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## CONTENTS.



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## The Protection of Scientific Property.

THE debate on the protection of scientific property at the last session of the Sub-Committee on Intellectual Rights of the International Committee on Intellectual Co-operation gained special interest from the presence of two members of the Italian National Committee, who submitted a memorandum suggesting substantial amendments to the preliminary draft Convention of Dec. 14, 1927. This draft Convention, which was presented to the Assembly of the League of Nations in September 1928, proposed to create by means of an International Convention and a corresponding Union a new right, leaving the existing structure of patent law and copyright untouched. The Convention is designed to secure for the authors of scientific discoveries participation in the material profits arising from their industrial exploitation.

Scientific discoveries which entitle their authors to receive remuneration from the users of the discovery must fulfil two conditions :

(1) They must be open to material utilisation, in the sense that they contribute to the production of a commercial commodity ; and

(2) They must lead to new means of production or new applications of existing means of production. Discoveries which are explanations of existing practice and purely retrospective in their application are thus definitely excluded, although of course they may strengthen industrial practice and increase its confidence.

In the second part of the Convention, the rights and obligations of the authors are defined, and in doing so, a distinction is made between the creation or recognition and the exercise of the right. While the rights of the author are derived from the unequivocal publication of the discovery, the exercise of these rights as against the users of the discovery is declared to be effective only as from the date of the registration, by an international organisation, of the deposit of a note claiming for the author the right defined in Article 1 over material applications of the discovery. Thus, in a dispute between two authors, priority may be established by the production of *any* document of unquestioned date, but in a dispute between author and users, the *only* lawful proof which can be adduced against the users is a note registered with an international organisation and accompanied by specified claims with reference to the practical application of the discovery: a result which would probably be achieved by the creation of a new bureau on the lines of the Berne Bureaux of Industrial, Literary,

and Artistic Property. The restriction of the exercise of the right to this condition on international registration under specific conditions of publicity meets a perfectly legitimate stipulation on the part of manufacturers if they are to incur liability or obligations.

Part III. of the Convention defines the rights and obligations of the user, and distinguishes clearly between the new right and patents. The new right confers no monopoly of exploitation; any undertaking may use the discovery, subject only to payment to the authors of a consideration, the nature of which is to be fixed either by free agreement between the authors and users, or failing such agreement, by judicial procedure. It is, of course, quite possible that a dispute may arise between men of science as to priority when the discovery is already receiving industrial exploitation. Article 12 of this section accordingly endeavours to secure that the industrial exploitation shall go on unhindered while the dispute is fought out; and a concluding article, inserted to ensure that the terms of contracts shall not destroy the legitimate expectations which the Convention arouses in the minds of discoverers, asserts that all private agreements which are contrary to the provisions of the Convention shall be deemed null and void, as being prejudicial to the public order.

On behalf of the Italian Committee, M. Piola-Caselli and Prof. G. Bruni (professor of general and inorganic chemistry at the Royal Engineering School at Milan) suggested the addition to Article 4 of a stipulation that the note claiming the right must be deposited within three years from the date of publication from which the right is derived, and further that the right should be limited to the duration of the inventor's patent instead of to the term of thirty years contemplated in Article 10. Further recommendations were made that the remuneration should be determined by the courts of the user's country, rather than by an international court of arbitration, and provision made for cases of joint discovery.

These proposals, while not receiving the full assent of the Sub-Committee, were referred to the different national committees for further discussion and criticism, whilst awaiting from governments their observations on the draft Convention and the accompanying note which has been drafted by the mixed committee of insurance and legal experts.

The present position is, accordingly, that a Convention has been submitted to the various governments for consideration, and this has been accompanied by a note contemplating the establishment of a system of guarantees for users of scientific discoveries, in the form either of mutual insurance or compensatory funds or both, and eventually the establishment of a fixed scale of insurance premiums in private companies.

This note is the outcome of the criticism of the draft scheme from industrial opinion, notably in the United States of America and in Germany, which indicated that the Convention would only be acceptable if accompanied by a note guaranteeing industrialists, through some system of insurance, against fresh liabilities arising from royalties due to men of science and inventors. The uncertainty of the representatives of British, French, and other insurance companies regarding the nature and extent of the risks which they might be called upon to assume under the proposed liabilities led to the convening of a small committee of insurance and legal experts, which met in Paris in December 1929 and March last and drafted the note to which reference has been made.

Meanwhile the fundamental idea of scientific property gains ground every year, and the absence of protection for scientific or theoretical discoveries is recognised more widely as not merely anomalous but also unjust. Mr. F. H. Carr, for example, in a presidential address to the Society of Chemical Industry, referred to the desirability of finding methods of remunerating those who have contributed to industrial invention by researches freely published in scientific journals. While the bulk of the controversy over the proposal of the Patents Committee of the Association of British Chemical Manufacturers regarding " dedicated patents " has centred round the efficacy of the protection they offered for the fine chemical manufacturer during the expensive development work required before chemical or biological products of this type can be marketed, the right of the discoverer to some reward has not been overlooked. As Senator Ruffini pointed out in his original report, the only result of withholding protection from therapeutics, as in the French and Italian patent systems, is that the industrialist is allowed to exploit the invention advantageously through the trade mark or registered name device, reaping the reward which might otherwise have fallen to the man of science, at least in part; the advantages to the public health are purely imaginary.

There are, indeed, those who, prompted by the growing evil of ' paper patents ' created, notably in industrial chemistry, by the intelligent forecast, question the suitability of our whole patent system,

with its basis of invention, to a modern industry in which the major advances are now almost always the result of organised scientific research and team work in which individual inventive ability or ingenuity plays a subsidiary part.

The present system admittedly refuses protection to a scientific discovery of first-class importance, and it is often impossible in a mass of patents to sift out the true knowledge from mere predictions which may or may not be verified by experience. Consequently, the public receives no real disclosure in return for the protection. In such circumstances, while the industrial research worker remains outside the Convention, any measure which encourages the growth of scientific research by offering real reward to scientific discoveries may be of real benefit to industry. At least some sections of industry to-day owe their difficulties in part to a lack of contact between their technical staff and workers in pure science. Fundamental scientific research remains the most important fertiliser for industrial research and development; and with the increasing mechanisation of our daily life and the intensive exploitation of the world's resources, its importance will become ever greater.

The use of the term 'Scientific Property' in the draft Convention is perhaps something of a handicap. It is liable to give a misleading impression and, in the opinion of some, its use has constituted an obstacle to progress, the word 'property' having caused apprehension among manufacturers. At the last session of the International Committee, the use of such expressions as "the right of the scientist to his discoveries" or "in the remunerative utilisation of his discoveries" found powerful advocacy, but in view of the general use of the expression and its connexion with the established terms 'Artistic Property', 'Literary Property', the Committee, however, decided that a change was inadvisable, if not impossible, now that the Convention had been drafted.

The Italian National Committee has set an example which might well be followed by others. The idea of protecting scientific property has been raised at an opportune time, and the six years or more which have elapsed since the inquiry and study of the subject were first commenced is none too long a period. It is to be hoped that the question will receive closer attention in Great Britain than has yet been the case, and that there will be no attempt made to curtail discussion or precipitate a decision by this or other governments regarding a Convention which may, indeed, prove impracticable, but may equally prove a valuable stimulus to scientific research and discovery.

## The Anatomy of History.

*Human History.* By G. Elliot Smith. Pp. 509. (London: Jonathan Cape, Ltd., 1930.) 21*s.* net.

TWO problems, above all, have engaged the attention of thinking men, since man first began to think: the 'riddle of the universe' and the 'meaning of history'. The study of each has come to have its proper technique and discipline. But central in one, and conspicuous in the field of the other, stands man himself: the 'proper study of mankind' is at the same time anthropology and *literæ humanissimæ*. Like the 'man in the street', with his guesses at 'what we are and whence we came', the anatomist, too, "cannot help puzzling over the behaviour of his fellows" and studies "the dead past of man and his strivings", mummification, gold-quest, warfare, and the like, "as a means of interpreting the living present".

The philosophy of history, as Dr. Elliot Smith, in the light of his special skill, expounds it, is a simple one: "it would not be an exaggeration to say that civilisation was evolved out of man's endeavours to understand the constitution of his own body and to preserve the life that animated it". Taking account of recent discoveries about primitive man, his early civilisations, the 'legacy of Greece', and prehistoric Europe, his object is "to search for the deep motives that have shaped man's career, and to call attention to the vital factors in human thought and behaviour, which have been ignored by most writers" (p. 13).

Among these "vital factors", on which the "fabric of civilisation" was built up, he reckons "ideas of the function of the heart and blood, the breath and moisture, the placenta, and the hypothetical 'life substance'" (p. 13). He thinks that "all man's early nature-studies were self-centred and in the last resort were related to the expressions of life in his own body". A similar notion underlay the "Physical Realism" of the late Thomas Case, but that was not circulatory philosophy, but muscular, as became one who was a cricketer, not an anatomist. Whither, then, does this transcendental omphaloscopy lead us? What is the meaning of "Human History"?

To appreciate the argument, account must be taken of the author's "new emphasis on the fact of the continuity of culture both in time and space", on which, however, he has repeatedly insisted elsewhere. What the "principle of continuity" explains in geology and biology, the "tyranny of tradition" effects in "Human History". Yet there was apparently a catastrophe, somewhere

and somewhen: for whereas "primitive men were decent, generous, and peaceful", mankind has, alas! somehow "acquired culture, and with it social unrest, dangerous practices, and methods of cruelty". An earlier exponent of the same theme ascribed the Fall to an apple. After reading "Human History", one suspects the placenta.

Broadly, then, human history is a drama in three acts. With two of them, other writings of Dr. Elliot Smith have already made us familiar, but the restatement of his views is welcome; not least as an illustration of that 'continuity' through which ideas, essentially the same, become *diablement changés en route*. For amid the "tyranny of tradition" we have glimpses of mute inglorious inventors, outside early Egypt, and antecedent; the Chellean method of flint-chipping, which "originated in one spot, where a pioneer invented it" (p. 95); the "relatively slight change necessary to attain such greater efficiency" as distinguishes Acheulean technique from Chellean (pp. 97, 115); and then "a new genius arose and invented the technique known to us as Mousterian" (p. 97). What a pity that the new material from the Bambata Cave in Southern Rhodesia comes just too late to illustrate, in thousands, the "relatively slight changes" necessary to replace traditional Mousterian into a specific local 'industry'! What an instance of 'continuity' defeating 'tradition'; and how difficult, except for a biologist, to distinguish this from "some process of so-called evolution", which by mere "tyranny of tradition" still means for many people, since the publication of the "Early History of Mankind" and the "Evolution of Culture", the survival of the fittest among "slight changes necessary to attain such greater efficiency" innumerable and ubiquitous; and we may note that it is on the morrow of such momentous pause in the record as marks the geological 'continuity' between Chellean and Acheulean gravels that the new theory postulates one "individual of outstanding genius", to make all the difference between Chellean and Acheulean technique.

So too, among uncompromising denials of the influence of geographical surroundings on mankind (p. 253), there are significant admissions. Though the "pronounced monogamy of the Food-gatherers" awaits explanation, "economic causes may well play a part. It may not be possible for a man to keep more than one wife" (p. 263). The Melanesians (p. 157) "probably only reached new islands when they were swept by the forces of Nature out of their course". Worse follows: "it may also be something more than a coincidence that the Hittites arose on the edge of the salt treeless tract in Central Asia Minor" (p. 287). Worst of all, "the natural crop of barley, which was growing wild on the banks of the Nile, seems to have provided the lure to attract the earlier settlers in Egypt" (p. 272); and though, of course, "some man of exceptional insight imitated the natural processes", the vital importance of irrigation "impelled the Egyptians to study the habits of their river" (p. 278), and "hence communities became herded together in villages, and people were forced into more intimate association", wore clothes, buried their dead, and set out on the 'life-quest' and all our woe, all unaware that geographical facts such as "the habits of their river" were incompetent to modify the habits of a people. Or was some "individual of outstanding genius" the first to scramble up the bank to keep his feet dry? In fact (p. 291), "we may draw the only possible inference and assume the invention of agriculture in Egypt, where Nature was annually pointing the way so clearly". A very naughty river, to break the 'continuity' of human history so!

More generally still, among mammals, "those which wander away from their original home and become subjected to new environment and new conditions of life, new food to search for, and new dangers to overcome, are more rapidly transformed than those that stay at home" (p. 159), and this is explicitly applied to Mediterranean man. Change of scene seems, after all, to suit those "individuals of outstanding genius" whose breaches in the "tyranny of tradition" illustrate the "principle of continuity" in biology. Instances abound in "Human History".

"The first hunting-grounds were only attractive if flint was to be found near them" (p. 95): "the increasing cold must have tried these roaming hunters severely", and "in the Acheulean strata are the ashes of the first hearths" (p. 96). So ancient is the habit, universally diffused to-day, of "borrowing a light". But who borrowed first, and from whom? Or did more than one 'pioneer' strike a light while striking a flint? Even among 'grassland' man—a particular *bête noire* of continuous history—"the population was kept small by the exigencies of the rainfall alone". In Greece itself the emancipation of human reason was not quite complete; for this country (p. 431) had been "continually subjected to the cultural influences diffused in the waters that bathed its shores", an interesting glimpse of the physics of diffusion.

Another very welcome shift of view is the generous

recognition of Tylor's "luminous expression" of the "principles that should inform any attempt to interpret the behaviour of men under conditions of civilisation". True, the old leaven festers still, in the reference (p. 329) to a "theory of universal animism which distorted the vision of ethnologists for more than half a century". But as it is admitted that Tylor "discovered so many examples of a peculiar phenomenon . . . the attribution of life and mind to inanimate objects", we are not far from the view that a certain outlook on human history, like Chellean flint-chipping, "originated in one spot, where a pioneer invented it".

For the Fall to have had such disastrous consequences—"social unrest, dangerous practices, and methods of cruelty"—the state of innocence must have been innocent indeed; and the rehabilitation of the 'noble savage' is one of the more important of Dr. Elliot Smith's contentions. For if civilisation, with all its evils, has resulted from man's endeavours "to understand the constitution of his own body and to preserve the life that animated it", what risks we run from the teaching of physicians and anatomists! What is odd, however, is that the "decent, generous, and peaceful" food-gatherers should for millennia and with such uniformity (or was it 'continuity'?) have missed the significance of the placenta: for it is admitted (p. 330) that "the study of the phenomena of birth is as old as man himself". As is insisted in the same context (p. 329), "even serious investigators by pushing just a little further than the evidence warrants the application of a bright idea, can make it nonsensical": and the reviewer craves pardon in advance, if he has played the pioneer in that way. But is the evidence as to the distribution of placenta-cults, or flag-worship, or other "dangerous practices", so complete as to justify inferences from presumed lack of them among "food-gatherers", or the complementary conclusion that the occurrence of practices resembling them results from diffusion of food-producing culture among peoples who do not in fact produce food?

The stress justly laid on the regional character of the Upper Palæolithic cultures—in spite of the corollary presumably postulating regional 'pioneers'—makes more surprising Dr. Elliot Smith's insistence on the brevity and insignificance of the phrases usually described as Neolithic, "anywhere except in Britain and western Europe". That the "real revolution" was the replacement of *H. neanderthalensis* by *H. sapiens* may be admitted, without overlooking the significance of the new technique of grinding and boring. In the Philippines, for example, there is stratigraphical evidence for two well-marked cultures with more or less 'polished' implements, accompanied by pottery, between the Upper Palæolithic and the Iron Age layers. Here it is not the Neolithic that is absent but the Bronze Age, which means so much to Dr. Elliot Smith. But, as he admits in another context (p. 106), "so again in the Neolithic Age a succession of new waves of population intruded from time to time, each bringing some new contribution".

There is, however, a reason for this apparent neglect of Neolithic phases. Unless the very short duration here assigned to them, particularly in the north-west, is admitted, it is difficult to establish the remarkable precocity of culture in Egypt, which is central in Dr. Elliot Smith's interpretation. That many elements of European civilisation spread from the Near East, is admitted. The question is whether other parts of the Near East themselves obtained them by 'diffusion' from Egypt; and as, until lately, the chronological inferences, from sequence-dating and stratigraphy combined, were better supported in Egypt than elsewhere, it is obvious that *if* these arts and practices originated in Egypt, their first appearance elsewhere should be subsequent. This, however, is just what has to be proved; and the very confident statements of Egyptian priority in "Human History" are not accompanied by evidence more conclusive than what has been so variously interpreted. In particular, the geographical distribution (or is it 'diffusion'?) of apparently wild congeners and precursors of the earliest cultivated grain-plants cannot really be said to be fully established yet; and in so far as it is approximately known, it seems generally taken to favour Asiatic origin for cultivated grains. Since this question of grain-crops is as fundamental to the Osirian theory of civilisation as the placenta-cult itself, readers of "Human History" must prepare themselves for another act of faith.

Nor is the "ancient tradition of Osiris recorded by Plutarch" more valuable corroboration of the hypothesis of an "individual of outstanding genius" at the beginning of Egyptian civilisation, than is Archbishop Usher's approximation to Prof. Breasted's date for this modern version of the Fall. For if the Egyptians were "living the life of Natural Man before they began their pioneer work", Osiris lived before the first potter; and this helps to explain a certain reluctance to grant high antiquity to the Badarian precursors of pre-Dynastic pottery. But Osiris is represented (p. 253) as

having made his amazing innovations not much earlier than 4000 B.C. What, then, becomes of the ceramic priority of Egypt? For the correlation of this phase of its culture with the Cretan series is at the top, not the bottom, of the twenty feet of pot-infested house-debris which underlies the first Bronze Age layer. And is not the admission (p. 279) that "like all human communities throughout the ages [the Egyptians] listened to the voice of authority", rather destructive of the view that it was because they were the first people to do so, that they involved themselves, and us all, in the 'dangerous practices' of civilisation?

Among these practices, as has been noted already, those based on observation of vital processes are represented as of central significance. Here a strong case is presented for regarding this whole group of beliefs and customs as concerned less with the reproduction of life, by so-called 'fertility' rites, than with the maintenance and enhancement of existing life—the life of the performer, or of someone whose continued existence seemed indispensable to him. This is a fresh and fertile suggestion, which it would be impossible to discuss adequately here, further than by noting how that notion gained new and tremendous vogue, as soon as efforts to maintain and enhance were transferred from *this* life to another, and men distinguished the transcendental maintainer of life from their own temporal chieftain. The relation of this view of early culture to those propounded already in Christopher Dawson's "Age of the Gods" and Hocart's "Kingship" will be obvious.

At last the curtain rises on Act III. Dr. Elliot Smith has discovered the Greeks. More precisely, he has gone a step further than Ure's "Origin of Tyranny". That was itself a venturesome book, wherein the invention of coinage, and the mobility thus given to wealth, were claimed as the material cause of that emancipation of individual enterprise from restrictions of communal ownership which in turn made possible the democratic movement in Greek city-states, with all that this implied. Dr. Elliot Smith's corollary is that there was concurrent emancipation from the "tyranny of tradition" in the world of thought, with the result that "mankind recovered intellectual freedom", even if people still do not always avail themselves of it to rationalise their lives. Yet mark the tragedy, that so high an achievement of this people of "transcendent genius" should be correlated in "Human History" with such a merely geographical accident as the occurrence of gold in the Pactolus river!

Not that 'continuity' was lacking even here. Dr. Elliot Smith has satisfied himself that there was "no break in the development of style" between Mycenæan and geometrical art (p. 431); also that the Doric column was "derived ultimately from Egypt" because "all later fluted columns must be derived ultimately from these Third Dynasty types". Such was the "tyranny of tradition" until the invention of coinage; though Dr. Elliot Smith is insistent that it did not apply to round pillars, nor to square (p. 451), which "given the idea of a pillar, might arise independently in any country and any number of times". But why? Are "individuals of transcendent genius" so common in the building trade?

But if Greece learned Egyptian notions by 'diffusion', it also taught that way. It is "an excellent illustration of the general theorem of the diffusion of culture", that "Greece provided most, if not all, the principles which distinguish" not only "the higher culture of Western civilisation" but also "those of Asia and pre-Columbian America". This leads straight to the thesis of the author's "Elephants and Ethnologists", but with greater insistence on the Hellenic (and therefore ultimately Egyptian) source of the "connexions between the Ægean, Scythia, and India" and therefore of "results which hitherto have been unduly minimised, if not wholly ignored" (p. 462). Thus we have "clear evidence of Cretan influence in Turkestan in Middle Minoan times" (p. 467), which will be news to the specialists. That Ionian rationalism may have inspired the 'rational philosophy' of the Buddha, has been suggested by others; what is less easy to accept is that "there was no architecture in India till the advent of Buddhism" (p. 472); especially as the ancient cities at Harappa and Mohenjo-Daro are mentioned immediately after. Eventual limitation to *stone* architecture (p. 474) is further qualified by excluding not only the stonework on those northern sites, but also the 'megaliths' of southern India; and the claim for Hellenic initiative would seem to fail, in face of evidence for Achæmenid models (p. 476). The case is indeed given away on p. 477: "could we discover what the wood carving was like" which dominates early Indian stonework "we should be more certain of the history of early Indian art. As it is, we can only judge from the surviving stone reliefs." It is admitted also (p. 476) that the 'honeysuckle' and other ornaments common in Greek architecture "were employed in earlier Assyrian" as well as in Persian. Is it true, further, that the halo is "used in Greek

paintings as an attribute of gods " (p. 479) before Christian times ?

Such perplexities may result from the condensation evident in this latest section of " Human History " ; and the survey of events in the west, and Greek influence on Christian and Moslem thought, is more summary still. But in the plan of the book there is a reason for this. It was the achievement of the Greeks " to restore to human reason the freedom it had lost " when man " began to devise civilisation " and " became entangled in the shackles of the theory of the State " (p. 497). The " conflict between the rationalism of Hellas and the superstition of Egypt " is, however, not over. In the words of Dr. Elliot Smith's epilogue, " it depends on the human population of the world themselves, which will win. For thought and courage can decide the issue." Of both there is abundance in this book, which is appropriately dedicated to the " vision and courage " of another " pioneer ", Dr. W. J. Perry. J. L. MYRES.

## Wind and Water.

*Wind and Water.* By Manfred Curry. Pp. 28+120 plates. (London : *Country Life*, Ltd., 1930.) 25*s*. net.

THIS is a handsome quarto volume of one hundred and twenty full-page photographs, the first half of which are studies of sea and lake, the second half of sailing yachts. The plates are a selection made by Mr. Curry from many thousands taken by various photographers. The smooth paper on which they are reproduced is free from pernicious glaze and restful to the eye.

Some of the wave studies are of exceptional merit. One by F. S. Schensky showing the back of a wave rushing on the cliffs of Heligoland admirably conveys the speed of the surge, and another by the same photographer of the front of a great breaker (presumably on the same shore) is an effective counterpart. The combing crest rises above the sky-line and is cambered in the centre. The moment of exposure of the plate has been exactly timed for the closing of the cusp upon the cushion of water in front, a critical moment seldom recorded.

Of the lake studies, two stand in happy contrast. The first is of Lake Constance in a Föhn wind, with lines of breakers below and long rolls of stormy cloud above, separated by the serrated summits of a mountain range—a beautiful composition. The second is of a tarn in Switzerland, in the clear waters of which the mountains

View the stillness of their aspect

more perfectly than is possible in the larger lakes fed by the turbid waters of a glacier stream. The study of the Walensee is an effective rendering of a contrast which always exercises an imaginative appeal—that of a vertical cliff of massive rock with the level lines of smooth water and a low shore in the distance.

There are two fine photographs taken at sea, both by Count Larisch, one of which shows the rush of a single wave rising high above the line of sight, the other a remarkable effect of rigging and spars, and a heeling deck awash in a heavy sea.

A number of photographs of yachts sailing will be of interest to those versed in the sport, but are for the most part lacking in pictorial effect.

The introductory letterpress is in two sections, of which the first and longer relates to waves and wind. Mr. Curry refers to his discoveries about waves. He has indeed made observations and formed opinions, but I venture to suggest that a further study of the work which has been published upon this difficult subject would lead to a modification of the views which he advances, particularly in regard to the preponderating importance which he attributes to the friction of wind in the formation of waves and the friction of the sea bottom in deflecting their direction in the neighbourhood of the shore.

With the comments of the author upon the relation of modern aerodynamics to yachting I am not competent to deal, and of this section of the introduction I can only say that Mr. Curry's enthusiasm for his sport makes agreeable reading even for one who is not a practical yachtsman.

VAUGHAN CORNISH.

## Mars.

*Le planète Mars : étude basée sur les résultats obtenus avec la grande lunette de l'Observatoire de Meudon et exposé analytique de l'ensemble des travaux exécutés sur cet astre depuis 1659.* Par E. M. Antoniadi. Pp. iv + 240 + 10 planches. (Paris : Hermann et Cie, 1930.) 80 francs.

THIS is unquestionably one of the most important books on Mars ever published, and it will always remain a standard work of reference for the period covered by the author's researches.

The book opens with a chapter on the planet in antiquity which illustrates the writer's wide knowledge of the literature and astronomy of ancient times. But it is especially with our knowledge of Martian topography as revealed by the telescope that it is concerned, and Chap. ii. contains an account of instruments, stations, and conditions

most favourable for a successful study of this interesting planet. It will be noted here that M. Antoniadi—who first in 1909 had the immense advantage of using systematically for the study of Mars the great 32·7 in. refractor of the Meudon Observatory, through the kindness of Dr. H. Deslandres (then its Director), to whom this book is fittingly dedicated—himself prefers refractors to reflectors, but it will be something of a surprise to some readers to find that he does not consider the secondary spectrum a serious drawback in the use of such instruments for planetary work. The view of Prof. Ritchey, which he quotes, that an important factor in the success of the Meudon telescope is the height of the object glass above the surface of the ground, is doubtless correct. Indeed, it has long seemed to the reviewer that the unsteadiness of the images so often given by reflectors—especially when employed in the open—arises largely from the fact that their specula are situated in the disturbed conditions near the ground level, as well as from the usual tube currents. Foggy weather, of course, naturally finds approval where large apertures are to be used, as also does a considerable altitude with the view of getting above the denser strata of the atmosphere, but the habit of employing diaphragms to improve the steadiness of the images is strongly criticised as seriously diminishing the separating power so essential in the resolution of planetary details.

The following chapter contains details of the orbital and physical elements of Mars, after which we come to a general account of the surface features as telescopically observed, including changes of colour, " the illusion of the canals ", the polar caps, clouds and other atmospheric phenomena, the habitability of the planet, and the two satellites. This concludes the first part of the volume.

Part 2 consists of a very full and detailed descriptive account of the planet's surface, and the changes, seasonal and otherwise, which have been observed to take place in the several markings. These details are well illustrated by a number of drawings, mainly by the author. The nomenclature employed is that of Schiaparelli, but this has been extended by the adoption of names from the maps of Lowell and Cerulli, and in the case of a number of more recently detected features the names have been assigned by M. Antoniadi himself.

It is to be noted that in general this descriptive part of the volume is intended mainly as a presentation of the author's own researches, but the history of our knowledge of the various features is carefully traced from earlier records and supplemented by the work of contemporary observers. Great care has been taken in the selection of the material presented, and there are abundant references to the work of members of the Mars Section of the British Astronomical Association, of which M. Antoniadi was for several years the director.

Of course, the great value of the work lies in the fact that it presents the conclusions of a particularly able and accurate observer using one of the very best instruments in the world, and, moreover, one who possesses very great skill as a planetary draughtsman. It will be clear to the reader that its inspiration lies in the wonderful views of Mars shown to the author by the great telescope at Meudon in 1909. It was these views which led to his final conviction that the so-called ' canals ' of Schiaparelli and Lowell were illusory, in the sense that their geometrical appearances, together with such phenomena as their occasional gemination, were the result of optical and physiological causes. In particular, the straight and linear appearance of many of these features was announced as nothing more than a consequence of integration by the eye of irregular spots and markings which were in general beyond the reach of distinct vision with the relatively small apertures usually employed up to that time. That there is some objective basis behind the Schiaparellian canals is, of course, fully recognised. This is illustrated in the chapter on " The Illusion of the Canals ", and for further details the reader may turn to the 1909 Report of the Mars Section of the British Astronomical Association published in vol. 20, part 2, of the *Memoirs*. The previous scepticism concerning the reality of these geometrical features will be well remembered. While some assiduous and trustworthy planetary observers using instruments of moderate size recorded a number of them, there were others, such as N. E. Green, E. W. Maunder (see a paper in *Mon. Not. Roy. Ast. Soc.*, vol. 63, p. 488, by E. W. Maunder and J. E. Evans), and Cerulli—to mention just a few—who consistently maintained that they were capable of an optical explanation. It was, however, the great Meudon refractor which actually showed to M. Antoniadi in 1909 those irregular spots and broken-up features into which the canal system is so very largely resolvable when adequate telescopic power is employed.

There is, however, one point to which it seems needful to direct attention in order to avoid further confusion. Most unfortunately, ever since the days of Schiaparelli, markings of very different characteristics have been designated ' canals ', namely, broad dark streaks on one hand and fine spider-web-like

lines on the other. This is partly attributable, no doubt, to considerable changes in the intensity and breadth of some of these markings; but so long as the term 'canal' is applied indiscriminately to all the linear markings and streaks, the general statement sometimes met with, that photography does not show the canals, is apt, if unqualified, to be misleading. The 'canals' bounding Elysium, and those in the neighbourhood of Solis Lacus, as well as strong broad features, such as the Casius and Nepenthes-Thoth have been for several years past, do come out very plainly on the photographic plate. Moreover, such features were seen and drawn before Schiaparelli's time, and, in general, so far from being straight, many of them are very distinctly curved. Of the objective existence of these markings we may feel assured. As in the case with the term 'mare' for the designation of lunar features, it may now be difficult, perhaps, to give up altogether the use of the term 'canal' for the linear markings of Mars, as M. Antoniadi has done, but the retention of the same term for objects of widely different characteristics can scarcely be other than a fruitful source of misunderstanding and confusion.

Another point which M. Antoniadi's researches —and, indeed, the work of many other observers, like Prof. W. H. Pickering, who has similarly devoted many years to the study of Mars and its seasonal changes—reveal with great clearness is that, despite its shortage of water, Mars is by no means as yet a dead world. The work under review is not directly concerned with those recent methods of investigation by photography in light of different wave-lengths or the measurement of the surface temperature with the thermo-couple which have gone so far to establish points of analogy with the earth, but the visual revelations of the telescope described by M. Antoniadi, such as the drift of the clouds and other manifestations of Martian meteorology, the seasonal changes in the colour, form, and intensity of dark markings like the Syrtis Major, the occasional developments and changes on an enormous scale like those observed in recent years in the Solis Lacus and Noachis regions of the disc, all indicate that Mars is still very much alive and full of interest for the student of its surface and physical state.

At the end of the volume are a number of plates which are exceedingly well reproduced. The first five are maps and these are followed by plates containing four whole-disc drawings of the planet as seen at Meudon during the apparitions of 1909, 1911, 1924, 1926, and 1928–29.

## Our Bookshelf.

*L'art primitif.* Par Prof. G.-H. Luquet. (*Encyclopédie scientifique : Bibliothèque d'anthropologie.*) Pp. iii + 267. (Paris: Gaston Doin et Cie, 1930.) 30 francs.

IN "L'art primitive" M. Luquet turns once more to the problem of the origin of art. Very briefly, his theory is that two forms of representative art are to be distinguished. First, there is the classical art of the adult, no longer to be regarded as the one and only form. Secondly, there is a form of art which is called 'primitive'. Under this heading, on the ground of their common characteristics, he groups certain tendencies opposed to those of the adult classical art—the art of children, some adults ("même des professionnels"), savages, and prehistoric man. Both in the individual and in the history of the human race, the urge to artistic representation arises in the same way—an accidental production or discovery of a resemblance to a real object. Hence comes a desire for the execution of a purposive reproduction, which in turn gives rise to the pleasure of creation. In this disinterested art lies the germ of magical art; but the pre-existence of the artistic product before its magical use is a necessary postulate. Further, while 'classical art' is static, primitive art is dynamic; by an intellectual realism it sees the whole story in time and space. Hence the representation of invisible parts, distorted perspective, and duplication.

M. Luquet argues his case ably, with illustrations drawn from primitive art and from infant psychology. The book is stimulating but far from conclusive. Savages are not children, whatever may be the similarities in the artistic products of each. Even if fortuitous resemblance gives rise to artistic activity in both cases, the savage brings a range of relatively highly developed concepts to bear upon his problem from the very first. There is, in fact, no reason why the magical impulse should not be present from the very beginning. The real analogy is not with the art of children, in which it is difficult to isolate the spontaneous activity from the imitative, but with such an urge as that for jewelry, in which an artistic product is the ultimate outcome of the magical efficacy of a natural object, afterwards imitated in some precious or magical material—for example, coral—and finally desired for its beauty or intrinsic value without reference to any original meaning.

*Some Applications of Organic Chemistry to Biology and Medicine.* By George Barger. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 5.) Pp. v + 186. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12*s.* 6*d.* net.

THIS volume represents the fifth of a series in which are reproduced the lectures delivered by distinguished visitors invited to Cornell University in accordance with the terms of the George Fisher Baker Foundation. The purpose of this Foundation is to facilitate intercourse between scientific

workers of different nationalities. Appropriately, Prof. Barger deals in his introductory lecture with the history of internationalism in science. The belief that scientific research is one of the most international forms of human endeavour, possibly only second to music in this respect, is illustrated by a remarkable range of examples that connects the brotherhoods of the schools of Vesalius, Fabricius, and other great masters of the Italian universities of the sixteenth century with the international contributions that led to the isolation, identification, and synthesis of adrenaline. Many other examples may be derived from the five lectures which follow and which deal with important recent developments in biochemistry. The chemistry of the hormones is presented in an able and comprehensive review, no small part of which is devoted to the fascinating story of the steps by which the constitution and synthesis of thyroxin was achieved. Other lectures deal with the chemistry of the vitamins, chemical constitution and physiological action, chemotherapy, and finally the nature of the curious blue adsorption compounds of iodine. A very interesting and stimulating volume.

*Niels Henrik Abel: eine Schilderung seines Lebens und seiner Arbeit.* Von C. A. Bjerknes. Umgearbeitete und gekürzte Ausgabe aus Anlass von Abels 100-jährigem Todestag von Prof. Dr. V. Bjerknes. Ins Deutsche übertragen von Else Wegener-Köppen. Pp. v + 136 + 1 Tafel. (Berlin: Julius Springer, 1930.) 6·60 gold marks.

PROF. V. BJERKNES has condensed the longer work of his father by omitting the details of Abel's mathematical work, so as to make accessible to all the biography of that ill-fated genius.

Abel was born in 1802. His abilities were dormant until he met with a sympathetic teacher, who soon prophesied his future greatness. However, a local reputation in a country like Norway required support from abroad. In spite of his poverty, Abel had a paper printed at his own expense and sent a copy to Gauss, the acknowledged leader of mathematical thought, whose appreciation would have made Abel's position secure. But the paper was poorly printed, with portions of the argument omitted, and Gauss tossed it aside. Later, Abel was given a travelling scholarship, but his resentment prevented him from meeting the only man who could have fully understood his work. In Berlin, Abel was welcomed by Crelle, who published in his newly founded *Journal* several of Abel's papers. But a professorship in Christiania, which Abel had confidently expected, was awarded to another. Fresh disappointments awaited him in Paris. He sent to the Academy what is now known as Abel's theorem. This should have assured his fame, but by some amazing mischance it was not printed until fifteen years later. Long before this, Abel had returned home and for two years struggled with financial cares. Then at last recognition came, and in 1829 he was offered a professorship in Berlin. Too late! He had died two days before.

H. T. H. P.

*Clouds.* By Prof. Alexander McAdie. Pp. iii + 22 + 52 plates. (Readville, Mass.: Blue Hill Observatory.)

MORE attention has probably been given to the study of clouds at Blue Hill Observatory, Massachusetts, than anywhere else in the world, and the appearance of a volume containing the cream of the many fine photographs of clouds taken there, in addition to a selection of photographs from other sources, is to be welcomed. The reproduction of these varies. According to the very high standard of the present day, many of the photographs of cirrus cloud can only be classed as poor, the essential fibrous structure being replaced by a wool-like appearance almost suggestive of fracto-cumulus at a first glance. Even the comparatively easily reproducible cumulus and cumulo-nimbus are not as a rule entirely satisfactory, a common fault being the total lack of detail in those parts of the cloud that are in shadow. Against these drawbacks must be set the exceptionally interesting view-point from which some of the low forms of cloud have been photographed, and the amount of light thrown upon their physical structure in consequence. It will come as a revelation to those who have not had many opportunities of studying clouds from above, the extent to which fog sheets can form 'surges' and cascades when drifting over hills, without being broken up or dissolved.

An important feature of the work is the historical sketch with which it opens. We cannot recall having seen a more comprehensive guide to the most important attempts at a scientific treatment of the study of clouds, from the tentative observations and speculations of Socrates to the recent intensive study of cloud formations in relation to moving pressure systems made by the French National Meteorological Office. Prof. McAdie has done good service to meteorology by this piece of work.

*The Measurement of Men.* By J. A. Harris, C. M. Jackson, D. G. Paterson, R. E. Scammon. Pp. vii + 215. (Minneapolis: University of Minnesota Press, 1930.) 2.50 dollars.

FOUR lectures, delivered under the auspices of Sigma XI of the University of Minnesota, are here published as a contribution to the exact study of man by means of measurement. Prof. L. Arthur Harris deals with "The Measurement of Mankind in the Mass", an exposition of statistical methods and some results; Prof. Clarence M. Jackson deals with "Normal and Abnormal Human Types", Prof. Donald S. Paterson with "Personality and Physique", and Dr. Richard E. Scammon with "The Measurement of the Body in Childhood". Prof. Jackson gives some interesting comparative figures from the army and from university students which will probably be new to most English readers; while Prof. Paterson makes some amusing and destructive comments, supported by statistics, on the distinction popularly drawn in the United States between the mentality of blondes and brunettes, and on the claims of physiognomy and phrenology to gauge character.

## 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.*]

### Emergent Evolution.

IT is curious that while the concepts of physics have been undergoing drastic revision, the same has not happened with regard to biology. It is true, Dr. E. S. Russell has recently examined very critically what is meant by organic development, but very much more is still necessary in respect of other conceptions of biological science. Here I refer particularly to the notion of 'emergence' in evolution—by which, Dean Inge says, we assert and deny change in the same breath! The conception, as it has been stated so far, involves confusion, and it would be well worth while for someone familiar with the formal methodology of science to attempt a very critical discussion of the matter.

The notion of emergence is illustrated by the formation of water from its elements. There is nothing in the reactants, it is said, which suggests the liquidity of the resultant: liquidity, therefore, is said to 'emerge' from the reaction of oxygen and hydrogen to form water. But may we not regard these reactants as mass-points in a Newtonian medium, moving in accordance with Newton's laws, and attracting and repelling each other with forces which are functions of their distances apart. We describe such a system of mass-points by position- and force-co-ordinates. Since the mind-body problem is the same in our perceptions of the properties of reactants and resultants, may it not be regarded as cancelling out, so that liquidity in the resultant *is* the changes of co-ordinates? Of course, we may make an analogous statement with regard to an electronic medium.

Again, the properties of the atom are said to 'emerge' from some configuration of the elements of the atom. But that configuration, to J. J. Thomson, was not the configuration imagined by Rutherford and Bohr, and, again, not the configuration of current physics. Yet the 'emergent' properties are still the same ones. Finally, we can make systems of equations representing the thermodynamic probabilities of two or more gaseous systems and we can deduce from those equations that the entropy of a combined system is proportional to the logarithm of the combined probabilities. May not the latter equation be said to 'emerge' from the former ones, and yet does it contain any terms that were not in the equations from which it was deduced? Is not what 'emerges' *a relation made in the mind of the investigator*? Were not the electronic configurations simply in the minds of mathematical physicists rather than in the atomic systems?

These examples are very simple ones: what emergent evolution rather contemplates are the origins of human mentality, 'values', the religious feelings, and God. Science now, in its modesty and self-critical outlook, is being said to admit, or at least tolerate, speculations with which, in a more assertive (or truculent) phase, it would have nothing to do. Has not the time come when notions such as that of 'emergence' and 'organicism' should be dispassionately and critically (or even unsympathetically) considered in the interest of sound thinking?

JAS. JOHNSTONE.

University, Liverpool.

### Embryology and Evolution.

I SHOULD like to comment on two letters by Mr. Haldane: one on "Natural Selection Intensity as a Function of Mortality Rate", in NATURE of Dec. 6, and the other on "Embryology and Evolution", in the issue of Dec. 20. In the first, Mr. Haldane criticises as "fallacious" Prof. Salisbury's argument that mortality amongst plants is mainly confined to the seedling stage and that at this period natural selection mainly works. He goes on to consider a case where two races vary as to a single character! Now, this is a travesty of what occurs in Nature. Two allied races do not differ from one another in a single character: they differ in a multitude of minute points, and it is quite impossible to say whether one or another of these points determines their survival. The 'characters', in fact, are mere abstractions. The organism is a whole, and the characters are the expression of its constitution; in a word, of the vigour of its reaction to its surroundings. The whole point of Prof. Salisbury's argument was that natural selection chooses the most vigorous, not that which possesses some special character, and this argument I believe to be perfectly sound.

In his second letter Mr. Haldane objects to four of the statements in my reply to Prof. Gates. I shall deal with these seriatim.

(1) Mr. Haldane claims that some microscopists have seen 'genes'. What they have seen are segregations of material in the stained and fixed chromosomes which they have identified as genes—a purely hypothetical conclusion. He further says that the presence or absence of a 'trabant', that is, not a gene but a small chromosome, makes a difference in the constitution of the plant *Matthiola*. This is quite possible, and I shall be glad to have it demonstrated. Prof. Gates was, I think, the first to show that an extra chromosome made a difference to the appearance of the mutant.

(2) Mr. Haldane asserts that scores of cases are known where in interspecific crosses characters behave in a Mendelian manner, that is, are due to genes. All I know on this subject is that my friends who are systematists, and have devoted their lives to the study of species and races, deny that such is the case. Of course, a mutant such as the domesticated race almost always 'mendelises' when crossed with the wild type; that is just what distinguishes a mutant from a racial character, and the case quoted by Mr. Haldane is such a cross.

(3) Mr. Haldane states that autocatalytic reactions are common in physical chemistry. By this is meant reactions in aqueous solutions which are accelerated by the products of the reaction. I put this question to three first-class chemists, all of them fellows of the Royal Society and one of them a bio-chemist, and as they were all unaware of any such case, I prefer to accept their testimony.

(4) Mr. Haldane objects to my posing the alternative of the organs being preformed in miniature in the embryo or being due to an 'unknown cause'. He says that bone is formed by an enzyme 'phosphatase'. This is a mere quibble. Enzymes are *means* employed by the embryo to develop its powers, and their orderly appearance is just as much a mystery as the appearance of the organs themselves.

Mr. Haldane's remarks about my refusing to take cognisance of the recent advances of science and his invitation to acquaint myself with the 'facts' of genetics and chemistry I prefer to disregard. I have quoted the authorities on whom I rely in chemical matters. As to genetics, I have served for seventeen years on the Council of the Institution to which Mr.

Haldane is attached as statistician, and I have watched all the work going on there, and the more I see of it the more I am convinced that Mendelism has nothing to do with evolution.

E. W. MACBRIDE.

43 Elm Park Gardens,
Chelsea, S.W.10,
Dec. 23, 1930.

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THE discussion between Prof. R. Ruggles Gates and Prof. E. W. MacBride, in NATURE of Dec. 6, bears in an important way upon the philosophy of science. May one without authority in biology offer what he hopes may be a useful contribution from the philosophical point of view?

It is the function of the scientific man to discover facts, to endeavour to co-ordinate them, and by generalisation to build up a useful scheme of hypotheses. Such a scheme must be a deterministic scheme or it cannot be useful, that is, it cannot be used to forecast further facts. When Prof. MacBride writes of mechanical hypotheses, he refers, presumably, to such a deterministic scheme. Whether the resulting scheme represents the truth is not the business of the scientific man as such, but of the philosopher.

As a philosopher Prof. Gates may believe himself to be a "mere mechanism" or a Drieschian entelechian organism. For science this is beside the question. A scientific man must continue to have faith in "so-called mechanical hypotheses", or, as Prof. Gates says, "there would be no further incentive to experimental embryology", and his function would cease. As a philosopher he may doubt whether such deterministic schemes will ultimately prevail, but as a scientific man he must carry on.

C. O. BARTRUM.

32 Willoughby Road,
Hampstead, London,
Dec. 10.

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### The General Factor in Spearman's Theory of Intelligence.

SPEARMAN'S theory may be summarised as follows:

(1) A mathematical theorem, that when all the tetrad differences such as $(r_{ab}r_{cd} - r_{ac}r_{bd})$ formed from $N$ variables $a, b, c, d, \ldots$ vanish, each variable may be considered as the sum of two parts (or 'factors') which are numerical multiples of a general factor $g$ (the same for every variable) and of a specific factor $s$ (different in each case). These $N + 1$ factors are all uncorrelated with each other.

(2) The attribution principally to mere error of sampling of the non-vanishing of the small tetrad differences formed from dissimilar mental measurements.

(3) The interpretation of $g$ as general mental energy, and of each $s$ as a specific ability.

Spearman's proof of (1) is given on p. v of the appendix of his "Abilities of Man" (1927). The value of $g$ (there called $\eta$) is given in the form of a complicated determinant involving a variable $i$ which is undefined except that it is "any new variable uncorrelated with all the others". No clue is given to show how the determinant was obtained. The object of this letter is to point out a straightforward method by which an equivalent but much simpler expression can be obtained, and to show the nature of the mysterious variable $i$, concluding with a very brief discussion of the psychological interpretation. The error of sampling is too large a subject to consider here.

To obtain an expression for $g$, first suppose that the variables *can* be divided into general and specific factors, that is, suppose that

$$a = m_a g + n_a s_a,$$
$$b = m_b g + n_b s_b, \text{ and so on,}$$

where the $m$'s and $n$'s are constants, but $g$ and the $s$'s variables, no two of which are correlated. (It is convenient to use *standard measure* for the variables; this ensures that all the means are zero and all the standard deviations unity.) We find that the tetrad differences all vanish and hence that $\{r_{bc}/(r_{ab}r_{ac})\}^{\frac{1}{2}}$ has a value depending on $a$ alone, so that it may be denoted by $\mu_a$. Now choose multipliers $w_a, w_b, \ldots$ such that the correlation between $g$ and the combined test $t = \mathrm{S}w_a a$ may be a maximum. This gives $w_a = \mu_a/(\mu_a^2 - 1)$. Then form an estimate of $g$ in the usual statistical way (assuming *linear* regression) by using a regression equation $g = r_{tg}\sigma_g t/\sigma_t$. This, of course, will not give the exact value of $g$. Call the unavoidable error $ki$, where $i$ is a variable and $k$ a constant chosen to make the standard deviation of $i$ unity. This leads to the expressions

$$g = k^2[\mathrm{S}\{a\mu_a/(\mu_a^2 - 1)\} + i/k]$$
and $$s_a = (\mu_a^2 - 1)^{-\frac{1}{2}}[a\mu_a - k^2\mathrm{S}\{a\mu_a/(\mu_a^2 - 1)\} - ik],$$
where $$k^{-2} = 1 + \mathrm{S}\{1/(\mu_a^2 - 1)\}.$$

It is easily verified that $i$ is uncorrelated with each of $a, b, c, d, \ldots$

Conversely, whenever the tetrad differences all vanish and in consequence the $\mu$'s exist, it is only simple algebra to verify that $a = g/\mu_a + (s_a/\mu_a)(\mu_a^2 - 1)^{\frac{1}{2}}$, with similar expressions for the other variables, and on calculating the coefficient of correlation between any two of $g, s_a, s_b, \ldots$ we obtain zero, provided $i$ is uncorrelated with $a, b, \ldots$ In this *converse* work there is no need to assume linearity of regression, which is needed only if we wish to deduce *independence* from zero correlation. There is also no appeal to Taylor's theorem. For $g$ to be real the coefficients of correlation between $a, b, c, d, \ldots$ must all be positive.

An interesting example, in which at first sight there appears to be no general factor, is the following:

$$a = \tfrac{1}{2}(\quad v + w + t + p),$$
$$b = \tfrac{1}{2}(u \quad + w + t + q),$$
$$c = \tfrac{1}{2}(u + v \quad + t + r),$$
$$d = \tfrac{1}{2}(u + v + w \quad + s),$$

where each variable on the right-hand side represents the score (reduced to standard measure) of a die. We find $r_{ab} = r_{ac} = \ldots = \frac{1}{2}$, and so each $\mu = \sqrt{2}$. This gives

$$g = \frac{1}{5\sqrt{2}}\{3(u + v + w + t) + (p + q + r + s) + i\sqrt{10}\},$$

and

$$s_a = \frac{1}{5\sqrt{2}}\{-3u + 2(v + w + t) + 4p - (q + r + s) - i\sqrt{10}\},$$

so we have resolved the overlapping group factors into the general factor which seemed to be lacking.

Some may consider that the occurrence of the chance or uncertainty factor $i$ in the above result robs it of all real value. But if the two-factor theory is true, the uncertainty cannot be avoided, for from $N$ equations we cannot determine the $(N + 1)$ unknowns (one $g$ and $N$ $s$'s). Moreover, by increasing $N$ the coefficient of the uncertainty term can be made as small as we please. However, it may be conceded that to a person who knew nothing about dice, the above expression for the general factor might convey a wrong impression, and to guard against a wrong interpretation of mental tests it is necessary to acquire some knowledge of them apart from the mathematical results. It is at once the strength and the weakness of mathematical reasoning that it is generally adaptable to more than one set of circumstances. Let psychologists find two individuals who do equally

well at a mental test, but such that one has a large $g$ and small $s$, the other a large $s$ and small $g$, and consider whether there is sufficiently good correspondence of these variables with what on other grounds may be considered general mental energy and specific ability. Other results, such as the difficulty in transfer of training, may be of service.

Further deductions from the above expressions for $g$ and $s$ are being investigated. I have been greatly helped by my colleagues, Miss A. E. M. M. Dallas and Mr. M. M. Lewis. H. T. H. PIAGGIO.

University College, Nottingham,
Nov. 22.

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I QUITE agree that Prof. Piaggio's proof is not only much simpler than that given in "The Abilities of Man", but also more illuminating. I agree with Prof. Piaggio generally, subject to the reservation that I do not consider (3), the interpretation of $g$ as general mental energy, to be any essential part of the theory. Essential for me is that the determination of $g$ and $s$ leads on to that of 'group' factors; and then the varying magnitude of all three kinds of factors under varying conditions connect them up with all the laws of the human mind, as also with such influences as age, heredity, instruction. Thereby, I believe, psychology is placed upon a new basis, in which the old but still prevalent 'faculties' are replaced by statistically established unitary functions. I suggest that all these positive observations are at present being side-tracked by undue prominence given to such speculative (however luminous) hypotheses as that of a 'general energy'. C. SPEARMAN.

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**Administration and Anthropology in India.**

MR. CODRINGTON is unaware of the facts that in this University lectures are given every year to I.C.S. probationers on the ethnology of India, and that an Indian area is selected for special study in the Tripos. The work done by Dr. Hutton and by Mr. Mills is evidence that fieldwork is existent in India. Nevertheless I share Mr. Codrington's regret that though the facts are accessible enough to those who have cared to work them over, the present discussions at the Conference are not enhanced by anthropology.

T. C. HODSON
(Reader in Ethnology).
University Museum of Archæology
and of Ethnology,
Downing Street, Cambridge,
Dec. 15.

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THREE of Mr. Hodson's criticisms I can answer very shortly:

(1) I am well aware of the existence of the I.C.S. probationers' courses: I have expressed the opinion that considering the importance of anthropology to the embryo administrator, they are scarcely sufficient.

(2) The option of selecting an Indian area in the Cambridge Anthropological Tripos is something. However, I have pointed out that the district gazetteers, which must be the source books for this work, are "uncorrelated compilations"; in my opinion, they are extremely difficult to handle critically, without some personal knowledge of the areas concerned.

(3) With regard to my alleged neglect of Dr. Hutton's and Mr. Mills's magnificent work, I can only point out that I was discussing the impending carving-up of India into federated units: the Assamese hills are not culturally part of India proper, and from the point of view of the problem under discussion, they offer no great difficulty, because their cultural boundaries are clearly defined.

The only remark of Mr. Hodson's that I feel called on to reply to in detail is his assertion that "the facts [of Indian anthropology, that is, as bearing upon the creation of a federal India] are accessible enough to those who have cared to work them over". If this is so, why is there no generally accepted handbook of Indian ethnology? Why is there no volume covering the field of India folk-lore? Why is it that no work has been done on Indian technology since the pioneer publications of Birdwood and Watt, nearly thirty years ago? How is it that the 1-in. sheets of the Survey of India are unpublished for large and important ethnic areas in India, although they are absolutely necessary for research of any kind in those areas? Why is it that until very recently one so seldom heard Indian research matters discussed at academic gatherings? Why is it that there are still so few specialists in Indian cultural studies? Why is the flow of publication so sluggish? . . . The answer can only be that the basic data, physical and cultural, have never been provided in the necessary quantity over the necessary range, and that in default of critically conceived local studies, in which the environment is taken into consideration, we have no means of manipulating the impressively massive, but uncorrelated, facts of our source-books—the gazetteers.

In checking the accessible literature, after any discussion of points of interest, with local observers fresh from India, one is forced to acknowledge gaps and discrepancies on all sides, and furthermore a wellnigh hopeless confusion of nomenclature. The present system of recording the castes and tribes of India, upon which the monumental Census Reports, perhaps the finest of their kind in the world, are based, is an artificial system in the botanical sense. Such groups of people as the Khorwa, Kapu, Vellala, Megh, and such a group as the Kurumban-Kuruba-Kurma complex, which are all paraded as ethnic units in the Census Reports, are not proved entities in any scientific sense. Few, if any, of them have been studied as they actually exist, in their villages and families: none have been studied, even generally, over the whole of their very large areas of distribution. In other words, the units have never been defined in their own environment, and we are therefore ignorant of the degree of homogeneity or variation of the alleged class.

For example, there are two great castes of glass-workers, nowadays mainly occupied in the manufacture of glass bangles, the Manihar and the Kachera. The former have a distribution running through the Punjab, Rajputana, and the United Provinces: the latter, who are much fewer in number, are confined mainly to Central India. What is the real relationship, ethnical and historical, between these two professional groups, and what bearing has their modern craft upon the enormous glass-bead manufacture of South India in Pallava times, of which we have just become aware? It will be seen that this problem is the reverse of the former. In many cases it is certain that unrelated groups have been lumped together under one caste title. It is as certain in other cases that the same people have acquired two or more official caste-names, because their distribution area straddles one or more official, political boundaries with opposing, official machinery on either side. The Beda [Bedaru], Berad [Bedar] and Boya are all differentiated in the Census Reports and gazetteers, as "castes" or "tribes", but they are actually the remnants of a widely spread *nation*, numbering almost a million and a half souls, if the kindred Ramoshis of the Bombay hills and Vedars of the South are taken into consideration. They are at present politically administered, as

inhabitants of various districts of the Madras and Bombay Presidencies, and of the Mysore and Hyderabad States. How is this block of ethnic and traditional interests to be treated on the proposed dissection of India? By modern standards the extant literature, a few dozen scattered pages, is totally inadequate, considering the gravity of the point at issue. . . . Here are a few of the problems which I had in mind when I said that sufficient facts were not accessible to split a population of such ethnic and traditional complexity into federated units with anything approaching scientific assurance.

To any Englishman the necessity of such a confession must be a bitter thing. The political issue is upon us—but we may still hope for the scientific issue. It is still possible to set to work, and so fill a glaring hiatus in anthropological knowledge. What is urgently wanted is a series of local surveys based on lines of centres drawn along and across the most obvious cultural borders: such a line as Junnar, Paithan, Ellora, Ajanta, Akot. Each centre would have to be treated as a living organism, attention being paid equally to the anthropometry, sociology, verbal traditions, local cults and antiquities, the survey extending perhaps ten miles or a morning's ride from each centre. As the investigation proceeds, errors in caste terminology will cancel themselves out. The task is a straightforward one of simple recording, which must, however, be based on a strictly standardised technique. . . . Fortunately there is some possibility of such work being done in the near future by a party of English and Indian scholars working over a number of such groups of centres.

I apologise for occupying so much space with this statement, but the situation is serious. My letter was intended to express my appreciation of the leading article on "Administration and Research in India" in NATURE of Nov. 22. I had no desire for controversy and I regret that I must differ from such an authority as Mr. Hodson. A confession of ignorance in the matter of Indian cultural studies is necessary at the moment, in order to create the possibility of regeneration. The first step must be academic recognition, in the form of a chair or lectureship.

K. DE B. CODRINGTON.

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London, N.6.

### The Function of the Air Sacs of Insects.

THIN-WALLED expansions of the tracheæ known as air sacs occur in those insects which have well-developed powers of flight. Misconception as to the function of these structures is common. They have been described as pumps, as reservoirs, and as balloons. The first term alone seems to give an accurate description of their function, for Lee has made it clear that they must ventilate the tracheæ: each air sac, when compressed, expels the air from the trachea between it and the spiracle. As reservoirs the sacs could be of little use to aerial insects, for the oxygen they contain would last but a very short time during flight, while there is an unlimited supply of air only a little farther from the tissues.[1,2]

The common belief that air sacs could act in the same way as the balloon or gas-bag of an airship is equally untenable. Packard[3] says: "It is evident that the enormous powers of flight possessed by the locust, especially its faculty of sailing for many hours in the air, is due to the presence of the air sacs, *which float it up on the atmospheric sea.* It will be seen that, once having taken to flight, the locust can buoy itself up in the air, constantly filling and refilling its internal buoys or balloons without any muscular exertion, and thus being borne along by favorable winds to its destination." Deegener[4] considers such a function possible when he says: " . . . es [das Tier] verdrängt mehr Luft und wird spezifisch leichter. . . . Ob sie [Verringerung des spezifischen Gewichtes] weit genug geht, um eine befriedigende Erklärung für die Existenz der Luftsäcke zu geben, lässt sich somit nicht entscheiden". (See also Comstock.[5]) It is not difficult to show that this decrease in specific gravity does *not* provide an explanation for their existence, and that they could not possibly buoy up the insect sensibly.

Consider such an insect as the bee, and for convenience include all tracheæ capable of varying in capacity under the title of air sacs. Let—

| | |
|---|---|
| Weight of insect *in vacuo* . . . | $= W$ |
| Weight of insect in air . . . | $= W_a$ |
| Volume of insect, with sacs deflated . | $= V$ |
| Volume of expanded air sacs . . | $= v_a$ |
| Volume of remainder of tracheal system | $= v_t$ |
| Density of external air (gm. per c.c.) . | $= d$ |
| Density of air in tracheal system . | $= d_t$ |

According to the Principle of Archimedes, the upthrust of the air on the insect is equal to the weight of air it displaces; therefore, the weight in air of this insect with air sacs expanded is:

$$W_a = W + (v_t + v_a)d_t - (V + v_a)d. \quad . \quad . \quad (1)$$

The weight of air in the tracheal system—$(v_t + v_a)d_t$—must be included in the weight of the insect, especially since it is this very air which is supposed to buoy the insect up.

Suppose that the air in the tracheal system is at the same temperature and pressure as the external air, that is, $d = d_t$. When the insect has its air sacs expanded

$$\begin{aligned} W_a &= W + (v_t + v_a)d - (V + v_a)d \\ &= W + v_t d + v_a d - Vd - v_a d \\ &= W + v_t d - Vd. \quad . \quad . \quad . \quad (2) \end{aligned}$$

When the air sacs are collapsed ($v_a = 0$), (1) becomes

$$W_a = W + v_t d - Vd. \quad . \quad . \quad (3)$$

That is to say, the weights in air in the two cases are exactly the same. Obviously, the weight of the air in the sacs is exactly equal to the additional upthrust due to its presence there.

Suppose that the air in the tracheal system has a lower density than the external air and take the extreme case when there is a vacuum in the uncollapsed system, that is, $d_t = 0$. Then (1) becomes

$$W_a = W - (V + v_a)d. \quad . \quad . \quad (4)$$

Suppose that $v_a = V$; that is, that the volume of the insect is doubled by the expansion of the sacs—an exaggerated case. Then (4) becomes

$$W_a = W - 2Vd. \quad . \quad . \quad . \quad (5)$$

If the density of the insect *in vacuo* is 0·5 gm. wt. per c.c. and of the air 0·0012 gm. wt. per c.c., the lift of these most remarkable sacs ($Vd$) would be about one four-hundredth part of the weight of the insect, comparable to half a pound in a man weighing fourteen stone. Actually the density of the air inside the animal cannot be very different from that of the external air, and in any case it is to be expected that the pressure in the tracheæ is sometimes above and sometimes below atmospheric pressure, so that any buoyancy effect is minute indeed.

The fact that the *density* of the whole insect would be reduced by the addition of air sacs does not affect the *weight* in air at all. If the insect were made as big as a house by the addition of weightless air sacs filled with air of atmospheric density, the same force would still be required to lift it, though its density would be enormously reduced. An

insect of this remarkable design would offer a very large surface to the winds, and wind forces would be very large compared with its weight and with the forces it could itself exert, and it would blow about like thistledown. But the insects which possess air sacs are just those which rise superior to these external forces, the swift and the strong flying ones. To them any increase in surface area is a disadvantage only to be borne if there is some greater advantage accompanying it. This advantage, I suggest, is the increased rate at which oxygen can reach the tissues when tracheal ventilation is aided by air sacs.

DONALD L. GUNN.

Department of Zoology,
The University, Birmingham,
Dec. 8.

[1] Milton O. Lee, *Science*, **69**, 1929, p. 334.
[2] Milton O. Lee, *Quarterly Review of Biol.*, **4**; 1929.
[3] A. S. Packard, "Zoology for Schools and Colleges", 4th edition, 1883, p. 344.
[4] P. Deegener in Schröder's "Handbuch der Entomologie", Jena, 1928, vol. 1, p. 376.
[5] Comstock, "An Introduction to Entomology", 1925.

### Mirage at Cape Wrath on Dec. 5, 1922.

THE compiler of the Calendar of Historic Natural Events is to be congratulated on the success of his enterprise. All the notes are interesting and many invite discussion. It is to be hoped that they will be republished in book form with references to the original authorities.

The note on the mirage seen at Cape Wrath on Dec. 5, 1922 (NATURE, Nov. 29, p. 865), is, I suggest, one of those which will require reconsideration before it is republished. In considering an observation of mirage, it is necessary to distinguish three elements: what the observer saw, what the observer thought he saw, and how his observation is to be explained. In this instance (NATURE, Feb. 17, 1923, p. 222) the lighthouse keeper at Cape Wrath was looking landwards through a telescope and observed that "a belt of the atmosphere appeared to be land and sea". It seemed to him that what he saw was a perfect representation of the whole of the coast-line from Cape Wrath to Dunnet Head, "an exact replica of what would have been seen from a distance of 10 miles out at sea". It is admitted, however, that "Cape Wrath itself was rather indistinct". Bays were noticed, but nothing characteristic, like a lighthouse, is mentioned.

All that is clear is that the observer saw in the sky a strip of variable width which suggested land to him, and that below this strip there was an appearance which could be taken for the sea.

Now, it should be remembered that it is often exceedingly difficult to discriminate between the distant sea and the sky. I have had many opportunities for observing inferior mirage at sea. One sees a distant rock and its image as a single symmetrical object and sometimes it is very difficult to get rid of the impression that the sea surface is visible right up to this object, even though one is convinced that reflection is being produced by warm air. The illusion is closely akin to the illusion of water in the desert.

Superior mirage is not so frequently observed, but it is to be expected that it will also be accompanied sometimes by the illusion of water where there is no water. The phenomenon observed from Cape Wrath was, I believe, a case of superior mirage. The reflection of distant hills might well have an irregular outline reminiscent of capes and bays.

From the meteorological point of view this hypothesis presents no difficulty. Superior mirage is explained as due to the total reflection of light, or rather the continuous refraction of light, at an inversion of temperature, warm air lying above cold in horizontal layers. Inversions are by no means uncommon phenomena.

I hope that its author will forgive me for saying that the original explanation of the Cape Wrath mirage as due to repeated reflection, light being reflected twice at vertical surfaces of separation between hot and cold air, is, to my mind, quite untenable. In every observation of mirage, the angles which the incident beams of light make with the reflecting layer are very small. When reflection is from air, direct reflection, such as occurs when an observer looks at the image of his own back in a pair of mirrors, is out of the question. As, however, columns of hot air and cold air with a vertical boundary could not persist for a minute, there seems to be no possibility of actually testing the reflecting power of such a combination. The Cape Wrath phenomenon loses in interest by being docketed in the familiar category 'superior mirage', but that is, I fear, inevitable.

F. J. W. WHIPPLE.

Kew Observatory,
Richmond, Surrey, Dec. 10.

### Saxifrage Crosses.

R. O. WHYTE [1] makes the statement (repeated under Research Items in NATURE of Nov. 1, 1930, p. 702) that the hybrid *Saxifraga potternensis* arose by doubling of the chromosomes at the semiheterotypic division of the $F_1$ between *S. rosacea* and *S. granulata*.

Doubling of the chromosome number may occur either during the somatic divisions or by failure of reduction. These two methods have definite characteristics differentiating them in respect to seed production. If the doubling takes place during mitosis, the seed production of that portion which is 'tetraploid' will be equal to or greater than that of the derivative and following generations. On the other hand, if the doubling takes place through failure of reduction, the number of seeds produced with the doubled chromosome number is a function of the number of unreduced germ cells. The proportion of these is necessarily small, and they are distributed irregularly over the diploid parent plant. Consequently the amount of seed produced per plant is much reduced as compared with that of the tetraploid offspring. On the other hand, somatic doubling gives full fertility in the *one part* affected.

The following table of the seed production of the $F_1$ plant and of the derivative 'tetraploid' generations illustrates the above fact, and indicates that *S. potternensis* probably arose from an $F_1$ plant which

| | Seed Production of $F_1$ Plant. | Seed Production of derivative Generations (for comparison). |
|---|---|---|
| **Doubling by Failure of Reduction.** | | |
| *Raphanus* × *Brassica* [2] | 45 per plant | 30 per pod |
| *Phleum pratense* × *P. alpinum* [3] | 46 in 5 hundred thousand flowers. 4 germinated | Over 400 per plant. 90% germination |
| *Digitalis purpurea* × *D. ambigua* [4] | 200 seedlings from 2 plants | 400 per capsule |
| **Doubling in the Somatic Tissues.** | | |
| *Nicotiana glutinosa* × *N. tabacum* [5] | 155 per fruit | ? |
| *Primula kewensis* [6] | 30, 90, 180 } per fruit. 287 germinated | 122 plants per fruit |
| *Solanum Lycopersicum* [7] | 20 per fruit. 10 germinated | 20 per fruit |
| *Saxifraga rosacea* × *S. granulata* [1] | 422 per fruit | 85 per plant (average of 6 plants) |

had a tetraploid number of chromosomes in a portion at least of its somatic tissue, and that it did not, as reported, arise from a semiheterotypic division of the $F_1$ hybrid. Doubling of chromosomes in the somatic tissue is of rarer occurrence than the origin of tetraploids by failure of reduction, and *S. potternensis* is an important addition to the small list of such somatically doubled forms.

F. W. SANSOME.

John Innes Horticultural Institution,
Merton Park, London, S.W.19,
Dec. 10.

[1] Whyte, R. O., Sterility and Flower Abnormality in the Tetraploid *Saxifraga potternensis*, *J. Genet.*, **23**; 1930.
[2] Karpechenko, G. D., The Production of Polyploid Gametes in Hybrids, *Hereditas*, **9**; 1927.
[3] Gregor, J. W., and F. W. Sansome, Genetics of Wild Populations, II., *J. Genet.*, **23**; 1930.
[4] Buxton, B. H., and W. C. F. Newton, Hybrids of *Digitalis ambigua* and *D. purpurea*, their Fertility and Cytology, *J. Genet.*, **19**; 1928.
[5] Clausen, R. E., and T. H. Goodspeed, Interspecific Hybridisation in *Nicotiana*, II. A Tetraploid Glutinosa-tabacum Hybrid—an Experimental Verification of Winge's Hypothesis. *Genetics*, **10**; 1925.
[6] Information kindly supplied by Miss C. Pellew.
[7] Own notes.

## Curling.

WE have been interested in seeing the results of Prof. Harrington's experiments on the motion of a curling-stone on ice, published in the *Transactions of the Royal Society of Canada*, and referred to in his letter in NATURE of Sept. 6, p. 351, which show a considerable increase in the friction for small velocities. This must produce, towards the end of a run, a couple tending to increase the spin of the stone; and no doubt explains the fact that the velocity of rotation remains nearly constant until very near the end. But it has little or no bearing on what we have regarded as our main problem (see NATURE of Mar. 15, 1930, p. 408), namely, the production of the curvature of the path of a stone, at a time when the instantaneous centre of the motion may be at a distance of 2 feet or more from the centre of the stone, a considerable distance compared with the radius of the cup.

Any difference of friction at the two sides of the stone, due to difference of velocity, must then be small. But for our purpose it is not necessary to consider the magnitude of it, because it has no tendency to produce the curvature. To account for the observed curvature of the path of the centre of a stone, we must find a force of sufficient magnitude in the direction of the normal to the path. Resolution of the forces shows that a difference of friction at the two sides, if this is the only asymmetry apart from the spin, contributes nothing towards the production of the required force.

We think that the final twist of a stone about a point of the cup, which occasionally occurs as the stone is coming to rest, may be due to regelation. This satisfies the requirement of being a thing which may happen, but usually just fails to happen.

W. H. MACAULAY.

King's College, Cambridge.

G. E. SMITH.

Riverbank, Woodbridge, Dec. 9.

## The False Killer Dolphin.

ACCORDING to a note in NATURE (Dec. 6, 1930, p. 892), recording the stranding of a false killer dolphin (*Pseudorca crassidens*) in Ceylon in 1929, this species is "regarded as on the verge of extinction". The same statement has appeared elsewhere, but I venture to inquire whether there is any evidence that it is correct.

The false killer was originally described, as *Phocæna crassidens*, by Owen, in 1846, as the result of the examination of a skull and other bones which had been found, sub-fossil, in the Lincolnshire Fens. In 1861 a school of about a hundred individuals appeared in the Bay of Kiel. In 1862 specimens, probably belonging to the same school, were stranded on the Danish islands, and were investigated by Reinhardt, who established the genus *Pseudorca* for this species. About two years later a considerable number of false killers were recorded from Tasmania. Skulls from this herd were sent by Mr. W. L. Crowther, in 1864, to the Royal College of Surgeons; and other specimens were sent by the same donor to the British Museum and the University Museum of Zoology at Cambridge. The species has more recently been recorded from many distant localities, including Travancore, Florida, Argentina, Lower California, and Peru. In 1906 several hundred individuals were stranded in the Chatham Islands. The Dornoch Firth school, October 1927, is referred to in the note published in NATURE, as well as the large herd which was stranded near Cape Town in December 1928.

Most of the earlier records of the false killer as a recent species are given by Dr. J. R. Garrood (*Proc. Zool. Soc.*, p. 177, 1924), who described the very interesting discovery of two skeletons in the Cambridgeshire Fens in 1921.

Justification for the belief that *Pseudorca crassidens* is on the verge of extinction seems to be very slight, in view of the above facts. Mr. W. R. B. Oliver's statement (*Proc. Zool. Soc.*, p. 577, 1922) that this dolphin "is met with in large schools in New Zealand and Tasmanian waters" is in favour of this conclusion. May it not fairly be supposed that the false killer, like many other dolphins, is an inhabitant of the open sea, and that its apparent rarity is merely due to the fact that it is not often observed in the neighbourhood of the land?

SIDNEY F. HARMER.

Melbourn, Cambs, Dec. 12.

## Foaming of Beer.

PERHAPS some light may be thrown on the phenomena referred to by Dr. H. S. Rowell in his letters in NATURE of Sept. 20 and Dec. 13, by investigations carried out by B. Shen, George King, and myself a number of years ago (*J. Chem. Soc.*, p. 1313, 1911; p. 1170, 1913).

While the stability of the foam will depend mainly on surface tension and viscosity, the size of 'head' formed under the ordinary conditions of pouring out a glass of beer will depend mainly on the rate of evolution of carbon dioxide from its supersaturated solution in the beer. This rate of evolution varies with the degree of supersaturation, which, in turn, depends on the nature of the beer and the method of its manufacture. A pale ale, for example, was found to evolve carbon dioxide more rapidly than a stout or export beer. The rate of evolution, moreover, depends greatly on the walls of the containing vessel and their effectiveness in supplying gas 'nuclei' to start the evolution of carbon dioxide.

Traces of grease on the surface of the glass are very effective in promoting the escape of gas, and I think that the difference in 'head' obtained with a dry and wet glass is probably due to this fact. Traces of grease are scarcely likely to be wanting from the surface of glasses dried under refreshment-room conditions. In the case of a wet glass, there will be an absence of air bubbles on the surface to act as nuclei. One cannot claim that the factors mentioned are adequate to account for all the phenomena, but they are probably the main factors involved.

ALEX. FINDLAY.

Department of Chemistry,
University of Aberdeen, Dec. 13.

## Entomology and the British Empire.

THE meeting of the Third Imperial Entomological Conference, which took place in London on June 17-27 last, has been regarded as a suitable occasion for a kind of stock-taking of what is being done towards combating insect losses in the British Empire. The Imperial Bureau (now Institute) of Entomology has done a useful service in bringing together data on this subject in an accessible and convenient form.[1] The criterion adopted is the amount of annual expenditure devoted to salaries, research, and general administration in each part of the Empire. While this method of treatment is an admirable one in many respects, it is obvious that expenditure respecting entomology incurred in one part of the Empire may not be strictly comparable with that incurred in another part: local needs, revenue, costs of living, and other factors vary so much in these respects. Due allowance needs, therefore, to be taken into account as regards differences of this nature.

When the losses due to insect depredations in the British Empire are represented in man-power, we arrive at some striking conclusions. If it be admitted that 10 per cent is a conservative figure at which losses due to agricultural pests alone may be placed, it would seem that one-tenth of the human effort on such a basic industry is dissipated by insect enemies. Taking the population of the Empire at about 450 millions, it may be assumed that an additional population of 45,000,000 could (if it were possible to eliminate insect pests) be supported by the same effort as that now exerted. It is estimated that in the Indian Empire, for example, the losses in 1921 due to crop and forest pests alone reached the huge total of £136,000,000, while the death-roll among the population due to insect-borne diseases was stated to be about 1,600,000 persons annually. In Canada about £30,000,000 is lost every year through insect depredations among field and fruit crops and to forests. In South Africa one pest, the maize stalk borer (*Busseola fusca*), incurred losses of about £2,750,000 in a single year. Figures of this kind are, naturally, only estimates, but they serve to drive home how great these losses are. The losses to human communities by death or ill-health arising from insect-borne agents of disease are most likely even greater than those occasioned to agriculture, but it would be exceedingly difficult to assess them.

A comparison of the effort made by the British Empire in coping with its entomological problems and that made by the United States is of considerable interest. The British Empire, with an estimated revenue of £1,400,000,000, devotes, in round figures, some £570,000 annually to work of this character, or 0·03 per cent of its income. There are fewer than three hundred[2] professional entomologists employed among a population which greatly exceeds 400,000,000 souls. The United States, with a population of about 106,000,000, spends an approximate sum of £2,000,000 (State and Federal allocations) annually, which works out at 0·25 per cent of its revenue of £800,000,000. It employs, moreover, not less than five hundred entomologists. The question is raised as to whether the British Empire can be justly claimed to be bearing its share in the world problems of insect control. On the basis of the United States' expenditure, that of the British Empire should be nearly six times as much as it actually is. Although insect problems in the United States are on a vast scale, they are more restricted in variety, and that country is faced with no responsibility so great as the tsetse fly problem in Africa and its immense toll of human life. The responsibility of an Empire so scattered, and concerned with so great a range of crops, peoples, and pests, would, therefore, appear to be a heavier one than that shouldered by the United States.

The varied responsibilities of the Imperial Bureau of Entomology have led to its outgrowing the original conception with which it was founded in 1913. Its recent change of title to that of "Imperial Institute of Entomology" indicates more adequately the scope of its activity and influence. The growth of its manifold activities are briefly dealt with in the Report of the Third Imperial Entomological Conference.[3] In recent years, for example, insects have been coming in at the rate of more than 5000 a month, and during the past five years very nearly 34,000 specific identifications have been issued. Despite the valuable aid given in this field by the staff of the British Museum, thousands of specimens are in hand which cannot yet be dealt with. There is urgent need for a competent dipterist on the staff: abstracting work is increasing beyond the means available and an additional preparator is required to cope with the influx of material. The rapidly increasing demands made upon the new Parasite Laboratory at Farnham Royal involve a further responsibility.

The higher salaries attached to official entomological appointments in many parts of the British Empire—but by no means all—compare favourably with those of other specialists in kindred posts. A perusal of the brochure[1] before us shows that there are two entomological posts of £2000 per annum or above; eight posts attaining a maximum salary of £1500 or above, but less than £2000 per annum; twenty-nine posts the emoluments of which attain £1000 per annum or above, but are less than £1500 per annum; and twenty-six posts the maximum salaries of which range between £900 and £984 per annum.* On the headquarters staff of the Imperial Institute of Entomology, for example, there are three posts exceeding £1000 per annum, one post of £1000 per annum, and four posts rising to a maximum of £950 per annum. The salaries of entomologists attached to the Advisory and Research Services of the English Ministry of Agriculture, on the other hand, are on a markedly inferior scale. There are, at present, only three entomologists in the highest grade of the services, and their maximum salaries are attained at £830 per annum (which sum is consolidated and does not carry cost of living

* These figures do not include posts at the British Museum (Nat. Hist.) or at any English university or kindred institution.

bonus). This disparity seems even more striking when it is pointed out that the estimated mean loss by one single species of insect—the frit fly—amounts to nearly 15,000,000 bushels of oats per annum in England.

At the present time, the British Empire lacks a sufficiency of young, properly trained entomologists of the right type. The causes of this shortage are various, and, among them, the number of new posts established in recent years has been an important factor. If developments are to progress at the same rate as hitherto, the matter of recruitment seems likely to become a problem of increasing difficulty.

[1] "A Summary of Data Relating to Economic Entomology in the British Empire." Prepared for The Third Imperial Entomological Conference by Dr. S. A. Neave. (London: The Imperial Bureau of Entomology.) 2*s*. 6*d*. net.

[2] "A List of the Entomologists employed in the British Empire." Prepared for The Third Imperial Entomological Conference. (London: The Imperial Bureau of Entomology, 1930.) 2*s*. 6*d*.

[3] "Report of the Third Imperial Entomological Conference, 17th-27th June 1930." (London: The Imperial Institute of Entomology, 1930.) 2*s*. net.

## Cancer Research.

SEVERAL of the papers in the Ninth Scientific Report on the Investigations of the Imperial Cancer Research Fund (London: Taylor and Francis, 1930. 20s.) deal with the fowl tumours which can be transmitted from bird to bird by tumour extracts filtered through filters so fine that the infective filtrate contains nothing large enough to be clearly visible under the highest powers of the microscope. The nature of this 'agent' is the most crucial question of current theoretical cancer research. It may, on one hand, be analogous to the invisible viruses which are associated with so many infectious diseases in animals and plants; it may, on the other hand, be a special example of the chemical substances arising from the disintegration or injury of cells which promote tissue growth. The 'agent' by which transmission is effected may, in short, arise in the cancer cell or may come into the body from outside.

The solution of this problem is, too, of more general importance, for the answer, whichever it is, cannot fail to influence our opinions as to the essential nature of the infectious viruses and the bacteriophage. So far, these 'filterable' tumours are known only in birds. Dr. J. A. Murray and Dr. A. M. Begg give careful discriptions of two; one is judged to be an endothelioma, the other is a slow-growing fibro-sarcoma. Both appear to be quite different structurally from the well-known Rous tumour, though it does not seem to be quite impossible that all are phases of the same kind of tumour. Dr. W. Cramer has reinvestigated the possibility of transmitting rat and mouse tumours by tissue which had been repeatedly frozen and thawed, and in which all the cells were presumably and, so far as could be ascertained by tissue cultures, actually dead. With carcinoma the inoculations were uniformly negative; some of the sarcoma preparations gave rise to fresh tumours and rapidly lost their infectivity on incubation or washing. In another paper Dr. Cramer and Mr. H. G. Crabtree point out that positive results are not always obtained with frozen preparations of the Rous tumour, which is generally regarded as the typical filterable bird tumour. The results, therefore, do not show conclusively that mammalian tumours can be transmitted from one animal to another without the intervention of living cells, but they certainly suggest that from some such tumours evidence may be obtained of a labile 'agent' similar to the 'agent' of the bird tumours.

Three other papers, by Mr. H. G. Crabtree, follow out the work of Warburg on tissue respiration. The most interesting discovery is that the epithelial overgrowths of fowl-pox and vaccinia have an active metabolism of the type which has been supposed to be characteristic of malignant tumours. This makes it more unlikely even than before that any alteration in cellular metabolism can be the cause of cancer.

Dr. R. J. Ludford discusses critically another theory of the origin of cancer, which supposes that malignancy may be due to chromosomal mutations in somatic cells—an idea specially associated with Boveri. It is truly a remarkable fact that tumours practically always breed true: that is, though a tumour may have little structural resemblance to the tissue from which it arises, it maintains a characteristic structure of its own throughout its history, which with some animal tumours is now a very long one, involving large numbers of animals. It is also true that various irregularities in mitosis and in the chromosomes are found in malignant tumours. But beyond these two facts there is really nothing to indicate somatic mutations as the basis of malignancy, and it is difficult to see how more conclusive evidence could be obtained.

It is the fundamental property of malignant tumours that they are functionally isolated from the rest of the body and take no part in the co-ordinated activities of its various organs and tissues: they live for themselves alone. Hence they would not be expected to have either blood vessels or nerves of their own. It has been stated from time to time that this generalisation is not universally applicable, and that nerves, for example, are sometimes present. Dr. Ludford has carefully worked over the matter in a number of mouse tumours and cannot assure himself that tumours cells are ever innervated: the nerves sometimes found in the substance of tumours have probably been accidentally incorporated in the new growth in the course of its invasion of normal tissue.

Dr. J. A. Murray and Dr. L. Foulds have examined in various ways the proposition that the development of one tumour in an animal tends to inhibit the appearance of another, and Dr. Cramer discusses another aspect of the same problem. There is no doubt some immunity, partly general and partly local, but attempts to define the facts more precisely appear to meet with the most embarrassing vagaries of experimental results. There must be some key point in the matter which has not yet been identified.

## Obituary.

THE RIGHT HON. LORD MELCHETT, P.C., F.R.S.

ALFRED MORITZ MOND was born on Oct. 23, 1868, at Farnworth, in Lancashire, within smell of the famous alkali works. His father, Dr. Ludwig Mond, was at that time a chemist at the Hutchinson Alkali Works; it was not until five years later that he founded the firm of Brunner Mond in partnership with John Brunner, an accountant at Hutchinson's. Mrs. Ludwig Mond has described to me the Farnworth days as very happy ones—they preceded some very strenuous times at Winnington.

Alfred Mond in his lifetime had thus seen the founding of the B.M. Works, as it is familiarly called in the north of England, the overcoming by strenuous effort of its early difficulties, both technical and financial, its growth to become the most important chemical firm in Britain, and its disappearance as an entity on absorption into Imperial Chemical Industries, Ltd. Although he was associated closely with the management of the firm in early days, after the retirement to London and death of Ludwig Mond the active management at Winnington passed into the hands of Sir John Brunner and his two sons, and Alfred Mond's energies were largely spent in other directions.

Educated at Cheltenham and the Universities of Cambridge and Edinburgh, he was called to the Bar via the Inner Temple and practised for a time on the North Wales and Cheshire Circuit before entering the family business at Winnington. Ludwig Mond had interested himself in two other chemical ventures, one a process of refining nickel by means of the carbonyl it forms with carbon monoxide, and the other the well-known Mond gas producer. Both required skilled handling to carry them to practical and commercial success, and as the Brunners stood aside from them, this work fell on Alfred and his brother Robert and cousin Emil.

By 1906 Alfred Mond found time to enter politics, and was elected for Chester as Liberal member in that year. For some years politics more and more engaged his attention, and it was not until about 1925 that he seriously returned to the chemical industry, becoming chairman of Brunner Mond at a moment of internal crisis and throwing himself in characteristic manner whole-heartedly into its management. Imbued with an intimate knowledge of world conditions and grasping the totally different state of affairs which the War had brought about in industry both at home and abroad, he set himself to bring about what is now known as rationalisation in the businesses in which he had authority. The three great combines, Imperial Chemical Industries, Amalgamated Anthracite Collieries, and International Nickel, have resulted from his efforts, and their bigness and the courage displayed in their creation have made Mond's name known throughout the world. All are too young as yet to have proved the wisdom of such rationalisation, but at least it is known to the scientific world that Alfred Mond's leadership involved recognition of the value and the utility of science in industry to an extent hitherto quite unknown in Great Britain.

Imperial Chemical Industries from the first has set out to foster and encourage the development of schools of research at the universities, so that I.C.I. might always find an adequate supply of highly-trained chemists available; it has bettered the conditions of employment of chemists at its works and brought into being at its individual factories research staffs of a magnitude and a capacity equal to that of any organisation in the world. If what we believe of the powers of the scientific worker in industry is true, no better means could have been taken to ensure from the outset the prosperity of Britain's greatest manufacturing concern. In Mond's own words, "my belief is that the chemist will solve the present economic and industrial problems of the world".

To understand Mond himself, one must know something of the altogether exceptional characters of his father, a scientific worker and an inventor first and last, and of his mother, a woman of unique artistic charm and vivacity and surprising brilliance of intellect. He thus inherited a feeling for science and an appreciation for art which have at times prevailed over those qualities, requisite for a successful politician of the fighting type and an industrialist and financial magnate of the first order, by which the world knew and judged him and with which he was so richly endowed.

As a consequence Mond was highly flattered by his election to the Royal Society, and he welcomed with pride the honorary degrees bestowed on him by St. Andrews and Manchester; he took active interest in a number of scientific societies even when at his busiest in other ways, becoming, for example, founder president of the Institute of Fuel, president of the British Science Guild, and was designated president of the Society of Chemical Industry for its jubilee meeting this year, besides being always ready to lecture or otherwise help scientific institutions.

In industry on the technical side, Mond had the widest possible views and great courage; he was able to grasp immediately the merits, demerits, and potentialities of the schemes put before him and, once satisfied, to ensure that they were immediately given practical effect. Until recently it was as a politician that England knew him best, and no man has gone further in politics under greater personal handicaps. Latterly it is as a politician, a leader of industry and an Empire-builder combined in one man that he has won notoriety and fame. He had the gift of going to the root of any question, grasping the realities and unmasking the shams—his extraordinary power of quick thinking enabled him to see round the corner of the problems of the day. Underlying most of his public utterances it is possible to discern the spirit of science, and it is for the electors of the future to see that more men of his type represent them in Parliament. Alfred Mond made use to the utmost of those gifts which he acquired by heredity

and by training, and his boundless energy enabled him to attain the very top in every field of endeavour: he has passed away at the very height of his career. His death on Dec. 27 last is a loss that science as well as Great Britain can ill afford.

E. F. ARMSTRONG.

## SIR FRANCIS OGILVIE, C.B.

SIR FRANCIS GRANT OGILVIE, who died suddenly at Edinburgh on Dec. 14, at the age of seventy-two years, came of a family which had long been honourably associated with scholastic and scientific occupation. He graduated M.A. at Aberdeen and B.Sc. at Edinburgh, and in 1886 was appointed Principal of the Heriot-Watt College, Edinburgh. In 1900, he became Director of the Royal Scottish Museum of Science and Art at Edinburgh, and thus began that activity in museum administration which occupied the greater part of his working life.

Three years later Ogilvie was appointed Principal Assistant Secretary for Technology and Higher Education in Science and Art at the Board of Education, and there began that close connexion with the museums and scientific institutions at South Kensington which continued for many years. At that time, in his position under the Board of Education, matters relating to the Victoria and Albert Museum (by which title the South Kensington Museum had been known since 1898), the Royal College of Science, and the Royal School of Mines came before him, and consequently, when the scheme for forming the Imperial College of Science and Technology from the Royal College of Science, the Royal School of Mines, and the City and Guilds Engineering College was under consideration, the working out of the details and the drafting of proposals mainly fell to him to carry out.

By 1908 the art collections of the old South Kensington Museum were safely housed in the new buildings of the Victoria and Albert Museum, but those illustrating science and engineering still remained in a part of the buildings which had originally been constructed for the Exhibition of 1862. On the initiative of Sir Henry Roscoe an influential and representative body of scientific men and leaders of industry brought to the notice of the Government the urgent need of adequate accommodation for these collections, and for their active development; with the result that in 1910 a Departmental Committee, under the chairmanship of Sir Hugh Bell, was appointed by the President of the Board of Education to consider and report upon the Science Museum and the Museum of Geology in Jermyn Street, Ogilvie being the secretary of the Committee. In this capacity he got together the evidence for the Committee, and its report, which was published in 1911, set forth clearly the lines on which the Science Museum might advantageously be developed, and on which it has in fact been developed since then, although the War delayed this until he had ceased to be Director.

On the death of Mr. W. Last in 1911, Ogilvie was appointed Director of the Science Museum, retaining also a certain administrative supervision of the Geological Museum and Survey; but the War put a stop to the construction of the new Museum buildings which the Committee had recommended and to the development which they had approved. He then became Assistant Controller of the Trench Warfare Department and then later of the Chemical Warfare Department at the Ministry of Munitions, so that his reorganisation of the Museum had to be postponed. Shortly after the conclusion of peace he became Principal Assistant Secretary to the Department of Scientific and Industrial Research from 1920 until 1922, when he retired.

During his twenty years' work Ogilvie had acquired an unrivalled knowledge of all that had taken place in the course of the establishment and development of the various scientific and educational institutions which had grown up at South Kensington, and this was of great value to the governing bodies of many of them on which he served, namely, as a governor of the Imperial College of Science and Technology, as a commissioner of the Exhibition of 1851, and as a member of the Senate of the University of London.

He was also the president of the Museums Association in 1927–28, and gave valuable evidence before the Royal Commission on National Museums and Galleries. He held the chairmanship of the Geological Survey Board from 1920 until last year.

## PROF. FRANTIŠEK WALD.

THE prominent Czech chemist, Prof. František (Franz) Wald, formerly professor of physico-chemistry and metallurgy in the Czech Polytechnic High School of Prague, died on Oct. 19 in Moravská Ostrava-Vítkovice, the well-known ironworks. He was born in Brandýsek, near Kladno, and after studying in the German Polytechnic High School of Prague, whence he brought no theoretical bias, he devoted himself to technical chemistry, being for many years chief of the analytical and research laboratory of the ironworks in Kladno.

While there, Wald published several interesting papers on the philosophical points of theoretical chemistry, especially "Die Energie und ihre Entwertung" (1889). Other of his important papers on thermodynamics were published in the *Listy Chemické* and in the *Zeitschrift für physikalische Chemie*. His paper on the fundamental chemical ideas was read at the Philosophical Congress in Paris (1900), and was reprinted, together with his other papers, in Ostwald's *Annalen der Naturphilosophie*. Owing to the originality and depth of his ideas, Wald was nominated in 1908 ordinary professor in the Czech Polytechnic High School, in which he was active up to the year 1927.

Space does not permit me to give all the titles of Wald's philosophical publications, and it is also impossible to give a short account of his ideas, which were very original and therefore very different from what the great majority of chemists regard

as the fundamental notions of our science. First of all, Wald was an 'anti-atomist', and so Ostwald, who was at that time (1901) 'anti-atomist' himself, included him in his well-known series of "great men of science". The doctrine of Wald is purely phenomenalistic, that is, it is devoid of any hypothesis concerning the reality of processes which would explain observed phenomena. He worked out a theory of chemical stoichiometry based on the empirical laws of constant proportions, and, accepting the part that the composition of substances varies discontinuously, he was able to deduce the law of multiple proportions. In his deductions Wald disregarded the difference between simple and compound bodies (that is, our elements and compounds), a chemical unit of water being, in its interior, just as homogeneous as is that of hydrogen or oxygen. My objections, brought forward in a special meeting and based on the specific heats of gases and liquids, were disregarded by him; all 'bodies' were merely 'pure phases' to him, and he was original in explaining them by the use of the first up to the fifth dimension—of course, as said above, without the use of the atomic theory.

Wald also enlarged Gibbs's ideas of phases, and deduced a modified phase rule in a simple and original manner. To the question *cui bono?* the practical side of scientific chemistry will give no answer, but from the point of view of chemical philosophy his ideas may be regarded as splendid, something analogous to the views of the great philosopher Heraclitus, and they really both require 'a good swimmer'.

BOHUSLAV BRAUNER.

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WE regret to announce the following deaths:

Prof. A. A. T. Brachet, For.Mem.R.S., Rector of the University of Brussels and director of the Laboratory of Embryology of the Faculty of Medicine in the University, aged sixty-one years.

Major E. A. FitzGerald, author of "Climbs in the New Zealand Alps" and "The Highest Andes", on Jan. 2, aged fifty-nine years.

Prof. Hans Kniep, director of the Institute of Plant Physiology at Berlin-Dahlem, on Nov. 17, aged forty-nine years.

Mr. H. A. Lowe, honorary fellow of the Textile Institute, who discovered in 1899 the process of 'tensioning' mercerised cotton fibre, on Dec. 26.

Prof. S. G. Navashin, of the Botanic Garden, Tiflis, Georgia, who was a foreign member of the Linnean Society of London, on Dec. 10, aged seventy-three years.

Prof. T. Wibberley, formerly Harrington professor of agricultural research, University College, Cork, who was known for his work on the breeding and introduction of new varieties of oats and wheat, on Dec. 22, aged fifty years.

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## News and Views.

THE New Year's Honours List contains the names of the following men of science and others associated with scientific work: *Baron:* Sir Ernest Rutherford, chairman of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research, and until recently president of the Royal Society. *Baronets:* Sir John Rose Bradford, president of the Royal College of Physicians; Sir Richard Gregory, editor of NATURE. *K.C.B.:* Dr. F. E. Smith, secretary to the Committee of the Privy Council for Scientific and Industrial Research. *K.C.M.G.:* Hon. Sir Walter Hartwell James, Chancellor of the University of Western Australia; Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew. *Knights:* Prof. C. R. Beazley, professor of medieval and modern history in the University of Birmingham; Mr. W. W. Hornell, Vice-Chancellor of Hong Kong University; Dr. E. G. Graham Little, member of Senate of the University of London since 1906; Dr. R. W. Livingstone, Vice-Chancellor of the Queen's University, Belfast. *C.B.:* Mr. R. L. Hobson, Keeper of Ceramics and Ethnography, British Museum. *C.I.E.:* Lieut.-Col. H. W. Acton, director of the School of Tropical Medicine and Hygiene, Calcutta. *C.B.E.:* Miss Caroline Haslett, director of the Electrical Association for Women and secretary of the Women's Engineering Society (Inc.); Miss Edith Helen Major, Mistress of Girton College, Cambridge; Miss Louisa Martindale, president of the Medical Women's Federation and vice-president of the Medical Women's International Association; Prof. Sidney Russ, professor of physics, Medical School, Middlesex Hospital, for work in connexion with radium; Mr. J. J. Shaw, secretary to the Seismological Investigations Committee of the British Association. *O.B.E.:* Dr. W. M. Aders, lately economic biologist, Zanzibar; Mr. R. S. Capon, Superintendent of Scientific Research, Royal Aircraft Establishment, Air Ministry; Mr. J. M. Carey, H.M. Divisional Inspector of Mines; Mr. J. S. Corbett, secretary of the Empire Forestry Association; Mr. A. de V. Wade, principal assistant in the Native Affairs Department, Kenya. *M.B.E.:* Dr. V. E. Wilkins, Assistant Principal, Ministry of Agriculture and Fisheries.

THE inclusion of the name of Sir Ernest Rutherford confers on the New Year's Honours List a quite unusual distinction. One of the earliest of the distinguished band of research students who were attracted to Cambridge by the discoveries of Sir J. J. Thomson, he rapidly made his mark on physics. Incidentally he was one of the earlier workers in wireless telegraphy, but it is with the science of radioactivity that his name has become inseparably linked. Not only was he the first to recognise the complex nature of the radiations given out by radioactive substances, but he was also the first to unravel the knotty problems presented by the decay curves of these substances, and to enunciate the simple laws governing their disintegration. In a few years he covered this field so completely that little was left for subsequent research save the filling in of details and the adjustment of a few constants. If the value of a scientific theory is to be judged by its fertility, Rutherford's publication of his nuclear theory of the

atom must be regarded as one of the greater landmarks of science. The conception of the atom as a miniature solar system having a central massive positively charged sun around which the electrons circulate like planets, was a bold one, as it had been demonstrated beyond doubt that a system of this type must be unstable on the generally accepted laws of electro-dynamics.

BY simple but cogent arguments, however, Rutherford succeeded in demonstrating that the planetary structure of the atom was the only one consistent with experiment, and a whole mass of unexplained and apparently unconnected observations crystallised into coherence around the new idea. The theoretical work of Bohr and his successors, and the consequent rise of the new spectroscopy, were the natural and inevitable outcome of this new conception of the atom. Leaving the problem of the arrangement of the electronic satellites to others, Sir Ernest has more recently launched a mass attack on the problem of the structure of the nucleus itself. The difficulties in the way of determining the structure of a particle so minute that a million million of them could lie along a line a centimetre or so long are sufficiently obvious, but so skilfully has Sir Ernest directed the attack that a solution of the problem may be confidently expected in the very near future. It is announced that Sir Ernest is taking the title of Lord Rutherford, and scientific workers everywhere will wish him health and long life to enjoy the title which he adorns.

THE connexion of holders of the highest office in the Royal Society with the peerage of Great Britain provides some interesting reminiscences. The Society began its presidency, in fact (after incorporation on July 15, 1662), with a peer of the realm, namely, Viscount Brouncker, who held office from April 1663 until Nov. 30, 1677. He was a mathematician—the first to introduce continued fractions. Huygens, in a letter to Oldenburg, congratulated the Society on having so eminent a mathematician for its president as Lord Brouncker; and Sprat the historian, his contemporary, says, "This office was annually renewed to him by election, out of the true judgment which the Society made of his great abilities in all natural and especially mathematical knowledge". From Nov. 30, 1686, until the anniversary meeting of 1689, the Earl of Carbery was president. He succeeded Pepys, and in the year following the death of Charles II., the founder. Another peer was then chosen—the Earl of Pembroke; but his tenure lasted one year only. He was three times married; too much occupied apparently to give attention to the Society, for his name does not appear as presiding, on any one occasion, at the council or ordinary meetings. After two commoners had occupied the chair (Evelyn had twice declined), John, Lord Somers, Lord Chancellor, was unanimously elected president, the mantle devolving, moreover, on a bachelor. A great and powerful figure, he filled the chair for ten years, presiding regularly over the council and meetings.

LORD SOMERS resigned the presidency of the Royal Society to Sir Isaac Newton, who was followed by two other commoners, Sloane and Folkes. The latter was succeeded in 1753 by the Earl of Macclesfield, who held office for twelve years. He was mainly instrumental in procuring the change of style in 1752. His interests lay in astronomy and chemistry. Altogether Lord Macclesfield was a brilliant personality in the Society's affairs, and, by the way, an upholder of pomp and ceremony. He died in office on Mar. 17, 1764. The Earl of Morton succeeded him, a distinguished patron of science. In 1746 he had visited France and was for a time imprisoned in the Bastille. Like the former president, he died in office, on Oct. 12, 1768. Following the foregoing particular social attachments, seven commoners were successively elected presidents of the Royal Society, down to 1830, when the Duke of Sussex assumed the chair. Afterwards, in order, were the Marquess of Northampton, the Earl of Rosse, and Lord Wrottesley. Reverting to previous practice, eight commoners were in turn elected, all highly distinguished in various departments of science. The eighth, Sir William Thomson, elected Nov. 30, 1890, was made a peer (Lord Kelvin) whilst in office. He was succeeded by Sir Joseph Lister, who was raised to the peerage (1897) whilst president of the Royal Society. A commoner then took office (Huggins), and he was succeeded in the presidency by John William Strutt, Lord Rayleigh, who served from Nov. 30, 1905, until Nov. 30, 1908. Since that date no president has been raised to the peerage during his term of office.

MAJOR A. G. CHURCH'S action in voting against the Government in the division on the Dyestuffs Act has resulted in his resignation of his office as Parliamentary Private Secretary to Mr. Tom Shaw, Secretary of State for War. In a statement to the Press following his resignation, Major Church said that Great Britain is more dependent on the progress of science and the application of science to industry than any other country, and that prominent members of the Government have done service to this dependence in their public utterances. Nevertheless, although most of the professional scientific bodies in the country, including the Association of Scientific Workers, of which he was general secretary, have expressed the opinion that the Dyestuffs Act should not be allowed to lapse until after the fullest inquiry has been made into the possible effects of any such course on the progress of the dyestuffs and allied industries and on organic chemical research, and although the experts in the Government Defence Services advocated the continuance of the Act, the Government decided to allow it to lapse, ostensibly in the interests of the textile trades. This decision was reached without consultation with the representative scientific bodies concerned, and the Government did not even take the obvious course of referring the matter either to its own Advisory Council for Scientific and Industrial Research, or its Economic Advisory Council, or the Medical Research Council, or the Committee of Civil Research; in other words, the Government paid no regard to scientific opinion. Major Church contrasted the Government's attitude towards scientific workers with its attitude towards the executive of the Miners'

Federation and the coal-owners before and during the passage of the Coal Bill; and towards local education authorities, the teachers' organisations, and the religious bodies over the Education Bill. Apparently, he said, in spite of the incalculable value of the work of men of science and the effect of science on the body politic, the Government felt they could be ignored because numerically they are insignificant and presumably their political influence negligible. He voted against the Government deliberately in order to focus attention upon what he regarded as a grave fault of Government.

FRIENDS of Dr. C. E. P. Brooks will be glad to hear of the award to him of the Buchan Prize of the Royal Meteorological Society in recognition of his numerous researches in the field of meteorology and climatology. Dr. Brooks is distinguished as the author of a large number of papers contributed to the *Quarterly Journal of the Royal Meteorological Society* and to the *Meteorological Magazine*, a number of official memoirs issued by the Meteorological Office, as well as of several books. These works embrace such topics as the distribution of the weather elements in different parts of the globe and their correlation, sunspots and lake-levels, forests and rainfall, weather periodicities, and British floods and droughts, with a large amount of statistical material invaluable to students of climate. But Dr. Brooks's most important scientific work is in the field of palæo-climatology, wherein he has enlarged our ideas greatly, and in this field his book published a few years ago on "Climate through the Ages" occupies a prominent place in the very wide literature on the subject. It is obvious that certainty about the past climates of this planet cannot be reached, but probability can; and it is not too much to say that Dr. Brooks has given us a good indication not only of the major phases of climate which the earth has gone through in the geological past but also the minor phases that have preceded the present phase in our own islands. Dr. Brooks's cardinal principle that redistributions of land and water are quite capable of bringing about the changes of climate that are inferred to have taken place has been criticised, but it is probable that most climatologists will support this principle, particularly in cases where accumulations of ice and snow enter to complicate the situation. Of the formidable power possessed by ice and snow to engender further cold Dr. Brooks himself has provided a mathematical demonstration.

THE Melchett Medal of the Institute of Fuel, for the year 1930, the first to be awarded, will be presented to Dr. Kurt Rummel, of the Wärmestelle, Düsseldorf, at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, on Friday evening, Jan. 23, at 6.30. The Melchett Medal was instituted by the founder-president, the late Lord Melchett, who offered the Institute a few months ago a sum of money sufficient to found the medal in perpetuity. It is to be awarded annually, "to such person, whether a member of the Institute of Fuel or otherwise, as in the opinion of the Council has done either original research, or professional, administrative, or constructive work of an outstanding character, involving the scientific preparation or use of fuel, provided the results of such work have been made available within recent date for the benefit of the community". Dr. Rummel was born on July 1, 1878, at Aschaffenburg, Bavaria. In 1919, he took charge of the Wärmestelle, Düsseldorf, of the Verein Deutscher Eisenhüttenleute. At that period the contraction of the German coke-producing areas under the terms of the Treaty of Versailles and the diminishing tonnage in the German mines in the producing areas led to a great scarcity of fuel for industrial purposes, and the Wärmestelle was formed primarily for improving fuel economy in iron and steel practice. Much of the work of the Wärmestelle, done under Dr. Rummel's guidance, is of fundamental importance, and a wide range of papers embracing investigations dealing with problems relating to coke oven technology, blast furnace, open hearth, and rolling mill practice has been published. Members of all scientific and technical societies are cordially invited to attend the presentation and lecture.

THE ability of the electric arc to reproduce speech when the current from a telephone transmitter is superimposed upon it was demonstrated many years ago, and this peculiar form of loud-speaker is well known as the 'speaking arc'. On Jan. 2, Mr. J. L. Baird demonstrated to a representative of NATURE that under proper conditions the arc can be made to follow the normal rapid modulations of television. A small arc lamp, upon which the television current had been superimposed, was placed behind an aperture in a diaphragm, the light from the arc being concentrated on the aperture by means of a lens. A second lens was adjusted between the aperture and a revolving Weiller mirror drum with thirty mirrors, the lens and drum being arranged so that an image of the aperture traverses a screen of white board, forming a television image, the image being transmitted from the standard Baird transmitter used in the B.B.C. daily transmissions. The detail and definition of the received image were comparable to that received on the standard commercial television receiver, and the brilliance of illumination was remarkable. This demonstration of the successful modulation of the arc with television signals appears to open up considerable possibilities. The chief difficulty met with in the projection of television images on large screens has been the obtaining of a modulated light source of sufficient brilliancy. Two methods have been used: the neon tube and the Kerr cell. The brilliance of the neon tube is not great; the Kerr cell gives more brilliant results, but it also has definite limitations. With the Kerr cell system, light from a powerful arc lamp is passed through two Nicol prisms, between which is a vessel containing two adjacent electrodes immersed in nitro-benzene. The television signals are impressed upon the electrodes and vary the plane of polarisation, and thus the amount of light passing. The efficiency of this device is very small; 50 per cent of the light is lost through polarisation, and

further losses are entailed in passing through the prisms. By modulating the light of the arc directly, these losses are obviated, and the television arc would therefore appear to have a useful future.

A PHYSICAL conception of the end of the world formed the basis of the presidential address delivered by Sir Arthur Eddington on Jan. 5 before the Mathematical Association at the London Day Training College. The world, or space-time as Sir Arthur Eddington called it, was shown to be a four-dimensional continuum, thus offering a choice of many directions to take in order to look for the end. From a space dimensional point of view the world is spherical; but then the time dimension must be considered too. This consideration formed the basis of the lecture. Entropy, that is, the measure of the disorganisation of a system, was suggested by Sir Arthur as being the fundamental theme upon which to work. Despite the phenomenon of evolution, whereby all types of systems have become and are still growing more highly organised, there is, on the whole, a general loss of organisation. Such ever-increasing organisation will perforce swallow up finally the organisation due to evolution. Sir Arthur Eddington emphasised this conception, showing that finally the whole universe will reach a state of complete disorganisation, a uniform mass in thermodynamic equilibrium. This would be the end of the world. He considered finally what such an end would be like; but, realising that the doctrine of spherical space and the results connected with the expansion of the universe have become modified, he merely made one of several possible suggestions. Taking the widely supported hypothesis that matter slowly changes into radiation, he suggested that the world will finally become a ball of radiation, growing ever larger, with the radiation becoming thinner and assuming longer wave-lengths. About every 1,500,000,000 years the radius would be doubled, and this increase would carry on in geometrical progression.

ACCORDING to an announcement in the *Times* of Dec. 31, the collection of antiquities from the Roman Wall, formed by the well-known Northumbrian antiquarian, John Clayton of Chesters (1792–1890), has been conveyed to a body of trustees for permanent preservation in Northumberland. The collection will continue to be housed in the building erected for it in 1896 by Mr. G. N. Clayton, subject to the goodwill of the present owner of the Chesters estate, Mr. John Maurice Clayton, the donor to the National Trust of the fort of Borovicus (Housesteads), to whose generosity the present gift to the nation is due. The first body of trustees includes Sir George Macdonald, Mr. Robert Holland Martin, Mr. R. G. Collingwood, Mr. R. Carr Bosanquet, and Mr. Parker Brewis. The collection is well known to archæologists as the finest assemblage of Romano-British antiquities in the north of England and a most important source of information for the history of the Roman occupation of Britain. It includes a large variety of objects in bronze, pottery, and other materials, as well as more than 300 inscribed or sculptured stones. The famous "Chesters Diploma", a diploma of military discharge and citizenship on two fragments of bronze tablets, presented to the British Museum by Mr. Clayton, is represented by a replica. A statue of Cybele, a bas-relief of the war-god, Mars Thingsus, and inscribed altars dedicated to Jupiter, Apollo, Mars, Cocidius, Antocidius, Vitiris, Huitris, Fortuna, and Minerva are noteworthy objects forming part of the collection.

THE collection of objects at Chesters, from the Well of Coventina, 3½ miles distant, is of considerable interest to students of early British culture. These include a sculptured stone stele dedicated to her by Titus Domitius Cosconianus, prefect of the first cohort of Batavians; another stele on which the goddess is represented with two attendant nymphs holding vessels from which pour streams of water; numerous altars dedicated to her and other deities, bronze brooches, bronze figures of a horse and a dog, and more than thirteen thousand coins which had been given as votive offerings at the well. Coventina was evidently a water-goddess whose cult, judging from the number of offerings, must have been of considerable importance. The writer in the *Times* cites Sequana upon the Seine and Damona at Bourbonne-les-Bains as similar cults of local water-goddesses; but as their names indicate, these, like Coventina, were Celtic in origin. The local cult of the water-goddess was a characteristic feature of early Celtic religion and traces of such cults are to be found in many parts of Britain. A noteworthy example was situated near Bath. It is usually to be found, however, that these goddesses have suffered a transformation, first into a god and then into a Christian saint, who becomes the patron of the spring or well, at which votive offerings have been made throughout the ages down to modern times.

FOLLOWING its usual practice, the *Engineer* devotes a great part of its first issue of the year to a review of the technical progress which has taken place during the past twelve months in naval construction, electrical engineering, steamships and motorships, aeronautics, hydro-electric engineering, and bridges. Noting that seventy-five years have passed since the *Engineer* was founded, it is remarked: "As we glance back over the long period of our existence, we are unable to discover any year which resembles that which has just ended", and "we do not believe that in the whole history of the mechanical engineering and metal trades any parallel can be found for the conditions which now prevail". Admitting that for these conditions there is no single obvious cause, and that the complaint is practically world-wide, the article touches upon matters affecting the industries of Great Britain, such as the attempt to maintain a higher standard of living than is perhaps justified, the possible effects of fiscal policies, and taxation, which is twice as high as in Germany, two and a half times as high as in Belgium, four times as high as in Italy, and twice as high as in the United States.

THOUGH 1930 was not a fruitful year in the industrial field either at home or abroad, it holds to its

credit the completion of a few great civil engineering works, notably the closing of the arch of the great Sydney Harbour Bridge. This bridge has a steel arch of 1650 ft. span. The Kill Van Kull Bridge between New Jersey and Staten Island is of the same type but with a span of 1652 ft. An examination of the two bridges and the methods of erection show many differing features. Another fine bridge is the Montreal Harbour Bridge over the St. Lawrence River, the main span of which is a symmetrical cantilever having a length of 1097 ft. from centre to centre of the main piers. Good progress has been made with the Hudson River Bridge at Manhattan, New York, the steel wire cables of which have a total strength of 350,000 tons. The span from the centres of the cable supporting towers is 3500 ft., and the total weight of the suspended superstructure will be no less than 90,000 tons. When completed, the bridge will have two decks, the upper deck giving accommodation for eight lines of roadway traffic and two footways, while on the lower deck there will be two sets of two railway tracks. Another bridge completed during 1930 but of an entirely different and very striking character was the ferro-concrete arch bridge over the river Elorn at Plougastel, near Brest, the bridge having three main spans, each of which is 611½ ft. from centre to centre.

THE La Brea asphalt pits, not far from Los Angeles in California, have gained world-wide fame on account of the extraordinary number of remains of sabre-toothed tigers and other mammals which have been found embedded in them. The census of skeletons of birds, just completed by Dr. Hildegarde Howard, is scarcely less imposing. From Science Service, Washington, D.C., we learn that of more than 4100 birds recovered, 69 per cent are predatory species; and of these, diurnal birds of prey (2500) far exceed nocturnal forms (400)—evidence, similar to that yielded by the mammals, that most of the creatures caught in the glaur were in pursuit of others seen to be in difficulties. Some extinct forms are in large numbers: 500 individuals of the turkey, *Parapavo*; more than a hundred of *Teratornis*, a vulture larger than any flying bird of the present day, as well as numerous smaller extinct vultures. The caracara, now confined to more southerly regions, is represented by 250 examples. Many species still existing in California occur profusely—the American golden eagle with more than 880 individuals, the California condor 190, the bald eagle 150, the red-tailed hawk 113, great horned owl 104. Ducks and geese are fewer, in all less than 100; waders less than 60; two species of stork (one extinct, the other now a southern form), 28 individuals; 30 cranes, 8 herons, 2 ibises, and one grebe.

THE annual report for 1929 of the Rockefeller Foundation, New York, recently issued, covers the first year of operations of the new Rockefeller Foundation, which, as foreshadowed in the report for 1928, is now constituted by the merging of the Rockefeller Foundation and the Laura Spelman Rockefeller Memorial into the new corporation. The activities of the Foundation, formerly limited to the domain of international public health, have been extended and now include, in addition, the advancement of knowledge in the medical sciences, the natural sciences, the social sciences, and the humanities. In the international health division, the work on malaria and hookworm disease prevention and investigations on yellow fever have been continued. In the medical sciences, aid has been given to institutions, including the University of Oxford and St. Bartholomew's and the London Hospitals, and to nursing institutions. In the natural sciences, aid has been given to various biological institutes and for the support of *Biological Abstracts*, and a grant made to Prof. Michelson for a re-determination of the velocity of light. In the humanities, the British Museum is to receive aid towards the publication of a new Catalogue of Printed Books.

PROF. G. ELLIOT SMITH, who has just returned from a visit to China, will deliver a public lecture, with lantern slide illustrations, on Peking man, at 5.30 on Jan. 15, at University College, London, W.C.1.

DR. HERBERT LEVINSTEIN, chairman of council and past-president of the Society of Chemical Industry, formerly managing director of British Dyestuffs Corporation, Ltd., has been awarded the Society's medal for 1931. The medal was awarded chiefly for his capable and valuable work in the dyestuff industry.

AT the meeting of the London Mathematical Society on Thursday, Feb. 5, at 5 P.M., at Burlington House, London, W.1, Prof. G. N. Watson will deliver a lecture on "Ramanujan's Note-Books". Members of other scientific societies who may be interested are invited to attend.

AN earthquake of moderate intensity was recorded at Kew Observatory at 10 h. 1 m. 44 s. G.M.T. on Jan. 2. According to a message broadcast by the United States Coast and Geodetic Survey, the shock occurred near lat. 18° N., long. 108° W., under the Pacific Ocean about 300 miles from the Mexican coast. The Kew observation agrees with this.

IT is announced in the *British Medical Journal* that the Dr. Sophie A. Nordhoff-Jung Cancer Prize for the best work of recent years in the field of cancer research has been awarded to Dr. Alexis Carrel, of the Rockefeller Institute for Medical Research in New York, for his development of the method of tissue cultivation and his application of it in the solution of the basic problems of pathological growths, especially the growth of malignant tumours. The commission of award was composed of Profs. Borst, Döderlein, von Romberg, and Sauerbruch.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A Principal of the Doncaster Technical College—The Secretary, Education Offices, Doncaster (Jan. 12). An assistant pathologist at the Sheffield Infirmary and demonstrator of pathology in the University of

Sheffield—The Registrar, University, Sheffield (Jan. 14). Three assistants at the Acton Junior Technical School for, respectively, electrical engineering, mathematics and English, and machine tool practice, workshop processes, and mechanical drawing—Dr. J. E. Smart, Education Offices, Acton, W.3 (Jan. 17). Two assistants on the higher technical staff of the Science Divisions of the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S.W.7 (Jan. 24). A post-graduate student at the Long Ashton Research Station of the University of Bristol for a special research on the synthesis of organic compounds—The Director, Agricultural and Horticultural Research Station, Long Ashton, Bristol (Jan. 26). A teacher of marine engineering and a teacher of ship carpentry and boat construction at the Marine Industrial School, Suez—The Under-Secretary of State, Ministry of Education, Cairo (Jan. 31). A professor of engineering (mechanical engineering and motive power) at the Imperial College—City and Guilds College, South Kensington—The Academic Registrar, University of London, S.W.7 (Feb. 16). Three officers for the Forest Service of Burma—The Secretary, General Department, Office of the High Commissioner for India, India House, Aldwych W.C.2 (Feb. 16). A professor of botany and a professor of commerce in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, 73 Strand, W.C.2 (Feb. 28). A temporary full-time assistant master for engineering subjects—The Principal, Technical Institute, Ashford, Kent. Two officers for the regional organisation of broadcast adult education in Yorkshire and the West Midlands—The B.B.C., Savoy Hill, W.C.2.

ERRATUM.—Prof. L. D. Mahajan has pointed out that in line 6 of his letter entitled "Liquid Drops on the Same Liquid Surface" (NATURE, Nov. 15, 1930, p. 761), he gave the height of Den Kund incorrectly as 1000 ft. instead of 10,000 ft.

## Our Astronomical Column.

**Large Fireballs.**—Mr. W. F. Denning writes that on the early evening of Dec. 27 last at 5.45 P.M. a large detonating fireball was observed from several parts of England. Mr. G. H. Brown, of the meteorological station at Horfield, Bristol, described the object as very large and bearing a broad train of sparks. The fireball moved at a low altitude along the southern sky from east to west; it looked like a large firework and gave a very impressive spectacle. It fell at an angle of about 30°. The object was also seen on the east coast at Eye, and it traversed a course from under $\theta$ Aquilæ to beyond and under the three well-known stars in that constellation. Another record comes from near Finistère, in the north-west of France, where the inhabitants were alarmed by the appearance of a great detonating meteorite.

The observations show that the fireball passed over the north of France and must have suffered disruption and collapse in the neighbourhood of Finistère. The real path will be investigated, and it seems that the radiant was either in Perseus, Auriga, or Orion, which have yielded large fireballs in past years from the same positions.

The Finistère fireball was followed by another at 12.20 P.M. on the same date. It illumined the heavens with a degree of intensity which startled some of the spectators. One report states that the flight of the object was perpendicularly downwards in due west. It ejected a stream of bright sparks as it descended; several people watched it, without, however, being able to record its exact place by the stars. Its radiant point may have been in Auriga, but more observations are necessary. It could scarcely have belonged to the system which supplied the brilliant apparition earlier in the night.

**Absorption of Light in Space.**—A paper by Dr. R. J. Trumpler in *Publ. Astr. Soc. Pacific* for August 1930 gives reasons for believing that there is a sheet of light-absorbing matter distributed over the galactic regions and extending to a distance of 100 parsecs or more on each side of the central galactic plane. This result was first arrived at by a study of the open galactic clusters and then confirmed from other material. The amount of absorption is given as 0·7 mag. at a distance of 1000 parsecs for light of wave-length 4300. It is concluded to be less for red than for blue light, amounting only to 0·38 mag. at 1000 parsecs for wave-length 5500. It is noted in corroboration of this that the *O* stars, though probably the hottest of all, appear yellower than the *B* stars owing to their greater distance.

From consideration of the possible mass of the interstellar matter, it is concluded to be not in separate atoms but in particles the mass of which is of the order of $2 \times 10^{-19}$ gm. (that is, some 3400 calcium atoms). There appear also to be free atoms of calcium and sodium to account for the fixed lines of these elements in the spectra of distant stars; but the selective absorption is not due to these. The dark patches in the galaxy may be due to specially dense clouds of the general obscuring matter.

Since the spiral nebulæ and the globular clusters are at a considerable distance from the galactic plane, their light traverses a comparatively short distance of the sheet of absorbing matter. Hence their loss of light is small, and the distances derived on the assumption of no absorption are not greatly in error.

The dark equatorial bands seen in many of the spiral nebulæ afford an additional argument in favour of the presence of a similar layer in our own galaxy.

**The Leonid Meteors.**—It has already been noted in this column that a fairly rich shower of these meteors was seen in North America on the morning of Nov. 17. The *Daily Science Bulletin* of Dec. 18, issued by Science Service, Washington, D.C., states that a still richer display was seen on Nov. 17 by G. T. Bieling, officer of the steamer *Annetta*, which was then near Porto Rico. The display lasted from midnight (Eastern Standard Time) until dawn, being greatest at $3^h\ 40^m$ A.M. "One was a brilliant fireball, that exploded in a flash so bright that an excellent photograph could have been taken by its light. A luminous trail was visible for 25 minutes."

These observations give some ground for hope that the rich portion of the Leonid stream has not finally deserted the neighbourhood of the earth, and that the next few Novembers may retrieve the general disappointment produced by the failure in 1899.

## Research Items.

**The Azande Law of Legitimacy.**—Further impressions of the Azande are recorded by Major P. M. Larken in *Sudan Notes and Records*, vol. 13. Zande law appears to be one of compensation, directed almost entirely to the satisfaction of the individual and, except indirectly, not safeguarding the rights of the community. Death was the punishment for malicious magic and for concealing cases of smallpox, but beyond this, there was no idea of a malefactor suffering for having infringed the law established for the protection of the tribe as a whole. Though for some offences a plaintiff might press for the death penalty, the majority of acts were compoundable by the payment of damages. A man who wished to marry a girl addressed himself to her father or guardian. The bride-price was twenty spears, which was paid to the father and not to any other member of the family. Children born without payment of spears were illegitimate and, as such, the property of the mother's family. If they were girls, the mother's next-of-kin was entitled to the bride-price. Any boys among illegitimate children were entitled to their sisters' bride-price, which did not in that case go to the mother's next-of-kin. A payment of only one or two spears was sufficient to legitimise the children, provided the balance was paid fairly quickly. If the father refused to complete payment of the price, the chief would probably order the return of the woman with her children to her family, the father retaining one child in consideration of part payment of the bride-price. The father had a legal right to legitimise his children by paying spears, and his wife's family had no right to refuse. Children of women captives of war, or given in payment of a debt or as presents by a former husband, were legitimate only if their father had paid the bride-price for their mother.

**Earliest Cultures of the South-Western United States.**—Dr. E. B. Renaud, of the University of Colorado, describes the results of a series of explorations in caves and rock-shelters of New Mexico and Oklahoma during the summer of 1929 in *L'Anthropologie*, T. 40, No. 3. The oldest remains from this part of the United States are those of 'Folsom man', a series of very fine lance-heads found during 1927 and 1928 in the Folsom gravel-pit in association with the bones of an extinct bison. For these relics Pleistocene age has been claimed. Of this early period, Dr Renaud's expedition of 1929 produced nothing but a fragment of an implement of the Folsom type. The evidence points to a very primitive culture of a hunting people, probably with only temporary habitations. Exploration of the caves of the fumaroles of the Cimarron valley established two horizons, separated by a considerable interval of time, of which the lower represented a long occupation by hunting nomads. A considerable number of stone implements were found, which in their general appearance recall the Mousterian of Europe. They were followed after an interval, represented in one cave by a layer of 20 cm. thickness, by another people, who, though still hunters, seem to have made a greater use of vegetable foods, as is indicated by the presence of 'metates' for grinding seeds. Next in the sequence comes the culture of the caves of Oklahoma, of which a number were explored at Kenton. The stone industry in quartzite exhibits a great variety in form and purpose. Though less coarse than that of the fumaroles, it is purely utilitarian and shows no effort to attain beauty of form. These caves being dry, a number of objects of wood, sandals, basketry, and fibre work had survived. These people had taken to agriculture, although still hunters. Their culture is comparable to that of the Basket-makers. Next in order came the volcanic caves of New Mexico, where was found a culture similar to that of the Oklahoma caves, with implements of stone, bone, and wood, the coarser character of the stone implements being due to use of inferior material. The evidence for a rudimentary culture of maize was reinforced by male and female figures made from maize cobs, sometimes 'accouplés' and, therefore, obviously magical.

**Population Census.**—In view of the approaching census, it may be of interest to recall that Prof. Raymond Pearl and Mr. Lowell Reed published in 1920 a forecast of the population of the United States up to 2100 based upon data obtained by fitting a logistic curve to the census counts of the population from 1790 to 1910. Prof. Pearl and Mr. Lowell now compare their forecast with the actual counts of the 1920 and 1930 censuses (*Science*, Oct. 17, 1930, p. 399). The forecast figures in millions were 107·4 for 1920 and 122·4 for 1930, the actual census figures being 105·7 and 122·7 respectively. The forecast thus missed the counted population by 16 parts in a thousand in excess for 1920 and by 2·5 parts in a thousand in defect for 1930.

**Chinese Ants.**—Prof. W. M. Wheeler (*Bull. Pekin Nat. Hist.*, vol. 5, pp. 53-81, 1930) states that the Chinese ant fauna is a mixture of two components one of which is Palæarctic and the other Indo-Malayan and representing a northward and eastward migration of species from Indo-China, Siam, Burma, and India. The ant faunas of Japan and Formosa exhibit a similar mixture of two components, the Palæarctic being greatly in excess of the Indo-Malayan in Japan, and the Indo-Malayan greatly in excess of the Palæarctic in Formosa. This island possesses a considerable number of endemic species of palæotropical affinities, but endemicity is meagre in the ant fauna of Japan; indeed, so many of the ants formerly supposed to be peculiar to Japan have been found in China that the species of the two countries may be said to constitute a single fauna—the Sino-Japanese. The list of Chinese ants which follows includes 138 species, 54 sub-species, and 53 varieties, for each of which the author gives a reference to the original description, cites the type locality, and mentions the Chinese localities from which material has been received. The Palæarctic component comprises 29 species, 11 sub-species, and 16 varieties—about 23 per cent of the entire fauna. The remainder is the Indo-Malayan component.

**Development of the Rabbit Embryo.**—In *Contributions to Embryology* (vol. 21, 1930), issued by the Carnegie Institution of Washington, Mr. P. W. Gregory gives a vivid picture of the earlier stages in the formation of the embryo of the rabbit. By applying an exact technique to a very large number of pregnant does, he has confirmed an observation made by Dr. Martin Barry in 1839 that the egg is shed from the ovary and enters the oviduct 10 hours after coitus, and that the male element fertilises the egg 2 hours later. In 10½ hours after fertilisation the egg is undergoing its first cleavage; in 2 hours more it is forming its 4-celled stage; in another 6 hours it has passed into the 8-celled stage; the 16-celled stage is entered at the end of the second day following coitus. At the end of 70 hours, counting from the time of coitus (60 hours from fertilisation), the ovum passes from the oviduct into the uterus, being then in its 16-celled stage. At the time of this passage the ovular mass has become differentiated into an inner

cell mass enclosed within a surrounding protective envelope of the trophoblast. The author pays a tribute to the exactness of a similar investigation which the late Prof. Assheton, of Guy's Hospital, published in 1894.

**Effects of an Epicaridan Parasite.**—B. W. Tucker (*Quart. Jour. Micr. Sci.*, vol. 74, part 1, Sept. 1930) points out that the effects of epicaridan isopods on their hosts have not hitherto been studied in detail. He found in Naples in 1924 that 21·5 per cent of the specimens of the burrowing decapod crustacean *Upogebia* were parasitised by the epicaridan *Gyge branchialis*. Fixation of the parasite to the host normally takes place when the latter is 17 mm. in length. The length of life of *Upogebia* appears to be about three years, and that of the parasite is normally coextensive with that of its host. The effect of the parasite on the general vitality of the host is negligible —moulting and growth are not materially affected. Parasitised male *Upogebia* have chelæ agreeing in size and appearance with those of the female, and they develop the appendages of the first abdominal segment which are normally present in the female only. Parasitised females are unaltered externally. Scattered oocytes occur among the male germ-cells in the testes of many normal males, and are eventually shed into the lumen of the testes, where they degenerate. Whether they arise from modified spermatogonia or are distinct from the outset was not ascertained. The testis in parasitised males shows all stages from slight reduction to complete atrophy and the tendency to develop oocytes is much accentuated ; in a few cases a tract of testis appears to have been completely converted into ovary. In the large majority of parasitised females the gonad is entirely absent ; in the remainder the ovary is in a state of diminished activity but not otherwise abnormal. The modifications of sex characters in parasitically castrated Crustacea are exclusively in the direction of feminisation and cannot be interpreted as a return to primitive or juvenile features. Geoffrey Smith's theory—that the parasite, by withdrawal of nutriment, reacts on the host in a manner similar to an adult ovary—is considered to be the only one which makes any approach to a real explanation.

**A New Tetraploid Species-Hybrid.**—Three cultivated species of the Convolvulaceous genus *Quamoclit* have been studied by Sigeroku Nohara (*Jour. Coll. Agric. Imp. Univ. Tokyo*, vol. 11, No. 1), who has also studied their hydrids. *Q. coccinea* and *Q. pennata* differ markedly in cotyledon and leaf form as well as flower shape and colour. The $F_1$ is in general intermediate and sterile. There are also two forms of *Q. pennata*, one having rose red flowers and the other a corolla which is white tinged with dilute greenish yellow. The $F_1$ of the hybrid between these forms is also intermediate. A third species, *Q. sloteri*, has been much more recently introduced into Japan. It appears to have been collected first in America in 1849 by George Englemann, of St. Louis. Dr. Kano has determined the chromosome number of this species as 30 (haploid), and that of the other two species as 15. Hence *Q. sloteri* is tetraploid. It has larger pollen grains than the other species and is probably a cell giant. It resembles in many respects the (sterile) $F_1$ hybrid obtained by Nohara by crossing *Q. coccinea* with *Q. pennata*, but is stouter and fertile. Hence it is probably a hybrid species, having arisen either in Nature or under cultivation by chromosome doubling in the sterile $F_1$ hybrid. *Q. sloteri* is now a fixed race, but it gave rise in cultures to a reversionary type resembling the $F_1$ of *Q. coccinea* × *Q. pennata*. The chromosomes of this plant were not counted, but it was probably diploid. *Q. sloteri* crossed with *Q. coccinea* also gives sterile hybrids which will no doubt be found to be triploid.

**The Scientific Pruning of Vines.**—" The Fruiting Habits and Pruning of the Campbell Early Grape " is the title of *Technical Bulletin* No. 106, published by the Agricultural Experiment Station of Michigan State College. The writer is N. L. Partridge, who has treated his subject very thoroughly. Studies on the relation to the yield of fruit of current season's growth, diameter of shoot, position of the fruit on the canes, size of cane, internodal length, and other factors have been made, and the results considered in relation to practice. The variety ' Campbell Early ' yields most good produce from large-diameter shoots, whilst its sister variety ' Concord ' produces its best bunches on shoots of moderate size. It is best to leave about fifteen internodes on shoots of ' Campbell Early '. Shortening beyond this length materially reduces the yield. If the vine will not support four canes of this size, it is better to reduce their number rather than to shorten them. This knowledge is very valuable, for it introduces the grower on one hand, and the scientific worker on the other, to a much neglected field of inquiry. It would be very helpful if we had similar studies of our English horticultural plants, coupled with detailed biochemical investigations.

**A Disease of the Douglas Fir.**—The genus *Phomopsis* has provided many puzzles for mycologists in the past, and our lack of knowledge became acute when it became necessary to differentiate *Phomopsis Pseudotsugæ*, a disease of the Douglas fir, from other closely allied fungal parasites. A detailed study of the genus by G. G. Hahn (*Trans. Brit. Mycol. Soc.*, vol. 15, parts 1 and 2, pp. 32-93; 1930) has done much to elucidate the facts concerning such species as attack conifers. Eight of the latter have been described in great detail, and a dichotomous key has been devised to separate them. *Phomopsis occulta* has been proven the same fungus as *Diaporthe conorum*, thus adding weight to the prevailing idea that *Phomopsis* represents an imperfect stage of *Diaporthe*.

**Salt-Plugs in Southern Persia.**—An important paper by J. V. Harrison on the salt-plugs of Laristan has appeared (*Quart. Jour. Geol. Soc.*, vol. 86, pp. 463-522 ; 1930). The extrusive salt has come to the surface at different periods from Oligocene to Pliocene, has formed hills and salt-gypsum ' glaciers ', and after erosion has in some cases left great corries in the limestone mountains of the region. The salt always comes up from below, and in widely different localities of the Persian Gulf territory has brought up with it Middle Cambrian fossils, as well as boulders of rocks which have no parallel in the succession of exposed systems from Ordovician to Pliocene. The salt-plugs lie in the autochthonous area in front of the South Persian nappes, and it is suggested that they originated where compression acted upon mobile salt and gypsum beds of Cambrian or even greater age. Compression may arise from tangential pressure or from the weight of the overlying strata, but once the salt has accumulated at an underground nucleus, it is still not clear what was the source of the energy that drove the salt to the surface. The hypothesis of salt movement through solution and recrystallisation is no longer accepted. The salt has responded to external forces as a plastic material, and the resulting tectonics are transitional between the disharmonic folding of less mobile incompetent strata and the intrusions of more mobile igneous magmas.

**Partial Absorption of X-Rays.**—The issue of the *Zeitschrift für Physik* for Nov. 27 contains a paper by Dr. B. B. Ray, in which he describes with some detail his experiments on the partial absorption of X-rays. This effect, to which several references have been made in NATURE recently, appears to consist in the transfer of energy from an X-ray quantum to an electron in a light atom without important deviation of the quantum. The spectra have been recorded photographically with a Siegbahn vacuum instrument, and the paper is illustrated by reproductions of three plates, which show unambiguously the lines in question. Dr. Ray mentions that these are not coincident with lines which might have been produced by impurities, and that they are also distinguished by being somewhat diffuse. The width of the lines is stated to correspond, in order of magnitude, to the ionisation potential of the absorbing atoms, and the conclusion is reached that the electron responsible for the change in energy of the radiant quantum may be transferred to an optical energy level of the atoms, or expelled with zero velocity. Dr. Ray adds some remarks on the apparent magnitude of the absorption coefficient of X-rays when various dispositions of apparatus are made, and upon the *J*-phenomenon.

**Black-Body Radiators.**—A. C. Egerton and M. Milford describe two forms of black-body radiator in their paper on optical pyrometry in the December number of the *Proceedings of the Royal Society* which, although not completely novel in principle, afford simple and relatively inexpensive sources of full radiation. The first consists of a wedge of thin platinum foil which is heated electrically, either in a vacuum or in hydrogen or argon. With an angle of 10°, such a system is known to be within less than one per cent of 'black'. The other consists of a tube of platinum (1·4 mm. external diameter, 10 cm. long, and 0·15 mm. thick) with a 0·3 mm. hole in the middle of the wall, through which the internal black-body radiation can be investigated. Both forms were used with various minor modifications, temperatures being preferably determined by the melting of wires hung down the middle of the tube. A monochromatic filter, for which a 'didymium glass' is employed, is also described, transmitting a band of light between 5740 A. and 5600 A.

**A Differential Ebullioscope.**—Under the title "Construction of a Differential Ebullioscope for determining the Purity of Individual Liquids and of Azeotropic and Eutectic Mixtures", Prof. W. Swietoslawski, of the Warsaw Polytechnic, describes (*Roczniki Chemji*, **10**, p. 570; 1930) a new type of ebullioscope. It consists essentially of two similar sections so that the vapour formed when the liquid in the lower part is heated then passes through the upper section, the object being to observe both the boiling point, $tH$, and the condensation temperature, $tB$. Prof. Swietoslawski also describes a micro-ebullioscope for the study of relatively small quantities of liquids. The special advantage of this ebullioscope is that it enables a careful study of the boiling temperatures of pure solvents and of 'constant boiling' mixtures to be made. Furthermore, it is shown that the boiling point, $tH$, and the condensation temperature, $tB$, are identical when no impurity is present. With his collaborators the author has examined a number of pure liquids and azeotropic and eutectic mixtures, temperatures being measured by a small Beckmann thermometer and also electrically. For methyl alcohol (Poulenc) $tH - tB = \Delta t = 0{\cdot}043°$ C., methyl alcohol (Riedel-de Haën) showed $\Delta t = 0{\cdot}023°$, whilst a German preparation had $\Delta t = 0{\cdot}000°$. When, however, the last sample was allowed to stand for several months in the apparatus, it showed a difference of 0·052° C. Toluene-free benzene (Merck) also had $\Delta t = 0{\cdot}000°$; toluene (Merck's "chemically pure" for molecular weight determinations) gave $\Delta t = 0{\cdot}040°$, whilst purified and dried carbon disulphide gave at first $\Delta t = 0{\cdot}008°$, and after a further purification, $\Delta t = 0{\cdot}000°$.

**Crystalline Modifications of Electrolytic Chromium.**—Bradley and Ollard (NATURE, **117**, p. 122; Jan. 23, 1926) stated that chromium prepared by a special method is a mixture of two allotropes, a body-centred cubic form and a hexagonal close-packed form. Later workers, however, reported that the electrolytic deposit consists only of the body-centred cubic structure. In the *Journal of the Society of Chemical Industry, Japan*, November 1930, vol. 33, No. 11, however, Sasaki and Sekito state that they have confirmed the existence of both the forms described, which are produced by the method of Ollard, and they have also found another modification of the same type as α-manganese, with 58 atoms in a unit cube. X-ray methods were used and details of the lattice structures are given.

**Organic Compounds of Gold.**—Diethyl gold bromide, $Au(C_2H_5)_2Br$, first described by Pope and Gibson in 1907, is shown by Gibson and Simonsen, in the November number of the *Journal of the Chemical Society*, to have a doubled formula in benzene solution. In the associated form the gold atom has a completed octet of electrons. Experiments are described which show that gold in these compounds has a co-ordination number of four, and a slow hydrolysis of the compound in water is assumed to be due to the formation of an aquo-salt, $[Et_2Au(H_2O)_2]Br$, giving the reaction for the bromine ion. Amino-diethyl gold bromide, $(C_2H_5)_2AuBr,NH_3$, and pyridino-diethyl gold bromide, $(C_2H_5)AuBr,C_5H_5N$, the first compound being previously described by Pope and Gibson, were prepared. They are colourless, highly crystalline compounds with similar properties, sensitive to light, soluble in organic solvents, and almost insoluble in water. Other interesting compounds, such as diethyl gold acetylacetone, are described in the paper.

**Stereochemical Influence on Substitution.**—Mills and Nixon in the November number of the *Journal of the Chemical Society* describe some experiments with substitution derivatives of δ-hydroxy-hydrindene which have a bearing on the configuration of the carbon valencies in the benzene ring. If, in a doubly bound carbon atom, the angle $\alpha$ between the two single bonds is the same as that between the valencies of the carbon atom in methane, 109·5° according to the tetrahedral theory, then the angle $\beta$ which the single bonds make with the plane of the double bonds would be 125·25°. On the assumption that the external angles are increased approximately proportionally when the internal angle of each CH residue is reduced to 120° in the formation of a Kekulé benzene nucleus, the angle $\alpha$ which each of the external valencies makes with the intranuclear single bond on one side of it is less than that, $\beta$, which it makes with the plane of the double bond on the other side. In compounds in which the benzene ring is fused with appropriate five-membered rings, the stable compound will be that in which the linking common to the two rings consists of a single bond, since this will be under the less intramolecular strain caused by the approximation of the intervalency angles to 108°. The effects of fusion of a benzene ring with six-membered rings are also considered. The experiments described in the paper are held to confirm the results anticipated from theory.

## Early Human Types and Culture Sequences in South Australia.

PRELIMINARY observations on two adjacent sites in the Lower Murray Valley which have an important bearing on the antiquity of man in South Australia are described in vol. 4, pt. 2, of the *Records of the South Australian Museum*, by Mr. Herbert M. Hale, curator, and Mr. Norman R. Tindale, ethnologist of the Museum. The sites are in the neighbourhood of Old Devon Downs, seven kilometres below Nildottie township. One was an island, Tartanga, between the river and a lagoon; the other a cliff-shelter opposite Old Devon Downs station and a kilometre and a half west of Tartanga, the existence of which had already been reported by Sheard in 1927. In the same year a human skeleton was found by Mr. A. R. Roy embedded in sand-rock in this part of the Murray Valley and it was decided to undertake the examination of the sites. Operations began in April and were continued in November and December 1929.

At Tartanga, beneath four layers of 'recent' deposits, five consolidated strata were examined, of which the lowest and earliest, *A*, represented the lagoon shore, while *B* to *E* above represent successive surfaces of an old island now nearly eroded on the western side of the lagoon. All show signs of human occupation except *F* and *G*, which are practically sterile. Borings below *A*, which was not very deeply excavated, suggest that there are at least two further strata below with signs of human occupation.

Of the five consolidated strata, *A*, the lowest, though not extensively examined, yielded burnt stone, suggesting hearths, stone chippings, and shells of mussel (*Unio*). In the strata *B* to *E*, among the food debris were quantities of mussel shell (*Unio proto-vittatus* n.sp., which differs in having a uniformly thicker shell from the *Unio vittatus* now common in the adjacent lagoon), jaws and vertebræ of fish, fresh-water tortoise, birds (unidentified), and bones of mammals (opossum, wallaby, kangaroo). Flakes, chippings, and implements of stone and bone occurred throughout the layers. Skeletal remains representing three individuals, including the skeleton found by Mr. Roy, were recovered. An examination of the dentition, possible in two cases, showed that it was superior to that of the present Australian aborigines and belonged to children of from ten to twelve years of age. The remains were mineralised and firmly embedded in the matrix. Above the sterile strata *F* and *G*, *H* showed hammer stones and high-backed knives similar to implements known to aborigines now living near Lake Eyre, while *I* showed traces of recent occupation.

In the cliff-shelter the deposits were excavated to a depth of four metres, and in twelve successive layers showed four cultural stages. Skeletal remains of several individuals were found—all children. In one case, found in the third layer from the top, the teeth showed strongly marked simian characteristics.

The cliff-shelter cultures follow the Tartanga culture after a considerable but undetermined interval. The first two culture phases have been named 'Pre-Pirrian' and 'Pirrian', the latter being characterised by a leaf-point artefact with retouched edges and prepared butt which has been christened 'pirri', a well-known type on old camp sites in many parts of South Australia but not observed among living tribes. This culture was followed suddenly by a people who apparently at first fed largely on the small mammals of the plains, but nevertheless possessed double-pointed fusiform fishing-bones, 'muduk', whence the culture is to be called 'Mudukian'. This culture was rich in stone and bone industries. It was followed by the 'Murundian', so called from a local sub-tribe, and divided into an early and late phase, of which the latter may represent the culture of the district when first visited by the white man. Local native legends indicate that within tribal memory there has been a southward movement of people from up the river. It would seem that if this movement is linked with Murundian levels, the latest cultural phase has not extended to the coastal parts of eastern Victoria, where the people of a somewhat earlier phase, possibly Mudukian, existed until the present time. Contemporary with Mudukian and Murundian, early and late, are rock markings which show three distinct types. The occupation of the shelter was sufficiently long to admit of a number of faunal changes, possibly due to climatic variation.

The interest of the investigation of these two sites lies only partly in the fact that they are the first old camp sites in Australia on which a cultural sequence has been worked out in association with human remains after an excavation which has been conducted in strict accordance with archæological methods; Tartanga has an additional importance in the fact that it has been suggested, after an initial comparison, that the Tartanga human remains when examined in further detail may be found to represent a type intermediate between the modern Australian aboriginal and the Talgai skull, which is claimed to be of Pleistocene age.

## Noise and its Measurement.

THE Noise Abatement Commission, Department of Health, City of New York, has now published the report of the committee appointed by Dr. Wynne on the noise in New York City and on the best way of diminishing it. It gives the results arrived at by experts in neurology, otology, law administration, acoustics, engineering, and the motor-car industries. They have definitely established laws which have hitherto only been vaguely suspected. The committee has effected some progress in the direction of noise abatement.

The shipping companies have co-operated with the committee in diminishing the noises of steam whistles and sirens. The drivers of mail motor vehicles have instructions that their horns are only to be used for the purpose of preventing accidents. Noiseless turnstiles have been invented and are being used at several railway stations. The Health Commissioner and the police have special powers to control the indiscriminate use of loud-speakers.

In addition to getting the law amended, engineers have been encouraged to invent less noisy machinery and motor-cars. The Press also is educating the public to realise the costliness and danger to health due to much needless noise. It is pointed out that the noise in cities like London, Paris, and Berlin is not nearly so nerve-racking as the noise in New York. The erection of buildings goes on much more leisurely, and in European cities there is little complaint from neighbours about harsh and blatant loud-speakers and there is little outpouring of radio programmes into the streets day and night. It is said that taxi drivers in New York are becoming hard of hearing, and that boiler workers and other

mechanics exposed to a constant riveting noise are also becoming very deaf.

The absolute amounts of energy in the sounds of ordinary experience are exceedingly small in comparison with those of other forms of energy. For example, the power equivalent of more than one million voices is necessary to light an ordinary electric lamp. The average speech power of the loudest single voice is about 1000 microwatts, and this falls to 0·1 microwatt for the quietest speech and to about 0·001 microwatt for the softest whisper. However, in most energy measurements of applied acoustics the interest lies not so much in the intensity of the sounds as in their loudness, that is, in the intensity effect produced upon the ear by them; and further, it is well known that the increase in power necessary to produce a perceptible increase in loudness depends upon the initial intensity of the sound.

From these considerations it is clear that in problems concerned mainly with power differences, whether acoustic or electric, a special unit is convenient, and that now being adopted in telephony is the *bel*, so named as a tribute to the inventor of the telephone. Two amounts of electric or acoustic power $P$ and $P_0$ are said to differ in power level by $n$ bels if $n = \log_{10}(P/P_0)$. The most convenient unit for most practical work is one-tenth of the bel, the *decibel* (db.) known also as the *transmission unit* (T.U.). Further subdivision of the bel is unnecessary, since a change of the power level of a sound by one decibel is about the smallest which can be detected by ear. It is unfortunate that another term, the *sensation unit*, is used in this connexion for the decibel by otologists, psychologists, and physiologists. Since, for pure tones, equal steps on the logarithmic scale sound approximately like equal loudness stops, and since a power change of one decibel is approximately the smallest such step detectable by ear, the sensation level of any sound reaching the ear is conveniently represented by the number of decibels it is above the threshold level for audition. In this connexion the term sensation unit is often used instead of decibel.

An idea of the size of the decibel can be obtained from some actual examples. If, in the discussion of speech power, the average speech power be taken as the zero level for comparison, then the level of very loud speech would be +20 db., of weak speech −20 db., and of a soft whisper −40 db. In measurements made on many speakers it has been found that the range of average powers used in conversation by the majority is about 21 db. Measuring from the limit of audibility, speech would be received at a level of 100 db. if the lips of an average speaker were within half an inch of the ear of a person having normal hearing. Measuring from the same level, the roar of street traffic in a city would be received at a level varying from 50 db. to 80 db., and the noise of an underground tube train passing a station at about 96 db. Two special gramophone records have been prepared in the Bell Telephone Laboratories, New York, in which the same complex sounds can be heard at different levels (see NATURE, **125**, 394; 1930).

## The Antiscurvy Vitamin in Apples.

A BRIEF reference has already been made in these columns to a preliminary report by Zilva and his associates of their work on the antiscorbutic potency of apples (NATURE, vol. 126, p. 248; 1930). The full experimental details of this research have now been published.*

In spite of much work on the properties of vitamin C, success has not yet attended attempts at its isolation: it is known, however, to be very susceptible to oxidation but to be stable to heat in the complete absence of oxygen. Its behaviour depends in part also on the presence of other substances in its natural sources; thus in lemon juice a reducing factor helps to maintain its activity, and destruction of this factor always leads to loss of potency. Deterioration of heated lemon juice is rapid on storage; and autoclaving the juice results in the appearance of a destructive factor (Zilva, *Biochem. Jour.*, vol. 23, p. 1199; 1929). It is not destroyed by fermentation and is most stable at the natural acidity of the juice; but is unstable under conditions detrimental to the growth of moulds and bacteria (J. Williams and J. W. Corran, *ibid.*, vol. 24, p. 37; 1930). It is precipitated by basic but not by neutral lead acetate; its activity is not dependent upon the presence of amide nitrogen, but iron, phosphorus, and sulphur are present in the most concentrated preparations so far obtained, though whether these elements are related to the potency is not known. It has been suggested that it is a weak acid (R. B. McKinnis and C. G. King, *Jour. Biol. Chem.*, vol. 87, p. 615; 1930).

Since chemical purification leads to increasing instability, indirect methods of approach, such as the establishment of a relationship between the antiscorbutic potency and the physiological condition of a plant, would at any rate increase our knowledge of the vitamin's properties and might even lead to its isolation. Zilva and his associates, therefore, have begun an investigation into the antiscorbutic activity of different varieties of apples, grown under different conditions and stored for varying lengths of time. Their results, although of a preliminary nature, have led to some interesting conclusions. The work is laborious, since all tests have to be carried out on guinea-pigs; the animals are given a diet of bran, barley-meal, middlings, fish-meal, and crushed oats together with autoclaved milk, on which, if no source of vitamin C is provided, they die from scurvy in 4-5 weeks.

Different varieties of apple were found to differ considerably in their antiscorbutic potency: Bramley's Seedling was the best, a daily dose of 3 gm. preventing the onset of scurvy and usually permitting of a fair amount of growth; King Edward had the lowest potency, a daily dose of 20 gm. failing to prevent the onset of scurvy, although it prolonged life. The protective doses of other varieties were: Dabinett, 10 gm.; Woodbine, 20 gm.; Cox's Orange Pippin, slightly more than 20 gm.; whilst for Worcester Pearmain, 20 gm. failed to give complete protection. No relationship was detected between antiscorbutic potency and the age of the tree, the soil or the season, or the date of picking the fruit.

Slight loss of potency occurred on storage at 1° C. in air, and a slightly greater loss was observed at 10° C. in an atmosphere containing 10 per cent carbon dioxide, 11 per cent oxygen, and 79 per cent nitrogen: Bramley's seedling survived storage, especially gas storage, better than Cox's Orange Pippin. A number of imported varieties were also tested, and it was found that Canadian were more active than Australian or New Zealand, probably due to the fact that the time between picking and test was greater in the case of the latter.

* "The Antiscurvy Vitamin in Apples." By Mary F. Bracewell, E. Hoyle, and S. S. Zilva. Medical Research Council, Special Report Series, No. 146. London: H.M. Stationery Office, 1930. Pp. 45. 9*d.* net.

The effect of heating fresh and stored apples in their skins at 115° C. in air for 50 min. was studied: no significant loss in potency was observed. Some chemical analyses were also carried out. In general, the chemical composition of the different varieties was very similar, but in some preliminary experiments it was noticed that the nitrogen content of King Edward was about twice as great as that of Bramley's Seedling.

In conclusion, the authors point out that the high antiscorbutic value of Bramley's Seedling, fresh or stored, cooked or uncooked, is of interest to the dietician, but that the lower potency of other varieties scarcely lessens their nutritive value, since they are consumed under conditions in which the vitamin C requirements are usually fully covered by the general diet.

## Industrial Health Research Board.

THE tenth Annual Report of the Industrial Health Research Board contains an account of the work done during the year 1929. The report is divided into two sections, the first dealing with problems of general industrial importance and the second with more specific problems submitted by Government departments and industrial associations.

In the first section an account is given of researches into: (*a*) Heating and ventilation, and in this connexion it is stated that rooms heated by under-floor and ceiling-panel systems feel warmer and more comfortable than rooms heated by stoves or hot-water radiators, and it is claimed that these systems have certain advantages in factories and for open- and semi-open-air schools.

(*b*) Vision and lighting. Further experiments are reported on the use of special spectacles in very fine processes, and a very interesting research shows that even 'coarse work' can be substantially improved by increasing the illumination. Arrangements are also being made to study the effect of natural ultra-violet radiation on factory workers.

(*c*) Noise and vibration studies have so far revealed little in the way of positive results.

(*d*) Accidents causation researches have been still further extended, and the results of tests on 1800 subjects are recorded. The original conclusions, published previously, have been in the main substantiated, namely, that there are certain workers who are prone to accidents and that these may be detected by tests. It would be interesting to know if the people who have street accidents are of this type.

(*e*) The problem of sickness absenteeism is receiving attention from several angles. On one hand, there is a general study in progress of the actual sickness occurring in different firms, and the medical diagnoses; while on the other, absenteeism among special groups, for example, coal miners, printers, cardroom operatives. A difficulty in this field is that relatively few firms have as yet realised the importance of accurate detailed sickness records. Closely linked up with this problem is that of psycho-neurotic illness, and a special investigation of psycho-neurotic symptoms among industrial, clerical, and professional occupations is in progress.

(*f*) Other studies relate to the physiology and psychology of work, and to the occupational fitness of mental defectives.

The second section describes work done on problems submitted by Government departments and industrial associations. The sickness investigations among printers and others have already been mentioned. In addition, there is an account of the effects of baths at the pit-head and various investigations on the fundamental principles underlying vocational tests. It is hoped to discover what qualities a candidate possesses rendering him more suitable for one occupation than another.

Some researches, owing to the nature of industrial conditions, cannot be conveniently followed in a factory, and in these circumstances arrangements are made with various universities to obtain special laboratory conditions. The problems of this kind reported refer to the extent to which acquired skill is transferred from one process to another, the relative effects of concentrated and distributed practice, the characteristics of learning curves, the effects of variety and uniformity in work, and the influence of incentives.

The Board concludes with an appeal for a wider interest in its work and in its practical applications.

## Development of River Systems.

THAT a river may be diverted by the capture of its headstreams by a neighbouring river has been regarded as well established since the famous paper of Beete Jukes (1862) on the river system of southern Ireland. This process has been applied to explain the developments of river systems in all parts of the world; but it is now declared to be impossible, on any material scale, by Dr. E. O. Marks, of the Geological Survey of Queensland (*Proc. R. Soc. Queensland*, 1930).

Dr. Marks rests his case on a detailed study of the rivers of Queensland. The watershed between those that flow inland and those that go eastward to the coast is inappropriately called the Great Dividing Range, which Dr. Marks justly rejects. He points out that the Queensland Divide has been in places lowered 1000 ft. by denudation, and yet the lateral displacement is so trivial that it amounts only to "minor nibbling". In two cases (the Fitzroy and the Burdekin) the change is more important, as those rivers once flowed west, whereas they now discharge east; but this change he attributes to their having overflowed the divide and thus cut it down. He calls this river-dumping, not river-capture, and says it is not due to encroachment upstream.

From the evidence of eastern Queensland, Dr. Marks argues that the ordinary physiographic view is incorrect, since he holds that denudation by rivers and waterfalls is only vertical and makes no serious encroachment upon the head of the river. River-capture he declares improbable, and the development of reversed obsequent rivers impossible; and he claims that as watersheds are fixed, "all that part of physiographical theory which depends on their migration must be discarded".

The paper directs attention to the usual nature of the main Queensland divide; its special character appears due to the subsidence of the coastal region, as illustrated by the formation of the Barrier Reef, and that it is recent is obvious from the nature of the Barron Falls. Australia has provided striking cases of watershed migration. The intricate dovetailing of the northern and southern river basins in the Victorian Highlands—where the main watershed has also been called the Main Dividing Range—is due to great changes in the position of a divide by rivers pushing their heads backward. The absence of proved displacements of the Queensland Divide does not disprove changes in areas that are geographically much older.

## University and Educational Intelligence.

BIRMINGHAM.—The degree of D.Sc. has been awarded to Martin Christopher Johnson for published papers on the adsorption of hydrogen and other molecular problems *in vacuo*; and Wilfred John Hickinbottom for numerous published papers in organic and physical chemistry and biochemistry, on carbohydrates, rearrangement of alkylanilines, acetone, butyl fermentation, and distillation of dilute solutions.

CAMBRIDGE.—The Director of the Solar Physics Observatory has, with the consent of the Vice-Chancellor, appointed Dr. R. O. Redman, of St. John's College, to be assistant director of the Solar Physics Observatory for five years from April 1 next.

Dr. C. P. Snow has been elected to a fellowship at Christ's College.

The Council of the Senate has issued a report on the regulations for the Botanic Garden. It is recommended that the Botanic Garden Syndicate shall consist of (*a*) the Vice-Chancellor, Master of Trinity College, the Provost of King's College, the Master of St. John's College, the Regius professor of physic, the professor of botany; (*b*) the present elective members; (*c*) four persons appointed by the Faculty Board of Biology "A"; (*d*) two persons appointed by Grace on the nomination of the Council of the Senate. It is recommended that the present Director shall be responsible for the management of the Garden under the Faculty Board of Biology "A". He shall give assistance to the professor of botany by teaching systematic botany in the Garden and in other ways. When the directorship falls vacant, the professor of botany shall either himself be director, or appoint as director, with the concurrence of the Faculty Board of Biology "A", a University teaching officer in the Department of Botany, the appointment to be made for a limited period, not exceeding five years. A director shall be eligible for reappointment.

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A COURSE of six lectures, dealing with "Some Philosophical Aspects of Modern Industrial Society", is to be given by Prof. P. Sargant Florence at the British Institute of Philosophical Studies, University Hall, 14 Gordon Square, W.C.1, on Tuesdays at 5.45 P.M., beginning on Jan. 20. The lectures, which are free to members of the Institute, are open to the general public at a nominal fee. A syllabus of the course, and other particulars, can be obtained from the Director of Studies, British Institute of Philosophical Studies, University Hall, 14 Gordon Square, W.C.1.

THE International Federation of University Women has issued a report of its council meeting held at Prague last July. The Federation now comprises thirty-four national associations of members of the universities of nearly all the countries of Europe, of the United States of America (more than 500 branches), Canada, Australia, New Zealand, India, South Africa, and Mexico. The Prague meeting was signalised by the gift of £1000 by President Masaryk to the Federation's Travel and Research Fellowship fund, completing the endowment of the first of these fellowships. The Federation has issued a complete list of international fellowships available to graduate students, both men and women, wishing to work in foreign countries. It endeavours to promote exchanges of teachers, junior medical officers, museum curators, librarians, archivists, and lecturers. It also organises group travel tours arranged with reference to special professional or cultural interests. For the coming season, tours are being organised in England, Germany, Italy, and Norway. The headquarters are at Crosby Hall, Cheyne Walk, London, S.W.3.

ON Saturday, Jan. 3, the first national conference for advancing the cause of adult education by wireless was opened at the London School of Economics. The conference was composed of representatives of the Central Council for Broadcast Adult Education and the British Institute of Adult Education. Dr. Temple, Archbishop of York, in a letter regretting his absence, pointed out the great importance of group discussions. Such groups are undoubtedly a great asset, since they prevent, as Dr. Temple remarked, the mere reception and indiscriminate assimilation of the material broadcast. It is conceivable that any type of broadcast talk would probably defeat its own object if received without question by the listener. With child education, such a possibility is eliminated by the teacher, who may clarify, stress, or amplify points at his or her own discretion. In the case of adult education, this is naturally very difficult, and therefore the formation of study groups, which promote discussions, is to be encouraged. The growing influence of broadcasting on education, especially in the case of adults, is made evident by the formation of four hundred study groups up to the end of last year. This should encourage the B.B.C. to continue its efforts in wireless education.

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## Birthdays and Research Centres.

Jan. 13, 1869.—Sir RICHARD PAGET, Bart.

I am at present studying the mouth gesture of the root words of modern English, a large proportion of which are found to be pantomimic. Thus, nearly all words beginning with STR have meanings connected with the tongue gesture which produces the STR-sound, namely, a stroking, streaking, or stretching from behind the teeth to near the back of the palate. Linguists might usefully compare the root words for gesturable ideas in the various language groups of the world from the point of view of mouth gesture.

On the experimental side there is a great opening for work with plasticine and rubber models to elucidate the methods of producing different qualities of tone in voice production. The musical experiment suggested on pp. 184-188 of "Human Speech" still awaits a practical trial by three expert players of the Swannee whistle.

Jan. 18, 1868.—Sir LEONARD ROGERS, C.I.E., F.R.S.

A forecast of the probable incidence of cholera, smallpox, and plague in India during 1930, based on the previous year's meteorology on the lines I had worked out, has proved remarkably correct. A similar forecast for 1931 will shortly appear.

A severe epidemic of leprosy in Nauru Island has been reduced by 40 per cent in three years by my plan of clearing up the cases by injections of hydnocarpates in the early stage, discovered by repeated examination of contacts; so the means of stamping out leprosy are now available.

The discovery I made in 1916–18 that the acid-fast bacilli of leprosy can be destroyed in the human tissues by hydnocarpates and morrhuates makes further work on these lines the most hopeful method of treating tuberculous disease. New preparations of hydnocarpus and cod-liver oils are now being tested experimentally and clinically against tubercle.

Jan. 22, 1881.—Prof. J. W. HESLOP HARRISON, F.R.S., professor of botany and reader in genetics at Armstrong College, University of Durham.

My researches on the botanical side are mainly directed toward the elucidation of evolutionary problems in the genera *Rosa* and *Salix*. In the section Caninæ of the genus *Rosa*, reproduction, whilst

facultatively sexual, is mainly secured by apogamy or sporophytic budding. Recently, however, cases have been detected in almost sterile crosses between *R. spinosissima* and the Caninæ in which a true parthenogenesis occurs. Offspring so produced is fully fertile and presents novel cytological features. Strongly resembling *R. spinosissima* and fitted for habitats of that species, such plants become a by no means negligible element of certain *R. spinosissima* populations, which thus approach the condition of hybrid 'swarms'. The problems presented by these populations are being attacked genetically, cytologically, and in the field.

On the zoological side, I have found that the larvæ of the moth *Selenia bilunaria* respond readily to their environment in respect to pigmentation. The inheritance (or otherwise) of such colour effects is being studied in crosses between alderwood and hawthorn hedge strains, as well as in others involving larvæ experimentally treated. Simultaneously, work proceeds on the inheritance of bivoltinism induced in univoltine northern races of the same insect.

## Societies and Academies.

### LONDON.

**Geological Society**, Dec. 3.—**H. Dewey**: The Palæolithic deposits of the lower Thames valley. Recent work near Swanscombe (Kent) has revealed some facts of interest with regard to the relationship of the Thames deposits to Palæolithic man. The deposits of the 100-foot terrace in the old pit at Milton Street are still being extensively worked. They are upwards of 30 feet thick, and are divisible into three beds of sandy gravel, lower, middle, and upper, separated one from the other by beds of marly loam; and they rest upon a clean-cut surface, or 'shelf', of chalk and Thanet sand at a level of 88 feet above O.D. Correlation between the deposits at Milton Street with those at Ingress Vale is established.—**P. Tesch**: The Riss glaciation in the south-eastern parts of England. The plains of western Germany and northern Holland and the North Sea basin were covered by the ice-sheet of the Riss glaciation. Short accounts of the fauna and flora of these beds are given in the paper. A close conformity is shown to exist between the Dutch deposits and those of Norfolk. The author does not agree with the late F. W. Harmer that the two ice-sheets of East Anglia mark two different glacial periods, but only re-advances during one, the Rissian, glacial period.

**Royal Meteorological Society**, Dec. 17.—**J. Glasspoole**: Heavy falls of rain in short periods (two hours or less). The paper gives details of intense falls in 10, 15, 30, and 60 minutes as recorded in 7 years at 14 stations distributed over the British Isles. This is a more detailed examination than has been carried out previously; thus, at Camden Square (London) 0·16 inch or more has fallen in 10 minutes on 22 occasions in 7 years, and on the average of the 14 stations 0·80 inch or more has occurred in an hour once in 7 years. Details are given of the heaviest, second heaviest, and third heaviest rains in specified times at each station. —**M. T. Spence**: The factors affecting visibility at Valentia Observatory. This paper analyses by means of frequency tables the relationship at Valentia between visibility and (*a*) cumulus cloud, (*b*) wind force, (*c*) humidity. Visibility is better when there is cumulus cloud in the sky than when there is not; it deteriorates with increasing wind force, and improves with decreasing relative humidity down to comparatively low values of humidity. The relationship between visibility and cumulus cloud is regarded as showing that visibility at Valentia is generally better in air of polar origin than in air of equatorial origin. The deterioration of visibility with increasing wind force is not due to the stronger winds being land winds or to their being more humid than the lighter winds: it is concluded, therefore, that sea spray, the amount of which varies with wind force, gives rise to the greater obscurity with strong winds. Improving visibility with drier air at comparatively low values of relative humidity may be associated with slow evaporation from the hygroscopic nuclei.

### DUBLIN.

**Royal Dublin Society**, Nov. 25.—**J. Joly**: The application of gamma radiation to deep-seated tumours (2). An apparatus was exhibited (made in accordance with a design recently published in the Society's *Scientific Proceedings*) whereby two tubular applicators, each yielding a beam of unscreened gamma rays from a suitable radium or radon source, are carried round a template in such a way that the beams intersect at any given distance, and the point of intersection traces out a path determined by the shape of the template. The apparatus may be strapped in position on the patient's body and fitted with suitable templates so that all parts of a deep-seated tumour may be subjected in turn to the focusing action of the convergent beams. A small electric motor with suitable reduction gearing moves the tubes slowly round; or use might be made of the patient's respiratory movements by means of an inextensible belt lined with a light rubber tube lightly distended with air, the variations in pressure of which would provide the requisite power.—**H. H. Dixon** and **G. Joly Dixon**: The exudation of water from the leaf-tips of *Colocasia antiquorum* Schott. The liquid issuing from the leaf-tips of *Colocasia antiquorum* is practically pure water. Hence it has been concluded that osmotic action is not responsible for its expulsion. Flood showed by histological and experimental methods that the stream is not due to glandular action. The authors demonstrate by simple working models that a continuous stream of pure water may be forced upwards by the osmotic pressure developed by solutions in the lower parts of the plant, and suggest that the pure water emerging is derived from these solutions, which have been depleted of their solutes, as they rise through the capillaries of the conducting tracts.—**H. H. Poole**: A modified form of radon capillary apparatus. The apparatus in use in the Society's laboratory for supplying radon tubes for therapeutic use has been further modified so as to combine the reliability of yield (90 per cent), obtainable with the original apparatus, with the ease of working characteristic of the modified form introduced two years ago.

### WASHINGTON, D.C.

**National Academy of Sciences**, (*Proc.*, vol. 16, No. 9, Sept. 15).—**Paul S. Galtsoff**: The rôle of chemical stimulation in the spawning reactions of *Ostrea virginica* and *Ostrea gigas*. Females are induced to spawn by the presence of sperm; there is a lag suggesting that the active principle, which is insoluble, is absorbed through the digestive tract. Male oysters are stimulated by egg suspensions, when there is no lag, and also by sperm. Males respond more readily to rise of temperature. One male having spawned stimulates its neighbours, both male and female, and so spawning may spread over a whole bank.—**Henry Borsook** and **Howard M. Winegarden**: On the free energy of glucose and of tripalmitin. The ratio of the theoretical maximum work obtainable by oxidation under physiological conditions to the total energy of the change is

nearly the same for these substances. It seems that fat is burned as such in the provision of energy for muscular work, or the energy released in the hypothetical conversion of fat to carbohydrate is not dissipated as heat but used as work.—**Wilder D. Bancroft and George H. Richter**: Claude Bernard's theory of narcosis. Bernard concluded that reversible coagulation of colloids of the sensory nerves produces or accompanies anæsthesia. Proteins are important in anaphylactic shock. Assuming that there is increased irritability as the nerve colloids approach instability and the beginning of reversible coagulation, it should be possible to observe, with increasing amounts of anæsthetic, first increased irritability, then anæsthesia, finally death if coagulation becomes irreversible. Thus, strychnine may be a stimulant in small doses and cause death in large doses; in an intermediate range of concentrations it is an anæsthetic. Similarly, yeast cells narcotised with alcohol show coagulation which can be reversed by removing the alcohol, when the cells recover. Thus the difference between an anæsthetic like ether and a habit-forming drug like morphine is that the former is rapidly eliminated whereas the latter or its products is retained, keeping the system irritable. Nitrous oxide acts indirectly; it interferes with oxygen metabolism, giving rise to acid products which cause flocculation.—**Linus Pauling**: The structure of the chlorites. The structure deduced leads to the general chemical formula: $X_mY_4O_{10}(OH)_8$, with $4 \leq m \leq 6$.—**Richard C. Tolman**: Discussion of various treatments which have been given to the non-static line element for the universe.—**Einar Hille and J. D. Tamarkin**: On the summability of Fourier series: third note.—**Francis F. Lucas**: The architecture of living cells—recent advances in methods of biological research—optical sectioning with the ultra-violet microscope. The ultra-microscope as developed for metallography has been applied to photograph the structure at different planes within a single cell or group of cells. The sensitivity of the fine adjustment of the microscope has been increased so that a movement of a quarter of micron is possible and series of photographs at these intervals are taken in the light of a cadmium spark. With a transparent specimen, detail above or below the exact focal plane does not interfere with the image, so a series of 'optical sections' is obtained. Since organic specimens are differentiated in structure by their selective absorption of ultra-violet light, staining is not usually necessary. Some striking photomicrographs are reproduced in the paper.—**L. S. Kennison**: A fundamental theorem of one-parameter continuous groups of projective functional transformations.—**Harry Merrill Gehman**: A special type of upper semi-continuous collection.—**R. D. Carmichael**: On expansions of arithmetical functions.—**A. D. Michael and L. S. Kennison**: Quadratic functional forms in a composite range.—**G. C. Evans and R. N. Haskell**: The mixed problem for Laplace's equation in the plane discontinuous boundary values.

## Official Publications Received.

BRITISH.

Annual Report on the British East African Meteorological Service, working in connexion with the Conference of East African Governors, 1929. Pp. 13+iv. (Nairobi.)

The Quarterly Journal of the Geological Society. Vol. 86, Part 4, No. 344, December 2nd. Pp. 463-532+xiv+7 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

Proceedings of the Royal Society of Victoria. Vol. 43 (New Series), Part 1, 30th September. Pp. v+100. (Melbourne.)

Record of the Royal Institution of Great Britain, 1930. Pp. 148. (London: Wm. Clowes and Sons, Ltd.) 5s.

Scottish Marine Biological Association. Annual Report, 1929-30. Pp. 23. (Millport.)

Imperial Institute. The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports and Exports) 1927-1929. Pp. 371. (London: H.M. Stationery Office.) 5s. 6d. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 1: A Modified Form of Radon Capillary Apparatus. By Dr. H. H. Poole. Pp. 6+1 plate. 1s. Vol. 20 (N.S.), No. 2: The Exudation of Water from the Leaf-tips of *Colocasia antiquorum*, Schott. By Prof. Henry H. Dixon and G. Joly Dixon. Pp. 7-10. 6d. Vol. 20 (N.S.), No. 3: The Application of Gamma Radiation to Deep-seated Tumours, 2. By Dr. J. Joly. Pp. 11-12. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Irish Academy. Vol. 39, Section A, No. 8: The Effect of Water Vapour on the Mobilities of Negative Ions in Air. By Prof. J. J. Nolan. Pp. 82-99. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 45: A Soil Survey of the Woorinen Settlement, Swan Hill Irrigation District, Victoria. By J. K. Taylor and F. Penman. Pp. 41+4 plates. (Melbourne: H. J. Green.)

The Deeside Field. Issued under the Auspices of the Deeside Field Club. Fifth Number. Edited by J. B. Philip. Pp. viii+92+32 plates. (Aberdeen: The Rosemount Press.) 3s. 6d.

Transactions of the Fourth International Congress for Psychical Research, Athens, 1930. Edited by Theodore Besterman. Pp. 259. (London: Society for Psychical Research.)

FOREIGN.

Sborník Vysoké Školy Zemědělské v Brně (Bulletin de l'Ecole supérieure d'Agronomie, Brno). Sign. C18: Vliv paprsků ultrafialových na vzrůst a látkovou výměnu ryb (The Influence of the Ultra-violet Rays on the Growth and Metabolism of Fishes). Napsal Dr. Boris Kostomarov. Pp. 55. Sign. D16: Auximetry—Přírůstoměry. Napsal Bohuslav Polanský. Pp. 90. (Brno: A. Píša.)

Práce Moravskí Přírodovědecke Společnosti (Acta Societatis Scientiarum Naturalium Moravicae), Brno. Svazek (Tomus) 5, Spis (Fasciculus) 42-46, 1928-1929. Pp. 415. (Brno: A. Píša.) 100 Kč.

Malayan Forest Records. No. 8: Durability of Malayan Timbers. By F. W. Foxworthy and H. W. Woolley; with a Note on Termites, by H. M. Pendlebury. Pp. 60+6 plates. (Kuala Lumpur: Director of Forestry.) 1 dollar; 2s. 6d.

Maryland Geological Survey. Vol. 12. Pp. 336+16 plates. Maryland Geological Survey. Baltimore County. Pp. 420+28 plates. (Baltimore, Md.: Johns Hopkins Press.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 12, Livraison 2, Octobre. Pp. 121-261. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 5, No. 5, November. Pp. 973-1187. (Washington, D.C.: Government Printing Office.)

CATALOGUES, ETC.

Calendar for 1931. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Calendar for 1931. (London: The *Chemical Trade Journal*.)

Bericht über die Tätigkeit des Verlages Gustav Fischer in Jena in systematischer Übersicht. C: Naturwissenschaften (von Ende 1929 bis Ende 1930). Pp. 32. Verzeichnis naturwissenschaftlicher Werke: Botanik; Veröffentlichungen seit 1926. Pp. 71. (Jena: Gustav Fischer.)

Books on all Technical Subjects and Applied Science, Second-hand and New. Pp. 96. (London: W. and G. Foyle, Ltd.)

## Diary of Societies.

*FRIDAY*, JANUARY 9.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—Dr. C. M. Yonge: Life on the Great Barrier Reef (Christmas Lecture for Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Royal Observatory, Greenwich: Mean Areas and Heliographic Latitudes of Sunspots in the Year 1929.—A. H. Wilson: The Transmutation of Elements in Stars.—Dr. W. J. S. Lockyer: A New Bright-hydrogen-line Star of Spectral Type B8 in Lacerta.—**General Discussion on Stellar Structure**, opened by Prof. E. A. Milne, followed by Sir A. Eddington, Sir J. H. Jeans, T. Cowling, and others.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.—L. R. Cox: New Lamellibranch Genera from the Tethyan Eocene.—R. Winckworth: (*a*) Growth of *Paphia undulosa*; (*b*) Molluscan Fauna of Pulicat Lake.—Dr. F. Moll and Dr. F. Roch: Teredidæ of the British Museum and the Jeffrey Collection.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—A. Dean and M. M. Macmaster: Mercury-Arc Rectifiers.

INSTITUTION OF STRUCTURAL ENGINEERS (at Wolverhampton), at 6.30.—E. R. Knight: Some Considerations affecting the Construction and Reconstruction of Bridges in Urban Areas.

OIL AND COLOUR CHEMISTS' ASSOCIATION (jointly with Society of Chemical Industry, Literary and Philosophical Society, and Society of Dyers and Colourists) (at Literary and Philosophical Society, Manchester), at 7.—W. O. D. Pierce: Human Factors in Colour Judgments.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—J. M. Heyes: The Design and Construction of Rayon (Artificial Silk) Machinery.

INSTITUTE OF TRANSPORT (Newcastle-on-Tyne and District Section) (at Y.M.C.A., Newcastle-on-Tyne), at 7.30.—R. W. Lee: Development of Road Passenger Services.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7.30.—C. H. Faris: The Application of Electro-deposited Metals to Engineering.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Doonan: Monel Metal: Some Notes on its Production and Industrial Application.

GEOLOGISTS' ASSOCIATION (in Botany Theatre, University College), at 7.30.—Special General Meeting.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—N. Fleming: Flap Extraction.—R. F. Moore: Bilateral Cataract from X-ray Exposure.

*SATURDAY*, JANUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (6): Large Sparks (Juvenile Lectures).

*MONDAY*, JANUARY 12.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—F. G. Woollard: Automobile Plant Depreciation and Replacement Problems.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. F. Shipley and others: Discussion on The Packing and Transport of Electrical and Allied Machinery.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—C. E. R. Bruce: The Distribution of Energy liberated in an Oil Circuit Breaker; with a contribution to the Study of the Arc Temperature.

ILLUMINATING ENGINEERING SOCIETY (at British Commercial Gas Association, 28 Grosvenor Gardens), at 7.—E. L. Oughton: Recent Developments in Gas Lighting.

INSTITUTE OF METALS (Scottish Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. G. Roberts: Chromium Plating.

CHARTERED SURVEYORS' INSTITUTION, at 8.—J. E. Drower: St. Paul's (Lecture).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Prof. J. W. Thierry: The Reclamation of the Zuider Zee.

INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—J. Stewart: Malting Barleys of 1930.

*TUESDAY*, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MINERALOGICAL SOCIETY, at 5.30.—Dr. F. C. Phillips: On a Soda-margarite from the Postmasburg District, South Africa.—F. A. Bannister: (*a*) On the Distinction of Analcime from Leucite in Rocks by X-ray Methods; (*b*) On a Chemical, Optical, and X-ray Study of Nepheline and Kaliophilite (with Chemical Analyses by M. H. Hey).

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. A. H. Gibson, T. H. Aspey, and F. Tattersall: Experiments on Siphon Spillways.

INSTITUTE OF MARINE ENGINEERS, at 6.—J. E. Allan: The Electrical Equipment of a Modern Ship.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.45.—E. C. Rossiter: Resins derived from Urea and Thiourea.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—S. W. Melsom, A. N. Arman, and W. Bibby: Surge Investigations on Overhead Line and Cable Systems.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—J. H. Francis: Concealed Floor Heating.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—R. Thorp: Hot Water Heating.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. E. Higham: Featherland (Nature Film).

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—F. G. Woollard: Automobile Plant Depreciation and Replacement Problems.

INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—N. C. Marples: The Applications of High-Nickel, Nickel-Copper Alloys and Pure Nickel in Industry.

QUEKETT MICROSCOPICAL CLUB (at Medical Society of London), at 7.30.—W. W. Allen: Pollination.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—W. G. Bateson: Head Hunting on the Sepek River, New Guinea.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. Adler: Paper.

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. E. F. Armstrong: Thoughts from a Chemist's Garden (Lecture).

*WEDNESDAY*, JANUARY 14.

ROYAL SOCIETY OF ARTS, at 3.—H. Barnard: Ancient and Modern Pottery (Dr. Mann Juvenile Lectures) (2).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—I. W. G. Freeman: The Aerial Cableways at Nag Hammadi Barrage, Upper Egypt.

TELEVISION SOCIETY (at University College), at 7.—Short Papers on Television Progress in Europe and America during 1930.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7.30.—Short Papers.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 8.—C. F. Hammond: The Concentration of Phosphoric Acid Solutions by means of a Submerged Flame.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London), at 8.30.—Dr. A. Adler: Paper.

*THURSDAY*, JANUARY 15.

ROYAL SOCIETY, at 4.30.—Lord Rayleigh: Iridescent Colours of Birds and Insects.—Prof. O. W. Richardson and L. G. Grimmett: The Emission of Electrons under the Influence of Chemical Action at Lower Gas Pressures.—E. G. Herbert: The Hardening of Metals by Rotating Magnetic Fields.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—U. S. Haslam-Jones: Note on Diophantine Approximation.—B. N. Prasad: On the Summability of Fourier Series and the Bounded Variation of Power Series.—M. R. Siddigi: On the Theory of Non-linear Partial Differential Equations of Parabolic Type.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with West of England and South Wales Oil and Greasemakers' Association) (in Chemical Department, Bristol University), at 7.30.—W. Kay: Mineral Oils and Lubrication.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Teesside Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—L. Ripley: Some Observations on Steel Founding.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.

CHEMICAL SOCIETY, at 8.—J. W. Baker: Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group. Part I. The Carbonyl Groups in Benzaldehyde and Acetophenone.—J. W. Baker and W. G. Moffitt: Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group. Part II. The Nitration of Benzaldehyde and Acetophenone in Sulphuric Acid Solution.—L. A. Elson and Prof. C. S. Gibson: 10-Chloro-5:10-dihydrophenarsazine and its Derivatives. Part XIV. Chloro-derivatives.—R. S. Cahn, Prof. C. S. Gibson, A. R. Penfold, and Prof. J. L. Simonsen: The Essential Oil of *Backhousia angustifolia*. Part III. The Constitutions of Angustione and Dehydroangustione.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Lieut.-Col. S. P. James: Some General Results of a Study of Induced Malaria in England.

BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street), at 8.30.—Dr. J. F. Brailsford: Hydatid Disease in England.—Prof. E. A. Owen and H. I. Jones: Ionisation Chambers for X-Ray Dosage Measurement.—Prof. E. A. Owen and Dr. P. Wright: Physical Characteristics of the Scheidt Ultra-Violet Ray Tube.

INSTITUTE OF BREWING (Yorkshire and North-Eastern Section) (at Queen's Hotel, Leeds).—H. M. Chubb: English Barleys of 1930.—T. R. Sutcliffe: Foreign Barleys of 1930.

*FRIDAY*, JANUARY 16.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (Clinical Meeting at Red Cross Clinic for Rheumatism, Peto Place, N.W.1), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—S. Butterworth and S. D. Smith: The Equivalent Circuit of the Magnetostriction Oscillator.—T. L. Ibbs and K. E. Grew: The Influence of Low Temperatures on the Thermal Diffusion Effect.—Dr. J. H. Vincent: Further Experiments on Magnetostriction Oscillators at Radio Frequencies.—Dr. L. C. Martin: The Theory of the Microscope.

BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street), at 5.—Medical Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at University, Liverpool), at 6.—Prof. G. T. Morgan: Organic Syntheses facilitated by Pressure (Hurter Memorial Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—S. F. Dorey: Some Factors influencing the Sizes of Crankshafts for Double-acting Diesel Engines.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

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

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7.30.—Dr. B. Moore: The Use of Fused Silica in Science and Practice.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—K. W. Willans: Some Problems Surrounding the Reorganisation of an Engineering Works.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (jointly with Tuberculosis Association), at 8.—Discussion: The Management of Pregnancy, Parturition, and the Puerperium in Tuberculous Women. Openers: Dr. G. Marshall and Dr. M. Hiley (Tuberculosis Association); A. Bourne and L. C Rivett (Obstetrics and Gynæcology Section).

SOCIETY OF DYERS AND COLOURISTS (London Section).—J. T. Holden: Researches on the Laundering of Fabrics.

## PUBLIC LECTURES.

*MONDAY*, JANUARY 12.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 3.—C. N. Hooper: The Control of the Marketing of Fish.—At 4.—C. Hattersley: Fish-inspection.

*WEDNESDAY*, JANUARY 14.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Dr. W. G. Savage: Bovine Tuberculosis.

UNIVERSITY COLLEGE, at 5.—Dr. J. C. Flugel: Art, Pleasure, and Reality.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Little Titchfield Street, W.), at 5.30.—H. A. Stayt: Coloured Peoples of the Union of South Africa.

MUSEUM AND ART GALLERY, BELFAST, at 8.—A. Bertram: How to Appreciate Pictures.

*THURSDAY*, JANUARY 15.

UNIVERSITY COLLEGE, at 2.30.—Miss Margaret A. Murray: Egyptian History.—Prof. G. Elliot Smith: The Peking Man.

*FRIDAY*, JANUARY 16.

UNIVERSITY COLLEGE, at 5.—G. P. Wells: Comparative Physiology. (Succeeding Lectures on Jan. 23, 30, Feb. 6, 13, 20, 27, Mar. 6, 13, and 20.)