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The Scientific Outlook

IT might have been expected that two such addresses as those delivered by Sir Alfred Ewing and Prof. Miles Walker at the York meeting of the British Association would have provoked a storm of criticism. Much of the criticism has, however, been directed at the details of the scheme proposed by Prof. Miles Walker, and some of the critics have assumed that his address advocated the participation in government of the engineer as distinct from other scientific workers, or indeed from those possessing a scientific outlook or the capacity to assess technical and scientific factors. Few of the critics have revealed any appreciation of the difficulties with which mass production confronts our civilisation or the moral weakness of man as compared with his tremendous command over natural forces.

The fact that both addresses were delivered by engineers has made it easier for prejudice to obscure the real issues by representing the addresses as sectarian clamourings for greater power. The fundamental challenge which they issue to the present order was ignored and it was left for Prof. J. L. Myres, at the Oxford meeting of the Association of Special Libraries and Information Bureaux, in an address on "Science and the Humanities", to direct attention to this challenge. Prof. Miles Walker's address does not so much outline an experiment in sociology, an attempt to relate knowledge and power more effectively and to eliminate prejudice, as offer a challenge to the general outlook of to-day, the poverty of which is one of our most serious troubles. Men have assumed too easily that the present depression will be ended by the old methods and that a return to prosperity will come without special effort.

Two things are involved in any such effort, on both of which Prof. Miles Walker touches : accurate knowledge of the changes which are taking place in our civilisation as a result of the application of scientific discoveries, and particularly of the consequences of power production and of the increased means of communication, whether in the sense of transport or of intelligence such as in broadcasting ; and secondly, the training which must now be given to people in this age to render them competent to live.

It is at this point that we reach the essential challenge to modern politics, economics and education implicit in the last part of Sir Alfred Ewing's address. What society must inevitably

consider is the relative value of science and the humanities both in the organisation and development of the world order and in the preparation of the individual members to enjoy the privileges and discharge the responsibilities inherent in membership of a society based on scientific achievements. The criticism of the scientific training given by our existing educational system, which came from Prof. Miles Walker, is supported by similar criticism from many other quarters; in neither education, politics nor economics is it wise to assume that our present institutions will stand the test without radical transformation.

The relative contribution of science and the humanities at this juncture of national or world affairs cannot be determined merely by reference to discussions on this subject in the past. The question must be examined in relation to the factors of to-day, and Prof. Myres in his analysis wisely refers us back to the main purposes of any system of education. One main object of education must be to place at the disposal of the next generation the experience accumulated in the past of what takes place around us and of the way in which people react to their environment, leaving it to the coming generation to make what use it chooses of such experience and to develop its own interpretation. This is, of course, the attitude which in the past scientific workers have adopted towards their own discoveries. They have been content for others to make of them what use they would and have been comparatively indifferent to the far-reaching consequences which for good or ill have sometimes flowed from their application. It is this indifference, or the divorce of knowledge from life, that has marred much of our teaching of science and created a prejudice against learning.

The economic consequences of the increased productive powers conferred by mechanical science, the prostitution of scientific knowledge to destructive purposes in armaments, the misuse or abuse of the advantages of modern transport, radio, the cinema for anti-social purposes, and the immense powers for mischief which the application of modern scientific discoveries puts in the hands of careless or vicious individuals in themselves have brought many to realise that neither science nor society can continue to be unconcerned with the social and moral consequences of scientific research. It is, however, less frequently perceived that brilliant progress in scientific research and discovery can proceed side by side with the full development of moral qualities and æsthetic or artistic tastes, and that in fact in the absence of such an environment scientific advance is impeded.

The pursuit of this main objective in education accordingly leads us to realise how closely related are scientific achievement and cultural or moral standards. Prof. Myres pointed out, however, how much more closely they are related in the second main objective of education, the training of the growing generation in the use of knowledge. This involves the development of human qualities and individualism, the teaching of self-consciousness and of control of oneself, individually and in relation to others. This aspect of knowledge or information is often overlooked, and results in the rigid distinction between the natural sciences and the humanities which has worked so much mischief in education. The human sciences—human biology, psychology, and statistical economics—form a coherent system and are a fitting subject of scientific study, while moral, political, economic and æsthetic subjects have a geographical as well as a historical aspect or distribution. It is only when the geographical distribution is taken into account that the humanities come into a right relation with life. Individuals and societies alike have a geography and a historical geography as well as a biography, and this inevitably wears thin the distinction between science and the humanities.

Moreover, the distinction between pure and applied science rests on essentially the same factors. So long as they are concerned with problems which have a systematic solution independent of local or temporary conditions, even agriculture and engineering are in effect pure sciences. It is only when they are taking account of local or temporal factors that they become 'applied', and perhaps one reason why so much is at present expected from the engineer is that the liberal traditions of the engineering profession make full allowance for distribution considerations. Accordingly, it should be obvious that a systematic science can only be one factor in education for life. It stands apart from the central mass of knowledge and needs supplementing. Similarly a so-called human science has little value when it becomes systematised and ceases to reveal something significant about man.

We may humanise the teaching of a systematic science by devoting more attention to its historical growth and regional applications, as is seen in the growing use of anthropology in the administration

and education of the backward races. We may clarify and intensify the teaching of the humanities by a firmer distinction between their systematic aspect and those historical and regional reconstructions which alone can set the present civilisation in an intelligible perspective. In so doing we should undoubtedly increase the effectiveness of the training we give as a preparation for life, but such teaching and training demand *a priori* an adequate vision on the part of those giving it. They must themselves have put their minds accurately and intelligently on the facts and situations they have to face.

It is the general absence of an adequate scientific outlook with all that it connotes—the willingness to accept change, the capacity to explore new situations, and to develop appropriate methods undeterred by prejudice or preconceived ideas—that is our gravest danger to-day. To that outlook there must be joined those moral qualities, sincerity of purpose, loyalty to truth, patience, courage, humility, unselfishness and the capacity to work with others, of which neither the philosopher nor the scientific worker has a monopoly and which both have demonstrated can be consistent with the exercise of the greatest intellectual gifts.

The clash between science and the humanities or the classics is long since out of place. The noblest resources of both are needed in the task before us if true are to be sifted from false values. Means must be found of making accurate knowledge of the facts of the universe eloquent and understood of all, and equally the moral consciousness of mankind must be roused to use his knowledge to great purposes. It is only as men are willing to face the full facts of the situation, to develop new methods where they may be called for, to renounce on occasion deeply embedded habits or even ways of thought and take up the challenge of adventure which scientific advance flings down to them, that we can hope to emerge from our present difficulties, and handle successfully the many problems presented by an age of mechanism with its concomitant leisure.

For the planning and national planning thus involved for the full exploration and interpretation of the phenomena of social life, scientific outlook and method must be harmoniously linked with a vision of humanity, a sense of values, of order and of beauty which mankind has learnt to find in the individual experience or biography recorded in the humanities in great literature and art.

The Origin of Mammals

The Mammal-Like Reptiles of South Africa: and the Origin of Mammals. By Dr. Robert Broom. (Issued under the auspices of the Carnegie Corporation of New York, and the Research Board, Union of South Africa.) Pp. xvi+376. (London: H. F. and G. Witherby, 1932.) 25*s*. net.

FOR many years the fossil reptiles found in the Karroo rocks of South Africa have excited great interest because they seem to include the ancestors of mammals, or at least show how some of the early reptiles may have passed into mammals. They date back to the Permian and Triassic periods, when mammals and birds must have had their beginning; and many of them are in so remarkable a state of preservation as whole skeletons that they are most satisfactory for study. Nearly all, however, are described in small scattered papers, and some are so strange that they have been interpreted in different ways at different times by various authors, so that it is not easy to obtain a good idea of the interesting phase of reptilian evolution which they represent. Dr. Broom has thus done good service to science by preparing an authoritative summary of our present knowledge of the subject, to which he himself has contributed the greater share during the past thirty years. With the aid of a grant from the Carnegie Trust he has published a handsome volume, which will be eagerly studied by all who are interested in current biological problems.

The Karroo rocks seem to have been formed at the mouth of a great river which spread its mud over what is now South Africa for many millions of years. There were desert regions around, and most of the sandstones originated from masses of blown sand. The area was sinking, so that an immense thickness of deposits accumulated, and great changes in the reptile life are observable in the successive layers or zones. Dr. Broom briefly enumerates these changes, and shows how some of the latest Karroo reptiles are the most mammal-like, while some of the earliest are most similar to the amphibians which were presumably their ancestors. There is, however, scarcely any trace of these ancestors in South Africa, for the lowest Karroo rocks, so far as known, rarely contain remains of vertebrate animals.

The greater part of Dr. Broom's book naturally consists of a technical systematic account of the various genera and species, which are arranged in

the several large divisions that he recognises. In each case a reference is given to the original description, when the species has been described before; and when there are synonyms or expressed differences of opinion, these are always discussed. There are also some important corrections of localities assigned to certain fossils in the writings of Owen and other pioneers. The descriptions and discussions are well illustrated by a series of clear diagrams drawn by Dr. Broom himself. There are, however, no illustrations of the actual fossils, to show their state of preservation and permit any judgment as to the reliability of the conclusions based on them. Dr. Broom, indeed, considers that such illustrations are not needed in a scientific treatise, and commends the restored figures of fossils published by Traquair and Marsh; but he omits to mention that Traquair's restorations were usually accompanied by drawings of the specimens on which they were based, while Marsh's restorations are considered so unsatisfactory by later American palæontologists that they have begun to publish figures of the original specimens for reference. He even approves a "restored skull drawn from two or three specimens", without giving any account of the nature of the fragments; thus producing composite portraits, so to speak, like those in certain early works on fossil invertebrates which have caused so much confusion in stratigraphical geology, and are now being remedied by the publication of photographs of the original fossils when these can be traced. This is our only serious criticism of the book, but it bears some marks of hasty compilation, and we would add that the descriptions of the species (especially new species) would have been more useful if the locality and horizon had always been stated. A table of distribution would have been a desirable addition.

Dr. Broom summarises his results in a most interesting chapter on the origin of mammals. He discusses the range and the relationships of the several groups, and among other curious facts notes the long range in time of the Anomodonts, which had a horny beak replacing teeth. Pointing also to the Chelonians and the birds, he remarks that the horny beak is one of the "most successful adaptations ever accomplished". He adds that "all the steps by which the mammals have arisen from the reptiles seem to be connected with change of habit and change of diet, comparatively slow moving forms have given place to others with greater and greater powers of active movement". Small omnivorous and carnivorous animals have the best chance of advancement, and the little Ictidosaurians of the Upper Karroo seem to be as nearly as possible mammals.

In a concluding chapter Dr. Broom gives a sympathetic account of the discoverers and chief collectors of the Karroo fossil reptiles, all of them amateurs well occupied in other vocations. Andrew Geddes Bain, the pioneer in South African geology, was a civil engineer. He was followed by his son and J. M. Orpen, and some medical practitioners, a clergyman, a farmer, a postmaster, a gardener, and a blacksmith. Dr. Broom himself, during most of his career in South Africa, has been busily engaged in the medical profession, and could only devote his leisure to scientific research. He is to be congratulated on his remarkable success; and his progress should be stimulated by the admirable review of past achievement which he has just completed. A. S. W.

Magical Arts and Beliefs in Europe

(1) *Witchcraft, Magic and Alchemy*. By Grillot de Givry. Translated by J. Courtenay Locke. Pp. 395 + 10 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1931.) 42*s*. net.

(2) *The Story of the Devil*. By Arturo Graf. Translated from the Italian by Edward Noble Stone; with Notes by the Translator. Pp. xiv + 296. (London: Macmillan and Co., Ltd., 1931.) 15*s*. net.

(1) EVEN if the claim that this book is unique as an iconography of witchcraft and the occult were not justified, it would still be noteworthy in any collection of works dealing with the subject of magic for the number and character of its illustrations. Three hundred and fifty figures in the text, and ten coloured plates, reproduced from carvings, drawings, paintings, prints, and manuscript or book illustrations, provide a panorama of the magical arts and beliefs in Europe from the Middle Ages to the beginning of the nineteenth century. Not only do these illustrations cover such obvious topics as the devil and his angels, the sorcerer and the witch, the alchemist, the astrologer, early users of the divining rod, and searchers after the philosopher's stone; but here are also divination and fortune telling—whether by the hand, the lines and form of the face, clairvoyance, or the cards and other material means—the tarot, the cabbala, and the talisman. The

pictures of the laboratories and apparatus of the alchemist and 'puffer' in various periods are of great interest to the historian of the development of scientific investigation.

The originals of some of the prints and other illustrations are of extreme rarity: many are in the possession of the author and other collectors; while those which are open to public inspection could be consulted only with much expenditure of time and money. Now brought together within the covers of one book and provided with an excellent running commentary, they are made accessible to every student, and their value enhanced enormously.

Not a great deal of the material collected here is connected directly with folk-lore, that is, with the belief of the folk in the stricter sense. In the early woodcuts from various sources a wizard crosses the sea by means of a spell, witches raise storms or sell winds bound by a knotted cord to sailors, and a witch draws milk from the handle of an axe stuck in a post. In passing, it may be suggested that it would be in accordance with popular belief if a sorry cow in the background were the source of the milk, rather than its condition the cause of a dearth which the witch is being asked to remedy, as the author believes.

The greater proportion of the illustrations which deal with the witch and related conceptions, however, are in what may be called the 'theological' rather than the popular tradition. They range from the Last Judgment to the Witches' Sabbath. It is not without significance that the artists' representations of the Sabbath, for example, agree down to minute detail with the 'official' description of orthodox writers. It is only in the eighteenth century, when the persecution of witches had died down, that discrepancies and fantastic details supplied by the artist's imagination begin to appear. In Spain, however, where the tradition perhaps, was stronger, Goya even at the beginning of the nineteenth century was able to maintain accuracy in detail, with startling and horrific effect. It is interesting to find that in Germany, so late as the middle of the eighteenth century, cartographers, in mapping the Hartz district, still kept up the tradition of showing the Brocken out of all proportion, and of representing on the map crowds of witches proceeding to the great celebration of the Sabbath on broomsticks and on foot.

Although an examination of those illustrations here which relate to witchcraft and attendant beliefs, when taken as a whole and in logical sequence, tends to confirm the view that the accounts of the organisation of the witches and their ceremonial, as we find them in the witchcraft persecution, were the product partly of theology, partly of imagination stimulated to excess by panic, hysteria, and psychopathic aberration, there is no doubt that they embody much that was taken from authentic popular beliefs, for which parallels can be found in the magic of primitive peoples. Sometimes these illustrations serve to emphasise such points in a way that the literature fails to do. It is interesting to note that in representations of the witches' and sorcerers' dances are cases, clearly, of the phenomena of possession which we know from other sources was rampant at times in medieval Europe. It is also made very apparent that witchcraft was closely allied to an animal cult and the werewolf belief. In a Teniers' print the witch takes on animal form as she flies up the chimney.

(2) That the devil was in the main a creation of the theologian, or perhaps it would be more correct to say that his character, attributes, and achievements were embroidered on a non-Christian concept by theological dogma, is supported by the material which has been brought together in Arturo Graf's book. The original, of which the volume now under notice is a translation, appeared so long ago as 1889. Had it been written to-day, or even a decade later than it was, the author's orientation might have been slightly different. Possibly he would have laid more emphasis upon the incorporation into Christianity of elements from the religions of the Mediterranean and the Near East, as well as on popular belief. This in no way detracts from the excellence of his work so far as it goes: but his picture would be by that the more complete in detail. That this would have modified his conception of the devil in any essential is improbable. The trend of his thought is indicated by the fact that he believed, at the time of writing, the devil was dead.

Graf's purpose was neither analytical nor controversial. He set out to give a plain descriptive account of the belief in the devil, mainly as it existed in medieval times. The belief, he held, originated in the conflict between the powers of good and evil which was the predominant element in Zoroastrianism and had been adopted by Gnostics and Manichæans. By the time of the medieval theologians, the two kingdoms of Heaven and Hell had taken their stand over against one another in the contest for the domination of the world with all the trappings and organisation in court and camp of an earthly principality. The author describes in some detail the precision with which the exact number of devils forming Satan's

and even in possessing, like it, pink and palatable flesh; it is more heavily built and shows itself a stronger fighter when hooked, though less resourceful. In size also it corresponds roughly with the salmon; the authors' best fish was forty-six pounds in weight, but monsters of a hundred pounds were heard of. Old-gold in colour, with red fins and tail-stripe, the dorado surpasses the true salmon in splendour; but apparently all four species of its genus, *Salminus*, share the name. The authors' adventures in pursuit of this golden quarry are well told and well illustrated, and notes on other fish and on the bird life encountered help to make up a very readable and instructive volume.

One Hundred Years in Yosemite: the Romantic Story of Early Human Affairs in the Central Sierra Nevada. By Carl Parcher Russell. Pp. xvi + 242 + 29 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1932.) 20*s*. net.

THIS attractive volume has inside its covers a map of the Yosemite National Park and adjacent regions and its frontispiece is a fine photographic portrait of Maria Lebrado, the last of the original Yosemite Indians, who died, at an age of more than ninety years, only last year. Full details of the warlike and other relations of the local Indians and whites are given, and it is plain that though the Yosemites were a troublesome tribe, the behaviour of the more advanced race was often discreditable. Most lamentable was the murder by a white man, of Major James Savage, one of those remarkable personalities who are able to control and win the affections of members of more backward peoples. No portrait of him appears to be extant, but those of some other celebrities connected with the development of the region are included, and a chronology with sources and bibliography of the history of human events in the Yosemite adds value to an already comprehensive work.

A Textbook of Practical Astronomy: primarily for Engineering Students. By Prof. J. J. Nassau. (McGraw-Hill Astronomical Series.) Pp. x+226. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 18*s*. net.

ALTHOUGH primarily intended for students in civil engineering, this book is admirably adapted for a larger class of readers. A book on practical astronomy must necessarily take a lot of the theoretical arguments for granted, but even so, the author has succeeded in incorporating a sufficiently adequate amount of theoretical matter.

The principal instruments described are the theodolite, sextant, and zenith telescope, and the practical problems discussed concern the determination of latitude, longitude, azimuth and time. The methods of reducing observations are carefully described and illustrated by numerous examples. A feature of the book is the excellent series of diagrams. The only weak part is the first chapter, which is rather sketchily written (there we read, for example, that planets are opaque *spheres*). The book can be warmly recommended as an introduction to elementary practical astronomy.

The Elements of Astronomy. By Dr. D. N. Mallik. Second edition, revised. Pp. iii+234. (Cambridge: At the University Press, 1932.) 14*s*. net.

THIS book treats of the usual subjects of elementary astronomy and, on the whole, it presents a satisfactory introduction for readers whose mathematical attainments are slight. Unfortunately, some parts of the book savour too much of a nineteenth century atmosphere. For example, the method of measuring the solar parallax by means of transits of Venus is fully described but there is no reference to the present direct practical method associated with observations of Eros; an example on 'time' has reference to an observation made in 1865 and the author appears to be unaware of the far-reaching alterations made in the almanacs in 1925, for he states that the Equation of Time is given in the *Nautical Almanac* for Greenwich Mean Noon. A second edition ought to have embodied the latest changes in astronomical practice and methods. The book is illustrated with numerous well-drawn diagrams (No. 34 is upside down). An interesting feature is the historical introduction with its background of ancient Hindu and Chinese astronomy.

Walter Leaf, 1852–1927: some Chapters of Autobiography. With a Memoir by Charlotte M. Leaf. Pp. x + 338 + 8 plates. (London: John Murray, 1932.) 10*s*. 6*d*. net.

CLASSICAL distinction, authority in the banking world, and social services, provide the threads of interest. Incidentally, we learn that Leaf's entry to Harrow School (1866) coincided with the appointment of the first science master, George Griffith. Again, the "new game of lawn tennis" was played at Cambridge about 1873. The court was the grass between the library of Trinity and the river. A badminton net, toy racquets, and parti-coloured indiarubber balls were obtained at the toy shops—the earliest apparatus used in the early days of a world game.

A Pocket Atlas and Text-Book of the Fundus Oculi. By Dr. G. Lindsay Johnson. Second edition, revised and enlarged. Pp. ix + 215 + 28 plates. (London: Adlard and Son, Ltd., 1931.) 12*s*. 6*d*. net.

THE revised and enlarged edition of this eminently useful guide to the uses of the ophthalmoscope will be welcomed by medical students and young practitioners. It is illustrated by a large series of Mr. Arthur Head's beautiful coloured drawings of the fundus, and the text is clear and easily understood.

Entomological Research in the Marquesas Islands

By Dr. HUGH SCOTT

THE Marquesas are the first islands chosen for intensive study by the Pacific Entomological Survey, which is being conducted jointly by the Bernice P. Bishop Museum, Honolulu, the Hawaiian Sugar Planters' Association, and other bodies. A preliminary general account of results by E. P. Mumford, director of the Survey, and A. M. Adamson, entitled "Entomological Researches in the Marquesas Islands", was prepared for the fifth International Congress of Entomology, in Paris in July 1932, and a few typewritten copies have been distributed.

Field-work was carried on by these two writers and others during the three years, 1929–31. Collections were formed of all terrestrial animals except birds (which were already fairly well known), all fresh-water animals, and plants (the last on account of their association with the insect fauna). Records were made of geographical, meteorological and other observations. Previous entomological work, the most important of which is based on the collections made by the *St. George* expedition, is being taken into consideration. The publication by the Bernice P. Bishop Museum of an extensive series of systematic reports has been begun, and an introduction is being prepared by Messrs. Mumford and Adamson.

The Marquesas are among the most isolated islands in the world, and are actually farther from continental land than any other comparable archipelago. Situated in 7°–11° S. lat. and 138°–141° W. long., they extend from north-west to south-east (the same direction as the Hawaiian and other Pacific groups) over some 230 miles. Their total area is about 500 square miles (that is, roughly one-fourteenth that of the Hawaiian Islands). All are high volcanic islands, almost entirely devoid of fringing coral reefs. The six larger islands reach an altitude of 3000–4000 ft.

Since the advent of Europeans, great changes have taken place, and are still rapidly happening, in the endemic flora and fauna. The familiar melancholy tale has to be told. Deforestation and denudation, for which sheep and other domestic animals are largely responsible, are far advanced. In the lower islands, the very interesting insect fauna seems doomed to extinction. In the higher islands, deforestation has affected much less the cloud zone above 2000 ft., where the moisture of the trade winds is precipitated as a heavy rainfall. But, even at these altitudes, the leeward slopes are relatively dry, and semi-arid *terres désertes*, denuded by grazing animals, occur. Moreover, the high forests are being invaded by a recently imported grass (*Paspalum conjugatum*), and a now cosmopolitan marauding ant, *Pheidole megacephala*, is an active agent of destruction.

The insect fauna has all the characters associated with isolated oceanic islands, *inter alia*, predominance of small size, dull colouring and obscure habitat; absence of many families and superfamilies, and of some entire orders; and disproportionate development of a few genera. Aquatic groups of insects and other fresh-water animals (as well as fresh-water plants) are poorly represented.

Groups entirely absent comprise the orders Plecoptera, Trichoptera, Ephemeroptera and Mecoptera (the first three of which are aquatic in their early stages); all the aquatic Hemiptera-Heteroptera constituting the sub-order Cryptocerata; among Hemiptera-Homoptera, the Cicadidæ, Cercopidæ, Membracidæ, aphids, and many families of Fulgoroidea; most families of Neuroptera, many great families of Coleoptera (for example, the entire lamellicorn series), many families of Diptera; and, in Hymenoptera, the sub-order Symphyta (sawflies, etc.) and most families of aculeates.

The authors regard these gaps in the fauna as strong evidence against the existence in past ages of extensive land areas in the Pacific. On the whole, this conclusion is probably right, but it may be pointed out that some of these groups are also absent from the faunas of islands not of volcanic and purely oceanic origin. Plecoptera, Mecoptera and Hymenoptera Symphyta are absent from the fauna of the Seychelles,* an ancient granitic archipelago, believed to be the remains of a much larger land, even if not of definitely continental origin. These groups are also, so far as is known, very poorly represented in Ceylon. Allowance must be made for their being apparently weakly developed in the tropics as a whole, both continents and islands, as compared with their much richer development in temperate latitudes.

Other features mentioned above, namely predominance of small size and dull colouring and weak representation of aquatic groups, are also characteristic of the fauna of the Seychelles. But disproportionately developed genera are much more numerous in the volcanic archipelagoes, and only of exceptional occurrence in the Seychelles.

Among the components of the Marquesan fauna one of the most interesting is the genus *Proterhinus* (Coleoptera, Rhynchophora). Originally discovered in the Hawaiian Islands, where more than 150 endemic species exist, it was made the sole genus of a new family. Afterwards a single species was found in Samoa and one in the Phœnix Islands, and two in the Marquesas must now be added. The genus most closely related to *Proterhinus* is *Aglycyderes*, of which one species in the Canary Islands and two in New Zealand are known†.

* See an abstract of "Summary and General Conclusions Regarding the Insect-Fauna of the Seychelles and Adjacent Islands", by Hugh Scott, (*Proc. Linn. Soc.*, Session 144, pp. 136–140, 1931–32).

† In several textbooks New Caledonia is included in the range of *Aglycyderes*, but I cannot trace any published description of a species in that country.

These two genera are now considered to form a single family. The distribution of *Proterhinus*, centred in Hawaii and with outlying species in other Pacific islands, is comprehensible, as is also the occurrence of related forms in New Zealand. But no explanation suggests itself for the existence of another relative in the Canaries, when no representative of the family has come to light in any other part of the world—even where the fauna has been intensively collected.

The degree of endemism is very high. Excluding wide-ranging forms, few or no species are common to the Marquesas and Hawaii or Samoa, the nearest high islands of which the fauna is well enough known for comparison. Among species the degree of endemism is probably lower than in Hawaii, but of the same order (that is, approaching 80 per cent); among genera it is much lower.

The proportion of endemic species restricted to a single island is apparently higher than in Samoa and of the same order as in Hawaii. For example, there is, as in many remote islands, a great development of endemic Curculionidæ, and, in the otiorrhynchine section, the number and diversity of species, each restricted to a single island, indicate that the archipelago is of considerable age. Like phenomena are noted among the Hemiptera-Homoptera, while, on the other hand, in one family of Hemiptera-Heteroptera a genus has developed into many closely allied endemic species, some of which range over several islands. Possibly these latter forms originated too recently to have diverged into separate species. It is too early to state whether any evidence is forthcoming of an increase in the habitable age of the islands from south-east to north-west, like that of which there is some indication in the Hawaiian archipelago.

Nor are generalisations as to the origin of the fauna yet possible; for, some groups of animals exhibit close relationships with the fauna of Hawaii, others with that of the south central Pacific islands lying to the south-west. Among the former are the Hemiptera-Homoptera, among the latter the Hemiptera-Heteroptera, and the endemic birds and land snails, which have little in common with those of Hawaii. Botanists have stressed the existence of important, though secondary, affinities between the Marquesan and Hawaiian floras.

Deductions bearing on past land connexions in the Pacific are also left until the fauna has been fully worked out. While the almost entire absence of coral reefs has been attributed to rapid subsidence, alternating elevation and subsidence have also been postulated. In either case, the number of species restricted to a single island indicates that the individual islands have been separated for a long period, if time be regarded in terms of what is needed for the formation of species.

The sections on association of endemic insects and plants, and the bearing of the investigation on agricultural and medical problems, cannot be discussed here. Enough has been written to show the nature of the questions discussed. The Survey may be congratulated on an excellent start.

Some Problems of Food Preservation

THE problems involved in the freezing, storage and transport of New Zealand lamb have recently been examined by the Food Investigation Board, in co-operation with the Empire Marketing Board, the New Zealand Department of Scientific and Industrial Research, the New Zealand Meat Producers' Board and the New Zealand Tonnage Committee representing the shipping lines trading between Great Britain and New Zealand.[1] The investigation involved an analysis of the physical conditions in the various storage chambers through which the meat passed and an examination of the effects of the environment on the quality and appearance of the carcases, as estimated from the loss of 'bloom'. Bloom is the freshly-killed appearance of the meat and is dependent upon the appearance of the superficial tissues, the exposed muscle, fat and connective tissue. It is affected by the following factors: the rate of cooling and freezing, which determines the opacity of the superficial connective tissue and, indirectly, the colour of the visible muscle; the amount of drying, excessive desiccation producing marked loss of colour in the muscle; the formation of methæmoglobin from hæmoglobin on prolonged storage, that conversion being hastened by sweating; and finally, excessive sweating, which also results in swelling of the connective tissue fibres with increase in their opacity.

When meat is frozen, the structure of the muscle is changed, so that on thawing it is not so resilient and there is a leakage of free fluid, usually referred to as 'drip'. Freezing probably denatures certain of the proteins so that they lose some of their power to hold water. At a temperature constantly below −8° C. other changes, such as those due to autolysis, microbial growth or hydrolysis and oxidation of the fat, are only slight. It is therefore the alterations in the physical properties of the meat which are of the most importance. They are indicated by loss of weight as well as by loss of bloom.

The survey has shown that there is no need for radical alterations of technique, although improvements at each stage of the chain of treatment are possible. It has been found that bloom is affected not only by the immediate ante-mortem treatment of the sheep but also by such factors as breed, diet, age at killing, etc. Southdown crosses were found to have a good initial bloom and that was correlated with a higher concentration of hæmoglobin in the superficial muscle; older animals had a better bloom than younger of the same breed. Starvation prior to slaughter had

little effect on bloom but strenuous exercise was definitely deleterious, the superficial muscle being of a dark reddish-grey colour. The important conclusion is drawn that, within limits, carcases having the superior initial bloom will maintain this superiority throughout the subsequent chain of treatment.

After slaughter the carcases are cooled, preferably at a low temperature (12° C.), and in air near saturation point. Hanging for 10–12 hours should precede freezing. At this temperature the rate and extent of loss of weight during hanging are reduced, so that the superficial desiccation is also less. The rate of loss of weight on subsequent freezing is also lower with an adequate period of cooling.

Each chain in the passage of the meat from the freezing chambers in New Zealand to the cold stores in London was examined in detail. The advantages and disadvantages of the different systems of refrigeration are pointed out. The danger points are the transport from store to ship in New Zealand and from ship to store in Great Britain. Recommendations to minimise the delays at these points in the chain are given in the report: too long exposure of the carcases to a high temperature results in softening and sweating. It was found that the average loss of weight during cooling, freezing, 28 days storage in New Zealand, ocean transport and 28 days storage in Great Britain was 3·65 per cent in prime quality lambs and slightly greater in second quality carcases. The longer carcases are stored the greater is the loss of weight and, therefore, of bloom. Since loss of weight occurs to some extent even under the best conditions of storage, it appears necessary, to prevent any loss of weight or bloom, to cover the carcases with bags impermeable to aqueous vapour. The ideal bag, however, has still to be evolved.

Another problem of cold storage is the prevention of the yellowing of the abdominal fat in rabbits. Even when kept at a temperature of −10° to −12° C., the superficial fat, in addition to becoming rancid, acquires on its exposed surface a pronounced yellow colour, varying in tint from light yellow to dark orange. The discoloration extends to a depth of a few millimetres and in advanced stages the yellow fat is wax-like in nature and can generally be peeled off from the white fat beneath. The period between the killing of the rabbits in Australia and New Zealand and their marketing in Great Britain varies but is on the average 4–5 months. The longer the storage the more frequently is the yellowing found.

J. R. Vickery has recently carried out experiments on the nature and cause of this yellowing: the results obtained have indicated the measures which can be adopted to prevent it.[2] It was found that the rate of development of yellowing during storage in the frozen condition was dependent, within limits, upon the duration and temperature of storage in the pre-freezing period: thus storage for two days at atmospheric temperature prior to freezing enhanced the yellowing to a degree approximately equivalent to one month's storage at − 5° C. The intensity and depth of penetration of the yellowness were proportional to the duration of storage in the frozen condition at a given temperature, and were greater the higher the temperature. At −10·5° C. the market value of the rabbits is affected within three to five months according to the nature of the pre-freezing treatment. At −18° C. yellowing is almost eliminated.

The yellow material accompanies the soaps on saponification of the fat and can be separated from the fatty acids by the use of ice-cold petroleum ether in which it is insoluble. It apparently has its origin in the oxidation of the linoleate glycerides under the influence of an oxidase present in the fatty tissue, the action of which is markedly accelerated by the presence of moisture and hæmoglobin. The pigment is probably an unsaturated ketonic compound.

The measures required to prevent yellowing are, therefore, the exclusion of oxygen and hæmoglobin, shortening of the time of storage and storage at a lower temperature. Air can be excluded from the abdominal fat by covering it with the muscle of the abdominal wall, hæmoglobin by thorough bleeding of the animals and cleaning the fat of all superficial blood: but a lower temperature of storage will still be necessary to prevent appreciable yellowing over periods of about six months.

Dr. Vickery also made a few observations on the development of rancidity in the fat of rabbits. It was found to develop on storage much more rapidly than is usually the case with other animals: its onset can be retarded by excluding air from the fat and storage at temperatures below −10·5° C., at which temperature rancidity may be expected in five months.

Further information on problems of food preservation can be obtained from the Index to the literature issued twice a year by the Low Temperature Research Station. The first number of vol. 4 contains a review of noteworthy developments during 1930-31,[3] to some of which brief reference may be made. Troy and Sharp have investigated the condition of lactose in dried milk, condensed milk and ice-cream. In dehydrated milk the lactose is present as an equilibrium mixture of non-crystalline α- and β-lactose; when milk is dried slowly below 50° C., lactose crystallises in the α-hydrate form. These facts are considered to explain the caking of milk powder and 'sandiness' in ice-cream. Parisi has shown that the velocity of crystallisation depends on the velocity of transformation between α- and β-lactose, and is influenced considerably by the hydrogen ion concentration of the solution. Lampitt and Bushill have shown that fat in milk dried by the roller-process can nearly all be removed by direct extraction with a solvent, while only a small proportion can be extracted in this way from spray-dried milk. The difference is attributed to the condition of the lactose; its crystallisation appears to result in 'freeing' of fat.

Slight hydrogenation of the fat has been found of value in the case of a number of foodstuffs: it prevents rancidity in tallow and lard; it stabilises the fat in butter without destroying its flavour; it bleaches palm oil without hardening it; and finally, in the case of cacao-butter, it prevents the 'blooming' of chocolates.

Morgan, Field and Nichols have found that the vitamin C content of prunes and apricots need not be reduced by dehydration or treatment with sulphur dioxide when the processes are carried out under properly controlled conditions. Clow and Marlatt state that the vitamin C content of tomatoes is the same whether ripening occurs in the field, in the greenhouse or is brought about artificially with the aid of ethylene. It has been shown by Kohman, Eddy and Zall that considerable loss of vitamin C and some loss of vitamin B occur in the canning of tomatoes in the presence of air: in steam this loss is not observed. Vitamin A is the most, and vitamin C the least stable. To preserve the vitamins it is essential to guard against oxidation during canning.

Morris and Bryan have found that the method of manufacture of steel may have a considerable influence on its rate of corrosion. In solutions of low acidity the main points of attack are the pits and seams of the tin, whilst in those of high acidity, the exposed portions of the tin are particularly liable to corrosion. It is recommended that citric acid be added to fruit of low acidity, that the sugar used be free from sulphur compounds (which have a considerable influence on the corrosion of tins) and that beet sugar be used, or agar added to inhibit corrosion.

[1] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 41: The Freezing, Storage and Transport of New Zealand Lamb. By Dr. Ezer Griffiths, Dr. J. R. Vickery and N. E. Holmes. Pp. x+178+19 plates. 7*s*. 6*d*. net.

[2] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 42: The Yellowing of the Abdominal Fat of Frozen Rabbits. By Dr. J. R. Vickery. Pp. iv+27. 6*d*. net.

[3] Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 4, No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+135. 2*s*. 6*d*. net. (London: H.M. Stationery Office, 1932.)

New Tank at the National Physical Laboratory

ON November 18, in the presence of a large gathering of naval architects, shipowners, shipbuilders, engineers and others, Mr. Stanley Baldwin, Lord President of the Council, opened the New Tank at the William Froude Laboratory, which forms a part of the National Physical Laboratory, Teddington. The New Tank has been built by the Government at a cost of £45,000 to meet the increased demand for model tests of ships' hulls, propellers and rudders, and like the Alfred Yarrow Tank, will be used in connexion with work for ships of the mercantile marine.

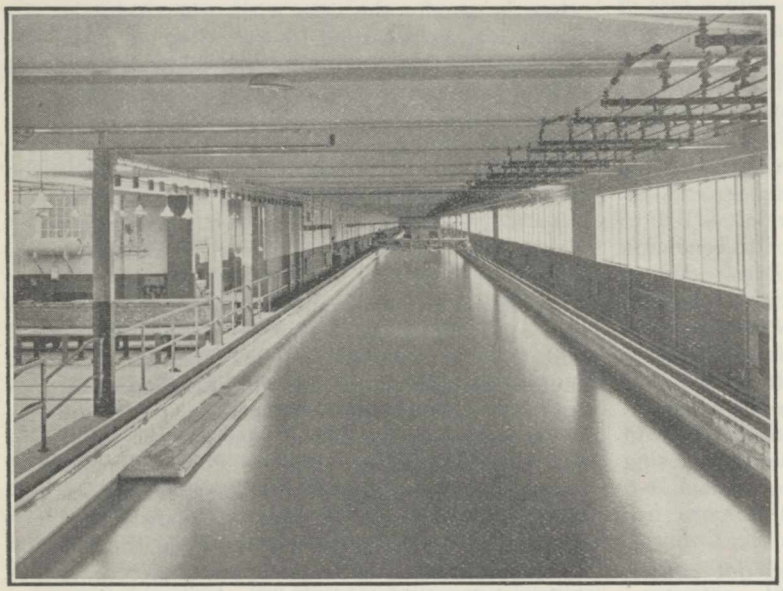

FIG. 1. The New Tank at the William Froude Laboratory

Referring to the work done in the Tank given to the Laboratory in 1910 by Sir Alfred Yarrow, Mr. Baldwin remarked that, in 1928–29 it had become impossible, though the whole staff of the Laboratory was working overtime, to comply with all the requests made for assistance by shipbuilding firms. During the years 1927–1930, 188 designs of hulls were tested in the Tank and it was possible to show how designs could be improved in no fewer than 114 cases. Among the results obtained, and adopted in the shipbuilding industry largely through comprehensive researches in the Yarrow Tank are the introduction of the 'cruiser stern' on ordinary mercantile vessels, the introduction of 'aerofoil' types of propellers, the change of rake now common in single-screw ships and the use of a central fin on this type of ship to control inflow into the propeller.

At the conclusion of his address, Mr. Baldwin went aboard the carriage of the New Tank and watched an experiment with the new equipment for testing the efficiency of propellers working in open water. Visitors present also had an opportunity of witnessing this and other demonstrations. A number of model hulls together with their recording apparatus were on exhibition, and with these were the drawings of the projected Propeller Tunnel, the cost of which (£5,000) is being defrayed by Sir James Lithgow.

The New Tank (Fig. 1) consists of a monolithic ferro-concrete water basin 678 ft. long over all and 20 ft. wide at the water surface. The depth

of water is 9 ft. for a distance of 446 ft. From this point the bottom slopes upwards gently for 36 ft. to the shallow end, 177 ft. long, where the depth of water is only 2 ft. The tank bottom and walls, the foundations of which are entirely separate from those of the building, were built in 20 ft. sections separated by 3 ft. gaps, which were filled in after the adjacent sections had set and hardened.

The carriage (Fig. 2) consists of a light frame structure of mild steel weighing approximately 10,000 lb. including its equipment. The rails on which it runs are 20½ ft. centre to centre. They were machined top and bottom before being fixed to the cast-iron longitudinal sleepers, and are exactly parallel with the surface of the water. The carriage is driven by two 56 h.p. electric motors at speeds of 2–30 ft. a second, and is brought to rest by slipper-brakes and a brake rail, operated by compressed air on the principle of the Westinghouse brake.

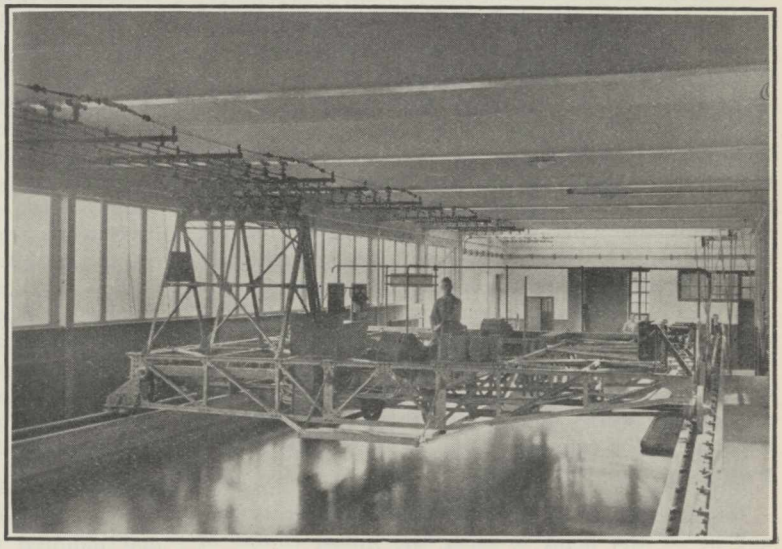

FIG. 2. The carriage of the New Tank

The control gear for the carriage is located at the side of the Tank, but should the current fail during the course of an experiment, the carriage is automatically brought to rest. In the central portion of the carriage there is an open well about 10 ft. by 4 ft. within which the testing apparatus is erected; just beneath this well the model floats in the water. In some cases the recording apparatus is placed in the models themselves, which are, of course, as usual, made of wax.

The history of experiments in Great Britain on the resistance of ships' models goes back to the pioneering work of Mark Beaufoy (1764–1827), David Napier (1790–1869), the Scotts of Greenock, the Halls of Aberdeen and others, but, as Elgar said in his Forrest Lecture in 1907: "The practical solution of the speed problem was effected by the late Mr. William Froude when he discovered the law of similitude or comparison which enables the resistance of a model, as ascertained by experiment, to be used for calculating the resistance of a model upon a different scale, or that of a full-sized ship of similar form."

Froude was born in Devonshire on November 28, 1810, and died at Simon's Town, South Africa, on May 4, 1879. After graduating at Oxford, he spent several years on railway construction and served under Brunel on the Bristol and Exeter Railway. In 1856, when Brunel was engaged with the building of the steamship *Great Eastern*, he asked Froude to investigate the motion of a ship among waves. From that inquiry Froude was led on to the study of problems akin to it, and through his experiments on towed models, the Admiralty, in spite of many adverse opinions, in 1870 constructed the historic experimental tank at Chelston Cross, Torquay, where Froude had settled. To-day there are more than a score of experimental tanks in existence and every one of them is a monument to the genius and work of Froude. The investigations carried out by Froude at Torquay, and later on at Haslar by his son, R. E. Froude (1846–1924) nearly all related to warships. But just as the credit for the inauguration of the first official tank belongs to Froude, so the credit for the construction of the first tank by private enterprise belongs to William Denny (1847–1887), whose tragic death at forty years of age removed one of the foremost advocates of model experiments. In 1875 Denny sent Froude the lines of the S.S. *Merkara*, built at the Leven shipyard, Dumbarton, to enable him to make trials with a model for comparison with those already obtained with the ship herself. With permission of the Admiralty, this was carried out. Six years later, Denny began the construction of a tank at the Leven shipyard and this is now the oldest in existence devoted to mercantile work. On its facade it has borne for 49 years an inscription to Froude "the greatest of experimenters and investigators in hydrodynamics".

In his papers, his speeches and his letters, Denny did all within his power to convince his fellow shipbuilders of the utility of experimental tanks, and in 1884 wrote: "The truth is that of all the problems about a steamship the only one at the present moment incapable of being solved by *à priori* methods in extreme cases is that of speed and power. No ability and no training will enable even the most skilful naval architect to overcome the want of an experimental tank in coping with these questions."

Denny's was often a 'voice crying in the wilderness', but to-day there are few shipbuilders or shipowners who do not realise the value of the work done in such tanks as that opened by Mr. Baldwin, and none whose work is not influenced by it.

News and Views

Comptroller-General of Patents

AT the end of this month Sir William Jarratt, the Comptroller-General of Patents, Designs and Trade Marks, is retiring from the Patent Office after thirty-eight years service and six years of the comptrollership. He was educated at the Royal College of Science and Trinity College, Cambridge, where he obtained a first class in the Natural Science Tripos, and a first class in the Mathematical Tripos; he was called to the Bar of the Middle Temple in 1910. Sir William has done much to enhance the high reputation of this great Government department and has been prominently associated with important developments in patent law. In view of the growing world-wide importance of broadcasting, it will also be gratefully remembered by all authors and composers that it was mainly owing to Sir William Jarratt's intervention at the Copyright Conference in Rome 1928 that there was inserted in the Copyright Convention the article "11 bis" ensuring that "Authors of literary and artistic works shall enjoy the exclusive right of authorizing the communication of their works to the public by radiocommunication".

WHILE regretting that Sir William Jarratt will not be at the helm to steer the initial course of the new Patents and Designs Act, from which so much is expected and which owes so much to his inspiration and labours, we are glad to be able to state that he is not retiring entirely from public life, and that as the secretary of the Trade Marks, Patents, and Designs Federation Ltd., he will still be able to utilise his great knowledge and experience in the same field. This Federation is a body devoted to promoting and securing mutual support and co-operation amongst traders in the British Empire and foreign countries in all matters relating to the protection of trade marks, patents, designs and analogous rights, and the suppression of unfair trade competition. Sir William's successor in the Patent Office will be Dr. Mark Frank Lindley. Dr. Lindley is a doctor of laws of the University of London and a bachelor of science with distinction in physics; he is a barrister-at-law of the Middle Temple and author of a standard work on "The Acquisition and Government of Backward Territory in International Law". Dr. Lindley, like Sir William Jarratt, combines scientific with legal attainments and has followed him through the ranks of the examining staff of the Patent Office, and the assistant comptrollership, to the comptrollership. It is very satisfactory to scientific men and to all those connected with patents in Great Britain, to find that the practice has again been followed of appointing a man with scientific as well as legal training to the comptrollership of the Patent Office.

Sir Aldo Castellani

SIR ALDO CASTELLANI, who has been appointed to succeed the late Sir Ronald Ross as director-in-chief of the Ross Institute for Tropical Diseases, has rendered long and distinguished services to tropical medicine. He is lecturer on mycology and mycotic disease at the London School of Hygiene and Tropical Medicine, professor of tropical medicine at the State University of Louisiana and also at the Royal University of Rome, so that the direct influence of his knowledge and experience extends to several centres of teaching and research. In regard to the large field of his activities, and in the number of his contributions to medical literature, Sir Aldo has had a remarkable career. He graduated at the University of Florence and continued his studies at Bonn and the Lister Institute, went to Uganda in 1902 on the invitation of the Foreign Office to investigate sleeping sickness, then was appointed by the Secretary of State for the Colonies to the Ceylon Medical School and afterwards went to Naples for a time to occupy a chair in the Royal University, which he resigned in 1918 to join Sir Patrick Manson on the staff of the London School of Tropical Medicine. He thus possesses the highest qualifications to influence the work and promote the development of the Ross Institute.

Anniversary Meeting of the Royal Society

IT is perhaps worth while to recall that in 1832—one hundred years ago—the proceedings at the anniversary meeting of the Royal Society on St. Andrew's Day were conducted by H.R.H. the Duke of Sussex, as president of the Society. Two awards of the Copley medal were made, and Michael Faraday received one of them. The second recipient (by deputy) was Siméon Denis Poisson, the eminent French mathematician, in recognition of his treatise "Nouvelle Théorie de l'Action Capillaire". He had been elected a foreign member in 1818, along with Baron Prony, Arago, Nathaniel Bowditch, and the Abbé Haüy. Poisson was born in 1781, and he died at Paris in 1840. He was associated with the Ecole Polytechnique there for nearly forty years, and he will be remembered as a prolific and illuminating writer in mathematics, physics, and astronomy. It was on this occasion that an announcement was made that following the example of the Paris Academy of Sciences, the Royal Society would in future admit no paper into its *Transactions* which had not been previously submitted to the consideration of at least two members of the Council best acquainted with the subject under discussion. The Society's roll of membership at the period in question appears to have comprised 11 royal personages, 45 foreign members, and 692 home fellows, a total of 748. In accordance with custom and following the afternoon's proceedings the fellows of the Society dined together at the Crown and Anchor tavern, the Duke of Sussex being in the chair.

The Pacific Entomological Survey

ABOUT four years ago, certain institutions in the Hawaiian Islands, including the Bernice P. Bishop Museum, the University of Hawaii, the Sugar Planters' Association and the Pineapple Growers'

Association, organised the above-named Survey for the purpose of exploring thoroughly and studying the various island groups in the South Pacific, especially as regards their insect fauna. It was felt that this was a most necessary piece of work, seeing that the islands are being rapidly changed in regard to both fauna and flora, owing to the introduction of foreign plants and animals. It was also believed that the information gained would not only be most valuable from a scientific point of view but also extremely useful in a practical way. The first part of the work, the survey of the Marquesas Islands, has been done, and the detailed results are now being published by the Bernice P. Bishop Museum, Honolulu. Reference is made elsewhere in this issue (p. 797) to a preliminary general account of the work which has been prepared by Messrs. E. P. Mumford and A. M. Adamson. The finances for carrying on this work have been mainly advanced by the planters' associations. Within the last year, however, these organisations have suffered heavy losses which have made it impossible for them to bear the entire load of continuing the task. The Survey is, therefore, now making an effort to gain financial assistance from other quarters. In view of the splendid work which has already been done and of the very great need for continuing the Survey, it is hoped that this important piece of scientific and practical work will not have to be abandoned.

China and American Scientific Expeditions

BY courtesy of Dr. Chang Chi, chairman of the Chinese National Commission for the Preservation of Antiquities, we have received a copy of a letter dated September 24 which was addressed by the Commission to the American Museum of Natural History, New York, and covering a statement of its position in relation to the Central Asiatic Expedition of the Museum. It will be remembered that this expedition, which has been engaged in palæontological and archæological investigation in Inner Mongolia since 1922 under Dr. Roy Chapman Andrews, came to an end with the season of 1930, after which date no further permit was to be issued by the Chinese authorities. In the covering letter, Dr. Chang Chi, writing on behalf of the Commission, describes the interruption of the work of the expedition as "a most unfortunate breach in the cultural relations between China and the United States", and expresses his own regret that negotiations should have been broken off largely for personal reasons. At the same time, he reaffirms the readiness of the Commission "to promote scientific co-operation, if proposed on a fair basis". The covering letter also refers to an editorial article in the American-owned and edited *China Weekly Review* dated September 10, of which also we have received a copy. It consists largely of a personal attack on Dr. Andrews. This attack, or rather parts of it, the Commission regards as mainly irrelevant, nor does it endorse all the views expressed in the article, although it holds them significant as voicing the views of foreigners resident in China.

THE statement addressed by the Chinese Commission to the American Museum of Natural History, in addition to defining its attitude in the situation which has arisen from past activities of the American expedition and its members, declares that it is "ready to consider or submit to the proper higher authority or refer to the proper Chinese scientific institution any proposal of Sino-American co-operation for scientific exposition, despite any possible existing personal misunderstanding". It recites the terms of the agreement with Dr. Andrews of March, 1930, which, while safeguarding "Chinese interest and participation in this important scientific enterprise", assigned to the American Museum the bulk of the specimens obtained by the expedition, requiring only the return to China of representative duplicate fossils and two casts of unique specimens; and it claims to have voiced Chinese public opinion in 1928 when objecting to Dr. Andrews's activities in making archæological and palæontological investigations under cover of a hunting passport. The chief point in the memorandum, however, is the question of Dr. Andrews's recent attitude. It is stated that after repeated assurances from him that the expedition of 1930 would be final, a letter of application for a further permit for 1931 was received from him, and that without any interview with any member of the Commission. Further, in recent statements, for which he is presumed to be responsible, politics have been imported into a scientific question with the object of forcing a concession from the Chinese Government by political influence. Thus not only has the friendly co-operation with the American Museum of Natural History been interrupted, but also mutual misunderstanding has arisen between the American and Chinese peoples as to their respective attitudes.

International Commission on the Teaching of Mathematics

THIS body, constituted at the Congress of Mathematicians at Rome in 1908, had secured by 1914 the adherence of twenty-eight countries, and had evoked a large mass of valuable reports, of which those for the British Isles formed two volumes of Special Reports issued by the Board of Education in 1912. The decision to revive the dormant Commission was taken at Bologna in 1928, and this year has seen a resumption of activities, culminating in two sessions during the Congress of Mathematicians at Zurich. Prof. Hadamard of Paris succeeds Prof. D. E. Smith of New York, who has been president of the Commission since the death of Klein. The secretary is Prof. Fehr of Geneva. Though anxious to co-operate, the Board of Education is unable to play the same leading part as before the War, and the Council of the Mathematical Association has agreed to take over responsibility for the English Sub-Commission, at least until the Oslo Congress of 1936. There will again be three Commissioners, who will be assisted by special committees when reports are to be prepared. The commissioners appointed are Prof. E. H. Neville, who is on the Central Committee of the Commission, Sir Percy Nunn, and Dr. D. M. Wrinch. Reports will be published in the *Mathematical Gazette*.

Growth of Industrial Organisations

IN the second of the series of lectures on industrial affairs at the Imperial College of Science and Technology, Mr. Austin Hopkinson discussed the advantages of the small industrial organisation. In his submission, there is no evidence that increasing the size of an industrial concern leads normally to an increase in efficiency; indeed history shows that most very large organisations of this type have soon become unstable, and their collapse has led to the loss of immense amounts of capital. A distinction should be drawn, however, between natural and artificial expansion. A limit to natural expansion by internal growth or by absorption of less efficient competitors is set only by the managerial capacity of individuals, and the ideal size cannot be expressed therefore by any simple formula such as statisticians have attempted to devise. When for any reason, however, a concern is expanded artificially beyond this limit, the expedients resorted to in attempts to establish financial stability are likely to be contrary to the interests of the community as a whole. The fact that very large industrial organisations have exceptional power to influence politicians, trade union leaders and the Press, makes them a potential danger to democracy, and, although Great Britain is justly proud of the integrity of its political and industrial life, the possibilities of abuses in the region where they overlap are exceptional and cannot be disregarded.

Defects of Large Industrial Units

In Mr. Hopkinson's view, the dangerous influence of large industrial concerns is not offset by any contribution to the happiness and prosperity of the community. The existence of twenty separate firms engaged in a particular branch of industry means twenty sources of energy and enterprise: their amalgamation into one large unit eliminates nineteen of these sources. The only way in which a nation can preserve a standard of living higher than that of others is by continuing to produce goods of higher quality or goods which the others cannot produce at all: tariffs and embargoes are merely temporary expedients. It follows therefore that competition from countries with a lower standard of life can be met only by frequent changes in the nature, form or design of the goods produced; but it is just this condition which the large organisation finds most difficult to meet, owing to the inertia resulting from its very size. Again, very large firms have the power to stimulate markets by intensive advertising and hire-purchase schemes, but by thus compressing the purchasing power of a life-time into a few years, an unhealthy state of the market is induced, and a temporary advantage may be wiped out by a subsequent collapse. Finally, the estimate that 44 per cent of total factory production in Great Britain is in the hands of firms employing less than two hundred people indicates the important part which the small concerns play in industrial life: their contribution to the national exchequer is, no doubt, proportionately great.

Typhoon Season in the Far East

THE cyclone season of the northern tropics is this year being extended abnormally far into the autumn in the Far East as well as in the West Indies, for a typhoon visited the Loo-Choo Islands so late as November 14, and reached Tokyo late on the following night. The wind is reported to have blown with a speed of nearly a hundred miles an hour, and to have caused much material damage. The loss of life was fortunately small compared with that caused by the Cuban storm five days earlier. Although there seems to be no essential difference between the typhoon of the western part of the North Pacific and the West Indian hurricane, both being typical examples of the tropical cyclone, the typhoon season is not concentrated into a few summer and early autumn months to nearly the same extent as happens with the West Indian storms. There is, however, more similarity in the seasonal distribution of those storms that reach Japan. July, August and September are the dangerous months for Japan and the neighbouring seas; whereas the seas farther to the south are occasionally affected by a typhoon even in mid-winter and early spring, the occurrence of an intense developing typhoon near Japan so late as November is probably even rarer than a similar development in the West Indies. It is known that there is a connexion between the variations of the general circulation of the atmosphere and the regions of formation as well as the direction and speed of travel of tropical cyclones, but it is very doubtful whether the cause of the present abnormal prolongation of the cyclone season can be explained. It is points like this which may be cleared up when meteorologists possess a long series of daily synoptic charts for the northern hemisphere such as those now being prepared by the Deutsche Seewarte, Hamburg, described in NATURE of November 12, p. 748.

An Easily Portable Episcope

THE increasing appreciation of the value of episcopes in teaching has created a demand for an instrument, simple in construction, easy to handle, capable of being brought readily into the ordinary class room, and reasonably cheap. The Wigmore episcope which has been recently put on the market by Messrs. Newton and Co., 72, Wigmore Street, London, W.1, seems likely to meet this demand. It is light and, being provided with two carrying handles, can be easily carried from one room to another. It can be immediately installed and used in any room which has a projection screen and an electric lighting supply. In use, the episcope is simply placed upon the object to be shown on the screen; the externally mounted reversing mirror is tilted to bring the image to the required height; and the image is then brought into focus. Two 250-watt lamps are used for illuminating the field, which is 5 in. by 5 in.; but the map or drawing or book, a portion of which is to be projected, may be of any size. When the instrument is about 10 ft. from the screen, a well-illuminated picture 4 ft. square is

obtained with good definition over nearly the whole of the area. The working distance may be varied from 6 ft. to 24 ft., giving pictures from 2¼ ft. to 9 ft. square, with of course a diminution in intensity at the greater distances. The episcope, which costs £12 12*s*., complete with lamps, should prove particularly useful for illustrating lessons in classrooms or for demonstrations in small lecture theatres, where a very large picture is not required.

Cultivation of Living Tissue Cells

AT the Friday evening discourse at the Royal Institution on November 18, Dr. R. C. Canti exhibited films demonstrating the cultivation of living tissue cells. The films consist of moving photomicrographs of the living cells of animal tissues taken whilst they are growing outside the body. The individual pictures are taken at relatively long intervals but are projected on the screen at the usual speed of 16 pictures per second. This gives the effect of speeding up and approximately three weeks continuous photography is shortened into half an hour. The first film opened with the demonstration of a 'tissue culture'. This was followed by a picture of a fragment of periosteum of the chick embryo under low magnification which shows the outwandering of the cells from the central mass or explant. Higher magnification is then employed to demonstrate the structure of vegetative cells and the classical stages of cell division. The picture then changed from healthy to malignant tissue and showed the characteristic cells of a cancerous tumour of the rat known as Jensen's rat sarcoma. Dr. Canti's second reel was devoted to a demonstration of the contents of the cell by the method of dark-ground illumination, which reveals certain structures, for example, granules and mitochondria, invisible by the ordinary methods of trans-illumination. The third reel contained subjects of embryological interest, namely, the development of the rabbit ovum from the single cell up to the morula stage, the development of the young chick embryo from the primitive streak and the development of the bony femur from the cartilagenous rudiment in the six-day chick embryo. The apparatus for taking the photographs is a combination of the cinema camera, microscope and biological incubator, with a specially constructed automatic mechanism for making the exposures at the desired intervals.

Colour Films

THE paper read before the Royal Society of Arts on November 9 by Mr. T. Thorne Baker gave a useful account of new developments in colour cinematography. Compared with other inventions like radio-telephony, the aeroplane and sound films, the coming of photography in natural colours seems very slow. The coloured films which have been shown at many picture theatres during the last two or three years are nearly all two-colour pictures. The main drawback is that the colours obtained in these pictures are not absolutely natural. But now methods have been devised for obtaining three-colour pictures. These require for the development of a satisfactory studio technique an immense amount of further research. In the early days of the sound film, many thought that it would have a short life because the reproduction of both speech and music was so bad. Yet improvements have proceeded so rapidly that it is now so good that the demand for silent films has almost ceased. A similar series of events will probably take place in connexion with colour films. Most of the various attempts made to please the eye by two-colour processes have failed. It has taken years to put three-colour processes into practical form. But once the natural colour film has been seen by the public it seems that they will soon cease to think that it is a 'colour' picture and merely derive increased enjoyment from its naturalness. Similarly, the expert who is familiar with the latest developments of colour films feels when he looks at the ordinary film, notwithstanding the exquisite photography and the magnificent art which characterise modern productions, that a serious omission has been made.

The Past and the Future in Psychical Research

SIR OLIVER LODGE, in his presidential address to the Society for Psychical Research on the occasion of its jubilee in June, discussed the past and the future with special reference to the history of the Society. He recalled the events of the last fifty years and noted how the disapproval and hostility which was encountered in the early years of the Society's existence are gradually diminishing. The hostility, he maintained, was directed mainly by spiritualists, who disapproved of the cautious procedure of the Society's officers and of the criticism to which narratives were subjected before publication. Although this can scarcely be maintained at the present day, it is true that the founders of the Society, with the establishment of thought transference as their primary aim, were, in fact, endeavouring to apply the scientific method to their inquiries. In his insistence on this Sir Oliver is justified, in spite of such famous cases as that of Sir E. Hornby in 1884, where some attention to essential details would have absolved Mr. Frederic Myers and Mr. Edmund Gurney from charges of carelessness in the preparation of their data.

IN his further discussion of the past, Sir Oliver asked his audience to remember the pioneer work of Myers, who, although of literary and even perhaps mystical tendencies, nevertheless realised the importance of the scientific treatment of those problems which were his greatest interest. To convince the world of telepathy was the dominant note of the early years: to-day, Sir Oliver thinks, may be the time for the Society in its corporate capacity to declare its belief in the reality of the spiritual world and in its interaction with the physical one. It is on this note that the address ends, and it finally concludes by Sir Oliver again asserting his personal belief in the "cosmic and permanent" existence of the human spirit apart from the discarded material organism, with its memory, character and affections intact.

Deep Petroleum Wells

MR. W. A. SAWDON contributes an interesting article to a recent issue of the *Oil Weekly* concerning the deepest oil wells yet drilled. The record which he gives proves conclusively the high state of efficiency to which petroleum engineering has attained in the last few years, and it would seem that, both from a technical and an economic point of view, the limit to the depth probed for oil has yet to be defined. The appearance of this article is timely owing to the fact that the deepest well drilled in the United States has just been completed in California, where a depth of 10,296 ft. has been reached. A feature of this well is that it was drilled with comparatively light equipment, contrary to the usual custom of involving extra heavy plant in order to achieve the great depths desired. This Californian well is not the deepest in the world, the record being held by a well drilled to 10,585 ft. in the State of Vera Cruz, Mexico. The first 10,000 ft. well to be drilled was, however, in California ; this attained a depth of 10,054 ft. but, like the Mexican well, no production was obtained. Probably the greatest producing well is that which was completed in July last in California at a depth of 9,710 ft., from which an initial production of 5,050 barrels of oil a day, accompanied by 5,000,000 cub. ft. of gas, was obtained. All these wells were rotary drilled.

Two other interesting oil wells may be added to the list ; one drilled by the percussion system (cable tool) in West Virginia to 9,104 ft., from which no production was obtained, the other, a Texas well, also drilled by the cable tool system to a depth of 8,900 ft. In the latter case a Diesel engine was employed as motive power instead of the more customary steam engine or electric motor as in the case of the other wells mentioned. Apart from technical development, in future the utility of the deep well will be governed entirely by economic circumstances, since any attempt to raise oil from a depth of two miles or more in the earth's crust must necessarily involve considerably greater expenditure in plant, equipment and running costs than has been the case in the past for shallower wells. There is little question that, assuming it is economically practicable, the petroleum engineering industry is capable of evolving both plant and operative system for attaining still greater depths, especially in cases where deeper-lying pay sands have to be tapped for the oil they contain. It is perhaps not difficult to visualise the day when over-production of oil will be a thing of the past and when reliance for the major part of the world's supply of crude petroleum will have to be placed on these very deep wells and on the revolutionised drilling technique which they imply.

Modern Methods in the Inland Telegraph Service

DURING the last two years, very rapid development has taken place in the inland telegraph service in Great Britain. Previously, a very exhaustive study had been made to find out the best methods of making the service more attractive to the public, more efficient as a means of communication, and less costly as regards the loss of State revenue. Instruments and machinery new to the service have been introduced. Teleprinters, typewriters, rectifiers, converters, thermionic valves and voice frequency signalling are the main features of the reorganised system. In a paper read to the Institution of Electrical Engineers on November 17, Mr. R. P. Smith described the new equipment in detail. A telegraph exchange service, 'the telex', has been made available to telephone subscribers, the necessary apparatus being installed on rental terms. The renters are able to receive and transmit printed communications in addition to the usual telephone facilities. They can also transmit messages to the Post Office, creating a new class of traffic designated 'Printergrams'—a word which we think not very happily chosen. We have now telegrams, phonograms and printergrams. At the present time, the supply of underground conductors is more than sufficient for the requirements of the public services. The vacant channels of communication are offered to the public, on rental terms, for the purpose of private wire circuits. The ascertained results of the reorganisation, which is still far from complete, show that the stability and accuracy of the service has been greatly increased. In addition, the latest figures show an improvement in the financial position. The changes also have increased the comfort and convenience of the army of workers who staff the telegraph instrument rooms.

Aerial Spotting of Fish Shoals

SINCE 1919, when the American Bureau of Fisheries first observed that fish shoals which could not be seen from the bridge of a ship were easily discernible from an aeroplane flying directly overhead, numerous attempts have been made to utilise aircraft for spotting shoals of fish. In Great Britain both the Ministry of Agriculture and Fisheries and the Scottish Fishery Board have made endeavours to locate herring shoals from the air but in both cases the experiments yielded no fruitful results. In the recently published report of the Danish Biological Station for 1932 interesting records of similar efforts to spot herring in Danish waters are given. Dr. H. Blegvad, director of the station, was in charge of the investigations and himself acted as observer. An important feature of the Danish experiments was that the Danish Broadcasting Corporation agreed to broadcast at once any information submitted to it from the exploring aeroplane. Unfortunately, only very few exceedingly small herring shoals were observed throughout the entire course of the investigations, which extended over forty flying hours. Their positions were immediately broadcast but the investigators were unable afterwards to obtain any information as to whether or not the broadcasts proved useful to the fishermen. Probably this entire lack of evidence is a very good indication of lack of positive results. The Danish investigators, therefore, like their British colleagues, have come to the

conclusion that, although in favourable conditions fish shoals in their waters may be spotted from the air, this method of locating fish is much too costly and uncertain to be of any practical value to the national fisheries.

The Future of Indian Agriculture

IN a survey and a forecast of the next twenty years in India (*Journal of the Royal Central Asian Society*, vol. 19, July 1932), Lieut.-Col. Sir Arnold Wilson makes a strong plea for the introduction of scientific method into public affairs. He predicts that in twenty years time the population of Asia will have increased by at least 20 per cent, and that in India alone the numbers may have grown to 427 millions. These figures mean that the great problem of the future will be that of food supply. Over the whole of Asia the predominant occupation is agriculture, while in India at least the cultivable area increases very slowly and seems to have reached the limit except for the redemption of barren areas by irrigation. Figures tend to show that in India the food yield has not kept pace with the growth of population, but that the gap has been partly filled by a decrease in the export of grain. Sir Arnold Wilson foresees the dwindling of this export trade and the growth of an import trade in wheat. To balance this, India will have to develop an export of other primary products, but the tendency will be to utilise these at home. An import of fertilisers will, however, be essential, for on the extended use of these in agriculture lies one of the few hopes for the avoidance of famine in the future and the maintenance of the present standard of living, low as it is.

Fenland Exploration in East Anglia

A COMMUNICATION from Mr. Miles C. Burkitt, which appears in *Man* for November, announces the inauguration of a committee for the exploration of the fens of East Anglia in connexion with the Cambridge Antiquarian Society and the Prehistoric Society of East Anglia. Recent archæological work in the area, notably a study of the prehistoric waterways by Major Fowler of Ely and of an early metal age site below peat by Mr. Grahame Clark, has served to demonstrate the importance of a region which can afford an unbroken sequence of deposits from quaternary to recent times. It is evident, however, that archæological investigation does not cover a sufficiently wide field for the complete study of the area, but needs supplementing by such studies, for example, as palæobotany and geology. It has, therefore, been decided, as already stated, to appoint a committee of experts to undertake systematic study in the various branches of scientific investigation between which co-operation is essential to a scheme of exploration. The Master of Downing, Prof. A. C. Seward, has consented to act as president and Major Fowler as vice-president of the Committee. Mr. Grahame Clark, Peterhouse, Cambridge, to whom communications relating to the work of the committee should be addressed, will act as secretary.

Rediscovery of an 'Extinct' Bird

RE-APPEARANCES of creatures regarded as extinct are occasionally reported but seldom proved. There can be no reasonable doubt, however, in the case of the black-capped petrel or 'diablotin' of Dominica, *Pterodroma hæsitata*. For many years this bird has been regarded as extinct, the last recorded capture having been made in 1871, but recently reports have become current that odd examples have been seen. The present position is summed up in a short article in the *Journal of the Society for the Preservation of the Fauna of the Empire* (Sept. 1932, p. 17). In 1900 Richmond stated that he had seen three, more have been observed in Haiti, and on May 2, 1932, Mary Rose (of Roseau, Dominica) invited a naturalist to examine a strange bird found lying helpless at her door after a stormy night. The naturalists who saw it (it died on May 26) agree that it was a 'diablotin'; and apparently the bird, although extremely rare, still breeds in the mountain fastnesses of Dominica. It is gratifying to find that steps were at once taken to ensure so far as possible the safety of the remnant, and on July 1 a special legislative order was issued granting the petrel full protection.

Magnetic Declination in the United States

THE U.S. Coast and Geodetic Survey makes magnetic observations at a set of repeat stations every five years, and publishes the results at similar intervals, in the form of tables of secular variation, and of charts showing the results of the original complete survey, made mainly between 1900 and 1910, brought up to date. A recent pamphlet by D. L. Hazard ("Magnetic Declination in the United States, 1930", U.S. Dept. of Commerce, Coast and Geodetic Survey, Washington; Serial 540, 1932; pp. 40, 10 cents) does this for the magnetic declination; the chart gives isogonic lines at 1° intervals, and lines of equal annual change at 1′ intervals. It contains much tabular matter and information of value to land surveyors, and is issued at a very low price.

Meldola Medal

THE Meldola medal (the gift of the Society of Maccabæans) is awarded annually to the chemist whose published chemical work shows the most promise and is brought to the notice of the administrators during the year ending December 31 prior to the award. The recipient must be a British subject not more than thirty years of age at the time of the completion of the work. The medal may not be awarded more than once to the same person. In awarding the medal for 1932, the adjudicators will, unless exceptional circumstances arise, give special consideration to work in physical or inorganic chemistry. The next award will be made in January 1933. The Council of the Institute of Chemistry would therefore be glad to have its attention directed, before December 31, to work of the character indicated. Communications should be addressed to the Registrar of the Institute, 30 Russell Square, London, W.C.1.

Announcements

THE Christmas Lectures at the Royal Institution are to be given by Prof. A. O. Rankine, professor of physics in the Imperial College of Science and Technology, on December 27, 29, 31, January 3, 5 and 7 at 3 o'clock. Prof. Rankine has chosen "The Round of the Waters" as the title of this, the "one hundred and seventh course of six lectures adapted to a juvenile auditory".

IT is announced by Science Service, Washington, D.C., that the John Fritz Gold Medal for 1932 of the American engineering institutions has been awarded to Daniel C. Jackling. Mr. Jackling, who has done much work in mining engineering and metallurgy, especially in the development of low-grade ores, was awarded the medal for "notable industrial achievement in initiating mass production of copper from low-grade ores, through application of engineering principles".

THE annual Congress of the Royal Institute of Public Health will be held at Eastbourne on May 30–June 4, under the presidency of the Right Hon. Viscount Leverhulme. The Congress will be divided into five sections: State medicine and industrial hygiene; women and children and the public health; tuberculosis; pathology, bacteriology, biochemistry and veterinary medicine; climatology and hydrology. Further information can be obtained from the Secretary, 23 Queen Square, London, W.C.1.

THE trustees of the Rockefeller Foundation have made a further grant of £5,000 towards the research funds of the National Institute of Industrial Psychology to be expended in the years 1933–1936. This is the fourth grant made by these trustees to the Institute. These gifts have enabled the Institute, under the personal direction of Dr. C. S. Myers, its principal, to conduct an extensive series of researches upon subjects having a direct bearing on industrial and occupational life.

AT the annual general meeting of the Philosophical Society of the University of Durham the following officers were elected for the session 1932–33: *President:* Prof. R. A. Sampson; *Vice-Presidents:* Profs. J. W. H. Harrison, P. J. Heawood, G. R. Goldsbrough, G. R. Clemo, G. H. Hickling, and J. Irvine Masson; *Hon. General Secretary:* Mr. W. M. Madgin; *Hon. Treasurer:* Mr. J. W. Bullerwell; *Editor:* Prof. G. W. Todd; and *Hon. Librarian:* Dr. F. Bradshaw.

DR. J. FLORIAN, Brno, Czechoslovakia, writes to point out that in his article on "The Early History of the Cell Theory" in NATURE of October 22 the first sentence of the second paragraph should read:—"Studnička came to the conclusion that the small granules ('globules') of 1/300 mm. in diameter, which H. Milne Edwards (1823) found in all the tissues he examined, are of varied origin and in great part mere artefacts." By a misunderstanding, for which the correspondent who sent us the article is responsible, the sentence read: "In 1823 H. Milne Edwards came to the conclusion that the small granules ('globules') of 1/300 mm. in diameter," etc. Dr. Florian saw a proof but unfortunately overlooked the alteration which had been made in the sentence.

IT is announced in *Science* of October 28, that the ninety-first meeting of the American Association for the Advancement of Science will be held at Atlantic City on December 27–31, under the presidency of Dr. John J. Abel. The opening general address will be delivered by the retiring president, Dr. Franz Boas. The first Maiben lecture, a new lecture established in memory of H. Maiben, will be given by Dr. H. N. Russell on "The Constitution of the Stars". The general headquarters of the Association will be Chalfonte-Haddon Hall, which will also house the members representing general science. On the other hand, members of the various sections of the Association will stay in definite hotels allocated to each section. So far as is possible, each section will hold its meetings at the hotel thus assigned to it.

ARRANGEMENTS have been made for Dr. Davidson Black of the Peiping Union Medical College, China, who will arrive in England early in December, to give a course of lectures in advanced anatomy in the University of London. The course, consisting of two lectures on *Sinanthropus*, will be given at University College, Gower Street, London, W.C.1. The first lecture will be delivered on Friday, December 9, at 5.30 P.M., and the second on Monday, December 12, at the same time. In addition to an account of the morphological characters of *Sinanthropus*, the lectures will include a historical statement and a description of the environment, physical and biotic, and the cultural horizon. Admission to all the lectures will be free and without ticket.

IN a review in NATURE of November 5, p. 682, reference is made to the transparent cellulose film "Cellophane". We have been asked to point out that this name is the registered trade mark used by The Cellophane Co., Ltd., and its associated companies to designate their product.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in chemistry (subsidiary botany) at the Woolwich Polytechnic, Woolwich, S.E.18—The Secretary (Nov. 29). A county librarian for the Buckinghamshire County Education Committee—The Secretary for Education, County Offices, Aylesbury (Nov. 29). A temporary junior chemist at an Admiralty inspection establishment—The Secretary of the Admiralty (C.E. Branch), London, S.W.1 (Dec. 10). An assistant librarian at the University of Glasgow—The Librarian (Dec. 15). A field geologist for economic investigation (not oil) in Iraq—The Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1 (Dec. 17).

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.*]

Quantitative Estimates of Sensory Events

DR. ALLAN FERGUSON'S article on Weber's law in NATURE of September 3 (p. 334) is to be welcomed as an eminently sane statement on a subject about which much nonsense has been talked. Fechner's work has been too much attacked by verbal discussion on the nature of measurement which Dr. Ferguson rightly criticises.

This speculative discussion has directed the attention of Fechner's critics from a serious mathematical blunder. Fechner integrated for the whole value of R values from zero upwards (assuming, therefore, that Weber's law held over this whole range), but after integration, he made a substitution which assumes the existence of an absolute threshold of stimulus below which there is no sensation (which is plainly inconsistent with the truth of Weber's law at low R values). This leads to the absurdity of negative sensation values when the stimulus is below threshold value, and the crowning absurdity of an infinite negative sensation for zero stimulus. This defect, however, is not fatal to Fechner's work and may be avoided by the method adopted by Dr. Ferguson of integrating only over the range of R values in which Weber's law, in fact, holds.

A further difficulty, however, arises from the fact that it is not certain that there is any range of stimulus intensities over which Weber's law is valid. The method of experimenting which has commonly been used on the authority of Fechner (that is, asking the subject for a judgment as to which of two stimuli is greater) does not give very self-consistent results, so no very close approximation to any law can be expected. Using Weber's original kind of stimulus—pressure—and a simpler experimental method giving greater self-consistency, I have found no indication of a tendency for $\Delta R/R$ to be constant. Any relationship is complicated by the fact that different kinds of sense organs are stimulated at different intensities of pressure, but an overlapping system of curves approximating to Houstoun's law seems a more probable explanation of the results obtained. This does not seem to be a mere result of a change in experimental method, since the old results given in the textbooks seem, on critical examination, to give no real support to Weber's law. Results commonly stated to be 'near enough to Weber's law' (such as Max Wien's on sound intensities), when reduced to a graph, are not very much like a straight line parallel to the base. Many such 'confirmations' of Weber's law prove on examination to be, in Mark Twain's words, a little straighter than a corkscrew but not so straight as a rainbow.

Dr. Ferguson is undoubtedly right in suggesting that the real problem of Fechner's work is unaffected by whether we start from Weber's law or some more complex relationship between R and S. The assumption in the passage from a law connecting differential thresholds with absolute values of the stimulus to a formula of the general form $S = f(R)$ or $S_1 - S_2 = f(R_1, R_2)$, (Fechner's implied assumption that just perceptible increments of sensation are equal sensation increments) may be regarded as a convention of measurement comparable with Fahrenheit's convention that he would take as equal temperature steps those that made equal volume increases in his mercury. If this convention gives us a system of numerical coefficients consistent with the experimental facts of judgments of relative supraliminal sensation differences (as apparently it does), it matters little whether or not we are to be allowed to call this process 'measurement' or by some other name.

It must be agreed that the conception of the sense interval is a mere evasion of the difficulties of the sensation. Several years ago, I described experiments at a British Association meeting which showed that the absolute sense interval involves precisely the same difficulties as the absolute sensation magnitude.

The greatest harm to the development of experimental psychology has come from Weber's law and not from Fechner's work. Fechner has contributed to this harm by focusing attention on Weber's law. The harm has been two-fold. First, experimenters have for half a century been occupied with trying to confirm or refute Weber's law, instead of with the real problem of trying to establish the more complex relationship which really holds between sensation and stimulus intensity. Much worse is the fact that they have been almost entirely occupied with those conditions of simplified perception in which alone sensation intensity is simply a function of stimulus intensity, and have neglected the much more important and interesting problems of perception which arise under less artificial conditions in which the perceptual experience is a function of the total experimental setting.

ROBERT H. THOULESS.

Dept. of Psychology,
University, Glasgow.
Sept. 7.

DR. FERGUSON'S discussion in NATURE of September 3 (p. 334) would have been briefer and possibly clearer if he had based it upon the general principles of measurement. These have been recently formulated by several independent writers; it is true they are not generally known, but they never will be if everyone refuses to refer to them. The chief of them may be stated briefly thus :—There are two distinct processes of measurement; one of these ('fundamental') is based on the recognition of a relation of equality and a process of addition, obeying certain laws; the other ('derived') consists in the assignment of a numeral representing the constant of a numerical law. Let us apply these to sensations.

In so far as the law

$$\delta R = kR$$

is valid, k is a true *derived* magnitude, exactly co-ordinate with density or viscosity. But that does not afford the smallest presumption that there is a *fundamental* magnitude S, between values of which the k's are differences; it is that presumption that has misled the followers of Fechner. It is certainly improbable that a quantitative science of sensation can be established unless a *fundamental* magnitude characteristic of it can be found; but the way to find such a magnitude is to seek for a process of addition, not to juggle mathematically with numerical laws.

The success of the search depends largely on what is meant by a sensation. Some psychologists hold that two sensations of the same kind cannot be experienced simultaneously. If they are right (and the question is not entirely one of words), sensations cannot possibly be measurable fundamentally; for it is quite certain that there is no process of addition whereby two non-simultaneous sensations can be combined so as to be equivalent to a single instantaneous sensation. If, on the other hand, we experience two simultaneous sensations when exposed to two stimuli, sensations can be combined and it is a question of experimental fact whether such combination satisfies the laws of addition. The most likely of these to fail is the associative law that, if a is equivalent to a' and b to b', then a combined with b is equivalent to a' combined with b'. For the sensation of brightness, this law (and certain others) are true within limits; that is why heterochromatic photometry is possible. Those who dismiss it as irrelevant on the ground that it measures stimuli and not sensations often fail to observe that heterochromatic brightness differs from homochromatic brightness and other typically physical magnitudes, because it cannot be measured by 'physical' methods, independent of any *specified* form of sensation; its measurement is inseparable from a sensation of a particular kind.

The law need not, however, be true for sensations of other kinds. It is almost certainly untrue for painfulness; and I doubt whether it is generally true for loudness. The loudness of added sounds is probably affected by their concordance or dissonance. But the experiments that might decide the matter definitely do not seem to have been made; until they are made, it is waste of time to discuss whether sensations are measurable.

Some people seem to believe that, though sensations are not measurable by either of the two physical processes, they may be measurable by some third process inapplicable to the magnitudes of physics. They should remember that physicists will not accept any process as measurement, unless it is based upon laws the validity of which is appreciable equally by all observers who are not so abnormal as to fail to appreciate their meaning.

NORMAN R. CAMPBELL.

THE two letters printed above emphasise the necessity for further discussion of the problem—a discussion which may very well be applied both to the vast mass of existing experimental data, and to the conditions under which fresh data may be sought.

The reason for the line of development adopted in my article will be apparent to anyone acquainted with the literature of the subject; and, as was pointed out clearly enough in the text, one of the primary matters to be considered in a future discussion is that of the application to the problem of the fundamental principles of measurement, the importance of which Dr. Campbell so rightly stresses. Anything that Dr. Campbell has to say on such a subject will be heard with respect; nonetheless, readers of his incisive letter should remember that a vigorous statement is not necessarily a final statement of the truth.

ALLAN FERGUSON.

70 Hadham Road,
Bishop's Stortford,
Herts.

Lubricating Oils and Cancer

THE letter from J. B. Speakman and N. H. Chamberlain,[1] suggesting that "the incidence of dermatitis and tumours may be caused by the difficulty of removing mineral oil from the skin", is supported by the fact that unsaturated mineral oils on exposure to light and air form compounds which are not emulsified by soaps, and which form coatings on wool fibres that are only removed with difficulty by solvents, and not at all by soaps. This insoluble layer is a possible source of irritation. Crude shale oils give a considerable amount of such insoluble compounds.[2]

Also, in the course of research work by the second of the undersigned, on emulsification problems in scouring of wool and wool fabrics, it has been noted that the ionisation process developed by E. V. Hayes-Gratze in co-operation with the Wool Industries Research Association, applied to a variety of oils, especially vegetable oils, gives striking results.

It gives products of greatly lowered surface tension, and highly water-emulsifiable nature, providing a means of wool oiling whereby not only are "oxidised oil" defects, to which commercial lanoline is subject, eliminated, but subsequent scouring is accomplished with the greatest ease.

In addition, hospital tests have shown that ionised oils possess remarkable curative properties in treatment of obstinate cases of dermatitis and ringworm, so that it may be inferred that their presence would tend to prevent skin infection, apart from facilitating removal of oil contamination.

H. R. HIRST.
A. T. KING.

Wool Industries Research Association,
Headingley, Leeds.
Nov. 7.

[1] NATURE, **130**, 578, Oct. 15, 1932.
[2] Hirst, *J. Soc. Dyers and Col.*, Dec. 1931.

A Continuous Spectrum of Pure Argon

IN the course of investigations that have been made at the Electrical Laboratory, Oxford, of the electrical properties of argon, it was found that when the gas is obtained in a high degree of purity several phenomena occur, in the appearance of the discharge and in the spectrum of the light emitted, which do not appear to have been noticed before. The argon was carefully purified by a method which will be described in another paper. It was examined spectroscopically at pressures from 1 millimetre to 150 millimetres and no lines due to impurities were detected in the range of wave-lengths from λ 2000 A. to λ 7000 A.

It was found that when an electrodeless discharge was excited in argon by continuous oscillations of about 100 metres wave-length in a tube 1·7 cm. in diameter, the discharge assumes two forms which depend upon the pressure of the gas and the intensity of the current. When the current in the tube is large, the discharge is a striated column, the striations consisting of globules (the size of which decreases as the pressure is increased) which lie along the axis of the tube between the electrodes; a form of the discharge which has already been described in a previous paper.[1] A recent photograph of this type of discharge in pure argon at about 40 mm. pressure is shown in Fig. 1. When the current in the tube is decreased, the striations disappear and the distribution of light in the tube takes the form shown in Fig. 2. In the striated column the colour

is purple and in the uniform column the colour is white. In a tube of 1·7 cm. diameter, at pressures less than 8 mm., it was not found possible to obtain the uniform column, and the discharge was striated for the smallest currents which could be maintained

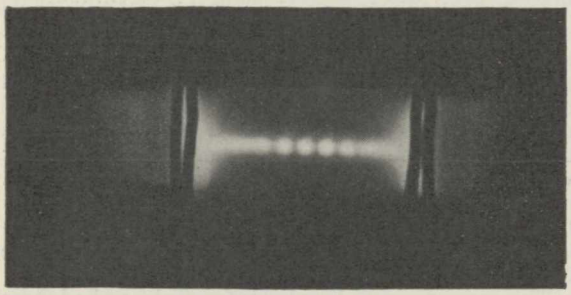

FIG. 1.

in the tube. Similar results were obtained in wider tubes, both of pyrex and of quartz.

The spectra emitted by the luminous column in the two types of discharge exhibit interesting variations as the pressure is increased. When the pressure is less than about 6 mm., only the line spectrum

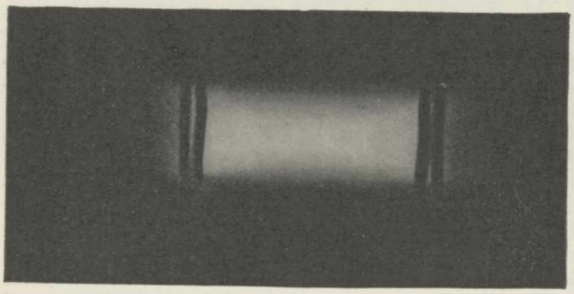

FIG. 2.

of argon is excited. As the pressure is increased, a continuous background appears which increases in intensity with the pressure, while the line spectrum becomes less intense. At the highest pressures (80–150 mm.) the line spectrum is completely absent from the uniform column with the exception of the

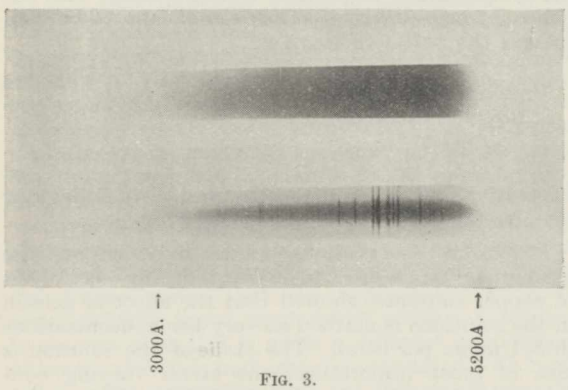

FIG. 3.

argon red line at λ 6965 A. The spectrum appears quite continuous from 6000 A. to about 2250 A., which is as far as can be measured with the spectrograph used. At the highest pressures in the striated column the continuous background appears as strongly as in the uniform column, but in addition the stronger lines of the argon red spectrum are visible above the continuous background.

Photographs of the spectrum of the striated and continuous discharges obtained in pyrex tubes containing argon at a pressure of 150 mm. are shown in Fig. 3. These were taken on Ilford Zenith 650 plates. Photographs will be published later of the spectra obtained with quartz tubes and panchromatic plates. These plates show the continuous spectrum sharply cut off at about λ 6000 A. and extending as far into the ultra-violet as can be measured with a quartz spectrograph in air, while the red line at λ 6965 A. appears prominently.

A very interesting feature of these investigations is that they show that it is possible to obtain a continuous spectrum in a gas discharge, over a wide range of wave-lengths, where the characteristic lines of the gas are absent.

S. P. MCCALLUM.
L. KLATZOW.
J. E. KEYSTON.

Electrical Laboratory,
Oxford.
Oct. 30.

[1] S. P. McCallum and W. T. Perry, NATURE, 124, 984, Dec. 28, 1929.

Continuous Spectrum of Sodium

I HAVE investigated the intensity distribution of the continuous spectrum of sodium, which is generally considered to be the halo of the *D* lines, and also of the relative intensity to the systems of discrete bands, under various conditions of excitation, and the main results obtained are here described.

The continuous spectrum begins to enhance when the pressure is increased to 1–2 mm., and as the pressure of vapour is increased more and more, without altering the temperature, the intensity of the discrete bands as well as that of the continuous spectrum are both increased considerably, the increasing rate of the former being greater than that of the latter.

Where the temperature of the vapour varies under a constant pressure, it is known that the more intensely the discrete bands are emitted, compared with the continuous spectrum, the lower the temperature of the vapour, but as the temperature of the vapour becomes higher, the case is reversed.

The intensity distribution of the continuous spectrum is nearly symmetrical on both sides of the wave-lengths and is at a remarkable maximum at the *D* lines, and the rise of temperature, without altering the pressure, or increase of pressure, the temperature being kept constant, causes the relative or absolute enhancement and, therefore, the (apparent) broadening of the spectrum. In the region of the shorter wave-lengths, its intensity decreases moderately at about 5600 A. and fades abruptly with a comparatively sharp edge at about 5500 A., and as we proceed farther towards the side of the shorter wave-lengths, the intensity of the weak continuous spectrum gradually decreases and terminates more or less abruptly at about 4550 A., while, on the side of the longer wave-lengths, its intensity is gradually and uniformly decreased.

The rotation structure is always sharply defined without showing any appreciable broadening of the band-lines as the result of the increase of pressure, and also of the rise of the temperature, until the condition (very high temperature) is arrived at where the discrete bands, and therefore each separate band-

line, ultimately disappear. It is proved that there is no direct connexion between the structure of the discrete bands and the continuous spectrum.

The continuous spectrum mentioned above may certainly be explained by the emission of the excited ^2P atoms during their collisions with other normal atoms (quasi-molecules). It seems that the emission of the main part of the strong continuous spectrum in the back-ground of the red band system is closely connected with the transitions $^1\Sigma_u^+ \rightarrow {}^1\Sigma_g^+$ of the quasi-molecules. Similarly, the continuous spectrum

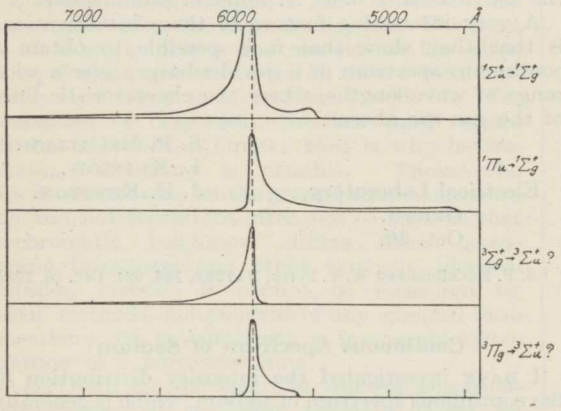

FIG. 1.

in the back-ground of the green band system seems to have an intimate connexion with the latter band system ($^1\pi_u \rightarrow {}^1\Sigma_g^+$). Besides, there is also possible the emission of a continuous spectrum due to the transitions $^3\Sigma_g^+ \rightarrow {}^3\Sigma_u^+$ and $^3\pi_g \rightarrow {}^3\Sigma_u^+$ of the quasi-molecules on the side of the longer wave-lengths of the *D* lines, or in the vicinity of them (Fig. 1).

The main part of the continuous spectrum emitted from the sodium arc, or from the sodium flame, when the density of sodium vapour is fairly high, has the same distribution of intensity as that obtained in this experiment.

Similar results are obtained in the case of potassium.

H. HAMADA.

Physical Institute,
Sendai, Japan.
Sept. 24.

Discontinuous Distribution in Plants

IN NATURE of July 9, p. 58, I gave an account of a genus of bees (*Hesperapis*) which was found to exist in dry regions of the south-west United States, and again in the dry parts of South Africa. I have just received from the Missouri Botanical Garden a very thorough revision of the genus *Menodora*, by Julian A. Steyermark. This is a genus of oleaceous plants, found in dry or semi-desert regions, in south-west North America, a large area in Central and southern South America, and a few forms in the Transvaal and adjacent parts of South Africa. Thus except for the South American area, the distribution nearly corresponds with that of *Hesperapis*.

One of the South African forms, certainly native and frequently collected in the Transvaal, has been supposed to be identical with *Menodora heterophylla*, which is abundant in Texas, and occurs in the Mexican States of Tamaulipas and Nuevo Leon. Mr. Steyermark points out that in spite of the great resemblance, the South African plant differs in a number of respects, so that he calls it variety *australis*. Evidently it should rank as a separate species, *Menodora australis*, as it cannot be supposed to have any direct genetic connexion with the North American plant. Mr. Steyermark himself calls it "a very striking instance, seemingly, of parallel development". On p. 109, however, he writes: "*M. heterophylla*, occurs with its variety in two widely separated continents, namely, North America and Africa. Since this distribution may be explained by the supposition of the existence of a land-bridge forming a ready means of dispersal for species between the continents, it may be supposed that *M. heterophylla* extended from North America to South Africa over the postulated lost continent, Gondwana, before the end of the Cretaceous."

This seems to me to be wholly fanciful, and had there been any such connexion, is it likely that this species of plants has remained unchanged since the Cretaceous, or that a few forms crossed over, leaving the mass of the fauna and flora behind? There is no reason to doubt that the genera *Menodora* and *Hesperapis* are of great antiquity, and presumably spread to their now remote outposts by way of Asia, but very similar species have evolved independently under similar conditions. Unfortunately xerophytic conditions are not favourable for the preservation of fossil plants and insects, so that we get very little evidence from the rocks concerning the past plant or invertebrate life of dry regions. We do, however, find in the Miocene deposit at Florissant, Colorado, fossil Proteaceæ, a family of plants now especially characteristic of South Africa and Australia, and a species of Nemopteridæ, curious insects with long slender hind wings, known from southern South America and dry regions of the Old World, but to-day wholly lacking in North America.

The distribution and origin of desert life may well attract all students interested in the wider aspects of biology. After visiting desert and semi-desert regions in many parts of the world, one is struck by the extraordinary character of the responses to the environment, producing similar and highly characteristic organisms, often of quite different origin. Judging by the completeness of the adaptations, and the great number of peculiar types, it seems that the South African desert area has some claim to be considered the oldest of them all.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado.
Oct. 7.

Protective Properties of Colloids and their Behaviour in the Electrolytic Deposition of Metals

PREVIOUS observations made by me[1] on the mechanical stress in cathode plates during electrolysis of copper sulphate, showed that the effect of gelatin in the solutions is marked at very low concentrations (0·5–1 mgm. per litre). The state of the solution is also of great importance, the stress varying considerably with the age of the solution. This makes it possible to follow the evolution of a solution as a function of time by the electrochemical method.

I have continued my experiments with other colloids: serum albumin, gum arabic, gum tragacanth, and dextrin, in concentrations varying from 1 to 500 mgm. per litre. The results show a very

pronounced parallelism between the protective action as measured by the gold number of the colloid substance and its action on the electrolytic deposit. Highly protective substances (gelatin and serum albumin) modify considerably the stress in the copper, whereas the less protective (gum arabic and gum tragacanth) have a much smaller effect. The dextrin with its very high gold number has no effect in the limits of the concentrations examined.

These results show that the effect produced by the colloids on the electrolytic copper deposit must be attributed mainly to phenomena similar to those manifested in protective actions, that is, they have to be brought back finally to adsorption.

P. A. JACQUET.

Laboratoire d'Electrochimie,
Ecole Pratique des Hautes Etudes,
Paris (V°)

[1] C. R. Acad. Sci., Paris, **194**, 456, 870; 1932.

Application of the Gold-Beater's Skin Test to Some Synthetic Tannins

IN several communications[1] we have shown that the generally accepted reactions for the tannins are quite unreliable, with the result that the above-named test was evolved.[2] The gold-beater's skin test demonstrates the *tanning* properties of a substance, and is given *only* by true tannins. Its application to the following synthetic tannins, prepared according to Emil Fischer,[3] digalloyl-glycol, trigalloyl-glycerin, tetragalloyl-erythrol and hexagalloyl-mannitol, shows them to possess no tanning properties whatever. These observations thus extend my objections,[4] since further emphasised by Tschitschibabin,[5] to Fischer's galloyl-glucose formula of gallotannin.

M. NIERENSTEIN.

The University,
Bristol.

[1] Jones, *Analyst*, **52**, 275; 1927; **53**, 429; 1928. Fear, *ibid.*, **54**, 227, 316; 1929.
[2] Atkinson and Hazleton, *Biochem. J.*, **16**, 516; 1922. Price, *Analyst*, **49**, 25, 336; 1924.
[3] Fischer and Bergmann, *Berichte*, **52**, 829; 1919.
[4] Nierenstein, Spiers and Geake, *J. Chem. Soc.*, **119**, 275; 1921. Nierenstein, Spiers and Hadley, *J. Amer. Chem. Soc.*, **47**, 1726; 1925.
[5] Tschitschibabin, Kirsanow and Korolew, *Annalen*, **469**, 93; 1929.

Inheritance of Acquired Characters

THE response evoked by my letter in NATURE of October 1 calls for a reply. Dr. R. A. Fisher, in his interesting communication,[1] points out that before my conclusion is accepted there are one or two preliminary points to be considered. His suggestion that the somewhat retarded ages of fatherhood of the upper and middle classes would alone explain the greater age of paternity cannot, I think, be accepted: the frequency curve would surely be displaced so as to be substantially parallel to the normal curve, but this is not the observed fact. Again, Dr. Fisher states that the comparison would be more valid if based upon birth order: I venture to suggest that this is quite a different proposition, although ability is undoubtedly correlated with birth order. The suggestion that the differences may be due to environmental modifications is a more plausible one but it cannot, I think, be sustained: a father seventy years of age is not likely either to survive to influence his child during the critical years of adolescence or to provide a substantially better environment than a father fifty years of age.

If my thesis is true it is important eugenically, since there emerges the possibility of materially improving a stock in one generation. In this connexion the tradition that Isaac was born when Abraham was an hundred years old and Sarah ninety is interesting, seeing that from him sprang the whole Jewish race. The story in *Genesis* is very circumstantial and emphasises that both parents were old and well stricken in age. It is commonly held, I believe, that such progeny is necessarily degenerate.

A. F. DUFTON.

Greenbank, Garston,
Hertfordshire.
Oct. 22.

[1] NATURE, **130**, 579, Oct. 15, 1932.

Ecology of Man's Ancestors

IN his recent book "The Causes of Evolution" (p. 10) Prof. J. B. S. Haldane makes the following incidental remark: "Thus that common enemy of man, the bed-bug belongs to a family whose members are mostly parasitic on bats. Dr. Buxton has, I think, suggested that it is a relic of the association of our palæolithic ancestors with bats in caves." It is, indeed, interesting to note that a number of other animals associated with man and his immediate environment belong to the ecological group of rock and cave communities. The members of the family Cimicidæ to which the bed-bug belongs are predaceous (not parasitic in the strict sense of the word) not only on man and bats, but also on pigeons and house-martins, and the original habitat of these birds, as well as of swallows, is amongst cliffs and in caves. The predaceous bug *Reduvius personatus*, often preying on the bed-bug, is found only in houses and sheds, but other species of the genus occur amongst stones, in rock crevices, etc., in the Mediterranean region. The same largely applies to the house-cricket and to the myriapod, *Scutigera*. The typical cave bugs belonging to the subfamily *Emesinæ* are represented in the animal community grouped around man by several species of the genus *Ploiaria* (for example, *P. domestica*). The geckos are typical rock animals but they are just as commonly found on the walls of houses.

All these facts lend strong support to the hypothesis that man originally belonged to the community of cave-inhabiting animals rather than of forest-dwellers such as the anthropoid apes. It would be of great interest to make a thorough analysis of the animals commensal with man in various countries with regard to their systematic, zoogeographical and ecological relations, since this may throw some light on the early history of mankind. So far as we know, this much discussed problem has not yet been attacked from the ecological point of view.

W. E. CHINA.
B. P. UVAROV.

British Museum (Natural History),
London, S.W.7,
Nov. 1.

Implements from the Raised Beach at Slindon Park, Sussex

WITH the help of a grant from the Percy Sladen Memorial Fund, I have recently examined the raised beach at Slindon Park, situated between Arundel and Chichester.

The section shows some 8 ft. of raised beach, consisting mainly of flint cobbles. Its surface lies

at about 135 ft. above O.D., and is covered by a deposit of Coombe Rock, varying from 6 in. to 9 ft. deep. Three main facts result from my investigation :

(1) The raised beach contains Chellean hand-axes and large thick flakes, both much rolled.

(2) At the top of the beach occur Acheulean ovates.

(3) Next comes a flake industry, which preceded the deposition of the Coombe Rock.

(1) The large flakes from the beach closely resemble in form and colour those found in the Cannon shot gravels of Norfolk. There are traces of striation. Some are reminiscent of Clacton types.

(2) From the top of the beach come several Acheulean ovates. Some are moderately rolled and battered ; others are unabraded. We are probably dealing with a storm beach, which was occasionally subjected to the action of the sea. The subsidence involved is about 120–125 ft.

(3) The lowest part of the Coombe Rock contains a floor yielding remains of a flake industry. There are Levallois flakes with facetted platforms, and flakes struck from unprepared cores. The industry includes rough hand-axes, both ovate in shape, and with squared corners, also choppers and large points, 'Abri Audi' in form.

From the 80–90 ft. raised beach south-west of Slindon Park, I have obtained several rolled flakes of Cannon shot gravel type.

I suggest that much of the beach belongs to the same interglacial period as the Cannon shot gravels. Its latest phase may be contemporary with (*a*) gravel deposits at Corfe Mullen near Wimborne in the Hampshire basin, where the surface of the gravel is about 135 ft. above the river ; (*b*) the Dartford Heath gravel in the lower Thames valley, where the top of the gravel reaches 137 ft. above O.D. Both these sites contain late Acheulean ovates.

The Coombe Rock at Slindon readily falls into line with a similar deposit which buried the early Mousterian workshop at Northfleet, and with the Upper Chalky Boulder Clay of East Anglia which succeeded early Mousterian cultures at Hoxne and Foxhall Road, Ipswich.

Mr. J. Reid Moir has kindly examined my material, and is in agreement with my general conclusions. A full report will be published in due course.

J. BERNARD CALKIN.

Wychwood School,
Bournemouth.
Nov. 2.

Angle of Elevation of Short Wave Rays

AN important problem in short wave propagation from both the purely scientific and the commercial aspect concerns the angle of elevation of the path of the ray both at the transmitting and receiving end.

During the past year the Radio Section of the Post Office Engineering Department has been investigating this problem. At Rugby Radio Station, energised aerials consisting of one or more tiers of horizontal radiators have been raised in stages from the ground and the resulting field has been measured near New York by the staff of the American Telephone and Telegraph Co., and the Bell Telephone Laboratories, who have closely collaborated in the tests. By plotting a series of curves giving the relative field strength of the rays projected at various angles of elevation as the aerials were raised and comparing with the received fields, it has been possible to ascertain the direction taken by the ray at the transmitting end. The details of the tests will be published later. In the meantime it is relevant to record that the usually accepted theory that for long distance transmission almost grazing angle to the earth gives the best distant field is inaccurate in the case of the Rugby–New York circuit. The investigation shows that during the past year the best angle of projection of waves traversing an all light path has varied only $\pm 2°$ or $3°$ from $10°$ to the horizontal.

Aerials giving rise to beams of varying concentration having their maximum radiation at angles of elevation changing from $5°$ to $10°$ have shown in all cases that the average field as measured at the receiving end has corresponded approximately to that portion of the energy radiated along a direction having an angle of elevation of $10°$. Field-strength measurements made in Berlin and Teneriffe by the courtesy of Herr Baumler of the Reichspostzentralamt, and Mr. W. H. Warren of the Compania Telefonica National des Espana, confirm that there is a definite angle of projection of energy along which attenuation is a minimum.

This angle is not necessarily the lowest to give a minimum number of reflections from the *F* layer associated with the name of Prof. E. V. Appleton.

T. WALMSLEY.

General Post Office (Radio Section),
86 Wood Street, London, E.C.2,
Oct. 31.

Dr. William Garnett

THE obituary notice of Dr. Garnett in NATURE of November 12 omits to mention his long connexion with the Royal Commission for the Exhibition of 1851 ; and as Dr. Garnett was justly proud of his membership of this body, perhaps a supplementary note may be of interest. The facts are these : Dr. Garnett was an original member of Lord Playfair's committee which devised and introduced the Commissioners' scheme of research scholarships, a scheme which has done so much for the improvement of scientific education both at home and overseas, and has also contributed in no small measure to the advancement of science. From 1890 until a few months ago, Dr. Garnett served without intermission as a member of the Science Scholarships Committee of the Royal Commission, and his recent resignation from that body, prompted by increasing deafness which latterly prevented him from following discussions at meetings, deprived the Committee of its senior member and its oldest friend ; and now his death removes the last link with that eminent body of men of science to whose wisdom and foresight higher education in Great Britain owes so much. I am privileged to know that, on his relinquishing his active participation in the affairs of the Royal Commission, Dr. Garnett received from H.M. the King a most gracious message of appreciation of the valuable services which he had rendered to the Commission for more than forty years. I believe that readers of NATURE will be glad to have their attention directed to this further aspect of his long and useful life.

EVELYN SHAW.

1 Lowther Gardens,
Exhibition Road, S.W.7.
Nov. 14.

Research Items

Peking Man.—The skeletal remains other than the skull parts of Peking man, of which the announcement of the discovery was purposely delayed, have now been described by Dr. Davidson Black (*Bull. Geol. Soc. China*, **11**, No. 4) The greater part of a left semi-lunar bone (os lunatum) was found by Dr. Bohler in material from Locus *B* of the Choukoutien cave. It is undoubtedly to be referred to the genus *Sinanthropus*. It differs in no important respect from that of modern man and confirms the inference from the stone implements, crude though they are, that the hands of Peking man were essentially like our own. In a culture stratum yielding quartz implements, from which came two adult jaw fragments and a parietal fragment of *Sinanthropus*, was also found a fragment of clavicle. It is the greater part of the shaft of a well-formed left clavicle lacking the eternal epiphyseal articular portion and the acromial fourth of the bone. It is moderately mineralised and a dark reddish-brown. The individual from whom it was derived was probably adult. The probable length, 15 cm., is about the average length of an adult modern North China male clavicle. A number of anomalous terminal phalanges have also been recovered, which could not well have belonged to any animal other than a hominid form. Expert opinion confirms this. In the first specimen recovered, the roughened area of the tuberositas unguicularis encroaches on the dorsal surface of the bone more widely, while ventrally it is much less developed, than in any known hominid. If it is the terminal phalanx of the hallux of *Sinanthropus*, it would seem probable that the morphology of the feet of this form and that of modern man differed much more widely from one another than that of their hands.

Pueblos on Zuñi Reservation.—The excavation of an ancient Pueblo site on the Zuñi Reservation, New Mexico, is described by Mr. F. H. H. Roberts, jr., in Bull. 111, of the Bureau of American Ethnology. When the site was excavated in 1930 it was found that the settlement consisted of three communal dwellings and two great kivas or ceremonial chambers. On account of the latter feature the site is to be known as the "Village of the Great Kivas". Two dwellings and one kiva were completely excavated. The larger dwelling consisted of three small ceremonial chambers, a great kiva and sixty-four rooms, of which four had constituted a second story. In addition there were four detached subterranean ceremonial chambers in front of the east end. The building had not been erected as one unit, but there had been several periods of constructive activity. The original structure was a rectangular block of thirteen rooms and two small ceremonial chambers. Up to the close of at least the first two of the periods of activity, the house type was predominantly that of the Chaco canyon, that is, of the northern Pueblo type. The character and size of later additions suggest an infiltration of other peoples, probably from the south. The kivas associated with the house are of two types. The smaller house contained twenty rooms. Originally a fairly small dwelling, it had been enlarged at various times. The material was more carefully worked than in house A. It had no kiva, another indication of its probably southern origin. Sixty burials were uncovered; but the remains were in poor condition. The skulls showed pronounced occipital flattening and a large proportion of decayed teeth, the latter feature probably being due to a deficiency in diet. The village seems to have had a population of about 100. It belongs to Pueblo III and dates from about A.D. 1000–1030, the period of Pueblo expansion.

Tuberculosis in Children.—Our knowledge of the pathology and bacteriology of tuberculosis in children has been extended by the work of Dr. J. W. S. Blacklock, detailed in a report issued by the Medical Research Council (Special Report Series, No. 172. London: H.M. Stationery Office. 3*s*. net). It supplies additional evidence of the paths by which infection comes, based upon a study of the primary sites in which the disease developed in 283 children found at autopsy to be tuberculous. The ages of the subjects were from a few hours up to thirteen years. Of these 283 children with tuberculous damage, more than 90 per cent died as the result of the infection; the site of the primary damage was most frequently in the chest (173 cases, or 61 per cent). Evidence was sought of the pathway of infection to the lung and lymphatic glands. For this purpose, a characteristic lung lesion described by Parrot half a century ago and recognised as marking the primary site of infection was sought for; this was found in 148 of the 173 cases, and the tubercle bacillus was isolated in most of them and examined as to its type—human or bovine. Wherever the primary lung lesion of Parrot was found, only bacilli of human type were obtained either from the lesion itself or from the glands in direct relation to it. Dr. Blacklock concludes from all the evidence that the pathway of infection in these cases has been by the air—all these children were infected through the air-passages by bacilli derived from other human beings. Investigations were also made on primary abdominal and surgical tuberculosis, and upon the significance of tuberculin reactions.

Clyde Bivalves.—Mr. A. C. Stephen (*J. Marine Biol. Ass. United Kingdom*, vol. 17, No. 1, 1932) has continued his investigations on the intertidal lamellibranchs of the Clyde, chiefly at Millport, and adds to his list certain forms living below low water mark, using the Robertson bucket dredge put through a 2 mm. sieve, with a check sample through a 1 mm. sieve. Four species are dealt with in the present paper—*Tellina tenuis*, *T. fabula*, *Abra alba* and *Cardium edule*. All these are important economically as fish food, *Cardium edule* (the common cockle) also as human food. *Tellina tenuis* extends to about 2½ fathoms but its growth is slower beyond low water mark than in any other part of its range, and the present results show that it is best adapted to life in the intertidal area. *T. fabula* extends from about low water mark to a depth of 10 fathoms. It grows rapidly, attaining a length of 4 mm. at the end of the first year, 8 mm. in the second and 10 mm. at the end of the third year. For both species the years 1926 and 1930 were exceptionally good for spat survival. It is found that after the disappearance or great thinning of any population, it is apparently renewed from spat, and the author is of the opinion that the clearing of the ground of adults as a result of high mortality after spawning or after unusual frost is the important factor for the survival of spat. Thus on the shore at the head of Loch Fyne, all the

cockles above low water mark were killed off by the severe winter of 1928–29, most of the present population being derived from the 1929 spat. The rate of growth in the cockle is greater at low water mark than farther up the beach. If it grows slowly in the first year it tends to lag behind always. Shells of the same length from higher levels are lighter than those from lower down.

Cultivation of *Catenaria*.—*Catenaria anguillulæ*, a chytridiacean fungus, has been found parasitic in the eggs of the liver-fluke of sheep (*Fasciola hepatica*), in the eggs of other helminthes and in small aquatic organisms. Evidence points to the tap-water in London and in Dublin as the source of infection of the eggs in the laboratory experiments. The cultivation of this *Catenaria* is recorded by J. B. Butler and A. Humphries (*Sci. Proc. Roy. Dublin Soc.*, vol. 20, No. 25, 1932) using various artificial media containing an aqueous extract of the eggs of the fluke with or without agar, and/or, egg albumen. In culture the development of mycelium was much more extensive than when the fungus was growing as a parasite. In one instance a single thallus produced more than twenty hyphal strands each bearing three to four sporangia. In another example more than 700 sporangia were present in a single outgrowth, possibly involving only one thallus. The more extensive development of the mycelium in artificial media supports the view that *Catenaria anguillulæ* is a form reduced through the influence of parasitism. Zoospores from the sporangia germinated on an artificial medium and produced a thallus, zoosporangia and zoospores. The variability of shape of the sporangia in culture and other points in the morphology are noted.

Digestive Enzymes in the Animal Organism.—As is well known, the digestive enzymes secreted in the animal organism pass into the urine, their presence therein furnishing a means of measuring the intensity of their formation and the activity of the digestive processes. In vol. 34 of the *Rendiconti della Reale Accademia delle Scienze dell' Istituto di Bologna* dated 1930 but only now just received, Prof. Pietro Albertoni describes experiments in which taka-diastase was injected into the blood of the dog. After the injection—into the jugular vein—the submaxillary saliva was examined and was found to be, as normally, devoid of diastatic properties. Stimulation of the chorda of the tympanum rendered the saliva denser but did not cause it to become diastatic. Hence the enzyme does not pass into the saliva, although it retains its physiological action since, injected into the blood, it determines mobilisation of the glycogen, producing hyperglucæmia. Thus, there is no question of a circulation of the digestive enzymes, which are absorbed but do not re-appear in the various secretions, and in all cases represent a specific product of the various glandular apparatus.

A New Method in Plant Taxonomy.—Kiichi Ohki appears to have given the 'spodogram' method of distinguishing species a very thorough examination in connexion with his studies of the Japanese Bambusaceæ, and does not appear dissatisfied with the method. The spodogram is obtained by taking a small piece of the leaf from the middle region and incinerating it carefully using a special apparatus first suggested by Werner (*Biologia Generalis*, 4, 1928). The ash when cool is mounted on a slide, with xylol and Canada balsam. In this way the outlines in particular of the epidermal cells are retained because of the silica contained in their walls. At first sight it would appear more reasonable, if such microscopic characters are to be used in taxonomy, to examine the full leaf tissue without resort to incineration, when the same characters together with others will be available for study, but the method of incineration certainly reduces the salient microscopic characters to a limited group, recognisable after incineration, which may be more simply treated in systematic study. Ohki's paper will be found in the *Journal of the Faculty of Science* (Tokyo, Section 3, Botany vol. 4, Part I).

British Basidiomycetæ.—Mr. Carleton Rea has re-published Appendix 2 to his book "British Basidiomycetæ" (*Trans. Brit. Mycol. Soc.*, vol. 17, Parts 1 and 2, pp. 35–50, 1932). The newly-described species belong to the genera *Pluteus*, *Lepiota*, *Psaliota*, *Amanita*, *Stropharia*, *Cortinarius*, *Inocybe*, *Tricholoma*, *Entoloma*, *Clitocybe*, *Hygrophorus*, *Flammula*, *Collybia*, *Leptonia*, *Mycena*, *Russula* and others. Many are uncommon or rare, but a few are common. Four new species and one new variety are described. These are *Psaliota floccosa* Rea, *P. impudica* Rea, *Leptonia acuta* Rea, *Clavaria griseola* Rea and *P. campestris* var. *squamulosa* Rea. Diagnoses of the five are given in Latin and English and they are illustrated upon an excellent coloured plate. Mr. Rea's "British Basidiomycetæ" is the most complete work which has appeared on the subject and it is most useful that the author should keep it up-to-date by the periodical descriptions of new species and varieties.

Heat Excluding Roofs.—In a paper on "Radiant Heat" read before the Institution of Heating and Ventilating Engineers on November 2, Mr. A. F. Dufton summarised the results which have been obtained at the Building Research Station on the relative merits of various forms of thin roofs as excluders of heat due to sunshine from the buildings they cover. Most roofing materials absorb about three-fourths of the sunlight that falls on them; for example, red tiles 67 per cent, blue slates 85 per cent, red asbestos tiles 74 per cent, old roofing lead 77 per cent, bituminised felt 89 per cent, galvanised iron when new 65 per cent, and when old and dirty 91 per cent. Whitewashing the upper surface of any one of these reduces the absorption considerably, for example, that of the dirty iron to 26 per cent. A glass roof under which the temperature was 188° F. when the temperature outside was 70° F. in the shade, when given two coats of whitewash on its top surface showed a temperature underneath of only 103° F. Mr. Dufton has not been able to detect that the rays from an incandescent electric light relieve the congestion of the nose produced by the radiation from an electric fire, although Sir Leonard Hill stated some time ago (*Times*, August 13) that they have this property.

Cosmic Radiation.—The issue of the *Physikalische Zeitschrift* for September 1 contains a valuable summary of our present knowledge of cosmic radiation with a long list of references, by Prof. Hoffmann of Halle. Systematic observations are now being made at Abisko, Königsberg, Potsdam, Innsbruck, Amsterdam, Dublin, Bandoeng and Cape Town, and each month new facts are discovered and new questions raised. After describing the electrometer, tube counter and Wilson chamber methods of

measurement, the author gives the principal results obtained. Curves of increase of the radiation with height in the atmosphere and of decrease with depth below the surface of water are given. With increase of barometric pressure the radiation decreases. It appears to come equally from all parts of the sky. The harder part of the radiation appears not to vary in amount with time but the softer part appears to be influenced by meteorological conditions in the atmosphere. The absorption of the radiation as it passes through matter is complicated by the production of corpuscular radiation. The question of variation of the radiation with position on the earth's surface is still unsettled, and much of the theory as to the origin of the radiation is speculative. (See also NATURE, 130, 570, Oct. 15, 1932.)

The Green Salt of Magnus.—The green compound of bivalent platinum obtained by Magnus in 1828 by the action of ammonia on platinous chloride is usually considered to be a complex salt $[Pt(NH_3)_4]$ $[Pt\,Cl_4]$, and a detailed X-ray examination published by Cox, Pinkard, Wardlaw and Preston (*J. Chem. Soc.*, Oct.) shows that this is the case, the four ammonia and chloride groups being arranged in a square about the platinum atom. A pink form also obtained is generally a different substance, namely, Cleve's salt, $[Pt(NH_3)_3Cl]_2$ $[PtCl_4]$, although in exceptional cases a pink orthorhombic form which is the true analogue of Magnus's salt is formed. It is suggested that, since the true pink salt of Magnus and Cleve's salt are convertible into the green salt, the transformation of Cleve's salt to Magnus's salt may take place by interchange of co-ordinated groups between anions and cations, and the ions of the Magnus salt would temporarily have a non-planar configuration. The pink salt may be this unstable form intermediate between the other two. The planar arrangement in the green salt of Magnus is analogous to that in K_2PtCl_4 and $[Pt(NH_3)_4]$ Cl_2, but in the latter the ammonia groups are rotating, whereas in Magnus's salt the evidence shows that they are not. This is no doubt due to the lower symmetry in the structure of the latter.

Astronomical Topics

Astronomical Notes for December.—Venus is still observable as a morning star, rising about 2½ hours before sunrise, with five-sixths of its disc illuminated. Mercury is about 7° east of Venus in the latter half of December. Mars and Jupiter are observable after midnight; they are only 4° apart at the end of the month. This will be the last opposition of Jupiter in north declination for some years, so advantage should be taken of it. Mars is 1½° north of Neptune on December 5. Uranus is still well placed for observation, in Pisces. It is stationary on December 28.

The winter solstice occurs at 1 A.M. on December 22.

The following are the times of the disappearances of stars occulted by the moon (as seen from London). ι Aquarii, December 3, 6^h21^m P.M.; μ Arietis, December 9, 11^h7^m P.M.; ρ Leonis, December 19, 0^h29^m A.M. (bright limb); the last star re-appears at the dark limb at 1^h25^m A.M., angle 331°.

A meteor radiant in the north of Gemini is sometimes active in the first half of December. Denning gave December 11 and 12 as the dates of maximum, but owing to moonlight, there would be a better chance some days earlier.

The most conveniently observable minima of Algol occur about 9 P.M. on December 16, and 6 P.M. on December 19.

The Leonid Meteors.—The weather in the London district was very unfavourable for observation on all the nights when meteors were expected. The only success reported in England is that of Mr. J. P. M. Prentice, the director of the meteor section of the British Astronomical Association, at Stowmarket; he recorded 20 Leonids between 5 and 6 A.M. on November 16; one of them was of magnitude − 3. The moon was so near that faint meteors would have been missed; moreover, there was a slight haze. Still, it is clear that if the earth had entered the dense part of the stream the number seen would have been much larger; if a great shower was seen anywhere, it was probably in the region of the Pacific Ocean, from which reports might be slow in reaching us. There is still a prospect of a rich shower next November; the great shower of 1866 was ten months after the perihelion passage of Tempel's comet. The moon will then be new.

Accelerations of Sun, Moon and Planets.—Dr. J. K. Fotheringham contributes a paper on this subject to the *Observatory* for November. He notes that it is now established that the solar and planetary fluctuations are correlated with the whole lunar fluctuation, not merely with the part that remains when the great empirical lunar term is excluded. The establishment of this fact facilitates the determination both of the individual fluctuations and of the secular accelerations, which cannot be deduced from modern observations until the fluctuations are known. The establishment of these preliminaries makes Mercury, on account of its rapid angular motion, the most suitable body for determining the solar and planetary accelerations. This and other lines of evidence lead to secular accelerations of 1·4″ and 4·8″ for the sun and moon respectively, the latter being in addition to 6·0″ for the La Place term (revised). The accelerations are proportional to the mean motions, except in the case of the moon. The value for the sun is confirmed, within narrow limits, by the independent researches of Prof. de Sitter, Herr C. Schoch, and Dr. Fotheringham. Thus results that were formerly the subject of much controversy may now be considered as fairly well established.

The ancient eclipses of sun and moon give the excess of the lunar acceleration over that of the sun, so that when either of these is found the other is deducible. Dr. Fotheringham announced at the meeting of the Royal Astronomical Society on November 11 that a portion of a tablet from Nineveh, which has been in the British Museum for many years, has now been deciphered with the aid of hints supplied by him. It proves to be a table indicating the manner in which the hours of day and night were reckoned. The day and night were each separately divided into six double hours, which consequently were not equal for day and night, but varied with the seasons. This clue will make it possible to improve the time determinations for the recorded eclipses of sun and moon, which may lead to a small revision of the values of the accelerations.

Imperial Cancer Research Fund*

THE tenth scientific report of the Imperial Cancer Research Fund is a substantial and profusely illustrated account of such of the researches carried out under the guidance of Dr. J. A. Murray as have not been published in the journals.

Five of the papers now published deal with the action of radium on tumours. The most important is by Dr. W. Cramer, who points out that a dose of radium radiation quite insufficient to kill cancer cells outside the body will often lead to the complete disappearance of growths to which it is applied *in situ* in the body. If a tumour irradiated in the body is after a few hours removed to another site in the same animal, it grows progressively. Hence, though radium has certainly some directly destructive effect on cancer cells, its main efficacy in curing tumours must be due to its action on the tissues of the host and so altering the surroundings of the tumour that it cannot survive. There is, as Miss Pullinger has also recently shown in human material, much damage to the blood vessels and also a great accumulation of leucocytes and other phagocytic cells, and it seems as if radium acts largely by encouraging the usually futile resistance which the tissues present to a growing tumour.

Dr. Cramer also shows that radium tends to inhibit or delay the carcinogenic action of tar. Dr. R. J. Ludford has analysed in detail the cytological effects of radium on a number of tumours, while Mr. Crabtree gives the results of an elaborate investigation of the influence of radium on the carbohydrate metabolism studied by Warburg's method. The results are negative in the sense that no difference was found between normal and malignant tissues, and glycolysis, specially characteristic of cancers, was in fact more affected than respiration. He has also examined the action of radium on the succinoxidase ferment of muscle

The other four papers, by Drs. Ludford and Foulds, are concerned with the reaction of tumours to vital staining with colloidal acid dyes. The chief results are that malignant cells do not segregate the dyes into their cytoplasm as normal cells do, and that the histiocyte series of phagocytic cells (which have a particularly intimate relation to vital stains) plays a substantial part in the resistance of the body to cancer, the details of which are at present not understood.

The thirtieth annual report of the Fund has also recently been issued. Among domestic affairs we notice with much regret that Sir Frederic Hallett has been compelled through ill-health to resign the post of secretary which he has occupied with such success since the foundation of the Fund thirty years ago. Appropriately enough, he is to be succeeded by Mrs. Harvey, daughter of the late Dr. E. F. Bashford, the first scientific director, who laid down the scope and objects of the Fund's investigations so well. The report also contains a very valuable summary by Mr. H. G. Crabtree of the present state of knowledge about Warburg's claim that the essential metabolism of the cancer cell differs from that of normal tissues. The claim has, on the whole, failed to stand the test of the voluminous investigations which it excited, but it has led to much interesting work and those who desire to know the situation as it stands at present cannot do better than consult Mr. Crabtree's account.

* Tenth Scientific Report on the Investigations of the Imperial Cancer Research Fund. Pp. viii+203+55 plates. (London: Taylor and Francis, 1932). 30*s*.

Electrical Units

SEVERAL of the many interesting papers presented to Section 2 of the International Congress of Electricity held in Paris last summer dealt with electrical units. Thirty years ago the general opinion prevailed that the realisation of the 'international' electrical units was much easier than that of the so-called 'absolute' units based on the c.g.s. system, but experience acquired in the last twenty years has considerably modified this view. H. L. Curtis, in Paper No. 4, discusses the various methods in use for the measurement of current in 'absolute' c.g.s. units, and urges the furtherance of investigations. The determination of the ampere in the c.g.s. system of units can at present be carried out with an accuracy probably higher than that attainable in the determination of the 'international' ampere by the deposition of silver.

E. Giebe, in Paper No. 3, writing on the determination of the ohm in absolute units, discusses four methods, of which two are in use at the National Physical Laboratory, one at the Physikalisch-Technische Reichsanstalt, and one at the U.S. Bureau of Standards; he concludes that "the accuracies of realisation of the absolute unit of resistance and of the mercury ohm are about equal," and adds: "the international mercury unit in use up to the present has decreased in importance, and could be discarded. This view was adopted in 1929 by the Comité International des Poids et Mesures, who on the recommendation of a committee of experts, decided to replace the international unit hitherto employed by the absolute unit, for technical as well as scientific purposes, and to accomplish the change as soon as a few more absolute measurements have confirmed our already accurate knowledge of the ratio of the two units."

Turning to the more technical papers, one by E. H. Rayner (No. 16) describes the electrostatic voltmeters and ammeters in common use at the National Physical Laboratory. The voltmeters, of the Kelvin multicellular type and all of the same range, are characterised by the lightness of the moving system, which weighs only 2·6 gm., although it comprises ten needles, a mirror and the damping device. Bifilar suspension secures great constancy of the zero point. The 130 volt range of the instrument is increased to about 40 kilovolts by resistance dividers, and to several hundred kilovolts by capacity dividers. The wattmeters are likewise made in one size only, have four quadrants and a single needle. "The three-electrode instruments used for measuring power and cognate magnitudes have been developed into wattmeters of a sensitivity and adaptability hitherto unattained by any other process. . . . A single instrument of each kind (voltmeter and wattmeter) with auxiliary apparatus consisting mostly of precision resistances, renders possible the measurement of almost all

electric magnitudes at power frequencies, with a range of sensitivities and an accuracy which it would be very difficult to obtain by other means."

N. E. Dorsey summarises and discusses, in a paper of general interest (No. 10), the results of the most important determinations of the velocity of light, of the ratio of the electromagnetic to the electrostatic unit of electricity, and of the velocity of propagation of Hertzian waves. He concludes that experiment confirms modern electromagnetic theory in regarding the results as being determinations by three different methods of one and the same quantity, and gives 299,792 kilometres per second as the most probable value. Dorsey directs attention to the apparently systematic decrease in the values obtained for the velocity of light during the last fifty years, but does not agree with Gheury de Bray that the fact indicates an actual decrease in the value of C, for, quoting from comments on the subject which appeared in these columns (NATURE, 120, 594, Oct. 22, 1927): "An absolute change in the velocity of light . . . could scarcely obtain acceptance unless supported by much more decisive observational material."

Engineering Methods in Optical Manufacture

MR. WILLIAM TAYLOR'S valuable presidential address on October 28 to the Institution of Mechanical Engineers gave a very illuminating résumé of the modern methods of photographic lens manufacture in use in the famous Leicester factory of Messrs. Taylor, Taylor and Hobson, Ltd., and of a number of original methods which are the fruit of his own genius as an engineer. Amongst these innovations may be mentioned the tubular cutter for lens blanks, the annular carborundum wheel for roughing, improved fine-grinding and polishing machinery with an automatic supply of rouge and water, and special machines for edging. The description of these, published in the *Proceedings* of the Institution, will well repay reading by all interested in methods of optical manufacture or allied processes.

It is at first sight surprising, as the address hints, to find very primitive methods still surviving in some optical workshops, and this in spite of all that modern engineering and mass production methods can achieve. It is no slight on Mr. Taylor's originality to remind ourselves that Robert Hooke suggested, nearly three hundred years ago in the preface to his "Micrographia", the use of the grinding wheel on an inclined adjustable axis for producing curves of any required radius, for there is a long step between the geometry of the method and its successful application in practice. It has to be recognised, too, that operations and machines which can be worked successfully in a large factory for more or less continuous production are beyond the scope of a smaller concern where the optical work, though important, does not justify the installation of any but essential machinery.

The logic of the mass production thesis is the concentration of production in a few centres; the problem which it brings is the fair distribution of the wealth created, both in the form of goods and leisure. The mainspring of the whole movement in mechanisation is, as Mr. Taylor implies, the ever-present urge to overcome physical limitations of all kinds. In itself, this is one of the most excellent of human aspirations, and the spirited defence of mechanisation which forms the closing part of the address is unanswerable, provided that mankind is educated up to the duties which its privileges involve. But since our ethical and political development is so slow, we may sometimes tremble lest over-quick rationalisation should produce a condition beyond our power to control.

Apart from considerations of this kind, it is unlikely that optical manufacture has yet reached a finally definitive stage; we may speculate, however, as to whether future advances will consist in a slow progress in matters of detail, or whether some leading invention will render possible the production at will of non-spherical surfaces of prescribed form and optical accuracy. This latter is, indeed, no new problem. Food for thought will be found in the theoretical work on the subject dating from the time of Descartes, and the practical experiments of Fraunhofer, Bessemer, Parsons, and others. Optical accuracy has not been attained, but our command over physical processes is growing, and grinding is not the only method of producing surfaces of required form.

Mr. Taylor has shown us that progress can still be made by courageous attack, and we should ask for nothing better than to venture forward.

L. C. M.

New Gaseous Lamp

ON November 15 at a special meeting of the Illuminating Engineering Society held at the Wembley Laboratories of the General Electric Company, Ltd., Mr. C. C. Paterson read a paper on luminous discharge tube lighting. He pointed out that the current through the discharge tubes does not follow Ohm's law. It varies in a complicated way with the pressure of the gas inside the tube, the apparent resistance diminishing as the current increases.

The new discharge tubes were suggested by Pirani in Berlin and by the General Electric Company of America. They make use of the experimental fact that if the cathode is heated to a temperature at which it will emit electrons freely, the voltage fall at the cathode will be greatly reduced and so large currents can be passed without serious sputtering taking place. The electrodes of these tubes or 'gaseous lamps' consist of alkaline earth oxides which can be heated electrically like small filaments. With the use of these electrodes the cathode fall is only about twenty-five volts. The current therefore can be thirty or even a hundred times as large as that obtainable with ordinary cold cathodes, being only limited by the heat developed by the discharge. The pressure of operation is so small that it can be obtained from any ordinary electric supply. The gas or vapour inside the gaseous lamp must emit a suitable spectrum and it must not decompose under the action of the discharge.

There are several other conditions the tube must fulfil. It has been found that a white light can be obtained from a neon tube provided a definite small

quantity of mercury vapour is present. It is not possible to mix a number of gases and vapours in one tube as each gas requires a definite voltage to stimulate it. It is not possible, for example, to harness a mixture of mercury and sodium vapour and neon gas in the same tube and so combine them to obtain a suitable radiation.

The fire-fly restricts its radiation to the visible spectrum only, whilst in the ordinary lamp a large proportion is emitted in the infra-red. The former is consequently an extremely efficient light source. If all the energy supplied to a discharge tube were emitted at a wave-length of 5,550 A., corresponding to the peak of the luminosity curve of the eye, the luminous efficiency would be about 670 lumens per watt. Compare this with the 12 lumens per watt of a 100 watt incandescent lamp. In practice it is now possible to make 100 watt sodium lamps with an efficiency of 70 lumens per watt. If the internal losses in the tube were negligible, theory shows that the efficiency would be 360 lumens per watt. Pirani has obtained this efficiency in the laboratory but it is impossible, as yet at least, to obtain it in a commercial lamp.

The development of gaseous lamps has been taking place rapidly during the last year. By placing neon and mercury tubes in parabolic reflectors, very efficient lamps suitable for flood-lighting are obtained. A 400 watt lamp is being developed at Wembley which seems very suitable for lighting streets and important thoroughfares. The street outside the Wembley Laboratories was shown illuminated in this way with very satisfactory results. Some people might find difficulty in distinguishing a 1*d.* stamp from a 1½*d.* stamp by the light from these lamps. Sodium lamps were developed first by Pirani in Berlin. There is a section of road admirably lighted by these lamps in Holland and another in Zurich. A similar lamp developed at Wembley is being tried for lighting stretches of arterial and country roads where the lack of good colour discrimination is of little importance.

Many avenues of research in connexion with gaseous lamps are still unexplored. It seems certain that their colour will soon be improved and that their efficiency will be very appreciably increased.

Industrial Research and National Problems

SIR FRANK SMITH, secretary of the Department of Scientific and Industrial Research, delivered the Norman Lockyer lecture of the British Science Guild on November 22, taking as his subject "Industrial Research and the Nation's Balance Sheet". Sir Arnold Wilson was in the chair.

Sir Frank Smith urged that the active prosecution of industrial research is essential for improving Great Britain's national balance sheet, which in the past ten months has shown an *apparent* adverse balance of some £263,749,000. To go on paying its way, it is necessary for British manufactured products upon which, together with its invisible exports, depends its ability to pay for imports, to continue to be as good or better than those of its competitors, while at the same time prices must not be higher. To this end, increased mechanisation and increased use of knowledge are necessary and "it is essential that the floodgates of international trade should be opened and that some measure of stability and freedom should be given to currency systems". These topics are discussed whenever men meet, but not so often do we hear of the necessity of financing industrial research, without which we shall fail to sell many of our products. "If a country had to choose between new knowledge and gold . . . the wise choice would undoubtedly be new knowledge for with it the gold can be obtained whereas without it the gold will be lost."

One hundred years ago there was no such thing as organised industrial research, and progress depended either on isolated research of men of genius or on accidental and unrelated observations. Later, in the nineteenth century, scientific men at the universities were occasionally asked to solve some of the problems of industry, but with the growth of the electrical, chemical and metallurgical industries, which depend on science for their very life, our industrial research laboratories came into being. "These laboratories aim at preventing industrial waste, at the standardisation of processes of manufacture and of the products, at lessening the costs of production and at the production of new types of goods. Their work does not replace the pure research work carried out at the Universities. It is supplementary to it. The outstanding characteristic of pure research is that it aims at increasing knowledge irrespective of application and it cannot be organised in the same way as industrial research. As Sir Joseph J. Thomson has said, 'Great ideas in science are as wayward as the fancies of a poet, and they cannot be controlled and organised.' "

Though industrial research has made great headway in Great Britain and the greatest and most successful undertakings have research laboratories of their own, this country is in many respects still doing less than some of its competitors; "there is with many industries far too much timidity and hesitation, and these must be overcome if this country is to retain much of our old-time supremacy in manufacture and export more manufactured goods."

Referring to the scheme for co-operative industrial research associations initiated by the Department of Scientific and Industrial Research in 1918, Sir Frank stated that there are now more than five thousand firms connected with the twenty research associations which have been set up. These firms have contributed about one and three-quarter millions to the cost of the work carried out. An investigation carried out by H.M. Chief Inspector of Factories covering nearly 128,000 factories employing about five million workers showed that less than five hundred of these factories employed more than one thousand workers each, while 117,147 factories employed less than one hundred workers each. It is well to urge that "industrial firms should build research laboratories, but it is obvious that not one of these 117,147 firms can take an effective part in industrial research as an isolated unit. . . . Co-operative research is the only solution to the problem of applying science to small units."

Sir Frank Smith then proceeded to consider the relations between research and the national balance sheet, in the case of Great Britain's largest import, food-stuffs; its greatest material asset, buildings; and its greatest natural asset, coal. He pointed out that the scientific study of refrigerating devices, which not so long ago were, like the photoelectric cell, mere toys of the laboratory, together with the

investigation of the biological problems involved in the transport and storage of foodstuffs, are doing much to help the national balance sheet by reducing imports through preventing waste.

In industrial processes care is taken to keep wear and tear of plant at a minimum and to design plant which is not likely to be obsolete, in such a way that replacement costs are comparatively small. The nation's most valuable plant is in the form of buildings, the value of which is estimated by Sir Frank at £4,500,000,000. Here science is helping by better planning and construction and by showing the builder how to choose his materials to greater advantage.

In the case of coal there are four ways in which research can help the trade balance: first by mechanising still further the hewing of coal and increasing the use of machinery in mines, thereby increasing our production power; secondly, by discovering means of obtaining more units of useful power from the fuel burnt; thirdly, by better marketing made possible by the application of the results of a scientific and comprehensive survey of our coal resources now being carried out; and fourthly, by the discovery of new and better methods for converting coal into powder, liquid and gaseous forms and the full utilisation of these forms.

University and Educational Intelligence

BRISTOL.—The annual Henry Herbert Wills memorial lecture will be delivered on December 15 at 5.15 P.M. in the Wills Laboratory by Lord Rutherford. The title of the lecture will be "Atomic Transformations". Admission will be by ticket obtainable from the Secretary.

LEEDS.—The honorary distinction of emeritus professor has been conferred upon Profs. F. W. Eurich, C. M. Gillespie, and R. S. Seton, who recently retired from the chairs of forensic medicine, philosophy and agriculture respectively.

LONDON.—The following degrees have recently been awarded: D.Sc. degree in biochemistry to Prof. E. C. Dodds (professor of biochemistry at Middlesex Hospital Medical School) for published papers on hormones, supported by 42 other papers and 3 books; D.Sc. degree in botany to Helen Kemp Archbold (Imperial College—Royal College of Science and Bedford College) for a thesis entitled "Ripening Processes in the Apple and the Relation of the Time of Gathering to the Chemical Changes in Cold Storage" (*Ann. Bot.*, July, 1932); D.Sc. degree in chemistry to Mr. J. R. I. Hepburn (East London College and Northern Polytechnic) for five published papers on "The Vapour Pressure of Water over Aqueous Solutions of Inorganic Electrolytes", and Ramsinha Thakur (Imperial College—Royal College of Science) for a thesis entitled "Three-Carbon Tautomerism in Dicyclic Systems"; D.Sc. degree in physics to Mr. J. H. Jones (King's College) for a thesis entitled "The Diffraction of Elastic Waves at the Boundaries of a Solid Layer Embedded in a Medium Possessing Lower Elastic Wave Velocities" (*Proc. Roy. Soc.*, A., 1932); D.Sc. in chemistry to Mr. B. S. Evans for twelve independent published works in inorganic analytical chemistry, together with four conjoint subsidiary contributions.

A STATEMENT for the academic year 1931–32 has been issued by the Rhodes Trust, Seymour House, Waterloo Place, London, S.W.1, from which it appears that, during the year, 71 Rhodes scholars took up their scholarships at the University of Oxford for the first time. The total number of scholars in residence during the year was 196, comprising 103 from the British Empire, 89 from the United States and 4 from Germany. Classifying the scholars by the subjects read, there are 42 taking natural science and medicine, 7 mathematics and 2 forestry.

THE annual conference of the Geographical Association will be held at the London School of Economics, Houghton Street, Aldwych, W.C.2, on January 4–6, and at the Imperial Institute, South Kensington, on January 7. The presidential address will be delivered by Dr. H. R. Mill on "An Approach to Geography" on January 4. Among the lectures to be given at the Conference are: Mr. J. M. Scott: "The British Arctic Air Route Expedition, 1930–31"; Mr. G. Huxley: "The Work of the Empire Marketing Board"; the Right Hon. Lord Meston: "Contrasts in the Ganges Basin"; Prof. Kenneth Mason: "The Exploration of the Himalaya"; Prof. R. G. Stapledon: "Climate and the Improvement of Hill Grazings"; and Sir John Russell: "Modern Changes in the Sources of our Food Supplies". Further information can be obtained from the Clerk, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester.

Calendar of Geographical Exploration

Nov. 28, 1605.—Discovery of Australia

Willem Janszoon of Amsterdam sailed in the *Duifken* from Bantam, Java, hoping to discover more about New Guinea. He reached the coast of New Guinea in lat. 5° S. and followed the shore round Prince Frederick Henry Island to the beginning of Torres Strait. Thence he steered south and traced the eastern shores of the Gulf of Carpentaria to 13° 45′ S. Janszoon thought the coast was part of New Guinea. Attempts to open up trade with the sparse groups of natives failed, nine of the crew being murdered by them. The Spanish, under Torres, in the 1605–7 expedition discovered the true nature of Torres Strait, but not until 1762 was this realised, for Spain was then entering on a period of decadence and the results of the voyage were overlooked. Whatever vague reports of a southern land may have existed before the voyage of the *Duifken*, Janszoon's exploration of the Gulf of Carpentaria forms the first record of the discovery of Australia.

Dec. 3, 1738.—La Vérendrye and his Sons

Pierre Gaultier de Varennes, Sieur de la Vérendrye, reached a Mandan village, after having for the first time in this latitude crossed long. 100° W. La Vérendrye began his famous career of exploration in Canada in 1726, constantly aiming at reaching the Pacific Ocean. In this he failed, but on his last journey (1738) he accomplished more than half the distance between Montreal and the Pacific. To him and to his sons is due the pioneer opening of the beginning of that route west of Winnipeg along which the Canadian Pacific Railway afterwards went. The La Vérendryes discovered Lake Manitoba, explored the Saskatchewan to the junction of the two main branches and established many forts. La Vérendrye's eldest son was killed in 1738 by Indians, but the other two in 1742 set out with Mandan guides and reached a mountain range with snow-clad peaks, probably the Rockies, though possibly the Bighorn Mountains.

Societies and Academies

LONDON

Royal Society, Nov. 17.—A. Michels and C. Michels: The influence of pressure on the dielectric constant of carbon dioxide up to 1,000 atmospheres between 25° C. and 150° C. The method used was in principle the heterodyne beat—one with a frequency of 508 kilocycles. By special arrangements it was possible to keep the beat note constant for long periods within 1 frequency per second. The dielectric constant varied between 1·0009 and 1·73. The accuracy obtained was ± 0·00035. The Clausius-Mosotti expression has been calculated below 100° C., and for pressures above 100 atm., as only in this region are there sufficient compressibility data. Owing to the accuracy of these latter, the accuracy of the Clausius-Mosotti expression is limited to one half per cent. The values found do not change with temperature by an amount greater than this figure, but show a tendency to decrease with increasing pressure.—E. N. da C. Andrade and B. Chalmers: The resistivity of polycrystalline wires in relation to plastic deformation and the mechanism of plastic flow. The specific resistance of metals which crystallise in the cubic system is unaffected by plastic flow, but for those which crystallise with a unique axis of symmetry it changes during the intermediate of the stages. For some metals the change is an increase, for others a decrease, the difference of sign being explicable in terms of the orientation of the slip planes in relation to the crystalline structure of the metal, supposing that there is rotation of the crystallites during the stage of the flow in question. At liquid air temperature the sign of the change of resistance of cadmium reverses, an effect which can be traced to the heavy twinning which takes place under stress at this temperature, as against distortion by glide at higher temperatures. A general result is that, in the cases investigated, the electrical resistance of a polycrystalline wire can be simply explained in terms of the resistance of the single crystals.—R. O. King: The beneficial effect of oxidation on the lubricating properties of oil. Experiments were made in conditions promoting oxidation of the lubricating oil and at constant speed and load. Friction in the circumstances falls as the temperature is raised, and generally passes through a minimum value (μ min.) at a temperature somewhat less than that of seizure (S.T.); lubricating value or performance is represented by the observed values of μ min. and S.T., which for a typical blended mineral oil were 0·0010 and 158° C., respectively at the beginning of oxidation. Viscosity increased with oxidation, but the consequent increase of fluid friction was apparent at temperatures below 50° only; at higher temperatures it decreased with the progress of oxidation and S.T. rose. Thus after about sixty hours of oxidation, μ min. diminished to 0·00045 and S.T. exceeded 300° C. The oil in a state of partial combustion remained an effective lubricant, μ being less than ever recorded for fluid friction, even with air as the lubricant. It is suggested that the active or polar molecules formed during the early stage of oxidation build up to an appreciable thickness on the adsorbed layer, and the friction observed is that on the surface of the built-up layer. The surface diminishes in rigidity in the direction of motion as the thickness of the boundary layer increases, and friction approaches zero as a surface of complete slip tends to be reached.

Physical Society, Nov. 18.—T. C. Sutton: The measurement of surface tension. A convenient method is described for measuring simultaneously the surface tension and the density of a sample of liquid. A few milligrams of liquid will suffice. The method has advantages, therefore, for the measurement of the parachors, $\gamma^{\frac{1}{4}}\rho$, of rare liquids. Volatile liquids may be used.—L. G. Grimmett: A sensitivity-control for the Lindemann electrometer. A circuit is given for varying the sensitivity of the Lindemann electrometer by means of one adjustment only.—B. Lloyd-Evans and S. S. Watts: An investigation into the flow of air in pipes. The authors examine the researches of Ombeck on the flow of air through cylindrical pipes. They obtain an expression which represents in a convenient form the phenomena that occur in a smooth-bore pipe. In particular, they separate the effects of acceleration of the gas from those of friction, and express the latter in terms of the equation suggested by Lees to fit Stanton's curve. Their results appear to justify the researches of Lees and Stanton, rather than the analysis made by Ombeck of his test figures.—Mary D. Waller: Vibrations produced in bodies by contact with solid carbon dioxide. Conditions under which very loud notes may be produced and maintained for a considerable time in metal objects capable of vibration, such as tuning forks, bars, discs, rings, and tubes, when brought into contact with a solid carbon dioxide block are described. Notes have also been sustained in quartz crystals. The vibration frequencies normally excited may range from about 1,000 to 15,000 ~. Lower frequencies have been excited in wires. Surface tension ripples may be produced on mercury. The vibrations are only produced by solid carbon dioxide of high density. The source of energy for producing the vibrations is the heat given up by the metal to the solid carbon dioxide.

PARIS

Academy of Sciences, Oct. 17 (vol. 195, pp. 633–684).—Camille Matignon: Injurious fogs. Referring to the fatal fog in the Meuse valley in December 1930, attention is directed to a noxious fog, also in the Meuse valley, which occurred on January 4, 1800, and observations of a contemporary observer are quoted.—Maurice Fréchet: The most general continued solution of a functional equation of the theory of probabilities in chain.—Alfred Rosenblatt: The unicity of solutions of partial differential equations of the first order.—Paul Montel: A class of meromorph functions.—A. Toussaint and H. Girerd: Comparison between the wall corrections in blowers of rectangular section and circular section.—Ch. Sadron: The standardisation of a blower for low velocities. For low velocities, less than 15 cm. per sec., the air current carrying smoke shows a curious phenomenon: the smoke thread splits up, the heavy parts fall out in drops and the interval between these drops is constant and is proportional to the air velocity. Hence this phenomenon can be utilised to measure the velocity of a very slow air current.—Jacques Métadier: The study of the Brownian movement in a field of force.—A. da Silveira: The Raman effect in solutions of cupric salts. From a comparison of the Raman spectra of solutions of copper sulphate and copper nitrate, the lines due to the sulphate ions and nitrate ions are distinguished.—F. Wolfers: Remarks on the Mach effect. A discussion of a recent paper by Demetrovic; analogous effects can be observed with X-rays.—J. Thibaud and

F. Dupré la Tour: The weakening of the nuclear radiation of beryllium in material screens.—Auguste Le Thomas: The influence of high proportions of silicon on certain properties of cast irons. The silicon varied from 1·1 per cent to 10·4 per cent and measurements are given of hardness, transformation temperatures, and temperatures of graphite formation.—René Dubrisay and Guy Emschwiller: The oxidation of iodoform solutions. Solutions of iodoform in benzene undergo rapid oxidation in daylight, with production of iodine, carbon monoxide and dioxide, but remain unchanged in the dark. After the addition of iodine and hydriodic acid, such solutions are oxidised in the dark. Oxidation differs with different solvents, and is sensitive to the presence of impurities in the solvent.—Seailles: The action of media with alkaline reaction on the crystallisation of the calcium aluminates and on the setting of aluminous cements. The alkalinity of the medium, defined by the hydrogen ion concentration, determines the form and the nature of the hydrated calcium aluminates which are formed starting from the anhydrous aluminates. This alkalinity causes the same phenomena and is independent of the nature of the base.—Paul Bary and Emile Fleurent: The influence of oxygen on the degradation of solutions of caoutchouc. The viscosity changes in rubber solutions brought about by rise of temperature are sensitive to the presence of traces of oxygen. In the absence of oxygen the change of viscosity is a hyperbolic function of the time.—Jacques Bourcart: The presence of a large crocodilian in the Miocene glauconitic molasse of El Kanséra and its stratigraphical signification. The bones found resemble those of *Dyrosaurus phosphaticus* but further work is necessary for the full identification.—Georges Denigès: The action of iodine on sea waters.—V. Frolow: The periodicities of the rises and falls of the Nile. A graphical study of the data available, Arabian from A.D. 621 until 1433, restarting during the eighteenth century for high water, and low water from 1838. The amplitude of the floods has become greater in modern times owing to the embankment of the Nile.—H. des Abbayes: Observations on the lichens of the neighbourhood of Banyuls (Eastern Pyrenees).—R. Hovasse: The Podamphora stage and the Ebriaceæ. The skeleton of *Podamphora Elgeri* has been regarded by A. Deflandre as arising from two different organisms: the author gives reasons for not agreeing with this view.—André Chevallier, Jean Guillot and Pierre Chabre: The ultra-violet absorption of certain plant and animal oils.—G. Guittonneau and J. Keilling: The formation of higher polythionates in the course of the solution of elementary sulphur in the soil. In addition to pentathionates described in an earlier paper, tetrathionic acid has now been isolated as the sodium salt. Thiosulphates are present in traces only.—J. Cheymol and A. Quinquaud: Serocalcemia and the kidney. On leaving the kidney the blood contains less calcium. After ablation of the kidney there is a temporary elevation of the proportion of calcium in the blood.

ROME

Royal National Academy of the Lincei, June 3.—U. Cisotti: Double tensors with a single divergence.—B. Caldonazzo: Hemisotropic quintuple tensors.—J. Capoulade: Frontier arcs rendered non-proper by the singularities of the coefficients in Dirichlet's problem for equations of the second order and of elliptic type with two variables.—L. Fantappiè: New demonstration of the fundamental formula for linear analytical functionals.—L. Geymonat: An observation on a theory of Carathéodory for harmonic functions.—M. Picone: Majoration of the error of approximation in the Cauchy–Lipschitz method of integrating systems of ordinary differential equations.—O. Franceschi: Projective study of the interior of a surface.—M. Pascal: Motion of a deformable body which remains similar to itself. (1) Fundamental formula and properties deduced therefrom. Abramescu's recent kinematic study of the motion of a deformable body which remains similar to itself was limited to the case of a plane body. The results obtained on extending this study to a three-dimensional body are now outlined.—A. Kolmogoroff: The general form of a homogeneous stocastic process.—A. Occhialini and G. Melchiori Ranghiasci: A simplified method for the photographic measurement of the length of spectral lines. This method consists essentially in subjecting both lens and film-holder to a succession of sudden displacements so as to obtain a number of separate images of the spectrum.—G. A. Barbieri and A. Tettamanzi: Contribution to the knowledge of compounds of divalent chromium. The following complexes of chromous compounds with organic bases, representing new types of chromous compounds, are described: (1) Chromodipyrridyl bromide, $[Cr^{II}(C_{10}H_8N_2)_3]Br_2$, $6H_2O$, isomorphous with, and similar in chemical behaviour to, ferrodipyrridyl bromide; (2) chromous hexamethylene thiocyanate, $Cr(SCN)_2$, $2(C_6H_{12}N_4 . HSCN)$, and (3) chromous hexamethylene chloride, $Cr\,Cl_2$, $2HCl$, $C_6H_{12}N_4$, $4H_2O$, which belongs to an entirely new saline type; ferrous, nickel, cobalt, and manganous compounds analogous to compound (3) have also been obtained.—O. Bottini: Influence of exchange cations on the capillary rise of water in the soil. In one and the same soil saturated with different cations, water ascends with different velocities. This phenomenon is due principally to the part played by the exchange cations in determining and adjusting the mutual relationships between water and soil, and in particular to the influence of such cations on dispersion and swelling. In this respect the cations are arranged according to a progression which is not difficult to recognise for the lyotropic series and for the hydration series.—Giselda Serra: A new species of *Schizaster*. A specimen, of unknown age and origin, found in the echinoid collection of the Palæontological Institute of the University of Rome, is named *Schizaster Portisi* n. sp.—Fausta Bertolini: The autotomy of the digestive apparatus and its regeneration in *Holothuria*, as a spontaneous and normal phenomenon.—T. Terni: The development of the fin of Urodeles, on the basis of morphological and experimental investigations.—Giulio Cotronei: Heart transplantations between Anura and Urodeles.—Z. Szantroch: Investigations on intracellular fatty substances in various tissues cultivated *in vitro*. The results obtained confirm those of Kaufmann and Lehmann and indicate that neither the Ciaccio method nor the Smith–Dietrich method allows the group of substances usually known as lipoids to be distinguished with certainty from glycerol esters.—U. D'Acona: Does striated muscle-fibre change in volume during contraction? Micro-cinematographic investigation of muscular contraction fails to disclose any reason for assuming variations in volume of the contracted muscle fibre as a whole. It appears to prove, however, that the separate strands of the fibre widen and increase in volume at the commencement of the contraction, that they next shorten (to about forty per cent of the original length) and diminish in volume,

and that they finally resume the initial length and volume. The de-contraction takes place far more slowly than the contraction. During the passage of the contraction wave, the inter-fibrillar spaces broaden either by longitudinal displacements of liquid or by disimbibition of the fibrils.

Forthcoming Events

SATURDAY, Nov. 26

UNIVERSITY OF CAMBRIDGE, at 5—(Henry Sidgwick Memorial Lecture in the College Hall, Newnham College).—Sir James Jeans: "The Farthest Depths of Space".

MONDAY, Nov. 28

ROYAL GEOGRAPHICAL SOCIETY, at 5.30—The Rev. J. W. Arthur: "Kilimanjaro and Kenya".

ROYAL SOCIETY OF ARTS, at 8—(Fothergill Lecture).—Lieut.-Col. Guy Symonds: "Safety of Life from Fire".

TUESDAY, Nov. 29

ROYAL INSTITUTION, at 5.15—Prof. Lancelot Hogben: "Colour Change in the Animal Kingdom" (succeeding lectures on Dec. 6 and 13).

WEDNESDAY, Nov. 30

FOLK-LORE SOCIETY, at 8—(at University College, Gower Street, W.C.1).—Prof. John Read: "Alchemy and Alchemists".

THURSDAY, DEC. 1

CHADWICK PUBLIC LECTURE, at 8—(at the Royal Sanitary Institute).—Dr. T. Carnwarth: "Public Health Administration".

BROWN INSTITUTION LECTURES, at 5—(at the London School of Hygiene and Tropical Medicine).—Prof. F. W. Twort: "Bacteria in Nature".

UNIVERSITY OF BIRMINGHAM, at 5.30—(Huxley Lecture).—Sir Arthur Salter: "Next Steps in World Recovery".

BRITISH PSYCHOLOGICAL SOCIETY, at 8.30—Discussion on "Adaptation and Fatigue", to be opened by Prof. F. C. Bartlett.

FRIDAY, DEC. 2

ROYAL INSTITUTION, at 9—Marchese Marconi: "Radio Communications by Means of Very Short Electric Waves."

INSTITUTION OF MECHANICAL ENGINEERS, at 6—(Thomas Lowe Gray Lecture).—E. F. Cox: "Eight Years' Salvage Work at Scapa Flow".

NATIONAL CONFERENCE ON THE PLACE OF BIOLOGY IN EDUCATION, Nov. 30 and Dec. 1 and 3—(at British Medical Association House, London, W.C.1).—The Right Hon. Viscount Chelmsford (Presidential Address) on Nov. 3 at 11.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (BRITISH SECTION), Dec. 1, at 10—(at the Leathersellers' Hall, St. Helen's Place, Bishopsgate, E.C.3).—Conference on "The Swelling of Proteins". Introductory address by Prof. F. G. Donnan.

Official Publications Received

GREAT BRITAIN AND IRELAND

Journal of the Society of Glass Technology. Edited by Dr. W. E. S. Turner. Vol. 16, No. 63, September. Pp. x+251–374+291–394+xxiv. (Sheffield.) 10*s*. 6*d*.

Proceedings of the Cambridge Philosophical Society. Vol. 28, Part 4, 31st October. Pp. 403–562. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Imperial Bureau of Animal Genetics. The Physiological and Genetical Aspects of Sterility in Domesticated Animals. By William Orr and Dr. F. Fraser Darling; with a Bibliography by Miss M. V. Cytovich. Pp. 80. (Edinburgh and London: Oliver and Boyd.) 2*s*. 6*d*.

University College of North Wales. Calendar for Session 1932–33. Pp. 446. (Bangor.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1932. Pp. 42. (Wakefield.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1482 (E.F.317): Relative Temperatures of Brass when subjected to Reversed Direct Stress in Vacuo and in Air. By Dr. H. J. Gough and D. G. Sopwith. Pp. 4+2 plates. (London: H.M. Stationery Office.) 4*d*. net.

Proceedings of the Royal Society. Series A, Vol. 138, No. A835, November 1. Pp. 259–478. (London: Harrison and Sons, Ltd.) 11*s*.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1932; with Appendices. Pp. 45. (London: H.M. Stationery Office.) 9*d*. net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 12: Scottish Carboniferous Ostracoda. By Mary H. Latham. Pp. 351–395. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6*s*.

University of Cambridge: Solar Physics Observatory. Twentieth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1931 August 1—1932 July 31. Pp. 4. (Cambridge.)

The University of Liverpool. Publications of the Hartley Botanical Laboratories, No. 8: Studies of Flowering in Heterostyled and Allied Species. Part 1: The Primulaceæ. By James Stirling. Pp. 42. (Liverpool: University Press of Liverpool.)

OTHER COUNTRIES

United States National Museum. Bulletin 164: The Canadian and Ordovician Formations and Fossils of South Manchuria. By Riuji Endo. Pp. iii+152+40 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

N.Z. Department of Scientific and Industrial Research. Apia Observatory, Apia, Western Samoa: Annual Report for 1930. Pp. iv+71. (Wellington, N.Z.: Government Printing Office.) 4*s*.

Journal de la Société des Américanistes. Nouvelle Série, Tome 24, Fasc. 1. Pp. 220. (Paris: Société des Américanistes.) 60 francs.

Ministère de l'Instruction publique et des Beaux-Arts. Enquêtes et documents relatifs à l'enseignement supérieur, 126: Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe, année 1930. Pp. 145. (Paris.)

Society of Biological Chemists, India. Some Aspects of Plant Nutrition. By B. Viswa Nath. Pp. ii+39. (Bangalore: Indian Institute of Science.) 1 rupee.

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June, 1932. Pp. 262. (Melbourne.)

Department of Agriculture, Straits Settlements and Federated Malay States. General Series, No. 10: Insects of Coconuts in Malaya. By G. H. Corbett. Pp. iv+106+19 plates. (Kuala Lumpur.) 1.50 dollars.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 9–10, Septembre-Octobre. Pp. 377–472. (Prague: Regia Societas Scientiarum Bohemica.)

Forest Bulletin No. 77: The Identification of Important Indian Sleeper Woods. By K. A. Chowdhury. Pp. v+18+30 plates. 3 rupees; 5*s*. 3*d*. Forest Bulletin No. 78: The Problem of the Pure Teak Plantation. By H. G. Champion. Pp. iii+38+2 plates. 12 annas; 1*s*. 3*d*. (Calcutta: Government of India Central Publication Branch.)

The Indian Forest Records. Vol. 17, Part 3: Immature Stages of Indian Coleoptera (11) (*Platypodidæ*). By J. C. M. Gardner. Pp. ii+12+2 plates. (Calcutta: Government of India Central Publication Branch.) 9 annas; 1*s*.

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 20, Memoir No. 1: New Fossils from the Agglomeratic Slate of Kashmir. By Dr. F. R. Cowper Reed. Pp. v+79+13 plates. 8.4 rupees; 14*s*. New Series, Vol. 20, Memoir No. 3: A Petrified Williamsonia (*W. Sewardiana*, sp. nov.) from the Rajmahal Hills, India. By Prof. B. Sahni. Pp. iv+19+3 plates. 2.2 rupees; 4*s*. (Calcutta: Government of India Central Publication Branch.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 109: Studies in Pasture Management; a Further Report on the Seasonal Composition of certain South African Pasture Grasses in relation to their Manuring and Intensity of Grazing. By A. J. Taylor. (Division of Chemistry Series, No. 120.) Pp. 19. (Pretoria: Government Printing Office.) 3*d*.

Union of South Africa: Department of Mines and Industries: Geological Survey. Memoir No. 28: The Bushveld Igneous Complex of the Central Transvaal. By Dr. A. L. Hall. Pp. 560+41 plates. 10*s*. Memoir No. 29: The Building Stones of the Union of South Africa. By W. Wybergh. Pp. 244+11 plates. 7*s*. 6*d*. The Geology of the Country surrounding Vryheid: an Explanation of Sheet No. 102 (Vryheid). By Dr. W. A. Humphrey and Dr. L. J. Krige. Pp. 66. 5*s*., including Map. (Pretoria: Government Printing Office.)

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 5, No. 3 (Mathematics No. 2): Über Flächen und Kurven (1), von Sôji Matsumura; Beiträge zur Geometrie der Kreise und Kugeln (1), von Sôji Matsumura. Pp. 33–142. (Taihoku.)

Bulletin of the Earthquake Research Institute, Tôkyô Imperial University. Vol. 10, Part 3, September. Pp. 499–903+plates 59–91. (Tôkyô: Iwanami Shoten.) 4.40 yen.

Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University. 1932, Part 1 (January-March). Pp. 6+2 plates. (Tokyo.)

The Rockefeller Foundation. Annual Report, 1931. Pp. x+420 (33 plates). (New York City.)

Scientific Publications of the Cleveland Museum of Natural History. Vol. 3: Physiology of the Temperature of Birds. By S. Prentiss Baldwin and S. Charles Kendeigh. Pp. x+196+6 plates. (Cleveland, Ohio.)

Annual Report for the Year 1931 of the South African Institute for Medical Research, Johannesburg. Pp. 65+2 plates. (Johannesburg.)

CATALOGUES

Cambridge Oscillographs. (List No. 118.) Pp. 32. (London: Cambridge Instrument Co., Ltd.)

Moll Recording Microphotometers. (MF.33.) Pp. 8. (Delft: P. J. Kipp and Zonen.)

Book Bargains. Pp. 24. (London: W. J. Bryce.)