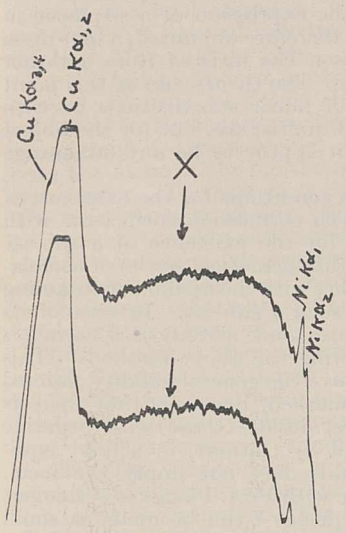

FIG. 1.—Photometric curves of spectrum taken through a carbon absorbing screen.

The question of such absorption is so important that I have also attempted to obtain these lines photographically, but have been quite unable to find them. In my work a copper target was used, first with a tungsten filament, and later with one of nichrome, so that the layer of tungsten, which sputters on the target from a tungsten filament, might not be present, thus giving greater intensity to the copper radiation, and also avoiding the stronger continuous spectrum from tungsten.

The carbon, first in the form of graphite, and later in the form of so-called amorphous carbon, was placed in the X-ray tube immediately before the slit. Afterward it was also used just against the slit on the other side, facing the crystal. The optimum thickness of the carbon screen for manifesting the effect sought should be $\frac{1}{\mu}$, where μ is the linear coefficient of absorption of the given wave-length for carbon. Screens were used of varying thickness, some thicker than the above value, and some thinner.

The spectrograph had a radius of about 14 cm. It was not evacuated. The calcite crystal was rotated uniformly over nearly one degree, by means of clockwork. In some trials it was also turned by hand about every ten minutes, and in other cases it was left stationary during the entire exposure. The time of exposure varied from five to nineteen hours. The tube current was from 10 to 25 milliamperes, and the voltage, while not accurately measured, was perhaps from 15 kilovolts for some exposures to 35 for others.

In cases where the crystal was allowed to stand, or was moved irregularly, certain lines, often quite sharp, appear, especially near the limit of the continuous radiation. If the crystal is moved, these lines also move and appear in another place. It is a common experience that such lines may be found with almost any crystal if it is not properly rotated. In my best photographs, with uniform rotation of the crystal, it is quite impossible to see any line in the place required for the partial absorption in carbon, and as found by Ray. Unfortunately, he does not state how the crystal was rotated in his experiments.

Ray has estimated the relative intensity of these Raman lines to be about $\frac{1}{400}$ or $\frac{1}{500}$ that of the copper K_α lines. Now Richtmyer and Taylor [5] give the intensity of the satellites $K_{\alpha 3,4}$ of copper as about $\frac{1}{400}$ the intensity of copper $K_{\alpha 1}$. On my plates the line copper $K_{\alpha 3,4}$ is strong; hence I conclude that the exposures are sufficiently long to produce the lines sought, if they were present in anywhere near the above intensity.

Fig. 1 shows a photometer record of one of the plates obtained. The two curves were taken at different levels across the spectrum to show that the irregularities are due to the grain in the plate. X marks the point in the spectrum at which the displaced line due to carbon should appear. The $K_{\alpha 3,4}$ line can be seen plainly.

GEO. A. LINDSAY.

Natuurkundig Laboratorium,
Groningen, Holland,
Jan. 17.

[1] NATURE, **125**, 746, 856; **126**, 399: and *Zeits. für Phys.*, **66**, 261; 1930.
[2] NATURE, **127**, 92; 1931.
[3] NATURE, **126**, 398; 1930.
[4] *Zeits. für Phys.*, loc. cit.
[5] *Phys. Rev.*, **36**, 1044; 1930.

Modification of Quanta by Photo-ionisation.

IN continuation of our previous communication of experiments on the phenomenon described by Dr. B. B. Ray,* we wish to report that we allowed silver $K\alpha$ radiation to pass through nickel foil 0·06 mm. in thickness, and photographed the spectrum of the emergent ray. We found, after an exposure of 150 mA.-hours, a modified band with a sharp edge at $\nu/R = 1019{\cdot}7$, fading towards the long wave-length side, but with no trace of blackening on the short wave-length side. The difference between ν/R of silver $K\alpha_1$ and that of the sharp edge obtained is $\nu/R = 612{\cdot}9$, while, according to Siegbahn, ν_k/R of nickel (K-absorption edge of nickel) is 612. The experiment, therefore, clearly supports the view that the quantum on its passage through the atom may impart to the electron in the K-shell all energies from $h\nu_k$ to $h\nu_0$ and become modified to quanta of any frequency less than $\nu_0 - \nu_k$.

SALIGRAM BHARGAVA.
J. B. MUKERJIE.

Physical Laboratory,
University of Allahabad,
Jan. 24.

* [NATURE, Feb. 21, p. 273.—Ed. NATURE.]

Raman Spectra of Organic Sulphides.

IT is more or less generally accepted that the various Raman frequencies of a molecule correspond to the oscillations of its component parts with respect to one another, each frequency being associated with one particular mode of oscillation. This conception of the origin of the frequencies is very fruitful in correlating the Raman spectra of molecules with their structure. One particular aspect of the application of this idea has attracted considerable attention during recent years, namely, the assigning of certain frequencies to each type of chemical bond and tracing their variation from compound to compound. We have made a detailed study of the Raman spectra of a number of organic sulphides and we give below the results obtained in two typical cases, ethyl sulphide and allyl sulphide, one representing the saturated and the other the unsaturated compound.

The Raman spectrum of ethyl sulphide is very simple, while that of allyl sulphide is rich in lines and also presents a continuous background. A comparison of the scattered spectrum of ethyl sulphide with that of ethyl ether shows a general agreement so far as the long shifts are concerned. The effect of the substitution of the heavier sulphur atom in the place of oxygen is to diminish the frequency shift, the changes in the shift getting smaller as the value of the shift increases.

	Wave numbers per cm.
Ethyl Sulphide $(C_2H_5)_2S$.	652, 1061, 1282, 1439, and 2923
Allyl Sulphide $(C_3H_5)_2S$.	410, 588, 741, 917, 1011, 1101, 1210, 1291, 1312, 1420, 1534, 1636, 3007, and 3088

Thus, corresponding to the sulphide shifts 1061, 1439, and 2923, we have the ether shifts 1082, 1457, and 2936.

The Raman spectrum of the sulphide resembles that of the corresponding alcohol in the region of the longer frequency shifts, while conspicuous changes are observable in the region of the shorter shifts. The frequency 652 in ethyl sulphide, which is presumably due to the C–S bond, is also the prominent frequency in carbon disulphide, the nature of the bond apparently having no effect on the oscillation frequency. This frequency is absent in allyl sulphide. Similarly, the prominent frequency 741 in allyl sulphide (which is also present in allyl thiocyanide) is absent in ethyl sulphide. It seems that the frequency 741 is characteristic of the unsaturated sulphides, and the frequency 652 of the saturated sulphides.

V. N. THATTE.
A. S. GANESAN.

College of Science, Nagpur,
Jan. 12.

The General Factor in Spearman's Theory of Intelligence.

I HAVE recently undertaken an investigation of the theory of 'factors' from a mathematical point of view. This work is now complete and I hope to publish it shortly in full. The conclusions in brief are that, with certain reservations, the theorems relied on by psychologists are correct. They are, further, independent of the theory of probability: that is to say, no questions of distribution arise until we come to applications.

It is surprising that this comparatively simple work has not been done before. The reason seems to be that it has always been approached from the probability point of view, whereby difficult but irrelevant considerations have been introduced. It may, however, be noted that Yule in his classical paper on partial correlation (*Proc. Roy. Soc.*, 1907) proved his results independently of distribution, and that Spearman (*Proc. Roy. Soc.*, 1922) stated that the theorem proved by Garnett for error distributions (*Proc. Roy. Soc.*, 1919) had a similar generality. This is the subject of Prof. Piaggio's letter in NATURE of Jan. 10. Another reason why mathematicians have as a rule failed to interest themselves in the theory lies in the special meanings assigned to common mathematical terms by statisticians and psychologists: independent for orthogonal, factor for component, array for section, etc., and the extension of the term 'error' to cover all components not under consideration.

The subject matter of statistical science is sets of measures of variates, that is, sequences of numbers, which for theoretical purposes may be reduced to standard deviation measure. These sequences can, like real functions of which they are a reduced case, be subjected to orthogonal partition and can be developed in series of sequences. N being the number of elements in each sequence, all sub-sets of N-1 independent sequences, orthogonal or not, are 'complete', and all sequences of the whole set can be developed linearly in terms of any complete sub-set. The possibilities for the expression of a sequence in terms of 'factors' are therefore unlimited, a fact upon which Godfrey Thomson has insisted from a rather different point of view. The theory can at this point be linked with that of linear substitutions or with that of unit vectors in multispace, but for the object in view there does not appear to be any advantage in doing so.

I have obtained the conditions for the existence of a sequence having given correlation coefficients with a given sub-set, and for the existence of a sub-set having a given array (mathematical sense) of correlation coefficients, together with the method of obtaining such a sequence and such a sub-set. In view of its great interest, I have also made a study of Spearman's two-factor form following the above methods. This form may be said to have the general validity claimed for it; it may be remarked, however, that there is another class of cases, besides those with negative correlations mentioned by Garnett, in which 'equiproportionality' (Dodd) does not imply the form. I do not entirely agree with Prof. Piaggio's statement that the arbitrary sequence i can be made as small as we please; this depends on the divergence of a certain series, which is not bound to diverge.

When we come to application, distribution is all-important. An orthogonal partition of a sequence is of course not invariant for monotonic transformations, so that a partition such as Spearman's two-factor form is entirely dependent on the distributions adopted. In statistical measurements as a rule, and in psychological measurements always, there is no measuring rod, so that distributions are at our mercy, and it is usual to make them fit some standard such as the curve of errors and to insist on the linearity of the regressions. It is therefore on this standard distribution that the two-factor theory must rest, and not on the general method of partition. Karl Pearson has criticised Spearman's 'hierarchy' of correlation coefficients from the point of view of closeness of fit. A mathematician with a less severe statistical morality will, however, have no objection to Prof. Spearman making his fit perfect by small monotonic transformations or linear substitutions.

Orthogonal partition often connotes physical reality, as, for example, with harmonics in sound; but it must be remembered that in such cases the partition is completely specified by physical laws and conditions,

expressed as differential equations and boundary conditions. Orthogonal partitions not so specified exist in infinite variety and have no physical significance. The question is, when do orthogonal partitions of sequences have a physical meaning? Spearman has discovered a remarkable method for the analysis of statistical data; the greatest caution is necessary in interpretation.

H. B. HEYWOOD.

Talking Beacon of the Cumbrae Lighthouse.

IN NATURE of Jan. 24, p. 138, a statement appears regarding the talking beacon of the Cumbrae Lighthouse which calls for some comment. The use of synchronous signals in air, water, and ether for navigational purposes dates, so far as I know, from experiments carried out near New York in 1911. These led to the installation of such signals on the Fire Island Lightship, where submarine bell and wireless dots were used to enable an approaching vessel to determine its distance from the lightship.

In complete ignorance of this pioneer work, I contributed several papers to the Royal Society between 1915 and 1918 on synchronous signalling in navigation, and more especially on the prevention of collision at sea. Two of these were reprinted on the North Atlantic Chart of the Hydrographic Office of the U.S.A. for June 1917. A discussion of the subject appears in a book (London: Fisher Unwin) in 1916; and finally, a general account up-to-date appears in the *Phil. Mag.* of July 1918.

In the last-mentioned paper (p. 18) the de Forrest system, as used at Point Judith at the western approach to Narragansett Bay, is referred to. "A phonograph [=gramophone] speaks the words. It cries the name of the lighthouse or lightship into the transmitter. The system is entirely automatic. . . . The voice, translated into ether waves, reaches the antenna on the ship and is there re-translated to the spoken words by a detector and telephone. . . . After every third repetition of the name of the station a much feebler voice speaks the warning: 'You are getting closer; keep off'."

Much of this is identical with the system installed at the Cumbrae Lighthouse; but Messrs. Stevenson replace the feebler etherial message by the now well-known method of synchronous signalling; that is to say, by signals issued simultaneously in different media. This method is available in two forms: signals travelling in air and in ether or signals travelling in water and ether. The latter is far more trustworthy, but is only of use to such vessels as are fitted with receptors for submarine sounds.

That risks attend the use of synchronous signals in which the atmosphere is one of the media is well known. This risk arises out of the fact that 'silent areas' under certain weather conditions may exist around the vessel—especially in fogs, *but also in quite clear weather*. This risk is specially referred to in every "Sailing Directions" issued by the Admiralty: "Sound is conveyed in a very capricious way through the atmosphere. Apart from wind, large areas of silence have been found in different directions and at different distances from the origin of a sound, even in clear weather. Therefore too much confidence should not be felt in hearing a fog-signal. . . . Taken together these facts should induce the utmost caution in closing the land in fogs. The lead is generally the only safe guide." In my yachting days I have more than once experienced such conditions; and, on one occasion, lasting for more than eight hours. This was off the western coast of Ireland, between Loop Head and Tearaght Island.

While it is very certain that the use of sound transmitted in air, as taking part in the estimation of distance, will in many cases prove available, it is questionable if this modification of the de Forrest system is wise. The latter acts as 'a still small voice' which is only heard when there is real danger: and of course two or more observers may listen in. Its directions reach the mariner as a spoken warning not to be misunderstood. The voice cries to him again and again "Keep off—you are getting closer"; "Keep off—you are getting closer".

The addition of Dr. de Forrest's warning voice to the name-call of the gramophone at Cumbrae would be easy, and the whole system would become more generally reliable.

I would like to add an expression of my complete concurrence with all that is said in the article on the Cumbrae Lighthouse beacon in the *Times* of Jan. 13 regarding the noble work for coastal navigation accomplished by the late Robert Stevenson and his successors, Messrs. C. A. and D. A. Stevenson.

J. JOLY
(Commissioner of Irish Lights).

Trinity College, Dublin,
Feb. 2.

Effect of Desiccation on the Bed-bug (*Cimex lectularius*).

IT is well known that, during starvation, the bed-bug, like many other insects, swallows considerable quantities of air, which serve to maintain the body volume in place of the food and tissues that are consumed. I have recently observed that if the first stage larvæ of the bed-bug are kept for several weeks in a moderately dry atmosphere (for example, 50 per cent relative humidity at 23° C.), as the circulating fluids become less, the gut, containing bubbles of air, becomes herniated into the bases of the limbs, and may extend far down the femora (Fig. 1).

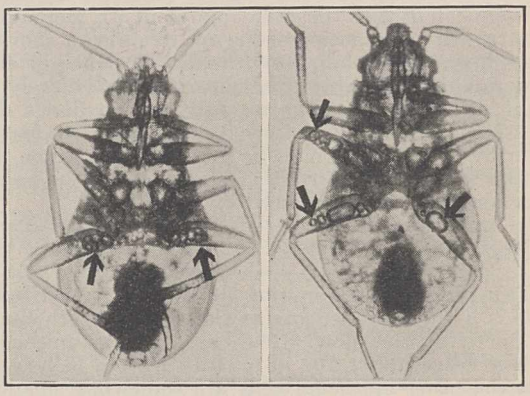

FIG. 1. FIG. 2.

If such insects are exposed now in a saturated atmosphere, although most of them die in a few days, others recover; moisture is taken in, and the bubbles of air disappear from the limbs. On the other hand, if they are retained in the dry atmosphere, the gut wall eventually breaks, and bubbles of air are set free into the body cavity (Fig. 2). The larva in this state is often still capable of sucking blood, and if given a moderate meal, both the bubbles in the gut and the free bubbles in the limbs disappear into solution. During this process a certain amount of blood usually escapes into the body cavity, and the red corpuscles can be seen circulating in the blood of the insect. I have had larvæ in which such corpuscles have continued to circulate, apparently unchanged, for three weeks—long after the blood in the gut had been completely digested.

Apart from the curious circumstance of desiccation in an insect leading to a femoral hernia which perforates to give rise to a surgical emphysema, these observations present two points of interest: first, that in the desiccated condition the larvæ are apparently hygroscopic and can absorb water vapour from a moist atmosphere (though the possibility of their taking up minute droplets of fluid condensed on the proboscis has not been entirely excluded); and secondly, that small foreign bodies, such as the blood corpuscles of vertebrates, can circulate in the blood stream, apparently indefinitely, without being removed by phagocytosis or otherwise.

I am indebted to Dr. H. B. Newham for taking the photographs of living *Cimex*.

V. B. WIGGLESWORTH.
London School of Hygiene and
Tropical Medicine, Jan. 22.

Conjunctival Halos.

THE letter on this subject from Mr. Sidney Melmore, in NATURE of Jan. 3, leads me to describe an experience of my own which may be of some little interest. Recently I was accidentally struck in the right eye with a dog-whip, and I was conscious of a faint mistiness in front of that eye. But I was surprised to find on looking at an electric light, on the same evening, that it was surrounded by a set of diffraction halos, two orders being visible. Unlike the case described in Mr. Melmore's letter, the space round the electric light was white and only the red ring of the first order halo was visible, whereas all the colours of the second order could be seen. A very approximate measurement of the first red ring gave its angular diameter as 7°, in fair agreement with the value quoted in Mr. Melmore's letter. An examination of the eye in a mirror showed that it was bloodshot, but revealed no trace of any abnormality in the part of the cornea immediately in front of the pupil. The intensity of the halos decreased with time, and they disappeared completely after five days. It would be interesting to know the nature of the small particles responsible for the halos, and how they were produced by the blow.

A. W. BARTON.
Repton School, Derby.

THE probable explanation in Mr. A. W. Barton's case is a transient œdema of the corneal epithelium, produced by the blow. The basal corneal epithelial cells average about 10μ in breadth by 18μ in height, and the other epithelial cells are somewhat smaller. These elements appear to be of about the right order in size.

J. HERBERT PARSONS.
54 Queen Anne Street,
Cavendish Square, W.

Embryology and Evolution.

IN the issue of NATURE for Feb. 7, p. 200, Mr. Malcolm E. MacGregor revives a form of vitalism that has lain dormant for a number of years; and well might it have been permitted to do so for as many more. It is surely well recognised that science is only a conceptual scheme which presumably bears some relation to the percepts that it attempts to correlate. What lies outside that scheme may indeed be of the greatest importance, but it is not science. Mr. MacGregor adduces no evidence that the force primarily operating the living cell is an external one. His wishes would be equally fulfilled by some form of hylozoism, but then it would be very difficult to acclaim the view as likely to be a guiding star for biological advance. If one wishes to hold such vitalistic theories as being true, one cannot remain immune from scientific attack except by rigid adherence to some form of dualism, such as that of the great Nicholas of Cusa. Thus, if it be contended, as he did, that there is an external form of experience subject to natural law but separate from an inner form that has no relation to such law and is beyond reason, then no scientific criticism is possible.

The sterility of vitalistic hypotheses in the past leads one to doubt their fertility in the future; and the deification of entelechy does not carry us far.

A. PINEY.
Woodham Mortimer Hall,
Maldon, Essex, Feb. 6.

The Photo-Reaction of Hydrogen and Iodine Monochloride.

WE are able to confirm the observations of D. P. Mellor and T. Iredale [1] on the photo-reaction between iodine monochloride and hydrogen, as against the photo inactivity of the mixture reported by Rollefson and Lindquist.[2] A rapid photo-reaction between these substances when not specially purified had been observed by us before the appearance of Rollefson and Lindquist's paper; the reaction, however, is much influenced by traces of impurities, for when special pains are taken to avoid contamination by organic materials, stopcock grease and the like, the rate of reaction under the influence of light is much decreased. There remains, however, an easily measurable reaction under the influence of the light of a mercury arc. The main products are hydrogen chloride (HCl) and iodine (I_2); no appreciable amount of hydrogen iodide has been found. The photo-reaction between iodine chloride and methane has also been established in this laboratory; the rate here is great compared with that of the hydrogen reaction. Both reactions are being investigated in detail.

S. E. ASHLEY.
WILLIAM WEST.
Washington Square College,
New York University,
New York, Feb. 2.

[1] NATURE, **127**, p. 93, Jan. 17, 1931.
[2] *Jour. Amer. Chem. Soc.*, **52**, 2793; 1930.

Growth Factors.

IN a recent communication (*Proc. Physiol. Soc.*, October 1930) Thompson demonstrated that by certain methods of extraction a growth inhibiting substance could be obtained from fresh parathyroid glands. Further work in this laboratory has shown that a similar substance can be extracted from the flesh of vertebrates. Purification of such extracts shows that the substance responsible is thermo-stable, is not a sterol, and is probably nitrogenous.

W. J. BOYD.
J. LATTER.
W. ROBSON.
Departments of Physiology and Botany,
King's College, University of London,
Feb. 23.

Transmission of *Leishmania donovani*.

WE have received the following telegram from New Delhi, dated Feb. 19:

"Lieut.-Col. Shortt reports successful transmission of *Leishmania donovani* to Chinese hamster by bites of artificially infected *Phlebotomus argentipes*. Hamster bitten repeatedly during twelve months; generalised infection found seventeen months after experiment began.—Scientific India."

We understand that the telegraphic address "Scientific India" refers to the Scientific Advisory Board of the Indian Research Fund Association.

Scientific Congresses in 1931.

DURING the summer of this year five important scientific gatherings will take place in London, all of which will be of an international character. The first of these will be the International Congress of the History of Science and Technology; the second the jubilee celebrations of the Society of Chemical Industry; the third the International Illumination Congress; and the fourth and fifth the centenary celebrations of the discovery by Faraday of electromagnetic induction and the centenary meetings of the British Association. Though the programme of the International Illumination Congress includes meetings at Glasgow, Edinburgh, Sheffield, Birmingham, and Cambridge, the delegates will meet in London before visiting the provinces, while the meetings of the other bodies will be held entirely in London.

Organised by Le Comité International d'Histoire des Sciences, of which the permanent secretary is Prof. Aldo Mieli, the Second International Congress of the History of Science and Technology is supported by Le Comité International des Sciences Historiques, the Newcomen Society for the Study of the History of Engineering and Technology, and the History of Science Society; and the aim of the Congress is to provide opportunity for intercourse and exchange of thought between all those who are interested in the various departments of the history of science and technology. The programme has been arranged to cover the period Monday, June 29, to Friday, July 3, and the headquarters of the Congress will be the Science Museum. Besides scientific communications, there will be social gatherings, visits to historic institutions, and excursions to places of scientific interest. The president is Dr. C. Singer, the honorary treasurer Sir William Bragg, and the honorary secretary Mr. H. W. Dickinson, Science Museum, South Kensington, S.W.7, from whom further particulars can be obtained. The Congress, it may be added, originated with the Comité International d'Histoire des Sciences, which was founded at Oslo on Aug. 17, 1928, and meets annually in Paris.

The jubilee celebrations of the Society of Chemical Industry, it has been announced, will be of a domestic character, the functions being thrown open only to members and a very few distinguished guests who will be the recipients of special honours. The Society was founded in 1881, and to-day has upwards of 7000 members, associate members, and subscribers. The meetings will commence on July 13 and will extend over the succeeding seven days. It is hoped the Lord Mayor of London will open the proceedings by receiving the delegates at the Guildhall, and succeeding events will include the annual dinner, the annual general meeting, the delivery of the presidential address, and the presentation of the Society's Medal. Visits to many works typical of the manufactures of London are being arranged; the Chemical Engineering Group of the Society is arranging an exhibit of special recording and measuring instruments in the Central Hall, Westminster, where there will also be an exhibit of British chemical plant arranged by the British Chemical Plant Manufacturers' Association. To mark the occasion permanently, Dr. Stephen Miall, editor of *Chemistry and Industry*, is writing a history of the chemical industry, to be published at a low cost immediately prior to the meeting, and a special jubilee number of the *Journal* of the Society will be published containing reprints of outstanding papers, biographies of presidents, medallists, and honorary members, and a history of the Society. While the preliminary programme was being arranged, the late Lord Melchett held the presidency of the Society, but he has now been succeeded by Sir Harry McGowan. The headquarters of the Society are at Central House, 46 Finsbury Square, E.C.2, Mr. H. J. Pooley being the general secretary.

The meeting of the International Illumination Congress, the ninth of its kind, will be divided into two parts, the first part consisting of a Congress which will be held on Sept. 2–12, and the second part consisting of meetings of the technical committees of the International Commission on Illumination, to be held on Sept. 13–19. The Congress, of which Mr. C. C. Paterson is the president, is being organised by the National Illumination Committee of Great Britain, in co-operation with the Illuminating Engineering Society, 32 Victoria Street, S.W.1, Col. C. H. S. Evans being the honorary general secretary. After assembling in London on Sept. 1–3, the delegates will then spend two days at Glasgow, three days at Edinburgh, two at Sheffield, two at Birmingham, and the remainder of the time, Sept. 13–19, at Cambridge. At the latter place will be held the plenary session of the International Commission on Illumination. A comprehensive list of subjects for discussion has been drawn up, and papers will be presented on the lighting of factories, offices, houses, vehicles, streets, museums, and lighting for traffic control, together with others on lighting for aviation and navigation, flood lighting, architectural lighting, laboratory technique, and the lighting of mines. Many institutions are represented in the general council of the Congress, the chairman of which is Lieut.-Col. K. Edgcumbe. The first three International Illumination Congresses were held at Zurich, and the others have since been held at Berlin, Paris, Geneva, Bellagio, and Saranac, New York.

We have on a previous occasion referred to the general arrangements for the commemoration of the centenary of Faraday's discovery, which are in the hands of the Royal Institution and the Institution of Electrical Engineers. While these two institutions have joined forces in making the plans, they are indebted to other societies for their co-operation. Thus, the Royal Society will entertain the delegates to the celebrations; the Federal Council for Chemistry will participate in the arrangement of the Faraday Exhibition, and assistance has been offered by Government, university, and other bodies with scientific interests. The provisional programme includes the reception of the delegates in the Lecture Theatre of the Royal Institution, and the Faraday commemoration meeting at the

Queen's Hall on Sept. 21, conversaziones at the Royal Institution and the Institution of Electrical Engineers on Sept. 22, and the opening of the Faraday Exhibition at the Albert Hall to the public on Sept. 23. This exhibition will remain open for about ten days, and it is hoped to publish a catalogue and description of it. The preparation of a souvenir of the whole celebrations is under consideration, and progress is being made with the preparation for publication of Faraday's famous diary. Of the six or eight volumes in which the work will ultimately be completed, it is hoped to have one or possibly two ready by September.

The second day of the Faraday celebrations, Sept. 22, will coincide with the opening of the summer meeting of the Institution of Electrical Engineers; while the third day, Sept. 23, will be the commencement of the centenary meeting of the British Association for the Advancement of Science, which has not hitherto met in London. During the afternoon of Sept. 23, Lieut.-Gen. the Right Hon. J. C. Smuts will be installed as president of the British Association and a reception of delegates will be held in the Albert Hall, this arrangement allowing the members to have a private view of the Faraday Exhibition. On the same evening General Smuts will deliver his address at the inaugural general meeting in the Central Hall, Westminster. The sectional and other scientific transactions will be carried on daily from Thursday, Sept. 24, until Wednesday, Sept. 30, inclusive. For the majority of these transactions meeting-rooms will be used in and near Exhibition Road, South Kensington, while the reception room will be in the Great Hall of the University of London. A preliminary notice has been issued by the Association giving the names of the presidents of the thirteen sections, among whom are Sir J. J. Thomson, Sir Alfred Ewing, Sir Halford Mackinder, Sir Harold Hartley, Sir C. Grant Robertson, and Sir John Russell. The usual programme of visits and excursions will be arranged, and in view of the very large number of institutions and buildings, houses, and memorials in London connected with the scientific men of the past, and the wealth of scientific work now being done in the metropolis, these should prove of wide and general interest. A large attendance of scientific workers from both the Dominions and foreign countries is expected, for whom the Association hopes to obtain private hospitality by residents in London. The full preliminary programme is expected to be issued in April, and this will be obtainable from the Secretary, British Association, Burlington House, W.1.

In addition to these congresses, two other scientific gatherings of unusual interest will be held in Great Britain. At Manchester on Mar. 17 the Manchester Literary and Philosophical Society will commemorate the 150th year of its foundation, while at Cambridge on Oct. 1–2 the centenary of the birth of James Clerk Maxwell will be celebrated. Founded in February 1781, the Manchester Literary and Philosophical Society will always be associated with the work of Dalton, who for half a century was a member. Other distinguished scientific men connected with the Society include Joule, Sturgeon, Hodgkinson, Fairbairn, Nasmyth, Wilde, Osborne Reynolds, Balfour Stewart, and Roscoe. The commemoration will include an address in the Athenæum Hall by Sir J. J. Thomson, to whom the Dalton Medal will be presented, and a dinner in the Midland Hotel. During the week the Society's house, 36 George Street, will be open to visitors. At the Maxwell centenary celebrations at Cambridge, addresses will be given by Sir James Jeans, Sir Joseph Larmor, Sir J. J. Thomson, and Profs. Einstein, Langevin and Planck. Maxwell was born on June 13, 1831, and died on Nov. 5, 1879. He was the first Cavendish professor of experimental physics and the founder of the great school of experimental physics at Cambridge. His contributions to optics, geometry, molecular physics, and other subjects are to-day less widely known than his fundamental work on electromagnetic theory, and his connexion with Faraday makes it appropriate that his centenary should follow the September celebration of the centenary of Faraday's discovery of electromagnetic induction.

Glasses for Use with Invisible Rays.*

By Dr. S. ENGLISH, Holophane Research Laboratory.

WHENEVER light is produced, invisible radiations—ultra-violet (U.V.) or infra-red (I.R.)—are, almost without exception, produced at the same time. Glasses which are transparent to the visible rays are not necessarily transparent to either the ultra-violet or infra-red; and similarly, opacity to one set of radiations does not imply opacity to the other two sets. In order to control these invisible rays, therefore, it is necessary to have ranges of glasses for transmitting and for absorbing these various bands of rays.

ULTRA-VIOLET RADIATION.

Of recent years the extraordinary biological activity of a small band of ultra-violet rays lying near the extreme end of the sun's spectrum, and extending from this wave-length (295 Mμ) up to about 320 Mμ, has established the fact that though ordinary glass, as used for windows and artificial lighting equipment, is transparent to the longest ultra-violet rays, it becomes opaque at about 310-320 Mμ. It is thus useless for transmitting rays of the biologically active wave-lengths. Several types of glass have been developed which are transparent to these so-called 'health rays', and to a limited extent to radiations of rather shorter wave-lengths than are found in the sun's spectrum.

Investigations in this field have proved that silica and boric oxide are the best two materials for making glass with a good transparency for the ultra-violet, while iron oxide and titania are the two most dangerous oxides in this respect. In

* Substance of a paper read before the Illuminating Engineering Society on Dec. 12.

making U.V. glass, besides reducing the amount of iron oxide entering the glass from various sources, it has been found necessary to melt the glass under chemically reducing conditions, for ferric oxide reduces the U.V. transparency much more than does a corresponding amount of ferrous oxide. For this purpose organic reducing agents are generally used, but recently, in some cases, inorganic reducing agents have been used very successfully. With these inorganic reducing agents it is possible to obtain a higher proportion of the total iron oxide content of a glass in the ferrous condition, and as a result the colour of the glass through a considerable thickness is pale blue, whereas the colour of glass reduced with organic agents is pale green or blue-green, or it may be a pale amber colour if too much carbonaceous matter has been used.

In connexion with that much-debated matter, the ageing of U.V. glasses, it has been shown that certain types of glass more easily lose a certain proportion of their transparency to the ultra-violet than do others. This loss of U.V. transparency appears to be due to the reoxidation of the ferrous iron in the glass to the ferric state, a process which proceeds slowly under the influence of direct sunlight until an equilibrium between the relative amounts of the two oxides is reached. When once this equilibrium is reached, no further loss of U.V. transparency occurs unless the conditions of exposure are altered. The extent of this loss of U.V. transparency depends on the total iron oxide content of the glass and on the conditions of manufacture ; it varies from so low a figure as 7 per cent at 300 Mμ for one type of glass up to 20 per cent or more for other types.

For the manufacture of medical and scientific U.V. lamps, clear fused quartz is an ideal material, but it is too transparent to the shorter ultra-violet rays and too expensive when worked into the desired sizes and shapes that are required for certain new types of U.V. lamps. These lamps, it is claimed, give sufficient ultra-violet light of the active wave-lengths to produce a light erythema ; but, it is also claimed, they are safe to use—continuously without medical supervision—either as a substitute for, or in parallel with, ordinary artificial lighting. One of these lamps consists of a daylight blue globe of U.V. transparent glass surrounding a tungsten filament, which is distinctly over-run, so much so that its average life is reduced to 300 hours. Another lamp has a clear U.V. glass bulb containing a drop of mercury, a tungsten filament, and tungsten electrodes between which a mercury vapour arc is struck almost as soon as the lamp is switched on, the heat from the filament being sufficient to vaporise enough mercury to start and maintain the arc (Fig. 1). A third lamp of this type is a low-pressure mercury arc enclosed within a vitreosil tube which is surrounded by a framework carrying sheets of U.V. glass. The lamp is meant for use along with ordinary artificial lighting units.

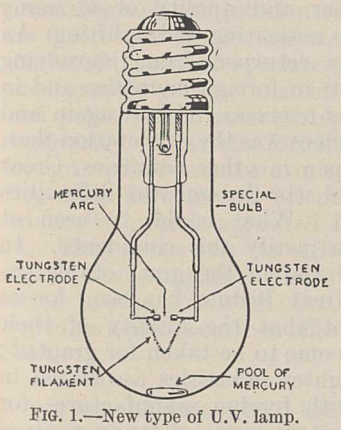

FIG. 1.—New type of U.V. lamp.

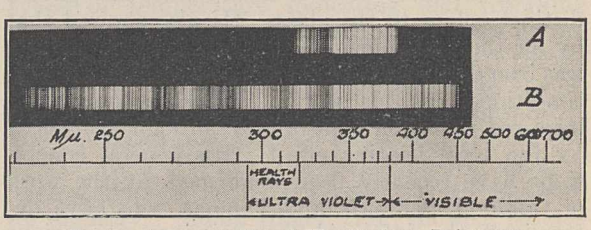

FIG. 2.—A, iron arc through Wood's glass ; B, iron arc.

Glasses containing sufficient nickel oxide on a potash base to colour them a very deep blue are so deep that in thicknesses of 3 mm. they are opaque to ordinary light, but are transparent to ultra-violet rays from about 390 Mμ down to about 310 Mμ (Fig. 2). They are referred to as Wood's glasses. With such glass it is possible to have a room completely dark but flooded with ultra-violet rays that only need to impinge on suitable fluorescent materials to reveal their presence. One such material is the so-called canary glass, which owes its fluorescent properties to the presence of a small percentage of uranium oxide on a soda lime base. Under the action of ultra-violet rays, this glass shows a very strong greenish-yellow fluorescence. Certain other glasses show a weak fluorescence, but none of them is in any way comparable to uranium glass in this respect. Besides its attempted use in invisible signalling, Wood's glass is finding many avenues of usefulness in research and commercial laboratories.

For absorbing ultra-violet rays while at the same time transmitting the visible spectrum without very much selective absorption, there are several glasses available, all based on Sir William Crookes's work, and all containing, as an essential constituent, cerium oxide. If selective absorption in the visible region is not objected to, then an amber-coloured glass made by the inclusion of iron oxide and manganese dioxide in the batch is very effective in absorbing ultra-violet rays.

INFRA-RED RADIATION.

On turning to the infra-red rays, extending from 0·78 μ upwards, we again have three types of glass : (1) for transmitting both visible and infra-red rays ; (2) for transmitting the visible and absorbing the infra-red ; and (3) for absorbing the visible and transmitting the infra-red. Considering them in this order, fused quartz, which of course transmits the vision rays freely, also transmits the infra-red radiations up to a wave-length of about 5 μ. It is not to be expected that glasses containing 70-75 per cent of silica will show any better infra-red transparency. Soda and lime, the other principal constituents of ordinary glass, appear to cause a

slightly decreased infra-red transparency, but this may be due to small amounts of impurities that are usually found in such glasses.

Sir William Crookes, in his work published in 1914, showed that many oxides conferred on glass the property of absorbing the infra-red rays to varying extents. Most of these oxides also gave a distinct colour to the glass. He also showed that by far the most effective material for this purpose was iron oxide melted into the glass under reducing conditions. In his work Crookes measured the infra-red radiation transmitted through his glasses by the total heating effect. His general conclusions have recently been confirmed by the work of Gehlhoff, Schmidt, and Thomas, who have determined the infra-red transmissions at various wave-lengths.

Several heat-absorbing glasses are available. They all employ iron oxide in the reduced condition, the only essential difference being the means that are employed to obtain the iron oxide in the ferrous state. Generally the iron and its reducing agent are introduced together by using iron oxalate as Crookes did. Recently, however, attempts have been made, with a certain degree of success, to use inorganic reducing agents, which retain a greater proportion of the iron in the ferrous state. Such glasses are blue-green in colour, instead of the green of ordinary iron-containing glasses.

Measurements show that the heat absorption of glasses of this type is to a certain extent related to the colour of the glass, but there is no close parallel, as is shown in the accompanying table.

LIGHT TRANSMISSION AND HEAT ABSORPTION OF VARIOUS GLASSES, 2·5-3·0 MM. THICK.

Glass.	Percentage heat absorption.	Percentage light transmission.		
		Red.	Green.	Blue.
H. (Clear) . .	74	59	72	71
T. (Clear) . .	72	59	71	71
C. (Cath.) . .	93	17	36	35
A. (Clear) . .	79	59	75	75
5. (Experimental)	·86	50	70	69
12. (Experimental)	93	25	45	44

As a last type of glass to be considered, there is a very interesting glass which has the power of absorbing all visible rays but transmitting infra-red rays. Such a glass, of course, appears black in thickness of 2 mm. and upwards, but in very thin sections it has a reddish amber colour. As a means of invisible signalling, this glass has almost, if not quite, superseded Wood's glass, since infra-red rays are easier to produce in quantity than ultra-violet rays; they also have the great advantage of carrying farther, as they are not so easily absorbed by the atmosphere. For burglar alarms and apparatus of that type, this glass has an interesting field of usefulness.

British Industries Fair.

THE British Industries Fair, 1931, to which brief reference was made in our last issue (p. 281), has exceeded its previous records in the total area occupied by the stands, in the number of exhibitors, and probably, also, so far as the evidence is available at the time of writing, in the number of overseas and home buyers, as well as of the general public, that have visited it. The integrated effort to demonstrate visually the extent, variety, and quality of the products of British industry required this year no less than four separated, but not unrelated, exhibitions: for the light industries, at Olympia, London; for the heavy industries, at Birmingham; for textiles, at the White City, London; and for artificial silk goods, at the Albert Hall, London. In the critical industrial period through which the country is now passing, the Fair was a remarkable and bold achievement, and tribute must be paid to the Department of Overseas Trade, to the Birmingham Chamber of Commerce, and to the various trade and industrial organisations, as well as to individual firms, that co-operated in its organisation. Information is not yet available, but will be eagerly awaited, as to the business orders that have been received for British goods, as the direct result of the Fair.

It will not be possible to review, even cursorily, the exhibits shown at the four separate sections of the Fair mentioned above, but it may be worth while to record a general impression of the exhibitions at Olympia. It is difficult to believe that any visitor could thoughtfully go through the Fair without being greatly impressed by the vast range, the great variety, the excellent quality, and often, be it said, the great beauty of the goods displayed. Despite the disheartening aspect of our unemployment figures and the faintness of our hopes of an early industrial revival, the evidence that Olympia afforded of the vigour and quality of so many British industries was reassuring and uplifting. An industrialist, recently returned from journeying overseas, related that, in foreign countries and in the British dominions overseas, he had again and again noted how confident was the expectation that, whatever might happen in other countries, Great Britain at least would win through the difficulties of the world slump. What could be seen at Olympia went far to justify this confidence. In the heavy industries and in the great staple exporting industries, Great Britain has been for so long in the forefront that the quality of their products has almost come to be taken for granted; but even in those lighter industries associated in the popular mind with foreign manufacture—for example, toys and certain kinds of fancy goods—the exhibits at Olympia provided striking evidence of the progress that has been made by British manufacturers.

The grouping of the exhibits according to industries was not only convenient for the buyer and

visitor; it necessarily created a series of mass effects also, so that it was impossible to escape getting, from each group, a general impression of the respective industry as a whole. In this regard, the china, earthenware, stoneware, and glassware exhibits formed a notable display, which included, it may incidentally be noted, some remarkably beautiful developments in decorative glassware. It is well worth the consideration of future exhibitors how they may develop what may be called the organised group exhibit. There can be no doubt that, so far from exhibitors losing anything by close association of their exhibits with those of similar, and even competitive, firms, they gain in mere advertisement value from the mass effect produced by the associated exhibit. The individual firm must ultimately benefit from any good impression created of the whole industry of which it is a constituent.

In this connexion, special praise should be given to the exhibit of the British scientific instrument manufacturers, which this year excelled, in area, in the number of exhibitors, and in the range and variety of exhibits, the achievement at last year's Fair. The total effect of the two great contiguous stands on which the British optical and scientific instrument manufacturers had arranged their exhibits was an assurance of the vitality and a guarantee of the future of this important British industry. Perhaps one of the most striking features of these associated exhibits was the manifestation of the extent to which scientific instruments are being used in all sorts of other industries in which, not so very long ago, they were unknown. In order to direct attention to this modern development, the exhibiting manufacturers published a brochure, for distribution at the Fair and otherwise, on scientific instruments in industry, from which it is interesting and encouraging to learn *inter alia* that ninety per cent of the cinematograph-taking lenses used at Hollywood are of British manufacture, and that an equal or even a greater percentage of the best cinematograph projectors used in the United States are fitted with British lenses. The exhibits on the combined stand of specimens of optical glass, of photographic lenses, and of prismatic binoculars lent point to the remarkable tribute paid to the superiority of certain British over corresponding foreign optical products in a letter by Dr. C. V. Drysdale, Director of Scientific Research at the Admiralty, which appeared in the *Times* of Feb. 14. That letter, as its writer claimed, but confirmed and amplified the statement made in a letter in the *Times* of Oct. 19, 1925, from Dr. Drysdale's predecessor in office, Dr. (now Sir Frank) Smith:

"It is a commonly held belief that optical instruments and optical glass of British manufacture are inferior to the instruments and glass produced by certain well-advertised Continental firms and sold in large quantities in this country. I wish to state that this belief is erroneous, and that it is based on prejudice rather than upon a knowledge of the facts. Comparative tests made with rigid accuracy in the laboratory, and trials under stringent service conditions, prove that British optical instruments and glass are inferior to none."

We have not space to notice, by way of example, more than a few of the instruments exhibited by the British scientific instrument manufacturers. Various types of temperature indicating and recording instruments, for use in industry, were shown by the Cambridge Instrument Co., Ltd., and by Negretti and Zambra. The display of microscopes by R. and J. Beck, Ltd., W. Watson and Sons, Ltd., James Swift and Sons, Ltd., and Charles Baker ranged from the simple student's form to the elaborate research microscope, and included types designed specially for industry. Adam Hilger, Ltd., showed, besides an interferometer, a colorimeter and a spectrograph, a 'steeloscope' which has been produced for the rapid identification, by visual observation by unskilled labour, of different varieties of steels. Newton and Co. showed an epidiascope, ingeniously fitted with mirrors so as to increase the illumination of the object to be projected; and Charles Baker had an epidiascope fitted with a fan to prevent the evil effects of overheating. Among the navigating instruments shown, reference may be made to a dead-beat compass shown by Henry Hughes and Son, in which increased steadiness and damping are secured by an ingenious use of fine radial filaments. Messrs. Ross, Ltd., exhibited, besides their great range of photographic lenses, a cinematograph projector and a telescope of exceptionally light design, in which the body tube is of light fabric instead of metal, and which was mounted on a light and easily folded tripod. Ensign, Ltd., had an interesting and recently designed aerial camera.

Of the other scientific exhibits displayed at Olympia, mention must be made of the Chemical Section. The Imperial Chemical Industries, Ltd., relied mainly, as last year, on a small cinema in which films were shown of the manufacture of some of their typical products, as well as of the social welfare work associated with the various units of this great organisation. The stands of the gas companies and of the various chemical manufacturing firms showed almost a bewildering range of exhibits, from the simplest raw materials to the most refined analytical reagents and 'fine' chemicals. Hopkin and Williams, Ltd., for example, showed a collection of radioactive uranium-bearing minerals and the products obtainable from them, and also an exhibit of barium sulphate for X-ray diagnosis.

It would be but random selection to refer further to particular exhibits. Taking the Fair, as it could be seen at Olympia, as a whole, it was a noteworthy and encouraging demonstration that Great Britain is still in the forefront of the manufacturing nations of the world. It is to be hoped that all the thoughtful planning, the careful organisation and the zealous co-operation that went to the making of the Fair will have their merited reward in a great and needed stimulus to British industry.

Obituary.

THE HON. SIR CHARLES ALGERNON PARSONS, O.M., K.C.B., F.R.S.

BY the death of Sir Charles Parsons on Jan. 12, while on a voyage to the West Indies, the world has lost the greatest engineer engaged in the production of power from steam since the time of Watt. It is due to his genius and perseverance that the steam turbine now produces practically all the electricity derived from steam power and every fast ship of large size, both naval and mercantile, is driven by steam turbines.

Sir Charles, who was in his seventy-seventh year, was the fourth and youngest son of the third Earl of Rosse, who built the great 6 ft. telescope at Birr, Ireland. He was educated privately and at Cambridge, where he was eleventh wrangler. He became a pupil at Elswick Works and in 1883 joined Clarke, Chapman and Co. of Gateshead, where he made his first steam turbine of 4 h.p., which ran at the unprecedented speed of 18,000 revs. per minute. The design of the dynamo to be coupled to it—and it must be remembered that the design of electrical machinery was in its infancy then—was quite as great a feat as the steam turbine itself. With increasing size, and improvements in design, the efficiency of the steam turbine increased until in 1888 a 32 kw. machine running at 8000 r.p.m. with 100 lb. per sq. in. saturated steam and non-condensing gave a consumption of 51 lb. per kw. hour, a figure that would be good even at this day.

In 1889 Parsons parted company from Clarke, Chapman and Co. and started the Heaton Works, Newcastle-on-Tyne, to manufacture steam turbines and other steam and electrical machinery. Here he met with the great setback that Clarke, Chapman and Co. retained his original patents for turbines with the steam flow parallel to the axis. He, however, designed a turbine clear of the original patents with the steam flowing radially, which, with the addition of condensing, culminated in a 100 kw. turbine running at 4800 r.p.m. giving the then record consumption of 27 lb. per kw. hour with 100 lb. per sq. in. steam pressure, 50° F. superheat, and 27 in. vacuum.

In 1894, however, as Clarke, Chapman and Co. had failed to make a success of the steam turbine, Parsons got back his original patents for a fraction of the sum originally asked for them, and the parallel flow turbine was reverted to, in a form, except for size and improvements in construction and design, essentially the same as the reaction turbine of to-day. In the forty-five years that have elapsed from the time he made his first turbine, the size has increased from the 4 kw. turbine of 1884, which is now in the Science Museum, South Kensington, to 50,000 kw. and even 200,000 kw.

In the same year Parsons resolved to apply the steam turbine to marine propulsion, and an experimental boat, the *Turbinia*, of 40 tons displacement, was built. At first it had one turbine, but, on account of what was then the little-known phenomenon of cavitation, not more than about 20 knots was attained. For one turbine, three in series were substituted, and on each of the three shafts there were three propellers, and thus, in 1897, the then record speed of 34 knots was attained. Two destroyers followed, one of which attained on trial 37 knots—which, it must be remembered, was obtained with coal and not oil fuel. Unfortunately, both these were lost at sea about 1901, due to causes which had no relation to the turbines. Soon afterwards two comparison ships, the *Amethyst* fitted with turbines and the *Topaz* with reciprocating engines, were built by the Admiralty, with the result that the performance of the turbine ship was much the better. As a result, in 1905 turbines were fitted into the battleship *Dreadnought*, and then became the standard for the Navy. On the mercantile side the growth was also very rapid, culminating in the *Mauretania* of 40,000 tons displacement and 68,000 s.h.p., which was designed in 1904 and finished in 1907, or just ten years after the *Turbinia* of 40 tons displacement. In 1912 the difficulty of a slow-speed turbine having to be coupled to a high-speed propeller was overcome by the introduction of gearing enabling each to run at the most suitable speed, and geared turbines have now become standard practice. In 1926 a further step was made in the *King George V.*, a Clyde passenger boat, where a steam pressure of 550 lb. per sq. in. was adopted.

Besides steam turbines, Parsons had many other interests: he made several experiments with very high pressures and temperatures, a 2000-ton press and large storage battery being installed for this purpose, chiefly in the hope of being able to make diamonds; but without success. He also experimented on still higher pressures by firing steel bullets into a block of steel having a hole the same diameter as the bore. Another experiment was to fire a large shot into a chamber containing a mixture of acetylene and oxygen, where it was estimated a temperature of some 16,000° C. was attained on the explosion of the gases. None of these gave any result. The reproduction of sound was another of his activities; he made a valve worked from a gramophone or violin which, when supplied with compressed air, gave a great augmentation of sound, combined in many cases with improved quality.

Parsons was always interested in optical work, largely inherited from his father, and so early as about 1887 devised greatly improved methods of producing search-light reflectors, resulting in Heaton Works constructing nearly all the parabolic search-light reflectors made in Great Britain. He also made reflectors with one axis a parabola and the other a hyperbola or ellipse, so as to give a flat beam for use on the Suez Canal or other purposes. By taking over the Derby Crown Glass Works, where he was able to make many improvements in the manufacture, he to a large degree saved the production of optical glass in Great Britain; and he also had a controlling interest in Messrs. Ross, Ltd., makers of binoculars and other optical instruments. He also took over the telescope works of

Sir Howard Grubb, F.R.S., which are now carried on at Walker Gate, Newcastle-on-Tyne.

Sir Charles was a firm believer in the importance of research in industry, and very large sums were set aside for this purpose. Also, accurate tests were invariably made of each machine as it was made, so as to give data for subsequent designs. He also firmly believed in the utilisation of what may be called highly educated labour, and had always on his staff university men and others with high education, but in all cases it had to be combined with good practical knowledge.

The Royal Society elected Sir Charles a fellow in 1898, and he served on the Council in 1907–9, being a vice-president in 1908–9; he was awarded the Copley and Rumford medals. He was made a K.C.B. in 1911 and received the Order of Merit in 1927. He was given many honorary degrees by various universities, and among other medals had the Grashof Commemoration medal of the Verein Deutscher Ingenieure, the Albert medal of the Royal Society of Arts, and the Faraday medal of the Institution of Electrical Engineers. He was an early member of the Advisory Council of the Department of Scientific and Industrial Research, and was on numerous other committees.

Sir Charles married in 1883 Katherine, daughter of W. B. Bethell, of Yorkshire, and had one son, who was killed in the War, and one daughter. He was a large benefactor to science, giving £5000 to the Royal Institution and £10,000 to the British Association, besides numerous gifts to various institutions.

GERALD STONEY.

IT is difficult to write of Charles Parsons, a great inventor, one to whom civilisation owes more than a friend's feeble pen can well express. Try to picture the world without his inventions, in the days when Atlantic travel took place in ships like the old *Scotia* of the Cunard Line, or the first *Oceanic*, which, when the White Star Line started some sixty years ago, created so much interest on Merseyside. Contrast these with the *Mauretania* and the *Lusitania*, the first great ships propelled by Parsons' turbine, or to come to our own days, with the Cunard *Aquitania* or the *Bremen* of the North German Lloyd Line. Maybe in 1931 we pay too much attention to speed, but time has a high value, and the minutes saved for useful work by the invention, which startled the world when the *Turbinia* first showed herself at the Jubilee Review in 1897, total many millions in number. These are due to Charles Parsons.

But for far more than speed and comfort in ocean travel are we indebted to the turbine and its inventor. Imagine modern life without electric power. This is neither the place nor the opportunity to collect statistics and estimate the percentage of that power generated through Parsons' work on the turbine; generated, too, in a manner so efficient that it is scarcely possible to hope for an improvement—unless, indeed, another Parsons shows us how to use atomic energy. For Parsons was never content to leave an invention until it was nearly perfect, nor was he stopped by difficulties which to many seemed insuperable. At first, the turbine was not a great success; he knew how efficient it ought to be, and he reached his mark. Kelvin well described his invention as the greatest advance in steam practice since the days of Watt.

So, too, with other problems: Parsons tried to produce a diamond, and at the end of his life agreed, no doubt, as Prof. Henry E. Armstrong has told us, that there is no valid evidence to show that it can be obtained by any of the hitherto asserted means; but the work is there, of the highest value—a contribution to knowledge impossible for any but a great man, applying to the problem all the resources of the engineer, all the inventive power of a brilliant mind.

Nor were Parsons' powers less shown in his more recent work. Telescopes and optical glass had for him a hereditary interest: and so he applied his genius to replace English optical glass in the position it held before the days of Abbé and Zeiss, and he did it, while in quite recent years he was devoting himself to further Hale's plans for a giant reflecting telescope.

Parsons made no special mark at Cambridge, where he graduated as eleventh wrangler in 1877. After the usual training of an engineer, he set to work to develop the turbine, but it was not until the end of the century that he received any distinct recognition.

No one meeting Parsons casually would have recognised in the gentle, modest man, somewhat quiet and hesitating in speech and manner, one of the world's great benefactors. In public he said little; but interest him in a problem, ask his advice on some knotty point of scientific or engineering practice, give him, perhaps, a little time for quiet thought, and your problem was solved, or if solution was not at once to be found, you were set on a track promising to lead to the desired end. Moreover, if the attainment of that end seemed of importance, you secured for the rest of your journey the support and assistance of a most wise counsellor and, what is more, a most kind friend.

For Charles Parsons was that to all who earned his friendship; and we, who have enjoyed it for the last twenty-five or thirty years, are the poorer for his loss, happy though we are to have known such a man, and to have learned from him some of the elements of true greatness.

R. T. GLAZEBROOK.

I FIRST met Sir Charles Parsons when he was appointed by the Lord President to the Advisory Council for Scientific and Industrial Research, on the resignation of Prof. Bertram Hopkinson owing to pressure of War work. Thus he was not an original member of the Council as has been stated in some obituary notices, though he joined it in the course of its first year of work. His acceptance of the office was a proof of his willingness to subordinate his personal views to the common good, for it was no secret that he thought the national

organisation of scientific research for industrial purposes would have been better placed under the ægis of the Royal Society than under the State. Yet he was as regular and active a member of the Council at its long and anxious deliberations as any of that brilliant group of seven distinguished men of science who formed the first Advisory Council. As he came to realise that the formulation of policy lay in fact, as it was intended to lie, with the Council rather than with the Minister or his officials, I think his old doubts disappeared, though he was always a little inclined to be suspicious of the 'machine', which, as the range of the Council's activities grew—and it grew very rapidly—necessarily entailed a great increase in administrative business and a corresponding enlargement of the Department. This watchfulness was all to the good of the cause, for the bureaucratic spirit will always be destructive of the aims and ideals of any organisation for the promotion of research, and more particularly industrial research, in which the utmost degree of co-operation between interested and independent bodies and the largest measure of decentralisation are essential to success.

Parsons was essentially a shy man, and his interventions in discussions at the Council were generally brief, and often by way of critical question rather than dogmatic statement. The longest speech I ever heard him make was a remarkable analysis of the conditions necessary for the successful application of new inventions or processes in industry, made before a departmental committee appointed by the Lord President to consider the problem of adequate rewards to scientific workers in government service for discoveries made by them in the course of their employment. He emphasised the comparative cheapness in time and money of small-scale laboratory research, and the high scientific ability, the costliness, and the patience needed for translating a new technique or process or device into industrial practice. He maintained that for this part of the work, where the risks were greatest, the greater reward was justly given. As a great industrialist himself, he would have liked to see, though he realised its inherent difficulty, direct assistance given to selected firms in working new ideas on a manufacturing scale. Failing that, he was a whole-hearted supporter of the policy of establishing co-operative research associations in the industries, for he hoped they would have a freedom in dealing with individual firms which was impossible to a department of State.

In two directions this belief of Parsons was influential. He was closely associated, as an original member of the Fuel Research Board established in 1916, with the late Sir George Beilby's scheme for the station at East Greenwich, where research into fuel problems is conducted both on a laboratory and a full manufacturing scale; and again, it was his active support which helped to secure for the British Scientific Instruments Research Association more generous and continuous assistance than was given to any other of these organisations. A letter from the Director of Scientific Research and Experiment at the Admiralty to the *Times* of Feb. 14, in which he records the proved superiority of British optical glass and optical instruments, is evidence of the wisdom of this policy. Parsons was himself a prime contributor to this result, for after his retirement from the Advisory Council in 1920, he became not only chairman of the Scientific Instruments Research Association, but also successively the owner of the Derby optical glass works and the controlling influence in the famous firms of Sir Howard Grubb and Messrs. Ross and Co.

Parsons entered the glass and instrument industries with the same high courage which had created his great engineering firms, and certainly with no expectation of monetary reward. He knew the conditions too well for that; but he remarked that he believed a good man of science ought to be able to make optical glass without a previous training in glass technique, and his family traditions gave him pride in a conquest which would benefit both science and his country. I have always thought that his interest in glass had its origin in the work of his father, and in the researches he himself undertook at Newcastle on the large reflectors he manufactured there for search-lights.

I remember, when Parsons took me over his works shortly after the War, that he showed me the shop in which these great reflectors were made, and explained how he had solved the problem of annealing them to withstand the strains set up in use. It was impossible to walk with him through his great works without realising that the research spirit informed the whole undertaking, while simultaneously the practical engineer was in control of every part. He was intimately acquainted with every machine in his shops, and again and again he would stop to explain how a weakness had been removed or better performance achieved by his personal intervention. Yet as we moved over to the small building in which he had for years experimented in the artificial production of diamonds, one began to realise the range of his interests, and his willingness to expend large sums and all his ingenuity on problems of no immediate practical importance.

Parsons was not, I should think, an altogether easy man to work with. No genius is. Like most shy men, he was a keen observer and sometimes a sharp critic of others. When he set himself to a task, he would work at it continuously, so he told me, for twenty-four or thirty-six hours or longer at a stretch. This intensity of application and speed must often have left his collaborators and assistants gasping behind him. Yet no man, I believe, did more than he to train his men in the method of his work. Had he been one half as careful of his own health as he was for that of his staff, this grave loss to industry, to science, and to Great Britain might have been postponed.

H. FRANK HEATH.

WE regret to announce the following deaths:

Mr. H. O. Beckit, reader in geography in the University of Oxford, on Feb. 19, aged fifty-six years.

Mr. G. E. Birkett, director of the Manchester and District Radium Institute, on Feb. 5, aged thirty-seven years.

News and Views.

ACCORDING to Dr. S. C. Lind, director of the School of Chemistry, University of Minnesota, research has shown that starting with a single, simple mother-substance, a complex mixture of hydrocarbons such as occur in natural petroleum may be synthesised by suitable reactions. The latter include the application of heat and pressure and, what is perhaps more novel, the bombardment of the initial substance with the alpha rays from radioactive compounds. The *Daily Science News Bulletin* issued by Science Service, D.C., records a recent communication of Dr. Lind's to the American Association for the Advancement of Science, and quotes him as saying: "The simplicity of such a mechanism may lend indirect support to the old idea of an inorganic origin from one or a few hydrocarbon gases such as might be produced by the action of water on metallic carbides in the earth's interior. On the other hand, it does not preclude animal or vegetable origin, but strongly suggests that the primary material, whether gaseous, liquid, or solid, is later subjected to thermal or ionic agents or both, which produce the complexity found in Nature."

WHILE we may discern radioactivity in a new, but none the less possible, rôle in this (Dr. Lind's) theory of petroleum genesis, any support to the moribund inorganic hypothesis, whether direct or indirect, must inevitably be completely razed by the overwhelming geological evidence now available with the progress of time and discovery of vast oilfields, the data of oil-occurrence of which were not available to enlighten the earlier views. But there is decided merit in the postulation of radioactivity as effecting some degree of ionisation of organic matter during the baffling process of destabilisation and actual formation of oil. It is this phase of the genesis which is still so hazy, and anything that chemists can do to throw light on the reactions involved, either mechanism or process, will prove of unquestioned service to science. But is radioactivity a potential function in the type of environment and at the comparatively shallow depth in the crust which modern views seem now to imply for the birth of the oil globule?

IN 1929, a laboratory for the study of the cold-working of iron and steel was established in the University of Sheffield and equipped by firms engaged in the steel wire and strip industries with a rolling mill and draw-bench for experimental work; a fellowship and two research scholarships were provided by the Ironmongers' Company. This laboratory has now been at work for a session, and has in progress a programme of research on the influence of the conditions of drawing on the properties of steel wire, especially with regard to its resistance to fatigue, and special instruments have been constructed for the purpose of the measurements. The behaviour of the cold-drawn wire in torsion, both continuous and alternating, is found to give a convenient means of following the changes in the progressive stages of drawing. The influence of the form of the die and of other factors on the properties of cold-drawn mild steel bars is also under examination. The rolling programme consists in a study of mild steel strip of the deep-drawing variety; and instruments have been constructed for the measurement of the pressures during rolling, and of the energy stored in the cold-worked metal.

AT the Fourth International Congress for Psychical Research, which was held this year at Athens and of which the *Transactions* have recently been published (London: Society for Psychical Research, 1930), Sir Oliver Lodge discussed the reasons for the non-recognition of psychical research by the majority of the scientific world. It would appear that he is of the opinion that eventually the sheer weight of evidence will overpower this hostility, which he thinks arises partly from a pardonable scepticism and partly from a vague recognition of the significance of psychical phenomena and consequent upheaval of ideas which must follow the acceptance of their reality. It may well be, however, that the chief reason that scientific men are chary of recognising psychical research is that they are unable to perceive the weighty mass of evidence of which Sir Oliver speaks. These *Transactions* indicate the kind of things which engage the attention of psychical researchers. Here are tales of raps and lights, of falling mortar and broken crockery, and even of showers of pebbles—of which some, strange to say, seemed to come out of the medium's hair! We read of sacred oleographs oozing human blood one day and on another exuding an organism usually found in very foul water: we are told of an incident where a ghost had to come back to earth to persuade a medium to burn some letters which suddenly appeared in her hands. Even Sir Oliver Lodge tells us a story of an occurrence in the presence of Sir William Crookes "on a well-lighted" dining-table and in "full light", whereas in what appears to be the actual record of the case, it states that the phenomena took place at night in a room lighted only by three spirit lamps. From the official proceedings at the Congress it appears that the next meeting will be held in London in the autumn of 1932, on the occasion of the jubilee of the Society for Psychical Research. Although the French, Italian, and American representatives seem no longer to be associated with the organisation controlling the International Congress, its continuance is assured so long as it is supported by the British and German national committees.

THE projected opening of the Cape-Cairo flying route on Mar. 5 gives interest to a paper on air communication in Africa recently read to the Royal Society of Arts by Mr. G. E. W. Humphery, and published in its *Journal* on Feb. 6. The route will follow British territory in the main, although it starts at Cairo. As far as Khartoum the direction is straight and there is little difficulty about landing grounds. Then a difficult bit of country begins and continues almost as far as Lake Victoria. For some months in the

year much of that country is under water, and on this part of the route it will be necessary, for the present at least, to use flying boats that can alight on the Nile and the lakes. It is hoped, however, that before long aerodromes will be available, making an aeroplane service possible. From Kisumu on Lake Victoria to Cape Town the surface conditions of the country offer no difficulties in the provision of landing places, but the aeroplanes must fly at a considerable elevation. The proposed route is via Nairobi, Broken Hill, Salisbury, Bulawayo, Johannesburg, and Kimberley. Three types of air-craft will be employed, changes being made at Khartoum and Kisumu. Speed will be about 100 miles per hour throughout, and a weekly service for passengers and mails is proposed. There will be no night flying, and the through journey will take eleven days. The opening flight on Mar. 5 will provide connexion with Kenya and Tanganyika, but the first through flight to the Cape will be deferred about three months.

THE aims and methods of the land utilisation of Britain were explained by Dr. L. Dudley Stamp in a paper entitled "Land Utilisation Survey" read before the Royal Geographical Society on Feb. 16. The primary object is to make a complete record of the uses to which the land of Britain is put at the present time. Six different categories are recognised: meadow and permanent grass; arable land, including rotation grass; heathland and moorland; forests and woodlands; gardens; and land agriculturally unproductive. The survey is to be recorded on the 'six-inch' Ordnance maps. This entails roughly 22,000 quarter-sheets, each showing six square miles. The work is being done by volunteer surveyors in various parts of the country and is of such a nature that schools can give valuable help. The Board of Education has recommended it to the notice of schools and emphasised its educative value. The sheets when marked are to be sent to the central office at the London School of Economics. There they will be reduced to a one-inch scale. It is then planned to publish, through the Ordnance Survey, a series of sheets corresponding to the 'one-inch' popular series. Many areas of the country are already arranged for, and several hundred volunteers are at work. It is obviously desirable that the whole country should be surveyed simultaneously, so that useful comparisons can be made and conclusions drawn on the existing state of agriculture. The completed survey will give precise information where statistics can give only average information.

AT the meeting of the Royal Microscopical Society on Feb. 18, Dr. Robert Chambers, professor of biology in the University of New York, gave a remarkable demonstration of his method of micro-dissection and micro-injection in an address on "The Nature of the Living Cell". Probably the most striking peculiarity of living matter, or protoplasm, is the fact that it exists only within the confines of microscopic dimensions. Protoplasm is protoplasm only in the form of living cells, plant or animal; therefore the only direct method of studying its properties is through the compound microscope under magnifications varying from 150 to more than 1000 diameters. The micro-dissection and micro-injection technique of Prof. Chambers was evolved in order to make it possible to manipulate the protoplasm within the living cell. The apparatus is a mechanical device for controlling the movements of spun glass micro-needles and pipettes within the field of the microscope. An apparatus of this kind, built in 1920, was first demonstrated before the Royal Microscopical Society about six years ago. Since then several different types of instrument have been developed by various workers. The present apparatus is a model based upon the original one of 1920, but has been modified from year to year by the addition of various improvements, and is so constructed as to permit operations upon the living cell under the highest magnifications. By means of this instrument many new facts have been discovered regarding the physical and chemical properties of protoplasm. We now know, for example, that the nucleus in many cells is a fluid body and is more alkaline in reaction than the cytoplasm in which it is immersed. The oxidation intensity of living protoplasm has also been determined by the injection into the living cell of dyes which are reducible; thus, when the colour disappears upon injection and can be made to reappear by the injection of an oxidising agent, we can be fairly certain that the protoplasm had reduced it in the first instance. Similarly, by this method, the physical properties of the hitherto hypothetically regarded cell membrane have been made the object of intensive study.

THE new series of *Bulletins* which are being issued by the Ministry of Agriculture and Fisheries are attractively produced on antique paper and bound in stiff cut covers. *Bulletin* No. 20 (1930), entitled "Some Beneficial Insects", was formerly *Miscellaneous Publication* No. 37, but has been rewritten and, in its new form, is now in its third edition. There seems to be no doubt that an increasing number of practical growers and others are interested in knowing something about those insects that confer benefit upon man and which, for this reason, should not be destroyed. This bulletin provides the general inquirer with the elementary facts concerning the life and behaviour of insect parasites and predators. It also gives some idea as to how, in some cases, it is possible to take advantage of their propensities and utilise them on a large scale for controlling noxious forms of insect life. We can commend the bulletin as being one of considerable educational value for rural and other schools. It explains and directs attention to an aspect of Nature too often overlooked. The two coloured plates add to its utility, since they represent accurately some of the chief kinds of beneficial insects prevalent in Great Britain. The bulletin may be obtained from the Ministry of Agriculture and Fisheries, price 4*d*., post free.

IN the Ministry of Agriculture's new *Bulletin* No. 9 (1930), entitled "Bee-Keeping", what was originally a sectional volume of collected leaflets has been revised and largely rewritten. It has been prepared for the information and guidance of those who wish to keep bees, and to assist those who have already

gained some experience of the craft. It is written in a plain, non-technical style, and controversial matters, such as those concerning the causative agents of foul brood, for example, are obviously outside the scope of an elementary publication of this kind. The bulletin contains 55 pages of text and 26 illustrations, and may be purchased direct from the Ministry of Agriculture and Fisheries, price 9*d*., post free. We welcome the new series of bulletins thus inaugurated, for there are many subjects that lend themselves to this method of treatment. Accurate up-to-date information and reliable illustrations are a *sine qua non* in such publications. The two bulletins briefly referred to are essentially popular in character, and the question may be raised as to whether there is also an opening for a second series of a more technical description.

IN his presidential address to the American Society of Parasitologists (published in *Science* of Jan. 9), Dr. N. A. Cobb pleads for more adequate and more accurate treatment of the Nematoda in text-books and in courses of zoology. He attributes the present unsatisfactory teaching on this subject to the fact that *Ascaris* is so commonly regarded as typical of the Nematodes, and this is responsible for such statements as that the only sense organs are papillæ on the lips, whereas "there is no lack of sense organs" in Nematodes. He admits the difficulties of classification and of laboratory studies on the free-living forms, which outnumber the parasitic forms; but would, nevertheless, so far as morphology is concerned, relegate *Ascaris* to the background, as it is "devoid of a single curious or interesting external feature to attract attention". There is much to be said for his plea that the study of the group would be more satisfactorily approached by the microscopic examination of small, living, transparent forms. These could be supplemented by the study of a transverse section, and for this purpose it would be difficult to find a better example than *Ascaris*, in which the histology, especially of the gut, muscles, and reproductive organs, is so diagrammatically clear. The retention of *Ascaris* in this way in the practical course would afford the opportunity of directing the student's attention to the great historical importance of *Ascaris* in the development of our knowledge of germ cells and of the nature and behaviour of chromosomes and other cell elements.

AN interesting and suggestive subject is discussed by A. S. le Souef in the *Medical Journal of Australia* for November—"Actions, Reactions, and Traits common to Men and Animals". From his own observations in the Zoological Garden at Sydney and from the writings of other naturalists, the author has collected examples of activities in birds and beasts which recall human actions. Some of these are the play of elephants, seals, and emus; the collecting instinct of many rodents and of bower-birds, which he suggests may be a forecast of the human collecting of birds' eggs and 'hard cash'; the song of birds and the dances of birds and monkeys; the thieving and the teasing tendencies of certain birds; instinctive fears, and so on. It is possible that there may be a direct ancestral connexion between these animal actions and human actions; but it is unlikely, and Mr. le Souef pushes his conclusion beyond the evidence when he states that "man in his body and mind and the resultant actions therefrom is an almost complete embodiment of the lower animals, combining in some degree the attributes of all species". Man, as a living being, possesses the functions common to all living organisms, and that these should sometimes find similar modes of expression, even in creatures which have no direct ancestral relation, like man and birds, is scarcely to be wondered at. In these actions and reactions we are looking upon common expressions of the essential life activities; but perhaps this is all that Mr. le Souef means.

VOLUME 22 of the *Collected Researches* of the National Physical Laboratory is a quarto volume of more than 400 pages devoted entirely to electrical matters. The 21 memoirs which are included have appeared in the *Proceedings* of scientific or technical societies or in other scientific publications during the past six years, and more than half of them during the last two years. Five of the memoirs relate to the carrying capacity and other properties of cables used in power transmission and come within the purview of the Electrical Industries Research Association or the Engineering Standards Association. One is devoted to the design of an air condenser which is a pure capacitance, and another to an accurate method of measuring dielectric constants of liquids. The remaining memoirs deal with problems which have arisen in wireless telegraphy—the properties of the antennæ and of the beam propagated, the construction and performance of instruments or apparatus used in wireless measurements, including quartz oscillators; nine of these memoirs relate to researches which were undertaken for the Radio Research Board. No one can look through the volume without being struck by the importance of the part the Laboratory is playing in the solution of the problems which arise in the work of the research associations which the industries have formed under the auspices of the Department of Scientific and Industrial Research.

THE 'Text' volume, the final one of the three annual volumes constituting the Registrar-General's Statistical Review for 1929, has recently been published (H.M. Stationery Office. 2*s*. 6*d*. net). It contains the official analysis of the vital statistics contained in Parts 1 (Medical) and 2 (Civil), issued recently. The population (England and Wales) at the middle of the year is estimated at 39,607,000 persons—18,969,000 males and 20,638,000 females. The figures indicate a higher growth among males, and the sex inequality, expressed as 1096 females in 1921, is thereby assumed to have been reduced to 1088 females, at the mid-year, per 1000 males. The deaths ascribed to cancer numbered 56,896, the highest number yet recorded for any one year. There is a marked decrease of mortality from conditions associated with alcoholism. Tables have been introduced

showing the mortality of the first 30 minutes of life, the reduction in the mortality from diabetes since the introduction of insulin (mortality from this disease at ages above fifty-five years, however, continues to increase), and reduction in the mortality from pernicious anæmia as a result of the new treatment with liver.

THE honour of knighthood has been conferred by the King upon Capt. Malcolm Campbell for his achievement of the world's land speed record on Feb. 5.

AN earthquake was recorded at Kew Observatory at 5 h. 44 m. 42 s. G.M.T. on Feb. 20. The epicentre is estimated to have been in Korea, near lat. 39° N., long. 126° E. The initial impulse was very sharp, but the amplitudes of the main phase were small. The shock is believed to have originated at a greater depth than usual, probably about 250 miles.

SIR JAMES JEANS has been awarded the Franklin Medal for 1931 by the Franklin Institute, Philadelphia, "in recognition of his many fruitful contributions to mathematical physics, especially in the realms of the dynamical theory of gases and the theories of radiation, and of his challenging explanations of astronomical problems and his illuminating expositions of modern scientific ideas".

IT is announced in the *Times* that Capt. W. P. B. Beal, formerly principal veterinary officer of the Gold Coast, has been appointed superintendent of the new zoological park of the Zoological Society of London at Whipsnade. Capt. Beal has had considerable experience in supervising the health of animals, planning experimental stations, and road making, and will be largely engaged in the development of the Whipsnade estate. It is expected that the new park will be open at Whitsuntide.

INFLUENZA has been prevalent all over Great Britain during the last few weeks, and for the week ended Feb. 14 the deaths from this disease numbered 458 in England and Wales and 116 in London. The disease is also widespread in the United States of America, and we learn from a *Daily Science News Bulletin* (Science Service, Washington, D.C.) that for the week ended Jan. 31 a total of 8362 cases was reported to the U.S. Public Health Service.

THE Ministry of Health has issued a circular respecting the outbreak of paratyphoid fever in Essex. Between Feb. 1 and 14, 172 known cases have occurred in the Epping Urban, Epping Rural, and Loughton districts, and the Borough of Walthamstow. The infection in all cases has been caused by the paratyphoid B type of bacillus; the illness has been severe in many cases, and up to Feb. 21 seven deaths occurred. The epidemic has been traced to infection of a particular milk supply at a dairy farm in the Epping Rural District. The infection appears to have been introduced by one of the employees on the farm, who, unknown to himself, was suffering from a mild attack of paratyphoid fever while at work and handling the milk before distribution.

THE third annual exhibition of apparatus relating to television, picture telegraphy, and talking films is to be held by the Television Society at University College, London, on April 15, from 2.30 P.M. to 9 P.M. The Exhibition Committee invites offers from research laboratories and institutions and from individual research workers and those engaged in experiments in any of these subjects, such offers to be sent as soon as possible to the Hon. Secretary, Mr. W. G. W. Mitchell, Television Society, 4 Duke Street, Adelphi, London, W.C.2, and giving particulars of space and any other facilities required. As on previous occasions, members of the Society exhibiting apparatus have the right of entering their exhibit in the annual competition for the Tuke Cup, which is awarded by an independent committee of judges for the most meritorious exhibit, in relation to television or cognate subjects.

A CATALOGUE of second-hand books, some 500 in number, on botany, ecology, entomology, forestry, natural history, ornithology, zoology (invertebrate and vertebrate), has just been issued by Messrs. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2. Copies are to be had free upon application.

THE Prague Summer School was inaugurated last year to afford English-speaking visitors, especially those interested in educational matters, an opportunity of attending a series of lectures on various aspects of Czechoslovak and central European civilisation and cultural life. The Summer School will again be held this year during the long vacation, on July 20–Aug. 8. The scope of the syllabus has been extended to include, in addition to other new subjects, an account of Czechoslovak contributions to the natural sciences. In connexion with the lectures a number of interesting excursions have been arranged so that members may see places of historical interest, the Karlsbad and Marienbad spas and springs, the radium mines at Jáchymov, etc. The director of the Summer School is Dr. B. Trnka, 55 Smetana Square, Prague, Czechoslovakia.

AN advanced course in oriental studies will be held at the School of Oriental Studies, Finsbury Circus, London, on Mar. 2, 3, and 4. The lectures will be given by Prof. B. Hrozny, professor of ancient eastern history in the Charles University of Prague, the subject being the "Excavations of Kultepe" and "The Hittites". The first lecture will deal with Prof. Hrozny's travels in Asia Minor and the excavations at Kultepe which led to the discovery of the now famous Assyrian merchants' archives of 2000 B.C. This lecture will be illustrated by some hundred coloured lantern slides. The second and third lectures, on the Hittites, will deal with the decipherment of the Hittite language and its recognition as Indo-European, the non-Indo-European Khattish and other newly discovered peoples of Asia Minor and North Mesopotamia, the Luish, in essence non-Indo-European, the Khurrish, who spoke a non-Indo-European language and are identified with the Horites of the Old Testament, and the Mitanni, who are of Aryan, or rather Indian, origin. Finally, Prof. Hrozny will discuss the relations of

the Hittites and the Greeks. At the first lecture the chair will be taken by Dr. A. E. Cowley, Bodley's Librarian in the University of Oxford. The lectures, which will be delivered in English, will begin on each day at 5.15 P.M., and admission will be free and without ticket.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A reader in statistics in the University of Cambridge—The Registrary, The Registry, Cambridge (Mar. 4). A scientific instrument maker at the University College of South Wales and Monmouthshire—The Registrar, University College, Cathays Park, Cardiff (Mar. 7). An assistant lecturer in science at the National Society's Training College for Teachers—The Principal, Training College, Berridge House, Fortune Green Road, W. Hampstead, N.W.6 (Mar. 9). Senior technical assistants and technical assistants at Admiralty establishments near London and in Portsmouth—The Secretary of the Admiralty, C.E. Branch, Whitehall, S.W.1 (Mar. 10). A director of the Manchester and District Radium Institute—The Hon. Secretary, Radium Institute, Nelson Street, Manchester (Mar. 14). A lecturer in economic history in the University of Liverpool—The Registrar, The University, Liverpool (Mar. 16). A principal and professor of organic chemistry at the Royal Institute of Science, Bombay—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Mar. 21). A biochemist, a technician in the research laboratory, and a junior biologist, each under the Newfoundland Fisheries Research Commission—The Newfoundland Government Office, 58 Victoria Street, S.W.1 (Mar. 22). A professor of chemistry at the Heriot-Watt College, Edinburgh—The Principal, Heriot-Watt College, Edinburgh (Mar. 26). A professor of mechanical engineering in the Engineering College of the Benares Hindu University—The Principal, Engineering College, Benares Hindu University, Benares, India (April 5). A principal of the Northern Polytechnic—The Clerk, Northern Polytechnic, Holloway, N.7 (April 17). Lecturers in, respectively, pure mathematics, civil engineering, and botany in the Queen's University of Belfast—The Secretary, Queen's University, Belfast (April 19). A lecturer in geography and elementary science at the Truro Training College—The Principal, Training College, Truro. A lecturer in physical training and hygiene at Southlands Training College—The Principal, Southlands Training College, Wimbledon Park Side, S.W.19.

Our Astronomical Column.

A Large Sunspot.—A large group of sunspots recently visible is the largest that has appeared for over a year. The group when near the sun's east limb on Feb. 14 was quite small, but between Feb. 17 and 19 it developed rapidly, and by Feb. 21 had become a conspicuous stream of spots easily visible to the naked eye. The central meridian passage of the group occurred on Feb. 20·8; its latitude was 6°, and its area on Feb. 17, 19, and 21 was respectively 150, 900, and 1700 millionths of the sun's hemisphere. On Feb. 19, spectroscopic observations made at 15^h showed a mass of hydrogen to be descending into the following member of the group with the velocity of about 30 km./sec. On succeeding days the group was not unusually active, so far as rather limited observations showed. It may be remarked that sunspots during 1930 were both appreciably less in number and smaller than in 1929. The sunspot minimum may be expected in two or three years' time.

A Faint Cluster near Betelgeux.—*Circular* No. 309 of the U.A.I. Bureau contains a report from Dr. Schüller, of the National Observatory, Prague, on a hitherto unknown cluster of faint stars in the position R.A. $5^h\ 40{\cdot}7^m$, N. Decl. 7° 21′; equinox 1855·0. Exposure of 5½ hours showed an open cluster of stars the magnitude of which is between 16 and 18, close to the edge of Barnard's dark channel No. 36. The cluster is not shown on Barnard's photographs, the Franklin Adams plates, or on those in the Atlas of selected areas. None of these extend to such faint magnitudes; their limit is about 15½ mag. The distance of the cluster is roughly estimated as 30,000 light years, assuming that its brightest stars are of type *A*. Its proximity to the dark lane suggests, however, that there may be some absorption of light, which would make the distance less.

Search for Possible Additional Satellites of Distant Planets.—It is well known that Sir W. Herschel announced the existence of six satellites of Uranus; but only four are now recognised. The possibility of the existence of additional satellites, both of Uranus and Neptune, has been considered by many; we learn from a *Daily Science News Bulletin* issued by Science Service of Washington, D.C., that a photographic search for possible new satellites has been made by Mr. W. H. Christie, using the 60-inch reflector and giving exposures from one to three hours. The result, however, was negative in each case. Mr. Christie concludes that if any bodies of the kind exist, they are not brighter than mag. 19 in the case of Uranus, or mag. 18·5 in that of Neptune. Even this negative result is of interest, and may save time, as establishing the uselessness of searching for such bodies with any smaller instrument. It would seem worth while to make an attempt in the case of Pluto; success is unlikely, but would be of value in giving Pluto's mass.

New Star Catalogue from Yale University.—Prof. F. Schlesinger inaugurated a new era in star catalogues when he published, four years ago, a catalogue of stars in the zone between 50° and 55° North Declination, the places being derived from photographs with a wide angle lens that included the whole width of the zone on each plate. He has now produced a similar catalogue of 7727 stars in the zone 55° to 60°. The zone was covered by 72 plates, the centres of which were 20^m of R.A. apart, so that nearly all the stars appear on two plates. They were taken between 1915 and 1917, but not measured until 1926 and 1927, this being done by Miss Ida Barney. Proper motions are deduced for almost all the stars in the catalogue. These will enable improved places to be obtained for the stars used as reference stars in the astrographic zones. They had previously been brought up from the Astr. Gesell. Catalogues without proper motion in the majority of cases. The probable error of the star positions in the new catalogue is given as ±0·15″ in each co-ordinate.

Research Items.

Finger-prints of Twins.—A study of the finger-prints of twins has been made by Prof. H. H. Newman (*Jour. Genet.*, vol. 23, No. 3). The material consisted of the prints of 100 pairs of same-sexed twins, 50 of whom were classed as identical and 50 as dizygotic or fraternal. He regards the whorl as the most primitive pattern, while some have given this place to the loop, which occurs in primitive form in anthropoids. He finds that the finger-prints of identical twins may be extraordinarily alike in pattern, although they always differ in minutiæ. The distribution of whorls, loops, and arches is the same in both types of twins and agrees with that of the general population. Radial loops and radial whorls are largely confined to the index finger. This is interpreted as a result of the early dichotomy of the limb bud, separating the thumb primordium from the rest of the fingers and tending to produce in the index finger a pattern the reverse of that in the thumb. Tented arches, which are common on forefingers, are interpreted as cases of partial asymmetry reversal. In identical twins the patterns on one or both hands resemble the hands of the other twin more strongly than do opposite hands of the same individual. The reverse is true of fraternal twins, and this difference can be used as a criterion for classifying doubtful twin pairs. If the finger patterns in human twins are compared with the scale patterns in armadillos, it is found that in both man and the armadillo parallel-imaging is about twice as frequent as mirror-imaging of asymmetrical peculiarities. This leads to the conclusion that monozygotic twins in man arise in the same general way as the quadruplets which normally occur in the armadillo, that is, by a process of budding in the early embryo.

Botulism in Wild Ducks.—For several years the death of millions of wild ducks in the western States of America has been attributed to poisoning due to the alkalinity of inland waters after a spell of drought. Further investigation, according to Science Service of Washington, D.C., has shown that there are difficulties in accepting the idea of alkalinity poisoning, one reason being that in some areas where the water was highly alkaline the disease was very much less prevalent than in others where the alkalinity was small, although in general the distribution of the disease agreed with the regions of alkaline waters in the United States. Dr. E. R. Kalmbach, of the U.S. Biological Survey, has now shown that the disease is a form of botulism poisoning, and that the causative organism is different from that which affects human beings. How the organism gets into the duck's body in the first place is not known ; but diseased tissues of one bird fed to another produced symptoms of the disease. One attack gives no immunity from another.

Chinese Fishes.—Papers on the fishes of China have appeared in recent numbers of two scientific magazines published in that country ; one concludes Henry W. Fowler's account of " The Sharks, Rays, and related Fishes of China " (*Hong Kong Naturalist*, Nov. 1930, p. 177), and has, in addition to short diagnostic accounts of species and clear outline drawings, a list of English, Latin, and Chinese names of all the forms. The second paper, by the same author, describes a collection mainly of fresh-water fishes, obtained at Tsinan, China (*Peking Nat. Hist. Bull.* vol. 5, Dec. 1930, p. 27). The collection contained twenty-two species, of which two gobies, belonging to the genera *Acanthogobius* and *Aboma*, are described as new. In the same magazine (p. 15) J. T. Nichols gives the synonymy of some Chinese fresh-water fishes in a paper which may be regarded as supplementary to the " provisional check-list " of the fresh-water fishes of China published as a *Bulletin* of the American Museum of Natural History in 1928.

Crustacea of the Vanderbilt Museum.—The *Bulletin of the Vanderbilt Marine Museum*, vol. 2 (Scientific Results of the Cruises of the Yachts *Eagle* and *Ara*, 1921–1928, William K. Vanderbilt commanding. Crustacea : Stomatopoda and Brachyura, by Lee Boone. Huntingdon : privately printed, 1930), is one of the scientific publications of the Vanderbilt Museum owned by Mr. William K. Vanderbilt, who made extensive collections in various parts of the world; and these collections housed in his own museum, Huntingdon, Long Island, are being described in a series of bulletins, of which the present volume is the second, the first dealing with fishes. There are several more volumes to come, which will be a great help to all zoologists. Miss Lee Boone is well known for her studies on crabs, and has dealt here with the Stomatopoda and the Brachyura in great detail. Most of the material was obtained in the West Indian region, five separate cruises in five consecutive years having been conducted by Mr. Vanderbilt, besides later work in the West Indies, supplementing the Galapagan Expedition. There are also collections from the Labrador New England region, the tropical American Pacific region, and the Mediterranean, representing terrestrial and littoral, besides deep-water species. A large number of little-known forms are present, and much that is new is included with regard to their distribution, besides colour and notes on habits made on the spot by Mr. Vanderbilt. Some of the crabs are well-known northern species, such as *Portunus holsatus* and *Stenorhynchus longirostris* ; but others are extremely rare. All are carefully described and well figured either by excellent photographs or by good line drawings, and the whereabouts of the type specimen (if possible) is given, with notes on general distribution and synonymy.

Culture of Entamœba.—L. R. Cleveland and E. P. Sanders (*Arch. f. Protistenk.*, **70**, 1930) state that when *Entamœba histolytica* is cultivated on slants of liver infusion agar, covered with horse serum in saline (1 : 6) and a small amount of sterile rice-flour added to each tube, " the amœbæ become as numerous as blood cells are in the blood stream ". A photomicrograph of a culture illustrates the abundance of the entamœbæ in such a culture. A pure line was established from a single cyst and the authors have made many studies on this pure line, for example, variation in size. They state that the size of the cysts when plotted produces a clear-cut unimodal size-distribution curve, as would be expected in a pure line. The authors express the view that *Councilmania dissimilis* is an atypical *E. histolytica* " produced, for the most part, by fixation in Schaudinn's fluid heated to 60° C.", that *C. lafleuri* may very well be atypical *E. coli*, and that the genus *Councilmania* is invalid. The authors have been able to produce countless millions of cysts of *E. histolytica*, and they discuss the conditions of encystation. They have also studied the excystation and the production of the quadrinucleate amœba and the eight trophic amœbæ which result therefrom. Their work confirms that of Dobell on these stages. They report that the octonucleate cysts occasionally seen in *E. histolytica* result from the encystation of binucleate trophic amœbæ, and

they describe a process of multiple fission in which "everything occurs that occurs during encystation except that no cyst-wall is formed and motility is not lost". In a further paper Cleveland and Collier (*Amer. Jour. Hygiene*, **12**, 1930) give details of the improved methods of cultivation of *E. histolytica*.

A New Endoskeletal Organ in the Hind Leg of the Halticinæ.—In a recent note (*Zool. Anzeiger*, **92**, 9/10, 1930) R. J. W. Lever has announced that while he was examining a Halticine beetle (*Oxygona acutangula* Chevr.) in Trinidad to confirm the presence of Maulik's organ in the hind femur (see NATURE, Oct. 26, 1929, 668), he noticed another structure. He gives a short description and six illustrations to show the form and its situation relative to other structures in the femur. It seems that the importance of Mr. Lever's note lies in the fact that a more comprehensive study of the structure of the femora of these extremely mobile insects is indicated. It is suggested that this study may be suitably taken up by those who have the opportunity of getting a variety of fresh material. Not only will such study throw light on the general question of jumping locomotion of insects, but it will in a great measure enlarge our views on relationships within the group.

Banana Transport.—As *Report* No. 36 of the Empire Marketing Board, Claude C. Wardlaw and Lawrence P. M'Guire, of the Low Temperature Station, Imperial College of Tropical Agriculture, give an account of "The Behaviour and Diseases of the Banana in Storage and Transport". In view of the fact that the so-called 'Panama disease' has spread to the West Indies from South America, where it has forced the abandonment of thousands of acres cultivated with the 'Gros Michel' strain of banana, it seems imperative to see whether other varieties, apparently not so susceptible to the disease, can be grown for export. Many varieties are available but are not such hardy travellers or have other undesirable qualities. The authors, as a result of preliminary trials on bulk storage under conditions equivalent to a ship's hold, report favourably on the 'Cavendish' variety. They discuss measures for shipping bananas with a minimum of trouble from disease, and examine, from this point of view, the new practice of cutting the stalks with a sterile knife and vaselining the cut surfaces. With careful handling of the fruit, this method may give still better results. Packing in paper bags may lead to complications because of the difficulty in ventilation and in rapid cooling; perforated paper bags may prove useful; but the practice which is most strongly recommended to the exporter is that, when he packs in crates, the whole bunch should be pre-cooled before cutting up for packing.

The Outer Layers of the Earth.—In the *Bull. Seismolog. Soc. Am.*, pp. 41-52, 1930, Daly discusses the discontinuities revealed by seismological research on the shell structure of the earth. From four different kinds of experimental evidence he deduces that the 'seismically effective' compressibility of a rock is about 20 per cent less than its compressibility as determined by the high-pressure method. He notes, however, that specially designed experiments to test this idea are urgently needed. The tentative conclusion, combined with seismic data, suggests that the uppermost layer of a continental block is essentially granitic down to about 30 km. A shell of granodiorite or quartz-diorite is indicated below this to a depth of some 45 km. The next shell is interpreted as gabbro down to 60 or 70 km. Below this there is, according to Gutenberg, a drop in the velocities of the longitudinal and transverse waves which is thought to represent the change from crystalline to vitreous conditions. Daly considers that vitreous basalt may extend down to 1200 km., and that there is no suggestion in the wave velocities of a shell of peridotite near the earth's surface. This interpretation implies that all the exposed peridotite of the earth is a derivative from basaltic magma, a thesis difficult to support. It also implies that the basaltic layer has practically no heat of radioactive origin generated within it. Moreover, it should not be overlooked that the outer 30 km. layer visibly contains large masses of granodiorite and more basic rocks, represented in depth by gneisses and amphibolites; the suggestion of 30 km. of granite, therefore, can scarcely be readily accepted.

Length of Glaciers.—The work of the International Glacier Commission, which from 1894 until 1913 published an annual report on the variations in lengths of certain glaciers, was interrupted by the European War. Its work has now been handed over to the Hydrological Section of the International Research Council. In order to make up with arrears before the resumption of the annual report, a statistical account has now been published of the observations from 1913 to 1928 (*Rapport de la commission des glaciers, Bulletin* 14, Section d'Hydrologie: Union Géodésique et Géophysique Internationale, Venice, 1930). Glaciers are grouped geographically and variations in length, where they have occurred, are given to the nearest half-metre. In some areas only one figure can be given for the whole period of the War. The observations come from various sources, and include the French, Swiss, and Italian Alps, Sweden, and Norway. A supplementary report on more scattered and less complete data is promised. The general impression given by the figures is one of retreat, but there are notable exceptions. The most striking is perhaps the frequent record of the advance of Norwegian glaciers since about the years 1921 and 1922. In the scanty Swedish records there is nothing comparable. Alpine records show very variable conditions, but the increase of the Mont Blanc glaciers was most marked about the years 1914–20. Several of the glaciers of the Rhone basin showed an increase towards the end of this period.

The Measurement of Spark-over Voltages by a Sphere-gap.—In the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, vol. 14, p. 278, Nov. 1930, T. Nishi and Y. Ishiguro give a helpful account of the anomalous phenomena when spark-over voltages are employed for measuring the electrical pressure. In high-pressure engineering it is common practice to measure the crest value of alternating pressures by means of a spark-gap with spherical electrodes. It generally happens, however, that a few stray and erratic sparks occur at low voltages before the gap gets into the condition where a definite steady voltage always produces a spark. When the electrodes are small the preliminary sparks at low voltages do not often occur, and rarely affect ordinary testing. Neither do they occur when the spark-gap is very small compared with the radius of either electrode. With spheres a metre in diameter, placed a metre apart, the first flash-over occurred at a voltage which was 6 per cent less than that obtained in the subsequent tests, all of which gave practically the same result. When the surfaces of the electrodes were carefully cleaned by a cloth soaked in alcohol and the test repeated, the first flash occurred when the pressure was 30 per cent less than its normal value; the next occurred when the pressure

was 12 per cent under the normal, the subsequent flashes occurring at practically the same voltage. Washing the surface with alcohol was very effective in lowering the pressure at which the preliminary sparks took place. The curious behaviour of the sparks is attributed to the surface conditions; but the exact cause the authors were unable to determine. They advise that the first few readings for a fixed spark setting should be rejected and only the steady value given.

An Electrical Pendulum. — A novel electrically maintained pendulum which was exhibited by the British Thomson-Houston Company at the recent Exhibition of the Physical and Optical Societies is illustrated in Fig. 1. A primary coil A carries a high-frequency current generated by a valve in the box; a secondary coil B, forming with its condenser C a separately tuned circuit, is suspended from knife-

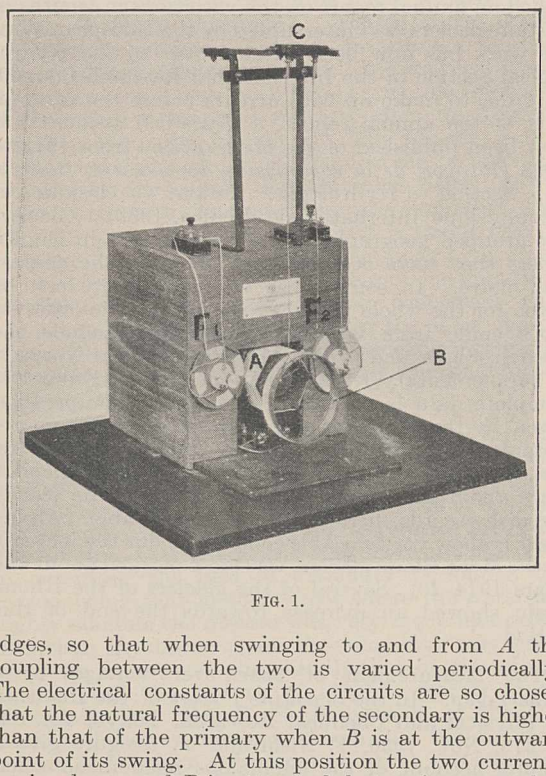

FIG. 1.

edges, so that when swinging to and from A the coupling between the two is varied periodically. The electrical constants of the circuits are so chosen that the natural frequency of the secondary is higher than that of the primary when B is at the outward point of its swing. At this position the two currents are in phase, and B is attracted, but as it approaches A an abrupt change of phase of almost 180° takes place when the coupling has increased to a certain critical amount, so that the force between the two becomes repulsive. Simultaneously the frequency assumes a higher value. On the outward path of B the converse changes occur, and so the swinging is maintained. The two values of frequency are shown by the alternate lighting of two lamps connected to separate coils F_1 and F_2, which are tuned by small condensers. The abrupt phase-changes are those which give rise to the well-known 'double-click' effect obtained with resonant circuits.

Trajectories of Electrons in Valves.—It is of some importance in connexion with thermionic devices to be able to find the paths of electrons within the apparatus. When small quantities of gas are of no consequence, the orbits may readily be demonstrated by their optical effects in the inter-electrode spaces —as, for example, has been done by E. Brüche in a recent test of Størmer's theory of the aurora (*Die Naturwissenschaften*, Dec. 12)—but for various reasons this method is not always permissible, and possibly not always accurate. An arrangement due to Mr. A. J. Maddock, of the British Thomson-Houston Company, which was shown at the recent Exhibition of the Physical and Optical Societies, still enables the points of impact of electrons on an anode to be found in a high vacuum. The anode is coated with carbon, which becomes strongly incandescent at any place where there is a concentration of the electron beams, rendering it very easy to show, for example, the effect of the grid-potential in concentrating the beams to a greater or less degree. The actual valve exhibited had an M-shaped oxide-coated filament, and was operated with an alternating anode potential of 700 volts peak value.

Levulinic Acid and Esters.—Sati and Shao-Yuan Ma in the December number of the *Journal of the American Chemical Society* describe a simple procedure for the preparation of levulinic acid from commercial glucose depending on the hydrolysis with boiling hydrochloric acid. An intermediate product is oxymethylfurfural. A yield of 150 gm. per kilo of glucose was obtained, after distillation under 7 mm. pressure, as large glassy crystals, melting at 33°-35°. From the acid, seven esters were prepared by direct esterification; they were obtained highly pure and their simple physical constants determined. The work was carried out at the National Tsinghua University, Peiping-West, China.

Hydroxylation and Peroxide Production during Slow Combustion of Ethane.—The 'chain theory' of reactions has proved very fertile in accounting for many experimental results otherwise difficult to understand. Peroxide formation is believed to play an important rôle in oxidation processes by determining the length of certain reaction chains, if not as the initial stage in the process itself. W. A. Bone with S. G. Hill (*Proc. Roy. Soc.*, **129** A, 434; 1930) have re-examined the slow combustion of ethane to see how far the view might still be held that the process is one of progressive hydroxylation. Peroxide formation was observed concomitantly with aldehyde formation, but no evidence was found that peroxide production occurred in the initial stages of the reaction and was not a product of oxidation of the aldehyde. While the hydroxylation theory was confirmed, the exact rôle of the peroxides detected must remain uncertain.

Absorption of Hydrogen by Nickel.—Contrary to what is observed with other metals, and also to the hypotheses of Hallwachs and Hermann, absorption of electrolytic hydrogen by nickel wire is accompanied by increase in the electrical resistance of the metal. The results of an investigation into this matter by Franzini, recently described in the *Rendiconti* of the Royal Lombardy Institute of Science and Letters, show also that the temperature coefficient of the resistance is diminished as a result of the absorption of the hydrogen. When the gas appears to be uniformly distributed throughout the mass of the metal, the relation between the increase of resistance and the amount of gas absorbed is probably linear, so that $\Delta r/r = cV$, and if V is expressed in volumes of hydrogen absorbed per unit volume of metal, the constant c has the value $0{\cdot}68 \times 10^{-4}$. If the gas is non-uniformly distributed, the increase in resistance is lower than that indicated by the above equation. The variation of the temperature coefficient of the resistance is also, in all probability, related linearly to the quantity of absorbed hydrogen.

The Origin of Bread Wheats.

By Prof. R. RUGGLES GATES.

AN immense amount of work has been done in recent years in crossing species of cereals and investigating the chromosome behaviour of the hybrids. These crosses include not only many cultivated and wild species of wheat, rye, oats and *Ægilops*, but also intergeneric crosses between these four genera, *Triticum*, *Secale*, *Avena*, and *Ægilops*. The results have thrown much light on the phylogeny of the bread wheats and their relation to other genera.

In all these genera the basal haploid chromosome number is 7, and each genus except rye contains species with $2n$, $4n$, and $6n$ chromosomes. It therefore seemed not unlikely that in all three genera the hexaploid condition had been independently reached, through parallel evolution, and that the bread wheats had therefore been derived from crosses between tetraploid and diploid species of wheats, forming triploid sterile hybrids in which chromosome doubling then gave rise to fertile hexaploid forms. The recent work has, however, brought much evidence to show that the genera *Ægilops* and *Triticum* are very closely related as regards some of their species, and that *Ægilops cylindrica* is directly or indirectly one of the ancestors of the hexaploid bread wheats or soft wheats. This latter view was first put forward by Percival in 1921 on taxonomic grounds, and has now been strongly substantiated by genetical and cytological work, confirmed by various other investigators. Various workers now approximate to the view that the *A* and *B* sets (of 7 chromosomes each) in *T. vulgare* came from the emmer ($4n$) wheats, while the *C* set has been derived from *Ægilops cylindrica* or its diploid ancestor, and a fourth (*D*) set from *Æ. ovata*.

Popova (1923) found that much natural crossing took place in Turkestan, near Tashkent, where the hills were covered with wild *Ægilops cylindrica*, *Æ. squarrosa*, and *Æ. crassa*, which crossed freely with wheat in the neighbouring fields. *Ægilops* species showed numerous parallel variations, as indicated by the variety names, *flavescens*, *rubiginosa*, *albescens*, *ferruginea*, *brunnea*, etc., in different species. The wheats also show parallel variations, awned or awnless, smooth or pubescent, ears white, red, brown, etc. Also *Æ. triuncialis* ($4n$), like the hard ($4n$) wheats, is resistant to rust and has a solid straw, while the other three species of Ægilops mentioned are affected by rust and have a hollow stem, like the soft ($6n$) wheats.

The chromosome numbers in more than twenty species of *Ægilops* have now been counted, chiefly by Schiemann (1928) and Sorokina (1928). Among the diploid species ($2n = 14$) are *Æ. squarrosa*, *Æ. speltoides* and *Æ. caudata*, while *Æ. triuncialis*, *Æ. cylindrica*, and *Æ. ventricosa* are tetraploid, and *Æ. crassa* and *Æ. turcomanica* are hexaploid. *Æ. crassa* from Turkestan is, however, tetraploid. Zhukovsky divided the genus into nine sections. In each of these sections the chromosome number is uniform, but the sections do not coincide with chromosome numbers, as is the case in *Triticum*. Asia Minor appears to be the centre of distribution of the genus, but evidently the classification of the species into sections has not yet reached a definitive state.

Crosses have been made between three subspecies of *Æ. triuncialis* ($n = 14$) and two of rye ($n = 7$), by Karpechenko and Sorokina (1929), using the rye as male parent. The F_1 grains were mostly shrivelled and the hybrid plants resembled *Ægilops* in the majority of their characters, but the fragility of rachis in rye was dominant. The 21 chromosomes in meiosis showed 5-7 bivalents, with the members of each pair end to end. Occasionally a trivalent of three chromosomes arranged tandem was seen.

Philipchenko (1930) made a study of the development of the ear in different species of wheat, *Ægilops*, and rye. He was so impressed with the fact that in *Triticum monococcum* ($n = 7$) the development is different from that of the $4n$ and $6n$ wheats and more like rye, that he proposed to regard it as representing a separate genus, *Monococcum*. The systematist's view has been that *T. monococcum* (and the wild form *T. œgilopoides*) stands apart from other species of *Triticum*. To place it in a genus by itself seems, however, rather an extreme action. Philipchenko found that the ear development in the hard ($4n$) and soft ($6n$) wheats was very similar, while the differences between *Monococcum*, *Triticum*, and *Secale* appear very early. On the contrary, in *Ægilops squarrosa* ($n = 7$), *Æ. ovata* ($n = 14$) and *Æ. crassa* ($n = 21$) he found no important differences in ear development, from which it is concluded that polyploidy has no influence on ear development in either *Triticum* or *Ægilops*.

Vavilov and Jakushkina (1925) reported on a study of *T. persicum* Vav. and its hybrids with other species of wheat, with *Ægilops* species, and with rye. This 'Persian wheat' was obtained at Moscow in 1902 from Haage and Schmidt, who had it from a firm in Moscow in the 'nineties. It was a black-awned spring wheat, very resistant to mildew, and showing considerable immunity to rust. Vavilov in 1916 found in Persia a series of varieties with black ears, pubescent, bearded, of the type of soft wheats; and Zhukovsky discovered in Turkestan a great diversity of varieties of this species. *T. persicum* is tetraploid and placed by Percival in *T. dicoccum*, but Vavilov regards it as forming a link geographically between the Asiatic group, rising to *T. vulgare*, and the Afro-Mediterranean tetraploid wheats. It produces a dirty-brown flour without the yellowness of the *durum* wheats, the bread being more like that from rye in appearance but having a peculiar flavour. Although tetraploid, it shows a number of characters belonging to the soft wheats. It produces fertile hybrids with other $4n$ wheats; but markedly sterile hybrids with $6n$ wheats, and still more with *T. monococcum*, as well as in crosses with *Ægilops triuncialis* and rye.

In 1914 Tschermak (1929) found in the Greek Theatre at Palermo, and afterwards as a weed in the Appian Way at Rome, the wild *T. villosum* or *Secale villosum*, which Bleier showed to be diploid. It was used as male in crosses with *T. spelta* ($n = 21$), *T. durum* ($n = 14$), and especially *T. turgidum* ($n = 14$). The latter hybrids were intermediate and mostly sterile. A few stronger F_2 plants were obtained from unprotected seeds. The strain was more fertile in F_3 and F_4, but showed no segregation. This is probably an amphidiploid with $(14 + 7) \times 2 = 42$ chromosomes, but the number has not been counted. The first observed case of this kind in wheats will be referred to later.

Some of the wheat-rye hybrids which have been investigated throw important light on the relationship of the cereals and the general manner in which the hexaploid wheats may have arisen. W. P. Thompson (1926) studied the cytology of a wheat-rye hybrid. The cross was easily made with certain varieties of *T. vulgare*, producing a very vigorous F_1, which was not quite sterile. Its chromosomes numbered $21 + 7 = 28$. The heterotypic metaphase in meiosis was very irregular. There were often one or

two, but rarely three, bivalents. Most of the chromosomes divided in the second division, but many lagging chromosomes formed extra nuclei. It was concluded that probably none of the rye chromosomes are homologous with those of the wheats.

The experiments on rye-wheat hybrids (*S. cereale* × *T. vulgare*) which Meister has been making for a number of years at the Saratov station on the Volga have yielded important results. Among the practical results has been the production of wheats with valuable rye characters, such as early ripening and winter hardiness. Meister also obtained a constant intermediate fertile hybrid in F_2. It has since maintained its type, and the F_6 plants recently examined by Levitsky and Benetzkaia (1929) showed 56 chromosomes. It is thus an amphidiploid with $(7+21)\times 2$ chromosomes. Meister and others have shown that the F_1 probably do not pollinate themselves, hence there is probably apogamous development of certain F_1 ovules with the somatic chromosome number, this number being doubled in the first mitosis of the egg cell. It was found that in the embryo sac of the F_1 the chromosomes do not conjugate but about 28 pass to each pole, so that eggs with 28 chromosomes must be formed. The meiosis in the pollen mother cells of the amphidiploid shows 28 bivalent chromosomes, but notwithstanding this balanced condition there are many irregularities from lagging chromosomes and disintegration of certain chromosomes.

Perhaps the most striking cases of an amphidiploid hybrid, however, and the first of their kind, were obtained by Tschermak and Bleier (1926). From the crosses *Ægilops ovata* × *T. dicoccoides* and *Æ. ovata* × *T. durum*, constant octoploid forms were derived by chromosome doubling in the F_2, producing plants with normal chromosome pairing in later generations. The frequency with which such forms can arise from *Ægilops-Triticum* crosses strengthens the view that the hexaploid wheats actually did arise from such a cross between tetraploid (emmer) wheats and a diploid species of *Ægilops*. In all the hybrids between *Æ. cylindrica* and the 6*n* wheats there are constantly seven close pairs of meiotic chromosomes, from which Percival concludes (1930) that seven of the chromosomes of these wheats have been derived from the tetraploid *Æ. cylindrica*.

Extensive studies of the chromosome behaviour in many hybrids between *Triticum* and *Ægilops* have also been made by Sax (1924), Jenkins (1929), Aase (1930), Longley and Sands (1930), Bleier (1930), and others. Bleier has recently concluded that pairing of the chromosomes in these hybrids depends partly on the varieties chosen and partly on the environment. He is less sanguine than some others that the phenomena of pairing will furnish a sufficient key to chromosome homologies in the various species. Sax supported the view that the hexaploid wheats came from crosses between emmer and *Ægilops*, based partly on chromosome pairing and partly on the fact that the characters which distinguish the hexaploid from the emmer wheats are all found in *Æ. ovata* and *Æ. cylindrica*.

Another interesting line of evidence of relationships has been obtained by Kagawa (1928, 1929). The volume of the pollen grains in the diploid *Æ. speltoides* was compared with that of four tetraploid species. In two of the latter (*Æ. squarrosa* and *Æ. triuncialis*) the volume was approximately double, suggesting that they might be autotetraploids, while in two others (*Æ. ovata* and *Æ. cylindrica*) it was not. In *Æ. cylindrica* × *T. dicoccum* during meiosis there were sometimes 1-4 end-to-end pairs, and in *Æ. ovata* × *T. polonicum* 1 or 2 such pairs. Occasionally the chromosomes in such a pair were of unequal size. But Kagawa's most interesting work was in carefully comparing the types of the somatic chromosomes in various species of *Triticum*, *Ægilops*, and *Hordeum*. The chromosome pairs in a species frequently show constant differences both in length and in the position of constrictions or spindle fibre attachments. By these methods it was found that *T. monococcum* has three long pairs of chromosomes (two of which have a single constriction and the third two constrictions), the other four pairs being progressively shorter, with characteristically placed constrictions. *T. polonicum* had four similar pairs and others that were different. By such comparisons of the chromosome sets in different species it was concluded that in *T. polonicum*, *T. dicoccum*, and *T. vulgare* most of the chromosome types were represented by a single pair in each cell, and similarly that the tetraploid *Ægilops cylindrica* could not have arisen from the doubling of the chromosomes in *Æ. speltoides*. While this work is doubtless subject to some revision, it seems to show that autopolyploidy has seldom occurred in these genera, but that higher chromosome numbers have usually appeared following crossing.

Watkins, in a series of papers (1928), has made an intensive study of crosses between *T. turgidum* (4*n*) and *T. vulgare* (6*n*). Among his conclusions may be mentioned that the differences between the conspicuous hexaploid types *vulgare*, speltoid, and *spelta* were due to three factors, *k*, *K*, and *Ks*, which were either multiple allelomorphs producing different degrees of keeled glumes (the most conspicuous difference between *turgidum* and *vulgare*) from the round-glumed *vulgare*, or more probably three groups of completely linked factors. This view is supported by the fact that these three factors or factor-groups all show the same linkage value with the factor for awns. The factor *Ks* in *dicoccum* is moreover identified with *Ks* in *spelta*, while similar factors *K′K′* are believed to be carried by the extra chromosome sets of *spelta*. Thus *turgidum* and *durum* are given the formula *KK*, and *vulgare* (*kk*)*K′K′*. By study of the cytology of reciprocal back-crosses of the F_1 *turgidum-vulgare* hybrids with both parents, it was found that 14 *turgidum* chromosomes pair with 14 of the *vulgare*. The conclusion was reached that the 14-chromosome pollen from the back-crosses carries mainly *turgidum* characters, while the pollen with 17-21 chromosomes carries mainly *vulgare* characters. The results did not disclose many factor-differences between the 14 *turgidum* chromosomes and the 14 *vulgare* chromosomes with which they pair, leading to the suggestion that a simple polyploid relationship exists between these two species.

Huskins (1930) finds irregularity in the meiosis of *T. spelta* and *T. vulgare*, and on this basis extends Winge's hypothesis of the origin of speltoid wheats through irregular distribution of certain chromosome pairs in the reduction division. Thompson and Robertson (1930) have also found in hybrids *vulgare* × *spelta* and *vulgare* × *compactum* a considerable proportion of pollen mother cells with one or a few lagging univalent chromosomes, such cells being much less frequent in the pure species. Similar results are obtained among the tetraploid wheats. Such phenomena indicate complete homology between chromosomes which fail to pair. Thompson has also shown that in various hybrids between species with different chromosome numbers there is disharmony between the embryo and the endosperm with its additional set of maternal chromosomes, thus leading to differences in reciprocal crosses.

Percival (1930) has studied 33 hybrids between four tetraploid *Ægilops* species (*ovata*, *cylindrica*, *triuncialis*, and *ventricosa*) and various 2*n*, 4*n*, and 6*n* wheats, as well as hybrids between the four *Ægilops* species themselves. In hybrids between *Ægilops* and

wheats he finds a certain number of bivalent chromosomes, which are all telosynaptic or end-to-end. In crosses between *Æ. cylindrica* and the 6*n* wheats, however, he always finds constantly 7 parasyndetic bivalents formed from the end-to-end arrangement by the chromosomes swinging round to lie side by side. This, as well as the characters of *cylindrica*, point to the presence of 7 *cylindrica* chromosomes in the hexaploid wheats. Hence telosynaptic pairing is regarded as evidence of a less complete homology or a more distant relationship between the members of a pair than is parasynapsis.

The hybrid *Æ. cylindrica* × *Æ. ventricosa* is sterile, but its characters show remarkable resemblance to those of *T. spelta*. In meiosis there are 5-7 bivalent chromosomes, chiefly parasyndetic but some telosyndetic, indicating that one set of chromosomes are homologous in the two species. The two types of pairing are also described in various species-hybrids by Aase. Percival also considers *T. dicoccoides* (4*n*) to be an autopolyploid of *T. ægilopoides*, and concludes that the emmer wheats are probably autopolyploids from the Einkorn wheats. These conclusions, however, require further evidence.

Nishiyama (1930) has described similar conditions in crosses of *Avena* species. *A. fatua* ($n = 21$) × *A. sativa* ($n = 21$) gives a hybrid with 21 parasyndetic bivalents in meiosis, leading Percival to conclude that cultivated oats was derived from the wild *fatua*, while *A. barbata* ($n = 7$) × *A. sterilis* gives telosyndetic pairs.

Watkins (1930) has just published an extensive critique of all the work on wheat (*Jour. Genet.*, vol. 23, No. 2), in which he points out difficulties with the theory of cumulative factors for size-inheritance as applied to wheats, and shows that the chromosome behaviour of hybrid cereals requires further study. While the details therefore remain uncertain, there is evidence for concluding that the origin of the hexaploid wheats has involved interspecific and intergeneric crossing, with allopolyploidy and probably also autopolyploidy, combined with the occurrence of numerous parallel unit mutations.

A recent study of the related grass genus *Agropyron* by Peto (*Can. Jour. Research*, vol. 3, p. 428) again shows 2*n*, 4*n*, and 6*n* species ($n = 7$), with evidence of natural hybridisation between species having the same or different chromosome numbers. This condition is probably very similar to that under which the wheats evolved, except that the hexaploid wheats may have arisen entirely under conditions of cultivation.

Upper Atmosphere over India.

THE inexpensive type of apparatus for obtaining readings of pressure and temperature at great heights in the upper atmosphere which was invented by the late W. H. Dines in 1907 has been employed in many countries. It has been used with one minor modification at Agra (*Gerlands Beiträge zur Geophysik*, vol. 25 (1930), pp. 266-278, by G. Chatterjee and N. K. Sur).

In Dines's apparatus the graph of each record, temperature and pressure being the ordinates and abscissæ, is traced by a sharp non-rusting steel point on a silvered copper plate little larger than a postage stamp, the motion due to variations of pressure being provided by a small aneroid box and those due to change of temperature by the expansion and contraction of a rod of German silver. Difficulty was experienced at Agra in obtaining a continuous scratch on the recording plate, especially when the sounding balloon carried the instrument into the stratosphere, which is there reached at a higher level than over the British Isles, and is in consequence much colder. It was found that the substitution of a deposit of colloidal graphite on glass, for the silver surface, overcame this tendency, and allowed very sharp records to be obtained with only slight pen pressure.

Owing to the rapidity with which rubber balloons perish in India, Vulpro tissue balloons (see NATURE, vol. 124, p. 793; 1929) were substituted for them in 1926; since then balloons have often risen as high as the stratosphere, and the number of observations obtained permits of a fairly detailed account of the seasonal changes of temperature between the level of the ground and a height of 20 km.

The monsoon season in India (June to September) was found to be decidedly the hottest up to nearly 14 km., and at this season the lapse-rate of temperature is higher between 12 km. and 15 km. than lower down, a state of affairs believed to be due to a difference of origin of the air above and below the average level of the cirrus clouds (12 km.). The base of the stratosphere (the 'tropo-pause') appears to be found at an average height of about 16 km. or 17 km. at all seasons, but its mean temperature has an annual variation with a minimum of 192° A. at about the end of the rainy season. The lowest value obtained at Agra so far is 181° A. at a height of 16·5 km. on Oct. 4, 1928, which equals the lowest yet found —at a slightly higher level—over Batavia in 1923, which for long was regarded as the lowest atmospheric temperature observed anywhere in the world.

'Sea Trout' or 'Bull Trout'?

THE brown trout and the sea trout, possibly members of one plastic species, have been the cause of much controversy. Living under widely varying conditions and possessing very different habits, they show differences in appearance which have given ground for much 'splitting' in the past. Furthermore, because they have come much under the eye of observant anglers, many without the knowledge of a trained biologist, who himself is always in difficulties when deciding where a 'species' ends and where it begins, it is natural that the popular accounts of these fish have shown very divergent opinions. That they are specifically indistinguishable is perhaps the general consensus of opinion at the present day, but there has still been a certain amount of indecision as to where exactly to place the so-called 'bull trout' of the Tweed and other rivers.

A critical examination of the sea trout of the river Tweed * comes therefore as a welcome addition to our knowledge of this interesting species. Mr. G. H. Nall, of the Scottish Fishery Board, has shown that the sea trout of the Tweed exhibit a marked difference from those of many other Scottish rivers in the great rapidity of their growth during sea life. As an example, the average weight of a fish in its third sea summer for the Tweed is 7 lb. 7 oz., as against 3 lb. 5 oz. for the Howmore, 2 lb. 13 oz. for the Ailort, 2 lb. 6 oz. for the Forth, and 2 lb. 3 oz. for the Spey. Similarly, for fish in their fifth sea summer the average weight for the Tweed is 12½ lb. as against the highest of 6 lb. 7 oz. for the Howmore amongst the above four rivers.

* Fisheries, Scotland, Salmon Fish., 1929, No. 5: Sea Trout of the River Tweed. By G. Herbert Nall. (London: H.M. Stationery Office, 1930.) 3*s.* 6*d.* net.

Coincident with this rapidity of growth is a short span of life, and consequently few spawning operations. There is an indication that the Tweed sea trout travel very far afield during their sojourn in the sea, which may account for their great growth; marked fish have been recovered from the South Esk, from off the Norfolk coast, off the Dutch coast, and off the Jutland coast of Denmark, though the numbers of recaptures from each place so far only amount to single figures.

Owing to the divergent characters of the spawning grounds in a river with so large a number of tributaries as the Tweed, and since the fish may stay close to their home neighbourhood or range very far afield during their sea life, it is possible that various types of fish may become apparent. As a result of his examinations, Mr. Nall comes to the opinion that "there is no evidence to justify the old belief that the Tweed has two or more distinct races of sea trout". He considers, however, that the sea trout of this river undoubtedly do form a well-marked local race, similar to that found in Northumbrian rivers to the south; but that this does not warrant them being considered a different species as the name *Salmo eriox* would imply, nor is the name 'bull trout' applicable, since it is a term applied in different districts to very different types of fish and is therefore misleading.

F. S. R.

University and Educational Intelligence.

BIRMINGHAM.—In his annual report to the Court of Governors, the Vice-Chancellor, Sir Charles Grant Robertson, announces that during the past session the upward tendency in numbers of students at the University was maintained. The number of new entries for the present session, however, shows a slight falling off. Sir Charles Robertson is of opinion that while the depression of trade may have little effect on the number of students entering the University, it has marked and far-reaching effects on the student who has, in consequence, perhaps £10 a year less to spend on the amenities which mean so much in a university education, as distinguished from mere university instruction. Considering that 49 per cent of the students hold scholarships or have assistance in meeting the expenses of their university careers, and that about 53 per cent began their education in elementary schools, it will be understood that such a curtailment of spending power affects many. "Hence, particularly in hard times, it is wise as far as possible to remember that expenditure on Library, Refectories, and Halls of Residence have their educational values. . . . In *principle*, the application of university income to promote activities or create opportunities, so as to secure that a university education, and not merely university instruction, is provided, is as justifiable as the allocation of that income to scholarships, exhibitions, lecture rooms, or apparatus." Reference is made to the increase in the Government grant to the University, and it is suggested that about half of this should go to increase the salaries of professors. The voluntary medical examination of intending women students has proved so satisfactory that all the women avail themselves of it, and it is suggested that a similar opportunity should be given to the men students.

Prof. S. W. J. Smith has been appointed to represent the University at the Clerk Maxwell Centenary at Cambridge in October.

CAMBRIDGE.—The Appointments Committee of the Faculty of Biology 'A' has appointed Mr. W. B. R. King, of Magdalene College, to be University lecturer in geology. The Faculty Board of Biology 'A' has appointed Dr. H. Godwin, Mr. J. Gray, of King's College, Dr. H. H. Thomas, and Dr. F. F. Blackman, of St. John's College, to be members of the Botanic Gardens Syndicate.

LONDON.—The London County Council has informed the University that the Council's block maintenance grant to the University in each of the four academic years, 1931–32 to 1934–35, will be £125,000. This is an increase of £20,000 on the Council's grant for the current year and of £44,000 on that for 1929–30.

ST. ANDREWS.—Dr. D. F. Cappell, lecturer in pathological histology in the University of Glasgow, has been appointed professor of pathology in the University of St. Andrews in succession to Prof. Sutherland, who retired at the end of last academical year. Dr. Cappell graduated in the University of Glasgow as M.B., Ch.B., in 1921, and has since been engaged in teaching and research work in pathology in the University of Glasgow.

WALES.—Five fellowships, each of the annual value of £200 and tenable for two years, are being offered to graduates of the University of Wales. Applications should be sent, by, at latest, June 1, to the Registrar, University Registry, Cathays Park, Cardiff.

AN election to Beit fellowships for scientific research will take place in July. Only candidates less than twenty-five years of age are eligible. The latest date for the receipt of applications (which should be sent to the Rector, Imperial College of Science, South Kensington, S.W.7) is April 14.

THE following scholarships are being offered by King's College of Household and Social Science: a 'Carl Meyer', value £80 a year, tenable for three years, and a 'Minor College', value £40 a year, tenable for three years. Particulars can be had from the Secretary of the College, Campden Hill Road, W.8.

TATE and Morgan scholarships for the session 1931–1932 are being offered by Battersea Polytechnic, and the examinations for them will be held on June 9 and following days. The scholarships will be tenable for two or three years. The yearly value of each will be from £20 to £30, with free tuition. Particulars are obtainable from the Principal. Applications must be made, at the latest, by April 18.

NOTICE is given by the Faraday House Electrical Engineering College that examinations for the Faraday and Maxwell scholarships will be held on Mar. 31, April 1 and 2. The annual value of the former scholarship is 80 guineas, and that of the latter 60 guineas. The scholarships are tenable for two years in the college and one year in works. Particulars are obtainable from the Registrar of the College, 62 Southampton Row, W.C.1.

THE Board of Education is again prepared to receive applications for Full-Time Studentships from teachers desiring financial assistance in order to attend approved full-time courses of advanced study at universities or other institutions at home or abroad. The amount of grant is fixed by the Board and cannot exceed £100 for an academic year. The course proposed, if academic, should be of post-graduate type, but the Board is prepared to consider also proposals involving travel or the practical study of industrial conditions connected with the teaching of technical subjects. Applications for the year 1931–32 should be made before May 31. Further information and application forms can be obtained from the Board of Education, Whitehall, London, S.W.1.

Birthdays and Research Centres.

Feb. 28, 1858.—Mr. J. SWINBURNE, F.R.S., past president of the Institution of Electrical Engineers and of the Faraday Society.

My present investigations are on the behaviour of the watch-balance and the photography in relief of microscopic objects.

Further research is little more than intellectual exercise, since humanity is too ignorant to utilise it well because natural science is immeasurably ahead of other branches of knowledge. Human happiness involves first a science of sociology, and this is scarcely begun. People do not know it exists, and think important questions can be settled without study. On social questions people are not merely ignorant; they are saturated with wrong ideas and prejudices and are full of negative knowledge. The history of early Greece is vague; but, we may take it, applied sociology, in the form of modern governments, is more than two thousand seven hundred years behind applied natural science.

Mar. 2, 1870.—Sir FREDERICK W. KEEBLE, C.B.E., F.R.S., controller of agricultural research, Imperial Chemical Industries, Ltd., formerly Sherardian professor of botany in the University of Oxford.

The investigations on which I am now engaged are twofold in object. The chief series, which is being carried out in co-operation with the agricultural research staff of Imperial Chemical Industries, Ltd., is concerned with the improvement of arable and grassland and the more profitable utilisation of pastures and meadows, a subject which, apart from its scientific interest, has a far-reaching importance in relation to the welfare of Great Britain and the Dominions of the Empire.

The second subject is the chemical and other means whereby the plant body is integrated so that, made up of similar parts having no apparent nervous ties, the organism nevertheless behaves continuously as a whole, co-ordinating the activities of the several parts in what appears to be the general interest of the plant itself.

Mar. 7, 1869.—Prof. ERNST COHEN, For.Mem.R.S., professor of physical chemistry, University of Utrecht.

The investigations I have carried out during these last few years with my collaborators, Drs. Moesveld, Helderman, Bruins, Douwes Dekker, van Dobbenburgh, Kooy, and Bredée, have shown that the physical and physico-chemical constants of *chemically pure* solid substances hitherto recognised are values which refer very often, if not always, to metastable mixtures, which contain two or more modifications of those substances in unknown proportions. These substances are *physically impure*. As a consequence of this fact, errors of 5, 10, 100, 200 and more per cent in the physical and physico-chemical constants of such substances may occur. We are now studying methods whereby the *chemically* and *physically* pure stable and metastable modifications may be prepared and their physical and physico-chemical properties ascertained.

Societies and Academies.

LONDON.

Royal Society, Feb. 19.—A. J. Allmand and L. J. Burrage: The discontinuous nature of the process of sorption of gases and vapours by porous solids. A summary is given of results obtained either at low pressures or by a new 'retentivity' technique, indicating the presence of discontinuities in the adsorption isothermals and isosteres of vapours on charcoal. The technique is described of a simple static method for the determination of adsorption isothermals, which permits of the detailed examination of a limited pressure range being rapidly carried out. Breaks in the isothermals were found in all cases. Measurements with silica gel and with benzene, carbon tetrachloride, and water also showed discontinuities, rudimentary or slight in the first two cases, but very pronounced with water. A view of the mechanism of the adsorption process is outlined which has features in common with Polanyi's modified theory and with recent suggestions of Semenoff. Distinctions are made between the behaviour (*a*) of activated charcoal and of silica gel and (*b*) of water (molecules natural dipoles) and of carbon tetrachloride (molecules without dipole moment).—L. N. G. Filon and F. C. Harris: The photo-elastic dispersion of vitreous silica. Double refraction was measured for a series of well determined wave-lengths, the load on the specimen remaining unaltered throughout each set of observations. The results show: (1) that the law of photo-elastic dispersion in silica varies slightly with the load applied, so that the usual assumption that the double refraction is proportional to the stress cannot in this case be exactly true; (2) that the curve of photo-elastic dispersion shows marked and highly localised oscillations; (3) that these oscillations are very probably due to some natural periods of the molecules.—C. G. Darwin: Examples of the uncertainty principle. Observations with electrometers and magneto-meters conform to the uncertainty principle of Heisenberg.—G. B. Deodhar: Some investigations in Röntgen spectra. (1) The $K\alpha$ and $K\beta$ groups of the elements silicon, phosphorus, sulphur and chlorine have been studied.—(2) A large number of sulphur compounds have been examined, and it is found that considerable changes in the relative intensities of the β_1 and β_x lines take place from substance to substance.—(3) The fine structure of the K-edge of silica is recorded and measured by using quartz as the analysing and absorbing substance. The observed fine structure may result from the ejected K-electron stopping in one of the possible virtual electron orbits in the SiO_2 molecule, as has been suggested in the investigation of the spectra of sulphur compounds.

Physical Society, Jan. 16.—T. L. Ibbs: The influence of low temperatures on the thermal diffusion effect. Measurements of thermal diffusion on the following gas mixtures at temperatures between 15° C. and −190° C. are described: helium-neon; hydrogen-neon; helium-argon; neon-argon; helium-nitrogen. There is a general tendency for k_t to decrease at low temperatures. It is found, however, that for the pairs of gases helium-neon and hydrogen-neon the change in k_t between 15° C. and −190° C. is small. Chapman's theory is used to deduce approximate values of the laws of repulsive force operating between unlike molecules during collisions. At low temperatures, molecules tend to become 'softer' and their behaviour is less like that of rigid elastic spheres. The 'hardest' molecules appear to show the smallest variation in k_t. The influence of helium in this respect on the value of k_t for a mixture is clearly shown.

Linnean Society, Feb. 19.—V. S. Summerhayes: The angiospermic flora of the Seychelles Archipelago. The angiosperms of the Seychelles number altogether 479 species, of which, after deducting 247 weeds and escapes from cultivation, 232 remain as indigenous. These include 7 marine and 54 littoral species, the remaining 171 being inland species. Neither the marine nor the littoral species afford much indication of the origin of the flora as a whole. The fact that the dominant forest trees are mostly of Asiatic affinity strengthens the indications that the flora of the Archipelago is chiefly Asiatic in origin. The total of 171 inland indigenous species is very small, considering the area of the group (160 square miles). This is probably due to the intense competition between the species of an originally much larger flora, consequent on the gradual reduction in area of a land mass of 20,000 square miles to the present islands. It is suggested that this took place relatively recently, since there is little evidence of specific segregation as between the floras of different islands or island groups.

DUBLIN.

Royal Dublin Society, Jan. 27.—A. R. G. Atkins and H. H. Poole: Photoelectric measurements of illumination in relation to plant distribution (4). Changes in the colour composition of daylight in the open and in shaded situations. Campbell's thin-film cæsium-on-silver vacuum cell was used with various coloured filters, the colour transmission curves of which were obtained by means of a monochromatic illuminator, and a Moll vacuum thermopile. The photoelectric current was measured in the field by J. H. J. Poole's neon lamp method. The relative intensities of the various colours in shaded sites were compared with those found for the diffuse light in the open. The measurements clearly show the great relative abundance of green and of deep red light in woods, and the scarcity of blue light. This change of spectral distribution seems to follow closely the colour transmission curve for chlorophyll. Measurements were also made of the relative colour intensities of sunlight and diffuse daylight in the open, under various conditions.

PARIS.

Academy of Sciences, Dec. 29.—E. Goursat: Some integrable forms of a Monge equation.—H. Deslandres: Simple relations of molecular spectra with the structure of the molecule. Since 1919 the author has pointed out that the frequency $d_1 = 1062 \cdot 5$ is a fundamental one in molecular and atomic spectra. In the present paper new data are given in confirmation, including some data based on the Raman spectrum.—L. Blaringhem and M. Chopin: The regularity of the surface tensions of the fresh latex of *Euphorbia Lathyris*. In an earlier communication, a description was given of an instrument capable of measuring the surface-tension of very small quantities of a colloidal liquid. The application of this apparatus to the measurement of the surface tension of the latex of *Euphorbia Lathyris* shows that the surface tensions of this latex are unexpectedly constant and might serve to characterise the type. Latices from other plants gave different figures.—Gabriel Bertrand and Mme. Y. Beauzemont: The proportion of zinc in the liver of the rat in course of growth. The percentage of zinc is highest in the liver of the new-born rat, gradually falling to about one-third in the adult rat.—Ch. Achard and M. Piettre: The mucin of articular fluids. Mucin from the synovial fluid is characterised by its high vicosity and percentage of sulphur (0·7 per cent).—C. de la Vallée Poussin: The conformal representation of multiply connex-plane areas.—C. Gutton and G. Beauvais: The reflection of electromagnetic waves. A repetition of Garbasso's experiment on the reflection of Hertzian waves by resonators with very short wave-lengths (17 cm.).—E. Mathias: The confusion between the effects of lightning proper with those of fulminating material. The author distinguishes between the effects of lightning, a current of electricity, and those of the explosive compound (a chemical substance) produced by the flash.—Henri Lagatu was elected *correspondant* for the Section of Rural Economy in succession to the late M. Godlewski.—Léon Pomey: A problem put by Chasles. (The generalisation of Pascal's theorem.)—V. Chepeleff and M. Lavrentieff: Conformal representation.—Henri Milloux: A general property of integral functions of infinite order.—A Buhl: Dynamical considerations connected with wave geometry.—Kao Lou: A map of the sky in the Paris National Library. This has been regarded as a Chinese map; but the author gives reasons against this view. The date of the map is probably A.D. 1711.—J. Ph. Lagrula: The homographic formulæ of verticity and their direct development.—Th. V. Jonescu and C. Mihul: The dielectric constant and conductivity of ionised gases.—Jean Louis Destouches: The theoretical interpretation of the Davis-Barnes effect. This explanation is based on a formula given by Stireckelberg and Morse.—J. J. Trillat: The phenomena of transformations of the nitrocellulose network. Their generality in cellulose compounds.—J. Peltier: Research on the flaws and vibrations of ferro-magnetic test pieces. A modification of the method previously described, in which an amplifying arrangement and loud-speaker replace the galvanometer.—Ch. Dévé: A projector of alignment.—George F. Jaubert: A reinforced pseudo-liquid colloidal diaphragm, intended for the electrolytic decomposition of water. The diaphragm is formed of metal gauze, with a colloid such as magnesium and calcium silicate (colloidal asbestos) deposited from suspension in a caustic potash solution by the action of an electric current. The layer thus formed offers no resistance to the passage of the current or the electrolyte, but is quite impermeable to the gases (hydrogen and oxygen). With cells taking up to 5000 amperes the hydrogen obtained is 100 per cent pure, but the oxygen contains about 0·5 per cent hydrogen.—La. Goldstein: Atoms of recoil in gaseous media.—R. Charonnat: Researches on the rôle of water in salts: the *aquo* combinations of the ruthenium-IV-ammines.—G. Darzens and A. Lévy: Dimethylallylbenzylacetic acid and isopropylbenzylvalerolactone.—L. S. Glichitch: A new monocyclic sesquiterpene alcohol, fokienol. This new alcohol has been obtained from the essential oil of Pe-Mou, *Fokienia Hodginsii*, and was obtained pure through its formate. Dehydrated by the method of L. Ruzicka and J. Meyer, fokienol gives 1 : 6-dimethyl-4-isopropyl-naphthalene (cadaline).—J. F. Durand and Lai-Wai Hsun: The action of the hexahalogen benzenes on mixed organo-magnesium compounds. Hexamethylbenzene was obtained by the action of methylmagnesium iodide in large excess upon hexabrombenzene: hexaphenylbenzene was prepared similarly from phenylmagnesium bromide.—P. Fallot and M. Blumenthal: The tectonic interpretation of the north-west of the Spanish Rif.—P. Rougerie: The daily variation of the earth currents recorded at the Parc Saint-Maur Observatory.—F. Bordas: The rain of mud of November 27, 1930. Analyses prove the similarity of composition between the dusts collected at Paris and in the south of France. The origin of the dust is doubtful, but northern Africa appears probable.—Jean Piveteau: The distribution of Teleost fishes in large natural groups.—André

Meunier: Researches on the variations in the coloration of plants in the course of drying. The arbutoside arbutine is the chromogen of *Orobus niger*.—Emile F. Terroine, R. Bonnet, P. Danmanville, and Mlle. G. Mourot: The excretion of creative substances as a function of the endogenous nitrogenous expenditure.—P. Chevey: An attempt to apply the method of observation of the scales to the study of the growth of the fish in the Grand Lac du Cambodge and of Tonlé-Sap.—Jean Loiseleur: The properties of the biochemical constituents, especially proteins, in anhydrous solutions.—A. Blanchetière: The fermentative hydrolysis of gelatine in its relations with the formation of the diacipiperazines.—P. Delanoë: The rôle of the porcupine as a reservoir of the virus of the Moroccan spirochæte, *Sp. hispanicum* var. *morocanum*.

Official Publications Received.

BRITISH.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 409, January. Pp. 121-212+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1929-30. Pp. 72. (London: The Crown Agents for the Colonies.) 5s.

Journal of the Royal Microscopical Society. Series 3, Vol. 50, Part 4, December. Pp. xvi+387-527. (London.) 10s. net.

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-third Annual Report, 1929-30, presented by the Council to the Court of Governors on the 24th October 1930. Pp. 39+6 plates. (Cardiff.)

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 4, No. 16: The Orbit of H.D. 32990 (103 Tauri, Boss 1216). By S. N. Hill. Pp. 261-269. 25 cents. Vol. 4, No. 17: The Wolf Rayet Stars. By C. S. Beals. Pp. 271-302+plates 10-11. 25 cents. Vol. 4, No. 18: The Orbit of Boss 3180. By W. E. Harper. Pp. 303-307. 25 cents. (Ottawa: F. A. Acland.)

The Presidential Address on The Influence of Physical Research on the Development of Wireless, by Dr. W. H. Eccles, given before the Institute of Physics on May 27, 1930. Pp. 18. (London: Institute of Physics.) 1s.

FOREIGN.

Comptes-rendus des travaux du Laboratoire Carlsberg. 18me Vol. No. 6. Pp. 72+10 planches. (Copenhague: H. Hagerup.) 5 kr.

Smithsonian Miscellaneous Collections. Vol. 82, No. 13: A Note on the Skeletons of two Alaskan Porpoises. By Gerrit S. Miller, Jr. (Publication 3107.) Pp. 2+1 plate. Vol. 82, No. 14: The Supposed Occurrence of an Asiatic Goat-Antelope in the Pleistocene of Colorado. By Gerrit S. Miller, Jr. (Publication 3108.) Pp. 2+2 plates. Vol. 82, No. 15: Three small Collections of Mammals from Hispaniola. By Gerrit S. Miller, Jr. (Publication 3109.) Pp. 10+2 plates. (Washington, D.C.: Government Printing Office.)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1930. (Publication 3073.) Pp. vii+147. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Selected Works on Natural History, including Periodicals and Publications of the Learned Societies and an Important Collection of Linnaeans. (New Series, No. 24.) Pp. 60. (London: Wheldon and Wesley, Ltd.)

Botany, Gardening and Agriculture. (Short List B.7.) Pp. 10. (London: Francis Edwards, Ltd.)

Catalogue of Books on Botany, Ecology, Entomology, Forestry, Natural History, Ornithology, Zoology, Invertebrate and Vertebrate. Pp. 28. (London: W. and G. Foyle, Ltd.)

The Nickel Bulletin. Vol. 4, No. 2, February. Pp. 33-64. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

FRIDAY, FEBRUARY 27.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Electricity Offices, Swansea), at 6.—B. Leggett: The Medical and Surgical Applications of Electricity.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. J. Montgomerie: Some Notes on Motor Engine Seatings.

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 6.30.—A. Lakeman: The Construction of an American Factory.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (jointly with Institution of Rubber Industry) (at Milton Hall, Manchester), at 7.—G. F. Thompson and E. V. Bratby: Colours used in the Rubber Industry.

WEST CUMBERLAND SOCIETY OF CHEMISTS (at Workington), at 7.—Dr. G. B. Slottman: Fuel Economy in Iron and Steel.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College), at 7.15.—A. Watson: The Work of the Building Research Station.

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7.30.—J. H. Strong: Some Modern Tendencies in Cotton Manufacturing.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. B. Moore: Fused Silica in Industry.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Tookey: Oil Engines for the Maritime Fishing Industry.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Dr. P. Manson-Bahr: The Epidemiology of Human Trypanosomiasis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Francis Younghusband: The Re-Birth of India.

ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—H. Sutton: Aircraft Light Alloys.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Thomas' Café, Swansea).—Dr. A. J. Amour: The Pathology of some Industrial Poisons.

INSTITUTION OF ELECTRICAL ENGINEERS (at Armstrong College, Newcastle-on-Tyne).—F. J. Baldwin: Overhead Line Work—More Especially in Connexion with the Grid (Students' Lecture).

SATURDAY, FEBRUARY 28.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—W. J. Dobbs: The Correlation of Trigonometry and Geometry in Elementary School Mathematics.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—J. Stephens: A Poetry Recital.

INSTITUTE OF BRITISH FOUNDRYMEN (East Midlands Branch) (at Technical College, Derby), at 6.—F. C. Edwards: Testing Castings.

INSTITUTE OF BRITISH FOUNDRYMEN (Newcastle-on-Tyne and District Branch) (at Neville Hall, Newcastle-on-Tyne), at 6.15.—C. E. Pearson: The Deterioration of Grey Cast-Iron on Repeated or Prolonged Heating.

INSTITUTE OF BRITISH FOUNDRYMEN (Wales and Monmouth Branch) (at Merchant Venturers' Technical College, Bristol), at 6.30.—W. Jackson: Interesting Moulding Jobs.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—Capt. A. E. Butterfield: Development of Unattended Navigation Lights.

MONDAY, MARCH 2.

ROYAL SOCIETY, EDINBURGH, at 4.30.—Dr. Baini Prashad: Some Noteworthy Examples of Parallel Evolution in the Molluscan Faunas of South-Eastern Asia and South America.—Prof. H. Briggs: The Classification and Development of the Carbonaceous Minerals of Organic Origin.—*To be read by title only*:—H. V. Lowry: Properties of the Function $E_{in}(x)$.—Dr. A. C. Aitken and A. Oppenheim: On Charlier's New Form of the Frequency-Function.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—E. Kilburn Scott: The Career of Matthew Murray.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—T. C. Gilbert and others: Discussion on Earthing *versus* Artificial Earthing.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—S. W. Melson, A. N. Arman, and W. Bibby: Surge Investigations on Overhead Line and Cable Systems.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol), at 7.—J. W. Rissik and H. Rissik: Heavy-Duty Rectifiers and their Application to Traction Substations.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—W. H. Gray, Dr. J. W. Trevan, and Miss H. W. Bainbridge: The Chemotherapy of Antimony.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presentation of the Royal Gold Medal.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8.30.—Miss M. N. Searl: Some Contrasted Aspects of Psycho-Analysis and Education.

HUNTERIAN SOCIETY OF LONDON (at Apothecaries' Hall), at 9.—A. E. M. Woolf: The Surgical Aspects of Diverticulitis (Hunterian Oration).

TUESDAY, MARCH 3.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Surg.-Capt. S. F. Dudley: Some Lessons of the Distribution of Infectious Disease in the Royal Navy (Milroy Lectures) (2).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Recent Experimental Physics (4): Adhesion (2).

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Clinical Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—S. Zuckerman: The Menstrual Cycle in the Primates. III. The Alleged Breeding Season of the Primates, with special reference to the Chacma Baboon (*Papio porcarius*).—Major S. S. Flower: Contributions to our Knowledge of the Duration of Life in Vertebrate Animals. V. Mammals.—Malcolm A. Smith: Description of a New Genus of Sea-Snakes from the Coast of Australia, with a Note on the Structures providing for Complete Closure of the Mouth in Aquatic Snakes.—E. Le G. Troughton: The Occurrence of a Male and Female *Grampus griseus* (Delphinidæ) at Sydney, New South Wales.—Dr. E. Schwarz: A Revision of the Genera and Species of Madagascar Lemuridæ.—Dr. W. J. Dakin: The Osmotic Concentration of the Blood of *Callorhynchus millis* and *Epiceratodus forsteri* and the Significance of the Physico-chemical Condition of the Blood in regard to the Systematic Position of the Holocephali and the Dipnoi.—Rev. E. J. Pearce: Report on the Halipidæ (Coleoptera): Mr. Omer Cooper's Investigation of the Abyssinian Freshwaters (Hugh Scott Expedition).

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—C. C. Paterson: Address.

EUGENICS SOCIETY (at 20 Grosvenor Gardens, S.W.1), at 6.30 and 8.30.—Study Circle.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. L. Shand: The Italian Riviera (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—L. A. Legros: Standardisation.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester University College Biological Society) (at University College, Leicester), at 8.—Prof. A. R. Ling: Polysaccharides.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at College of Technology, Leicester).—H. G. Taylor: Phenomena connected with the Collection of Current from Commutators and Slip-Rings.

WEDNESDAY, MARCH 4.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. A. Macfadyen: The Geology of British Somaliland (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—C. E. Horton: The Practical Correction of a Wireless Direction-Finder for Deviations Due to the Metal Work of a Ship.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—W. E. Fretwell: Public Baths and Wash-Houses: Engineering Equipment and Data.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—Dr. C. J. Smithells: Gases in Metals.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society), at 8.—Presidential Address.—*Papers to be read by title*:—H. Ikuta: The Investigation of Japanese Beeswax.—J. Bamford: The Denigès-Oliver Test for Morphine.

ROYAL SOCIETY OF ARTS, at 8.—W. G. Raffé: Training for Advertising and Commercial Art.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—D. C. L. Fitzwilliams: Fat Necrosis.—J. Taylor: Costo-scapular Crepitus.—A. D. Wright: The Small Incision for Perforation of Peptic and Typhoid Ulcers.—A. E. Porritt: The Injection Treatment of Hydrocele, Varicocele, Bursitis, and Nævi.—J. P. Ross: The Anatomy of the Spinothalmic Tract in Relation to Cordotomy.—J. P. Hosford: Prognosis in Fractures of the Carpal Scaphoid.—R. H. Boggon: Removal of the Stellate Ganglion in Raynaud's Disease.

THURSDAY, MARCH 5.

ROYAL SOCIETY, at 4.30.—W. L. Garstang and C. N. Hinshelwood: The Kinetics of the Combination of Hydrogen and Oxygen: the Influence of Iodine.—Dr. D. R. Hartree: Optical and Equivalent Paths in a Stratified Medium, treated from a Wave Standpoint.—H. J. Phelps: The Adsorption of Substances by Fuller's Earth.—*Papers to be read in title only*:—Prof. L. J. Mordell: The Arithmetically Reduced Indefinite Quadratic Form in n Variables.—J. S. Foster: The Effect of Combined Electric and Magnetic Fields on the Helium Spectrum II.—F. R. Terroux: The Upper Limit of Energy in the Spectrum of Radium E.—K. R. Rao and J. S. Badami: Investigations on the Spectrum of Selenium I.—J. K. L. Macdonald: Stark-Effect in Molecular Hydrogen in the Range 4100-4770 A.—T. Alty: The Reflection of Vapour Molecules at a Liquid Surface.—A. E. Moelwyn-Hughes and C. N. Hinshelwood: The Kinetics of Reactions in Solution. I., II.

LINNEAN SOCIETY OF LONDON, at 5.—H. E. Forrest and others: Discussion on The Relation of the Fauna and Flora of the British Isles to those of North America.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Surg.-Capt. S. F. Dudley: Some Lessons of the Distribution of Infectious Disease in the Royal Navy (Milroy Lectures) (3).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—Prof. J. B. S. Haldane: Respiration (3).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 6.—Rear-Admiral D. W. Taylor: Variation of Efficiency of Propulsion with Variation of Propeller Diameter and Revolutions.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (Annual Meeting) (at Bristol University), at 7.30.—Chairman's Address.

SOCIETY OF GLASS TECHNOLOGY (London Section) (at Science Museum, South Kensington), at 7.30.—Discussion on Furnace Design:—T. C. Crawhall: Some Early Types of Glass Furnaces.—F. W. Hodkin: Design of Modern Pot Furnaces.—L. E. Norton: Design of Modern Tank Furnaces.

CHEMICAL SOCIETY, at 8.—F. L. Gilbert, R. R. Goldstein, and Prof. T. M. Lowry: Studies of Valency. Part XV. Absorption Spectra of Polyhalide Ions.—R. V. Henley and E. E. Turner: The Reactions of Substituted Ammonium Aryloxides and of Related Compounds. Part I. The Preparation and Thermal Decomposition of some Tetra-substituted Ammonium Aryloxides.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.—Major P. G. Edge: The Uses and Scope of Vital Records in the Tropics.

FRIDAY, MARCH 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Discussion on Effects on Hearing after Fractured Base of the Skull: Lessons Resulting Therefrom.

ROYAL SANITARY INSTITUTE (at Guildhall, Swansea), at 3.—H. R. Tighe and others: Discussion on The Rheumatic Child.—Dr. J. M. Morris, E. Morgan, and others: Discussion on Housing.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. G. M. B. Dobson: A Photoelectric Spectrophotometer for Measuring the Amount of Atmospheric Ozone.—G. F. Tagg: Practical Investigations of the Earth Resistivity Method of Geophysical Surveying.—W. E. Pretty: Displacement of Certain Lines in the Spectrum of Ionised Oxygen (O II, O III), Neon (Ne II), and Argon (A II).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of the Nerve Supply of the Alimentary Tract and the Nature of Auerbach's Plexus.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (in Grosvenor Restaurant, Glasgow), at 6.30.—Annual Business Meeting.

SOCIETY OF DYERS AND COLOURISTS (jointly with Society of Chemical Industry) (at Engineers' Club, Manchester), at 7.—S. M. Neale: The Action of Caustic Soda on Cellulose.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—J. Urmston: The Electrical High-Pressure Testing of Cables and the Localisation of Faults.

JUNIOR INSTITUTION OF ENGINEERS (at Science Museum), at 7.—The Historic Locomotives at the Museum.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. M. Hug: The Netherlands East India State Railways and Electrification (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. C. A. Matley: The Deserts of California (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. G. M. B. Dobson: Ozone in the Upper Atmosphere and its Relation to Meteorology.

SATURDAY, MARCH 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford: Recent Researches on the Alpha Rays (1).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (at Bristol).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—A. M. Hocart: Spirit-Worshippers of the South Seas.

MONDAY, MARCH 2.

UNIVERSITY OF LEEDS, at 5.15.—Prof. G. Elliot Smith: Some Factors in Mind Making.

SCHOOL OF ORIENTAL STUDIES, at 5.15.—Prof. B. Hrozny: Excavations of Kultepe: The Hittites. (Succeeding Lectures on Mar. 3 and 4.)

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—Dr. W. Rosenhain: Hardness and Hardening. (Succeeding Lectures on Mar. 9, 16, and 23.)

TUESDAY, MARCH 3.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15.—Dr. C. H. Andrewes; Immunity in Virus Diseases (1).

GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy in Twelve Chapters: a Summary of Recent Advances. (Succeeding Lectures on Mar. 4, 5, and 6.) (Gresham Lectures.)

WEDNESDAY, MARCH 4.

KING'S COLLEGE, LONDON, at 5.30.—Dr. H. P. Biggar: The Great Age of Discovery: The First Explorers of the North American Coast.

UNIVERSITY COLLEGE, at 5.30.—Dr. C. Pellizzi: Pisa (*in Italian*).

BELFAST MUSEUM AND ART GALLERY, at 8.—A. P. Fitzgerald: Traffic Dangers and how to avoid them.

FRIDAY, MARCH 6.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. H. Wieland: Studies on Biological Oxidation (Pedler Lecture).

SATURDAY, MARCH 7.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Mediæval Maps and Travellers' Tales.

CONFERENCES.

FEBRUARY 27 AND 28.

ASSOCIATION OF TECHNICAL INSTITUTIONS (at Merchant Taylors' Hall, E.C.2).

Friday, Feb. 27, at 11 A.M.—Lord Eustace Percy: Introduction of Major-Gen. Sir Philip Nash as President Elect.
Principal B. Mouat Jones: Technical Education in Russia.

Friday, Feb. 27 (*afternoon*), and *Saturday, Feb.* 28 (*morning*)—
G. H. Gater: A Descriptive Account of Technical Education in London.
Comyns Carr: Industrial Administration.
Principal J. A. Todd: National Certificates in Commerce.
J. W. Ramsbottom: Commercial Education in America.

MARCH 5 AND 6.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting).

Thursday, Mar. 5 (at Chemical Society), at 2.30—
Dr. W. H. Gibson: Flax Wax and its Extraction.
Dr. R. G. Israel: The Recovery of Gum from Fossil Kauri Timber.
I. W. Humphrey: The Extraction of Terpene Chemicals from Waste Pine Woods.
(At Institution of Civil Engineers), at 6.30.—Baron Gian Alberto Blanc: The New Italian Leucite Industry (Public Lecture).

Friday, Mar. 6 (at Hotel Victoria), at 11 A.M.—Presentation of the Osborne Reynolds Medal, the Moulton Medal, and the Junior Moulton Medal.
At 11.45 A.M.—The President and others: Discussion on The Education and Training of the Chemical Engineer.
At 2.15.—Dr. D. M. Newitt: The Flow of Gases at High Pressures through Metal Pipes.

CONVERSAZIONE AND EXHIBITION.

SATURDAY, MARCH 7.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.