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Factors of Industrial Development*

AMONG the duties charged on the Economic Advisory Council is that of considering the possibilities of new industrial development and particularly the measures which could be taken to foster the growth of new industries, whether they arise as the result of the application of the creative discoveries of modern science or not. The growing burden of the unemployment problem and the seriousness of the general economic position has induced the Council to pay particular attention to the relation of research to industrial development. It is at last being realised that industrial research is an important factor in the unemployment situation, and one that tends to create employment or at least to compensate for the displacement of employment in other fields as a result of increased mechanical efficiency or other changes.

It is probable that we have reached the end of an era in which the creative discoveries of science as applied in the electrical industries, automobiles, radio and the cinema, have found employment for millions and absorbed in productive work a large proportion of the increasing population of the world for whom under the old conditions no work could have been found. The advent of power production has already closed that era and brought new problems, the solution of which so far has eluded mankind. In the new era, scientific and industrial research are of equal importance as assisting to develop that flexibility which is essential if modern industry is to deal with problems of the magnitude of that of unemployment; and in equipping the nation to deal with the dislocation and reorganisation inseparable from the dynamics of industry or society.

In March 1931 the Economic Advisory Council appointed a Committee to consider broadly the position of industrial research in Great Britain, and in particular whether the proposal to establish a new central national research organisation would facilitate the promotion of industrial development as a means of providing additional employment. The report of this Committee gives a valuable survey of the existing organisation of industrial research in Great Britain with the definite object of discovering any overlapping which could be prevented by further co-ordination, or any gaps which should be filled either by

* Economic Advisory Council. Report of the Committee on New Industrial Development. Pp. 29. (London: H.M. Stationery Office, 1932.) 6*d*. net.

the development of existing organisations or by the creation of some new body, as was urged by Mr. A. P. M. Fleming in a paper before the Department of Industrial Co-operation at the British Association centenary meetings last year.

The major part of the survey of existing resources is devoted to a critical review of the Department of Scientific and Industrial Research and its research establishments, including the research associations, and the report places the responsibility for much of the prestige of this young Department on the exceptional combination of scientific attainments, administrative ability, zeal, persuasiveness and sympathetic understanding of the point of view of business possessed by those at the head of its staff. This is a tribute worth noting in view of a common tendency particularly in official circles to deny the possibility or existence of such combination of scientific attainment and administrative ability. With regard to the permanent institutions of the Department, the Committee comments on the absence from the National Physical Laboratory of any dubious schemes designed purely to be impressive, and it considers that the Laboratory has developed as an organic structure in response to clearly defined needs and purposes. Similarly such primary needs of the community as food, fuel, water-supply and buildings appear to be adequately covered by the other research establishments of the Department, and the work carried out by the Bridge Stress Research Committee, the Steel Structures Research Committee and the Locomotive Experimental Station Inquiry Committee is regarded as evidence of the ability of the Department to improvise a temporary special organisation to meet the need for special scientific investigation in any field of industry.

Commenting on the Research Associations scheme, the Committee points out that the Advisory Council which adopted the scheme deliberately rejected the idea of forming one central institution to which industries could turn for assistance in research, and suggests that experience has confirmed the view that a research association which a particular industry controls, for which it feels responsible and in which it takes a pride, is able to contribute to the development of mutual understanding between men of science and industrialists in a way that would not be open to a central institution. Moreover, the Research Associations have made discoveries of financial importance and have to a remarkable extent converted the British manufacturer from an attitude of scepticism to one of appreciation of the potentialities of scientific research. They have also established special departments for development work designed to assist in testing the results of their investigations on a practical scale, and it is clear that the Committee has formed a very high opinion of the merits of the Research Associations scheme.

Without detracting from the praise deservedly extended to many of these Associations, it is possible to feel that the Committee on Industrial Development is a little unduly optimistic about both their achievements and future prospects. Few of the Associations are self-supporting, and in fewer still has there been any sign that the industry as a whole is prepared to shoulder the full burden of financial responsibility of its research needs. In consequence, there is uncertainty about the continuance of the Associations, and the initiation of large scale development work is a much less simple problem than that confronting the research departments of large units of progressive industry, such as the General Electric Co., Metropolitan-Vickers, and Imperial Chemical Industries.

The Committee is accordingly unconvinced that an important gap exists in our existing arrangements for industrial research, which would be filled by the creation of a new national research organisation to draw up programmes of research into the application in industry of ideas, inventions, or processes at present undeveloped and likely to remain undeveloped, and to institute the necessary researches. While admitting that notably in the older industries, much research which might usefully be pursued is at present left undone, the Committee suggests that the need would be met by the Department of Scientific and Industrial Research establishing a branch for the purpose of initiating the stimulation of research in such industries, and directs attention to the readiness of the Department to create organisations of its own in important industrial fields where it recognises the existence of a need for research.

The proposal for the creation of a new central research organisation rests on a distinction drawn by its supporters between research directed to the improvement of existing industries and that directed to the creation of new industries, the latter being normally responsible for increasing employment. While it is undoubtedly true that the application of scientific discoveries resulting

in the creation of new industries has given employment to millions, under modern conditions the displacement effects are becoming more serious, so that rise of a new industry frequently means the contraction of an older established one. So far as employment is concerned, the national importance of scientific research as a factor in determining the rise of new industries lies rather in the consequent ability of the nation to minister to the new needs, thus giving employment to some or all of those inevitably displaced by the disappearance of needs to which the older industries ministered. In the minds of certain leaders of industry, such as Sir Harry McGowan, to judge from his presidential address last year to the Society of Chemical Industry, there are even doubts whether violent fluctuations caused in industry by, among other factors, the sudden exploitation of a scientific discovery, are really beneficial; and in the type of planning towards which the world is tending, provision for fundamental research and the deliberate exploitation of its results either by the State or by industry seems essential.

Apart from this factor, it is at least open to doubt whether the distinction drawn between the two types of research is valid and whether scientific research can be directed specifically to the creation of new industries. We are still without a real technique of discovery, and important industrial developments as often as not are based on purely fortuitous discoveries. In general, the fundamental discoveries have resulted from patient and disinterested investigations, the quest of truth for its own sake. Where scientific research has produced striking results from its direct application to industrial purposes we have entirely different conditions: a mass attack by a team of specialists on a clearly defined objective in a field where a considerable body of accumulated knowledge already exists.

The Committee refers to the work of the Fuel Research Board on the economical extraction of oil from coal as an example of the ability of the Department of Scientific and Industrial Research to take the initiative in problems of this type as they arise, and accordingly it considers that here again the proposed new body would be likely in practice, by confusing purposes and distracting effort, to injure rather than forward the cause of scientific research in industry. Even in regard to large scale tests the requirements of development research appear to be sufficiently covered by the machinery of the Department of Scientific and Industrial Research, although the Committee recommends that it is desirable that there should be at the disposal of the Government a small fund capable of being readily used for research developments, and that provision should continue to be made in the Department's annual estimates for such a sum for expenditure on research developments or unforeseen requirements.

The report of the Committee makes a convincing case for the adequacy of the existing Government organisation for the promotion of industrial research, which may be readily accepted without suggesting that the position is entirely satisfactory. The real trouble is that indicated in the last annual report of the Department. While the existing organisation is adequate and sufficiently flexible to meet the varied needs, there is not yet a sufficient general acceptance in industry of the fundamental importance of research as a fixed charge comparable with obsolescence, insurance, etc., and an essential factor in progress. The work of the Department is limited by the extent to which a scientific outlook prevails in industry, and the real task is one of educating industry to use the facilities already available rather than to create a new organisation with ill-defined objectives and probable overlapping with the functions of existing organisations. It is only as this task of education, both in industry and in public affairs, is tackled with real energy and efficiency that we can hope to close those gaps which exist in our national organisation of research or secure the full utilisation of the facilities already available.

Despite the fact that new industries are not in general created by direct scientific discoveries, long range fundamental research is of prime importance to the nation, and at the present time the declared policy of the Committee of the Privy Council to concentrate available funds on the work of the most immediate practical value to industry tends to create a dangerous gap. It is the long range type of research that is most liable to be neglected by industry, and the present report has little to say on the manner in which the task of education is to be undertaken or the serious danger the situation represents to posterity. Admittedly the available facilities are not yet being fully utilised, and the stability of certain features of the national organisation such as the Research Associations is uncertain. We cannot, for example, regard the position as satisfactory

when an industry representing £500,000,000 of invested capital has difficulty in providing the sum of £21,000 required to maintain a Government grant of £5,000 to its research association, and this in spite of the successful conclusion of researches on insulating oils and buried cables which at an aggregate cost of about £27,000 have resulted in total savings to the industry of at least £300,000 a year as well as adding something like £4,000,000 to the value of the existing cables.

Important sections of industry still notoriously owe their difficulties less to economic conditions than to the past neglect of scientific methods and research. The Report of the Committee on New Industrial Development underlines once more the necessity for a more widespread and intensive educational campaign to demonstrate both the capacity of scientific research to provide, not the ready-made solution of industrial difficulties but the technique of solution, and the ability of the scientific worker to co-operate in the conduct not merely of the investigations themselves but also of those administrative problems involving scientific and technical factors which abound everywhere in industry and the State to-day. It is only as a result of such an educational effort that we can expect to find alike in industry and in the State a scientific outlook in high places which will make possible the statesmanlike planning and utilisation of our full resources, whether of the Department of Scientific and Industrial Research, of industry or of the universities, and the prosecution of industrial and scientific research in all its varied phases from the fundamental or long range scientific research to the semi-technical scale in a measure commensurate with national needs.

Himalayan Exploration

The Italian Expedition to the Himalaya, Karakoram and Eastern Turkestan (1913–1914). By Filippo De Filippi. With Chapters by G. Dainelli and J. A. Spranger. Pp. xvi+528+20 plates. (London: Edward Arnold and Co., 1932.) 50*s*. net.

WE expect this production will rank as one of the most elaborate books of travel published, both as regards letterpress and the three hundred illustrations, not to mention maps and mountain panoramas. It is indeed worthy of such a leader as Cav. Filippo De Filippi, so well known as a traveller and explorer in the Himalayas, which he first visited as a member of H.R.H. the Duke of the Abruzzi's celebrated expedition to the Baltoro glacier in 1909, of which the author was also the chronicler.

The expedition occupied from August 1913 until December 1914. It was originally described in the Italian edition published in 1923 of which this is mainly a translation, but has been treated by the author as a new and revised edition. This has given him an opportunity of referring to expeditions which have taken place since the original was issued. He has also added a general chapter on the scientific results which have been only partly published in detail up to date. Two additional chapters have also been added by Prof. Giotto Dainelli and Mr. J. A. Spranger. The author remarks in the preface: "I do not know if any other trans-continental expedition has ever been organised through such difficult regions, crossing vast desert tracts devoid of sustenance for man and beast; with so extensive and complex a programme of scientific research, requiring not only a considerable company of trained workers but also very cumbersome equipment, including quantities of the most delicate instruments, which had to be transported with infinite precautions and needed unremitting care and supervision." This quotation will give some idea of what had to be accomplished over, perhaps, the most difficult country in the world.

The expedition was essentially a scientific one, and had for its object investigations into geology, glaciology and morphology, anthropology, meteorology, and, above all, the author was interested in gravimetric measurements and the deviation of the plumb-line with the view of investigating conditions of isostasy "when expertly carried out in the heart of the Himalayas and Karakoram, where great altitude and various practical difficulties had combined, up till now, to prevent the making of such delicate observations." A further object was to make systematic observations for terrestrial magnetism, and finally, the exploration and mapping of the eastern end of the Karakoram and its unknown glaciers.

It was certainly an ambitious programme, which so far as we know, was efficiently carried out, though the detailed scientific accounts are not yet completed. Cav. De Filippi took with him a carefully selected band of Italian experts with Commander (now Admiral) Prof. Alberto Alessio, as second in command. Col. Henry Wood, R.E., of the Survey of India and Mr.

John Spranger were the two English members. In all there were eleven Europeans, each an expert in his own line, and two Indian surveyors, Rai Sahib Jumna Prasad and Rai Sahib Shib Lal, lent by the Government of India.

The volume before us is mainly descriptive of the journey, localities and their people, passed through from the plains of India to the heart of the Himalayas, and we fancy little has escaped the notice of this observant traveller. Local interest has been added by a sketch of the history and religions of these remote parts. In search of information every available source has been used. Numerous notes and references are scattered throughout the pages.

After passing from India through Kashmir, taking geodetic and geophysical observations at various places on the way, the expedition reached Skardu, the capital of Baltistan. There they spent the winter of 1913–14; established observing stations and settled down to a regular series of observations, while Prof. G. Dainelli made geological excursions in the province of Baltistan, at the same time examining the social and economic condition of the people he came across. Perhaps in no part of the world is a larger proportion of the inhabitants dedicated to the service of religion; this subject, therefore, naturally occupies much attention.

In the spring of 1914 the expedition moved up the Indus to Leh, the capital of Ladak, "a true little capital, the seat of a tiny cosmopolitan world with various classes and categories of citizens." Here headquarters were established for 2½ months. The time was occupied with geophysical, meteorological and magnetic observations and excursions in the neighbourhood, by which Prof. Dainelli continued his researches, a description of which he contributes in two chapters. In the middle of May 1914 the whole expedition left Leh for the Eastern Karakoram, crossing by the Lhang-la into the Shayok valley *en route* for the Depsang Plateau where, on June 1, a base camp was formed at a height of 17,590 ft. above sea level from which to work the summer campaign of exploration and for the setting up of an observing station.

It was from here the main exploring work was undertaken; the survey of Rimu glacier and of the upper waters of the Shayok and Yarkand rivers being the chief objective. Other trips connected with geological research were also undertaken. Although the Rimu glacier had often been seen before, this is, we believe, the first time it was thoroughly explored and mapped. It forms a peculiar feature in that the continental water divide between Central Asia and India actually crosses this immense glacier; the waters from one branch flow into the Shayok river and thence to the Indus, and from another branch to the Yarkand river, which is eventually absorbed in the Tarim basin of Central Asia. Four chapters are devoted to the exploration of this area and to the discussion of the various topographical problems of this complicated jumble of mountains and glaciers.

In the final chapter a synopsis of results is given. Observations for deviation from the vertical and anomalies of gravity were taken at a series of fourteen stations beginning at Dehra Dun in India and ending at Tashkent in Central Asia, most of these being at a great height above mean sea level. Relative gravity was determined by Sterneck's modified apparatus, eight pendulums being used. For the determination of the deviation of the plumb-line, where it is necessary to make a comparison between astronomical and geodetic co-ordinates, the zenith telescope and transit instrument were used. Difference of longitude was determined by wireless signals specially transmitted from Lahore and timed for the expedition at Dehra Dun. By this means it was possible to obtain a more accurate value of the astronomical longitude than could have been done before the days of wireless.

These observations have an important bearing on questions of isostasy, which have occupied the attention of Indian geodesists since the time of Everest. We have not, however, had an opportunity of seeing the results, though it is stated the observations "confirm the general conclusions drawn by the Survey of India from their own, taken in connection with those of the Russian geodetic service: namely, that gravity values are generally in excess in the Himalayas and Karakoram ranges, and in defect to the south and north of them, pointing to equal conditions of compensation, or of lack of compensation, in the Indo-Gangetic plain and the plain of Turkestan." A complete set of magnetic observations was also made at each station. The topographical work, carried out by Col. Wood and Mr. Spranger and the Indian surveyors Jumna Prasad and Shib Lal, has been embodied in a map on a scale of 1/250,000, which is with the book.

A full set of meteorological observations was

taken and pilot balloon ascents were made: "these have resulted in a large quantity of new data."

As of interest in the realm of geology, it is stated, "contrary to the current view that this group of mountain ranges has not been subject to great glacial expansions in the Quaternary Age, Dainelli has found the occurrence of two great expansions, and of at least four minor ones." "Particularly interesting is the demonstration of two periods of uplifting which took place in the Quaternary; one affecting also a large portion of the Trans-Himalayan region, the other only the chain of the Himalaya (Pir Panjal). These uplifts have a general bearing on the question of the glacial period." The geological investigations made, and the specimens collected, by the members of the expedition should add much information about this region.

It is stated that there will be, when complete, ten volumes of scientific results from the expedition. As a book of reference and a guide to future explorers the volume before us is invaluable; it is, of course, impossible in a short review to do justice to it. There will soon be little left that has not been explored and mapped in that area generally known as the Karakoram. A good deal has been done since the De Filippi expedition.

We think the maps accompanying the volume might with advantage have had more of the names mentioned in the text inserted on them, without any overcrowding; it would have made the text easier and quicker to follow. The volume contains an extensive bibliographical index and the translation has been well done by Mr. H. T. Lowe-Porter.

H. L. CROSTHWAIT.

Social Anthropology in Epitome

Early Beliefs and their Social Influence. By Prof. Edward Westermarck. Pp. vi+182. (London: Macmillan and Co., Ltd., 1932.) 7*s.* 6*d.* net.

IT is not given to every anthropologist to be pre-eminent alike in the field and in the study; and it is only when this happy combination of interests occurs that facts and ideas are likely to be brought into harmonious relation. Prof. Westermarck actually started his career as a theorist, obtaining as a comparatively young man the most brilliant success with his "History of Marriage"—a work which later he crowned, if it was scarcely possible to surpass, with his admirably documented treatise on "Comparative Morals". On the other hand, he has given many of his best years to first-hand study of the social institutions of Morocco, where so many grades of culture exist in juxtaposition that a stratigraphy covering all the transitional phases between savagery and civilisation will reward research, given wide enough acquaintance with the conditions and the requisite analytical acumen. Thus it is fitting that, in the ripeness of his knowledge and experience, such a thinker should set himself to give summary expression to his more general convictions concerning methods and results.

Those familiar with Prof. Westermarck's books—and they will amount to most serious students of anthropology—will perhaps find here no fresh surprise sprung upon them, but on the other hand will be glad to have the principles on which he has come to rely formulated and defended with such masterly clearness. Thus it is well known that Prof. Westermarck has always sought to steer a middle course between Frazer's and Durkheim's attempts to differentiate magic from religion. He agrees with the one that they severally imply coercion and conciliation; but with the other that both alike relate to the supernatural, and therefore have more in common than Frazer's notion of magic as "the bastard sister of science" would make it possible to assume. But this compromise involves difficulties of its own. Thus he writes: "It has only reference to religion in the abstract, not to the various religions. In the popular sense of the word, which certainly must be respected, *a* religion may include many practices which are what I have called magical"; and he goes on to hint that the Christian use of holy water and even the Eucharist itself have a magical import. But surely, to deny a religious character to the central mystery of the typical religion of civilisation is simply to play with words, unless indeed a valuation is intended such as would be quite out of place in a purely scientific account of an evolutionary process.

Further, believing as he does that religion is born of fear and originates in emotions excited by contact with the uncanny, Prof. Westermarck is disposed to minimise its influence as a social force; so that one cannot but suspect him of conceiving it too abstractly, and therefore failing to do justice to its nature as a living and working

institution. When he says that the importance of the religious bond as apart from the influence of marriage, local proximity and a common descent has been slight in its bearing on the growth of social organisation, or when, again, he insists that "the moral influence of religion has often been greatly exaggerated", he seems to me to be eviscerating human history in the interests of a bloodless category. Thus I suppose that he would not deny the social and moral activities of the Christian Church, but would nevertheless declare the religious element in them to be but slightly responsible for the concrete results.

Obviously, if one starts from a primitive impulse so limited by definition that it can never alter by way of expansion or sublimation, then any progress that occurs in a complex with which it is connected must be due to something else. If, however, one plays fair all round and treats the remaining impulses concerned in similar fashion, thereupon it becomes quite impossible to account for any development at all. In fact it puzzles me altogether how 'religion' can be anything different in essence from *a* religion, since I take it to be rather the *formule d'ensemble* that covers any and every religion as such, however variously it may have evolved.

Meanwhile, whether the reader is always in sympathy with the point of view or not, he is sure to derive profit from the masterly grip on the relevant evidence which is displayed in the treatment of every special topic alike. One feels that half a century of study and experience is behind the elucidation of that many-sided theme, the relation of the sexes, together with the resolution of the paradox that primitive religion sets a value both on chastity and on unchastity in different contexts. Again, many side-lights are here thrown on the history of morals, as for example in relation to the duties of charity and hospitality towards men and of respectful behaviour towards gods. Moreover, with morality, law is so closely bound up that the part played by methods of procedure such as the oath or the ordeal in the administration of justice is duly considered in turn. Thus we have here in compact and lucid shape the mature reflections of one whose command of fact and independence of mind entitle him to rank among the foremost exponents of anthropology in all that variety of aspects constituting its social side.

R. R. MARETT.

Implications of Science

The Universe of Science. By Prof. H. Levy. Pp. xiii + 224. (London: Watts and Co., 1932.) 7*s.* 6*d.* net.

THERE is no end to the number of philosophical or quasi-philosophical puzzles with which the present-day physicist may divert himself; the marvel is that, in all the pother and hurly-burly of questioning of fundamentals, there remain a few calm souls content to weigh and to measure, unperturbed by the dust raised by iconoclasts who question the very possibility of exact measurements.

"The Itch of Disputation will prove the Scab of the Churches," said an apophthegmatical Provost of Eton more than three hundred years ago. The correctness of view of those who describe, in similar vigorous terms, the grammars of science which pour from our presses in ever-increasing numbers, may be questioned; always provided that we measure first, and theorise about it afterwards, there is much to be gained, and nothing to be lost, by hurling shards at dogmas which seemed, a generation ago, fixed and unassailable.

Moreover, the layman wants to know all about it; his papers proclaim that the universe is dissolving into radiation, that the author of the universe is a mathematician, that the principle of free-will has invaded physics, that there is not 'a particle of evidence in favour of determinism'; and we are told that things not observable are not real, and must be omitted from our theorisings—an assertion which, like many of these novel sayings, is not so new as it appears to be; the schoolman who told us *de non existentibus et non apparentibus eadens est ratio* had the root of the matter in him.

A certain amount of looseness of definition is apparent in some of the topics which are occupying the attention of theorists, and one suspects that no small number of the disputes that have arisen would prove to be verbal if the protagonists would only define carefully such terms as *indeterminism* and *free will*. Uneasiness in these matters of definition is to-day, curiously enough, more apparent in the biological than in the physical sciences, and it is interesting to note that, with a certain hesitation, the suggestion has been made that botanical science might possibly be the better for the loss of the *Reiss-begriff*. This is perhaps going too far, even though plant physiologists may, in the past, have attached queer connotations to

the notion; define your terms strictly and stick to the definitions, is a two-century old piece of advice, which represents the most profitable line of action.

Prof. Levy's contribution to the study of these problems merits careful attention. It is well fitted, in its clarity of style and in the elementary nature of its exposition, to the needs of the amateur in these matters. Mayhap he may be a trifle bewildered at first, for Prof. Levy's attitude is distinctly not that of the indeterminist school. Indeed, he roundly says that "the interpreters of the new knowledge and understanding, Sir James Jeans, Sir Arthur Eddington, Professor Millikan, General Smuts . . . have almost without exception approached their problems against a background of outworn Idealist Philosophy, none the less significant in its colouring because it has been unobtrusively though tacitly present. The pendulum has swung in the opposite direction. It is a reaction against the confident materialism of a past generation, as dogmatic and as uncritical as was its religious counterpart."

Which is very well; but we could wish that writers of all shades of opinion would furnish themselves with accurate critical and historical knowledge ere they attempt to see the present against the background of the past. What is this "confident materialism" against which an already "outworn Idealist Philosophy" has reacted? If the allusion is to the *Kraft-und-Stoff* movement of the mid-nineteenth century, it must be remembered that its vogue was short, and while sciolists might and did continue to rail against the 'dead mechanism' of the universe described by science, Buchner's book read oddly enough even to a young inquirer of the later eighteen-nineties. Mach and Pearson had already pointed the way to a saner synthesis which is certainly not outworn in the nineteen-thirties.

Scientific methodology—and with this attitude Prof. Levy is, we think, in agreement—is as deterministic, in the philosophic sense, as ever it was. Even the uncertainty principle is envisaged in terms of the mechanical pushes and pulls to which our macroscopic world has accustomed us, and the uncertainty is an uncertainty of the *where* and *when* rather than an uncertainty produced by a breakdown of the law of causality itself.

Such topics, and the deductions therefrom, are of great interest to the present-day world, and the author handles them in vigorous and stimulating fashion. His writing abounds in apt allusion and illustration, and the chapter on mathematics, which is written in an endeavour to show to those unfamiliar with the science "how mathematical methods are used as an instrument in scientific discovery", is an admirable piece of elementary exposition. His second chapter will be read with considerable interest. It passes the compass of any one man's mind to see as a whole the moving shadow-shapes that constitute his perceptual universe, and, in the nature of the case, whenever he studies a portion of that universe, he must make what the author terms an 'isolate' of it. Such a necessary isolation bears with it philosophical consequences which are discussed in some detail.

One or two minor omissions require notice; it is curious, in such a work, to find no detailed treatment of the terms 'cause' and 'causality'; Heisenberg's name is not indexed, and there is no reference to the uncertainty principle; Mach receives no mention, and Pearson is referred to twice, on topics quite incidental to the major issues.

There is no finality in these matters, and Prof. Levy has contributed but one more term to an unending series; his contribution is, however, both scholarly and important, and will compel the interest alike of the layman and the expert.

ALLAN FERGUSON.

Short Reviews

The Heart of England. By Edward Thomas. (Open-Air Library.) Pp. xvi + 228. (London and Toronto: J. M. Dent and Sons, Ltd., 1932.) 3*s*. 6*d*. net.

IT would be difficult to conceive of a more apt title to this collection of exquisite open-air essays than that chosen by the author, whose little volume is by its very simplicity and fragrance bound to appeal to many readers, especially of natural history, as being something that will live. The author must indeed have been inspired when he took up his pen to describe with such vivid directness his impressions of the country he loved so well. To use his own words: "You exult because you are alive and your spirit possesses this broad, domed earth."

The book is divided into five parts: "Leaving Town", "The Lowland", "The Upland", "The Mountains", and "The Sea". After reading such a volume as this it is with a feeling akin to consternation to realise that though the first publication was in 1906 it was not reprinted until 1932. English literature indeed lost one whom it could ill afford to spare when Edward Thomas was killed in Flanders during the War.

Air Ministry : Meteorological Office. British Rainfall, 1931 : the Seventy-first Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1931 as recorded by over 5,000 Observers in Great Britain and Ireland. (M.O. 345.) Issued by the Authority of the Meteorological Committee. Pp. xxi+306. (London : H.M. Stationery Office, 1932.) 15*s.* net.

FOR the British Isles as a whole the rainfall of 1931 was 109 per cent of the average, the year being the ninth in succession with a general fall in excess. Over the country as a whole the rainfall of 1931 was less than that of 1930 but greater than that of 1929. In spite of the wet summer some places in south-east England had less than the average annual fall, and so did the north-west of Scotland where summer was dry, but a wet area with more than 130 per cent embraced the north English Midlands.

As in 1930, and, indeed, every year, there were some notable downpours which, however, were unusually frequent. These included the severe thunderstorms of May 27 in south-west England and south Wales, the widespread intense rains of June 14, the day of the Birmingham tornado and of a destructive cloudburst near Bootle in Cumberland, the long succession of torrential rains in August amongst which was the thunderstorm that on August 8 deluged Boston in Lincolnshire with 6 in. of rain, the Whitby floods of September 4 which were comparable with those in the same district on July 20 in the previous year, and finally the heavy falls in the west of November 3 when 7 in. fell at Trecastle.

Special articles discuss long rainfall records and the effects of unsuitable sites for rain and evaporation gauges. L. C. W. B.

(1) *Post-Primary Science.* By W. F. F. Shearcroft. Book 2 : Second Year's Course. Pp. 234. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1931.) 2*s.* 6*d.*

(2) *Practical Science for Seniors.* By G. W. Manfield. Book 1. Pp. 96. 1*s.* 4*d.* Book 2. Pp. 128. 1*s.* 6*d.* Book 3. Pp. 160. 2*s.* (London : Macmillan and Co., Ltd., 1932.)

(1) This book is arranged in a somewhat unusual manner. It is divided into sections instead of the customary chapters, though more than one section is taken to deal with each branch of physics. Exercises alternate with the text in each section. They are printed in heavier type than the text, which is unfortunate as one is accustomed to associate heavy type with important information. The contents of the present volume include sections on gases, the atmosphere and atmospheric pressure, expansion of gases, liquids and solids, elementary mechanics, heat and elementary biology.

(2) These three booklets describe experiments in those branches of physics which have an important bearing on everyday life. Whenever possible, home-made apparatus of a simple nature is used. Instructions accompanied by clear illustrations make the assembly of the necessary apparatus an easy matter. Those pieces of apparatus which cannot conveniently be made at home are given with their approximate cost in a useful list at the beginning of each booklet. Short notes on the experiments are given at the end of each lesson. Book 1 contains experiments in elementary mechanics, on air, water and heat. Book 2 gives further experiments in mechanics and also experiments on air-pressure, water-pressure, light, magnetism and frictional electricity. Book 3 is devoted entirely to experiments in electricity. They are handy little books dealing with practical work only.

Winter Nights Entertainments : a Book of Pastimes for Everybody. By R. M. Abraham. Pp. ix + 186. (London : Constable and Co., Ltd., 1932.) 5*s.* net.

MR. R. M. ABRAHAM has brought together a very large number of examples, with illustrations, of card games and tricks, paper folding, coin and match tricks, string figures and tricks, knots and splices, games for the agile, toys, problems, etc., which will amuse those of all ages who like mental and digital dexterity to while away tedious hours of convalescence.

The making of string figures by primitive peoples is very widely spread and, as the author notes, it has engaged the attention of many field-workers. One would have thought that the author would have taken this opportunity to point out their real interest and to indicate where other examples may be found ; instead of this he gives no references, though he has gleaned string figures mainly from Kathleen Haddon's (Mrs. Rishbeth) books. The process of making these has been modified in most cases, usually a new title has been substituted, and the localities have been omitted. For example : The tern is called the flying bird ; the Apache door, the hurdle ; the well, the fruit blossom ; a temporary grass hut, is turned upside down to represent a parachute ; the fly, crushing the cocoanut (*sic*)—a difficult feat ! ; the butterfly, the snail ; the porker (described by Prof. Compton), the galloper (horse). Certainly the author has played tricks on the original discoverers of these string figures and on his unsuspecting readers. A. C. H.

Imperial College of Science and Technology : Huxley Memorial Lectures, 1925–1932. Pp. iii+12+30+38+27+16+21+28. (London : Macmillan and Co., Ltd., 1932.) 2*s.* 6*d.* net.

THE seven memorial lectures on different aspects of Huxley's life and work which are here collected give a very readable and impressive picture of the influence which T. H. Huxley still exerts in the field of science. It may be true that, as Aldous Huxley remarks in correcting G. K. Chesterton,

"Huxley *is* more of a literary than a scientific man", but while in one sense as a scientific man Huxley is now a mere historical figure, in another sense his influence as a man of science is still profoundly felt. The impetus he gave to scientific ways of thinking, not merely in some specialised field such as biology but also in the everyday affairs of life, has not yet died out. The battle he joined on the place of scientific method in education is still unfinished but his teachings and example are as inspiring as ever. The publication of these lectures in more permanent form should make known to a wider circle of scientific workers something of the sincerity and the humility which characterised Thomas Huxley, and should encourage them to take part in the yet unfinished warfare which he waged for scientific leadership and to emulate his own felicity of exposition of the aims and results of scientific studies. R.B.

Botany for Schools : a Textbook suitable for School Certificate and similar Examinations. By Dr. E. R. Spratt and A. V. Spratt. Pp. viii+363. (London : University Tutorial Press, Ltd., 1932.) 4*s*. 6*d*.

THE course of botany contained in these pages is claimed to cover completely the syllabus of the various School Certificate examinations. The authors also claim that the book is "suitable for the general reader who is interested in studying and experimenting with plants". Few textbooks are of interest or use to the 'general' reader ; and this definitely is a textbook. A two years' botanical course is developed along orthodox lines. The photographs are good and are genuinely illustrative of certain botanical facts. The line diagrams, however, leave much to be desired, and in a number of cases they are misleading. The subject matter is presented in an appropriate form, but in places, especially the experimental physiology, it tends to be rather out of date.

As an examination textbook this work can be recommended, though it can scarcely be considered ideal or novel enough to be substituted for some of the better-known textbooks on the subject.

Bees, Wasps, Ants and Allied Insects of the British Isles. By Edward Step. (The Wayside and Woodland Series.) Pp. xxv + 238 + 111 plates. (London and New York : Frederick Warne and Co., Ltd., 1932.) 10*s*. 6*d*. net.

NO one who has read with interest the author's former well-known contributions to the "Wayside and Woodland" series could fail to welcome this, his last addition. The book is not claimed to be a rigid textbook on the Hymenoptera but sets out to give a general idea of these insects to field-naturalists. Therefore the treatment has necessitated the consideration of insects with no special regard to the natural sequence of groups, and only the more noticeable or important insects are fully described. A classified index of families and genera of the Hymenoptera is, however, appended. There are, also, a glossary of technical terms and a good general index. Step's books always have made good, interesting reading, but this, especially from the point of view of the profuse illustrations, can be looked upon as his *magnum opus*.

The Imperial Gazetteer of India. Vol. 26 : *Atlas.* New (revised) edition. Published under the Authority of the Government of India. Pp. vii + 66 maps + 41. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 17*s*. 6*d*. net.

THE last edition of this atlas was published in 1909 and is now out of date in many respects. The present edition has two more plates than the old, the additions being an extra map of the distribution of crops, thus allowing twelve crops instead of eight to be shown, and one of Bihar and Orissa. Considerable changes have been made in the archæological sketch map, in the plate showing economic minerals and in the numerous town plans, and all the maps have been revised. In addition to the twenty-nine plates of general distributional maps, there are nineteen plates showing the whole of British India, the native States and Burma on a scale of 1 to 4,000,000. Afghanistan is shown on a small scale. There is a lengthy index.

How I was Born : the Plain Story of Birth and Sex. By Cyril Phillips Bryan. Pp. vii + 105. (London : John Bale, Sons and Danielsson, Ltd., 1932.) 5*s*. net.

IN this book, Mr. Bryan makes a sensible and interesting contribution to the literature of sex and its human significance. He gives a plain and straightforward statement which could be read with advantage by both adolescents and adults. There is nothing of a pornographic or even emotional character in the book, but much information which should afford wise guidance to healthy life and parentage. Among the many subjects clearly discussed are birth-control, sex determination, maternal impressions, inbreeding and heredity, hybrids and venereal disease. Many common fallacies are unveiled and curious cases described. In every respect the author has been successful in his endeavour to place before general readers the main facts relating to the whole range of sex.

Detachment of the Retina : a Contribution to the Study of its Causation and Treatment. By J. Ringland Anderson. Published for *The British Journal of Ophthalmology*. Pp. xiv + 207 + 7 plates. (Cambridge : At the University Press, 1931.) 20*s*. net.

IN his foreword, Sir John Parsons truly describes this monograph as being exhaustive and reliable and likely long to remain the chief source of information on detachment of the retina. Dr. Anderson gives a clear account, with full bibliographical references, of the present state of our knowledge of the causation and of the empirical mode of treatment which in certain cases affords some measure of success.

The Redwoods of California: The Past in the Present

By Prof. A. C. SEWARD, F.R.S.

THOUGH much has been written on the Big Trees of the Sierra Nevada and the Redwoods of the Californian Coast Range, the subject of these impressive examples of links with the past is by no means exhausted. It was my good fortune to wander in several Redwood groves in the spring of this year. Through the generosity of Dr. J. C. Merriam of the Carnegie Foundation and under

FIG. 1.—A, normal (two-ranked) foliage shoot; B, abnormal shoot of *Sequoia sempervirens* (½ natural size).

the expert guidance of Prof. Ralph W. Chaney of the University of California, Berkeley, visits were paid to the large groves north of San Francisco; and as guests of Prof. G. J. Peirce of Stanford University to the Big Basin south of San Francisco near the southern limit of the Redwood belt.

The two living species of *Sequoia* (Sequoyah, a Cherokee Indian who invented an alphabet), *Sequoia gigantea*, sometimes called *Wellingtonia*, the Big Tree, and *S. sempervirens*, the Redwood, are familiar as cultivated trees in British parks and gardens: it is the latter species with which this article deals. The Redwood was introduced into England soon after 1840 (the exact date is uncertain) and some specimens already exceed 100 ft. in height: this species is characterised by the red colour of the wood and soft, fibrous bark; foliage shoots with spirally disposed linear leaves, ¼–1¼ in. in length, recalling those of the yew, which in the normal lateral branches are twisted by the torsion of the short stalks into two rows in one plane. On some leading branchlets and occasionally on abnormal lateral branches the leaves are shorter, more ovate and spiky and retain the spiral disposition. Though the normal two-ranked shoots are readily distinguished from those of *Sequoia gigantea*, abnormal branches bearing more tapered and scale-like leaves are very similar to the typical branches of the Big Trees. The ellipsoidal cones of *S. sempervirens* are surprisingly small, ¾–1 in. long and ½ in. broad; they consist of 14–24 seed-bearing woody scales. The cones of *S. gigantea* are of the same form but rather larger. A typical foliage shoot and an abnormal shoot are shown in Fig. 1.

Extending more than half the length of the State of California lies a broad and relatively dry plain through which the Sacramento and San Joaquin Rivers flow respectively south and north into San

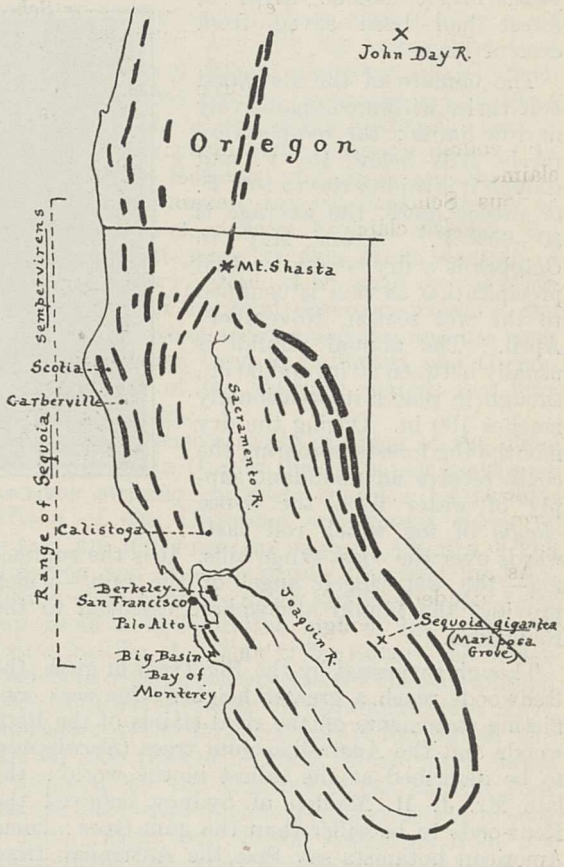

FIG. 2.—Sketch map of part of California and Oregon showing the Central Valley, the Coast Range, the western portion of the Sierra Nevada and, north of Mount Shasta, the Cascade Mountains, etc. Scale approximately 1 inch = 170 miles.

Francisco bay. The Sierra Nevada, including the highest mountains in the United States, form the eastern boundary, and the lower parallel ridges of the Coast Range lie between the western edge of the central valley and the Pacific Ocean. *Sequoia gigantea* is confined to a few localities on the Sierra Nevada, the most famous of which is the Mariposa Grove (Fig. 2): *S. sempervirens*, which has 'a

stronger hold upon existence', occupies a much larger territory to the west of the valley, from Monterey County in the south to a few miles north of the California-Oregon boundary, a distance of about 450 miles and with an average breadth of twenty miles. The Redwoods range from sea-level to an altitude of 3000 ft. Their distribution is not continuous. In some places the Redwoods form pure stands; there are forests in which the Douglas fir and other conifers are common associates; and areas in which the Redwood is absent either through human agency or from natural causes. A solitary giant by the side of the railway near Stanford University and the small town of Palo Alto (so named from the tree) is a conspicuous landmark.

A good road, the Redwood Highway, runs through the forests north of San Francisco and traverses a succession of groves which have been gradually acquired by the State, substantially aided by the Save-the-Redwoods League. Up to March of this year, nearly 30,000 acres of forest had been saved from destruction.

The climate of the Redwood belt varies within comparatively narrow limits; the temperature rarely falls below 15° F. and though it is said to rise to 100° F. or rather more, the average is 50°–60° F. From May to October is a dry season; actual precipitation as rain is confined to the wet season, November–April. The annual rainfall is usually between 20 in. and 60 in., though in places it occasionally reaches 100 in. During the dry months the forests bordering the coast receive an abundant supply of water from the dense clouds of fog which roll eastwards over the coast range hills. It is the summer fog—'the wet-winged angel of the rain'—which provides the humid atmosphere essential to the Redwoods.

Though surpassed by the Big Trees in girth, the Redwoods reach a greater height. One sees conflicting statements on the rival claims of the Redwoods and the Australian gum trees (*Eucalyptus*) to be described as the tallest in the world: the late Mr. J. H. Maiden of Sydney believed the Redwoods to be taller than the gum trees; some American botanists say that the Australian trees are the taller. But whether or not the Redwoods have longer stems, they are more majestic and make a stronger appeal to the imagination. It may be that in the future the alien eucalypts, which already play a conspicuous part in the Californian landscape, may exceed in height the native conifer. The highway on the north side of San Francisco bay passes through typical Californian scenery for several miles; low hills with smoothed rounded contours studded with clumps of live oak (*Quercus agrifolia*); on the lower ground sheets of the native blue and white lupin (*Lupinus bicolor*) and scattered patches of the glorious California poppy. Redwoods were first seen from the highway about thirty miles south of the small town of Garberville, with its typical 'main street', 230 miles north of Berkeley. Farther north we drove through miles of reserved forest areas, grove after grove of Redwoods with Douglas firs as their most striking companions. Between Garberville and Scotia, Redwoods are crowded on the hill slopes and along the deep valleys, where a fringe of alders, willows, and other trees forms the lowest zone of vegetation. Looking down from the steep hill-sides to the river-bed one sees weather-beaten and bleached stems and branches piled by the river in flood against obstructing rocks or stranded on banks of gravel, samples of contemporary vegetation on their way to entombment in river-borne sediment. Towering above the general level

FIG 3.—A Redwood forest: the large tree is 54 ft. in circumference, 6 ft. from the ground. (Photograph by Dr. A. A. Cannon)

of the forest on the high rocky ridges, spires of *Sequoia* and *Pseudotsuga* (Douglas fir) were silhouetted against the blue sky; the more drooping branches of the Redwood forming a contrast to the straighter arms of the fir.

The black oak (*Quercus Kelloggii*), the tan oak (*Lithocarpus densiflora*), the Californian lilac (*Umbellularia californica*), the Madrōno (*Arbutus Menziesii*), representing in the new world the strawberry tree of the Killarney Lakes and the Mediterranean flora, easily recognised by the red polished bark, the mountain dogwood (*Cornus Nuttallii*), maples and many other trees are some of the commonest neighbours of the Redwoods. A pink oxalis (*Oxalis oregona*), *Trillium*, the poison oak (*Rhus diversiloba*), irises, the red columbine (*Aquilegia truncata*), sword ferns (*Polystichum munitum*), the lady fern, and the far-flung bracken are a few of the abundant plants on the forest floor.

It is difficult to realise the height of the taller Redwoods in forests where there are few or no standards of comparison. Some of the giants, if

transplanted to the Close at Salisbury, would reach to within a few feet of the top of the famous spire. There are few trees equal to the Redwoods in resistance to fungus diseases, insect pests and forest fires: the thick fibrous bark and the wood, which in healthy trees lacks resin-ducts, are almost indestructible. The ordinary method of reproduction is vegetative, not from seed: the trees have remarkable capacity for regeneration by suckers from the roots. One often sees a ring of tall trees with a huge broken or charred stump in the centre of the circle: the moribund parent had developed a group of suckers which in course of time gained independence. A prone stem draped with nests of sword fern and many flowering plants may form a plinth bearing slender

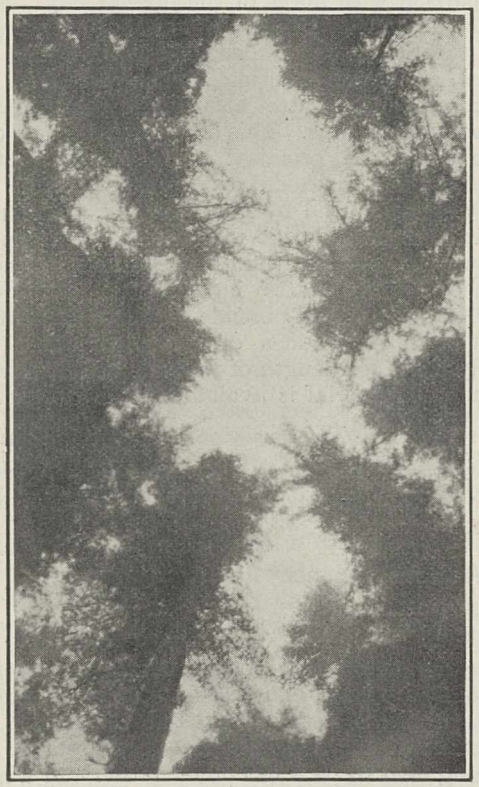

FIG. 4.—The canopy in a Redwood forest showing the sky pattern. (Photograph by Dr. A. A. Cannon.)

columns of young Redwoods. In the Big Basin, one specimen known as the Chimney Tree is a hollow trunk 100 ft. high, in which several people can stand and look upwards to the sky through the open end: the wood has been almost completely destroyed by fire; the shell still bears many vigorous branches.

On many of the trees are large and small burls, rounded excrescences like great warts, which are sold as souvenirs; when sawn off and placed with the flat surface in a saucer of water and wet moss, the dormant buds grow into an encircling wreath of two-ranked foliage-shoots.

It was not until we came to Scotia that the preserved areas were seriously interrupted by hillsides bare of all but charred stems and comparatively young trees which had grown from the roots of felled parents: the older trees were being sawn in the mills of a lumber company into huge planks.

The Redwoods appeal to us by their superbly fashioned columns, impressive examples of perfect architectural construction, bearing tapering cones of massed branches (Fig. 3); tree separated from tree in the distant canopy by small fringed spaces open to the light of the sun and to the sea fogs from the west (Fig. 4)*. They make an appeal as living things—some of them have been growing where they stand for twenty to thirty centuries—linking the present with a prehistoric past: groups of trees already centuries old surrounding ancestral relics bear witness to the continuity of the race through ages still more remote. At Calistoga, seventy miles north of San Francisco, one sees striking examples of petrified Redwoods, more than 100 ft. in length and 8 ft. in diameter, in beds derived from some Pliocene volcano, and with the stems have been found cones and foliage indistinguishable from those of the living species. It is easy to visualise a continuous series of generations linking the present with the latter part of the Tertiary period. In places where a Redwood climate prevailed, there is no reason to assume any substantial change in the forest flora of western America through the many thousand years of this small fraction of geological history. Nor, as we shall see, is there any evidence of essential difference between the Redwoods and their forest associates and the trees and shrubs which lived in California and Oregon in the middle of the Tertiary period, say fifty million years ago.

From an intensive study of some of the older Tertiary floras in Oregon, Prof. Chaney has shown that the striking contrasts revealed by a comparison of the Oligocene and recent floras of Britain are not found in western America. The Oligocene and Miocene plants described by Prof. Chaney were collected from localities in the John Day basin a little to the east of the centre of Oregon (see Fig. 2). Two of the floras—the Bridge Creek flora of Oligocene age and the Miocene Mascall flora—suffice to illustrate the appropriateness of the application to the Redwood flora of the phrase, 'the past in the present'. These floras have much in common but the elements of the Mascall flora indicate less humid conditions and greater exposure to light. More than 20,000 specimens from the Bridge Creek beds were examined and tabulated; and for comparison 8000 specimens of leaves, twigs and other scraps gathered from contemporary stream deposits in a canyon in one of the preserved areas (Muir Woods), where sediment is being deposited at bends of the river. In the Bridge Creek flora there are four dominant species, *Sequoia Langsdorfii*, *Alnus carpinoides*, *Quercus consimilis*, *Umbellularia* sp., which make up 86·44 per cent of the whole: in the recent stream

* I am indebted to Dr. A. A. Cannon of Stanford University for the photographs reproduced as Figs. 3 and 4.

deposits the corresponding species, *Sequoia sempervirens*, *Alnus rubra*, *Quercus densiflora*, *Umbellularia californica* constitute 85·44 per cent of the total number of species.

It is customary to speak of the Tertiary *Sequoia* with two-ranked leaves as *S. Langsdorfii*; but it may well be specifically inseparable from the existing Redwood. The plants of the Mascall flora are preserved in diatomaceous shale above the Bridge Creek beds and separated from them by sheets of lava. Several trees, such as species of *Quercus*, *Sequoia Langsdorfii*, *Umbellularia*, *Salix*, *Acer*, *Cornus*, *Rhus*, *Cerocarpus*, and many others have representatives in the Redwood forests, while there are several other plants which have their modern counterparts in eastern America and elsewhere. The resemblance of the Bridge Creek flora to that of the present Coast Range forests is much closer: among conifers *Pinus*, *Tsuga*, *Sequoia* and *Torreya* are common to both; among flowering plants *Myrica*, *Corylus*, *Alnus*, *Quercus*, *Berberis*, *Umbellularia*, *Fraxinus*, *Acer*, *Rhamnus*, *Cornus* and many others, all linking the Oligocene and recent floras by closely related species.

In the course of the gradual desiccation, since the Oligocene age, of the northern part of the Great Basin—the region through which flows the John Day River—most of the characteristic Redwood associates have disappeared from Oregon, though they have survived in the more humid belt on the western seaboard. The Bridge Creek flora, which is one of many examined by Prof. Chaney and his co-workers, is an example of an association still found in the Redwood belt; and in essentials it agrees with Tertiary floras recorded from Switzerland, Greenland, Spitsbergen, Siberia and Manchuria. We know that *Sequoia* flourished in Mid-Tertiary England, in the arctic regions as far north as Ellesmere Land, over a large area in Europe and the Far East, and in many parts of the New World. Why is the genus now confined to a narrow strip of California? No satisfying answer has been given: Prof. Chaney believes, and he is probably right, that "emergence and the consequent withdrawal of epicontinental seas have played an important part in the restriction of the Redwood forests".*

It is impossible in a single article to do more than direct attention to the nature of the work now being done on the reconstruction of some of the Tertiary floras of the New World and their comparison with floras of the present day. From Alaska through British Columbia, Washington and the States farther south are scattered vast stores of plants waiting to be collected and described; there are also large collections in Canadian museums. This field of work is exceptionally rich in promise: it is certain that by adopting the methods so successfully and convincingly employed by Prof. Chaney, who studies the extinct side by side with the recent floras and follows the latter beyond the southern boundary of the United States into Central and South America, it would be possible to follow the development and vicissitudes of the plant-world over nearly the whole length of western North America. Abundant material is available; the workers are lamentably few.

* For fuller information on the Bridge Creek, Mascall and other Tertiary floras and their relation to the modern Redwood Forest, see R. W. Chaney's papers in Publication No. 349 of the Carnegie Institution, Washington, 1925. Also a paper in Publication No. 346, 1927.

Relations between Pure and Applied Science*

By Sir James Baillie, O.B.E.,
Vice-Chancellor of the University of Leeds

THERE is still a certain amount of misunderstanding of what applied science means, especially on the part of those who draw a hard and fast line between pure and applied science, or of those who tend to regard applied science as of subordinate scientific interest and importance. There are some who treat applied science with a certain disparagement as being an attempt to adapt science to commercial purposes, a means of increasing wealth rather than of increasing knowledge. This attitude of mind is not perhaps so widespread as it used to be, but it still exists in Great Britain. Institutions such as the younger universities, which from the first seriously took up investigations which fall within the scope of applied science, have on that account been held to have derogated from the traditional conception of universities. Certainly up to recent years in Great Britain, no such problems were considered to deserve the attention of the academic mind. It was in fact for long held to be a recommendation and a merit that universities only taught and investigated subjects which could be studied in order to acquire knowledge for its own sake, and were useless otherwise except as promoting mental discipline.

It is instructive to observe that this narrow and indefensible outlook on knowledge is changing, and that the older universities are now taking a prominent and leading part in the advancement of applied science. We have only to recall in this connexion the important investigations carried on in both the older universities in the department of agriculture, and the work done in Cambridge to solve the difficult practical problems of cold storage. The institution, a few years ago, of the Department of Scientific and Industrial Research with its corollary, the setting up of the industrial research associations, is rapidly modifying and

* From a paper entitled "Applied Science in Yorkshire" read before Section L (Educational Science) of the British Association at York on Sept. 5. In addition to the extracts here printed, dealing with the relationships between pure and applied science, the paper outlined the development of technical instruction of all types in Yorkshire, and the work of the three industrial research associations which have their headquarters in the county, as well as that of special departments instituted in the Universities of Leeds and Sheffield to promote particular industries.

will in time completely transform the former attitude of the public and academic mind to applied science. When the history of universities in Britain comes to be written, it will be found that not the least of the contributions made by the younger universities to the development of academic life is that they led the way in recognising the scientific value and interest of applied science.

Applied science is neither more nor less than an investigation in the laboratory of the processes which are involved in the adaptation of Nature to the service of society in one form or another—a purpose which is surely eminently important and desirable. Some of these processes have been carried on empirically and with relative success for generations, to the great advantage of mankind. A large amount of experience has been accumulated and handed on by tradition, custom and instruction; but such experience has not been critically examined in the light of and by means of scientific method and resources. So far as rules have been arrived at in this way, the experience acquired rests on what we may call rule of thumb. The purpose of applied science is to substitute the rule of scientific law for the rule of thumb.

In other cases the laboratory examination of Nature's processes and material may lead and has led to the discovery of ways and means of adapting Nature to man's service in directions which have not been thought of in the past. In these cases the knowledge of the laws discovered by science precedes the adaptation of Nature's resources to man's use. New industries and manufactures may arise as the result of the antecedent work of the scientific investigator. Even here it must not be assumed that the application of science ceases to be science when the science is applied. The application consists in carrying out in detail the general laws discovered by science; and this in principle is in no way different from the process of verification by practical test which is an essential characteristic of scientific method. In other words, the application of science is a process of science as much as the discovery of the laws which are applied for man's service. Whether, therefore, the process of using Nature for man's ends precedes investigation by the scientist, or scientific investigation precedes and gives rise to the application of Nature to man's ends, is merely a matter of history and does not affect the meaning of applied science.

Applied science is thus quite distinct from the industrial and commercial development of the results of scientific investigation. This development depends on other considerations;—whether the capital is available to commercialise the results, whether anyone has the imagination and resourcefulness to produce an article which will appeal to the public, or whether the adaptation of the results for the use of man is economically profitable at a given time. Faraday's discovery of magnetic induction was of immense potential service to man, but it required time and genius of another order than his to foresee the ways and means to make it available for man's convenience.

Applied science does not differ from pure science by presenting a less difficult problem or by being less scientific than pure science. The sole differentia is that in the former case the results can promote man's desire to bend Nature to the service of the social life of man, while in the latter there is no such reference, at least directly or in the mind of the investigator while carrying on his investigation. The one aims at the active control of Nature, the other at the reflective comprehension of Nature. Both are essential to the fulfilment of man's life, and equally important ways of manifesting the supremacy of mind over Nature on which civilisation rests. Neither is subordinate to the other; and, as experience shows, they reciprocally assist one another, just as any science may produce results of value to another science. Sometimes we find that discoveries in pure science lead to new developments in applied science; sometimes achievements in applied science give suggestions for further investigations in pure science. Indeed there is no pure science, however apparently remote from social welfare, which may not in the long run promote the aim of applied science.

Apart from the fact that it is important to make clear the significance of applied science, the foregoing statement has a direct bearing on the subject with which the paper deals. For the development of applied science in Yorkshire has been governed by the recognition that effective control over Nature's processes, whether carried on in established industries or not, can only be secured by scientific investigation in the strictest sense. In the universities of Yorkshire in particular, applied science and pure science departments have been established from the first alongside one another. This has not been a mere accident, but a settled policy which, for the reasons given, must be considered to be as sound in principle as it has been fruitful in its results, both to the students of science and to those engaged in scientific investigation. The same policy has been adopted in the case of the higher technical colleges in Yorkshire, for example, those of Bradford and Huddersfield, where good work has been done not only on behalf of applied science but also in pure science.

No doubt in the early stages of the history of applied science in Yorkshire primary importance was attached to the practical usefulness of science for technical processes rather than to pure science. The practical mind of Yorkshire was inclined in the first instance to appreciate science for its value in furthering an intelligent interest in the productive industries of the area. This was but natural and not unreasonable; and since those concerned for the promotion of industrial welfare by means of science were, in general, not themselves trained in science, but had heard of or foreseen its value, it was perhaps inevitable that

the conception of applied science was understood in a comparatively narrow sense, as investigation and instruction in the craft side of industry and in the scientific subjects which seemed relevant thereto. The craft side is certainly an essential aspect of applied science, and must always be so if science is to be applied at all. It was only later and rather slowly that it was realised that this aspect merely sets the problem of applied science and that the understanding of the craft does not provide a solution of the questions which industrial processes raise. Still, even this humble beginning gave the start to what has provided a vast scientific undertaking.

The establishment of the Universities of Leeds and Sheffield, which represents the culminating point in the institutional development of applied science in Yorkshire, created new standards and a new outlook in the conception of applied science and its value for industry. Hitherto, applied science in the widest sense had been restricted to the communication of information on and the study of the technique of industrial processes carried on in the area, with some instruction of a rather elementary kind in certain of the pure sciences. The aim was to train or provide craftsmen with an intelligent appreciation of the rules and operations of their respective crafts, so that there might be in industry more competent and efficient workmen. With the advent of the universities and the spirit of detached scientific inquiry which inspires university work, applied science was able to become the critic and investigator of traditional industrial processes and methods, and to place the resources of a wider scientific outlook and knowledge at the service of craftsmanship. This raised instruction in applied science to a higher intellectual level. It could not be merely the communication of traditional knowledge acquired by experience in industry ; its aim was not simply to confirm but to transform existing practice in industry by training whole-time students in scientific principles and by promoting scientific investigation of industrial processes. This could not but be to the ultimate advantage of industry though the effects might not be seen for some time and the results might be slow in appearing.

The prosecution of applied science at this higher level had a further important consequence ; it suggested and indeed created a graded system of technical training and education with craft instruction in its various forms at one end of the scale and specialised scientific investigation into industrial processes at the other. The first could be appropriately taken over by the technical colleges, the second by the universities. There is at points a certain overlap, perhaps inevitable, between the work of the technical colleges and the universities. But the main distinction is clear between the purpose of the two types of institutions occupied with applied science. The primary business of the technical college is to provide craft teaching at a lower or a higher level, with higher scientific instruction and research occupying relatively a second place in the work of the college ; the main purpose of the university is to provide higher teaching in science and to carry on scientific investigations in applied science, with technical instruction occupying relatively a secondary place in its work.

Obituary

Sir Bernard Mallet, K.C.B.

SIR BERNARD MALLET, whose death on October 28, at seventy-three years of age, we regret to record, was the son of Sir Louis Mallet, a distinguished civil servant. He first entered the Foreign Office, from which he was transferred to the Treasury. He became a commissioner of Inland Revenue in 1897 and Registrar General in 1909, from which post he retired in 1920. His chief assistant for many years was Dr. Stevenson, who did such admirable statistical work in connexion with *inter alia* the differential birth rate, labour which never received adequate reward from the Government in spite of the loyal advocacy of his chief. Sir Bernard was president of the Royal Statistical Society in 1916–18, where, as everywhere, his personal influence was most valuable. He was for long an official of the Political Economy Club, and at its dinners must have met every living economist of note. He wrote several books, including a continuing series on the British budgets.

During the last years of his life, eugenics and the cognate subject of population occupied much of Sir Bernard's time. As to the latter, he was president of the World Population Conference held at Geneva in 1927, as a result of which was inaugurated the International Union for the Scientific Investigation of Population Problems, a now flourishing organisation in which he has continued to play an active part. He was a member of the International Federation of Eugenic Organisations, and attended meetings at Paris, Munich and in Dorsetshire. This last was somewhat of a novelty, the head-quarters being at the house of his cousin, Capt. Pitt-Rivers. A paper by him was read at the International Congress at New York this year.

Sir Bernard joined the Council of the Eugenics Society in 1918 and became its president in 1928. About that time the Society received a large bequest from an Australian pastoralist, the exaggerated hopes thus aroused in truth causing no small trouble. The Society prospered greatly under his guidance, the progress made in regard to sterilisation being especially noticeable, whilst several new schemes were set on foot, of which the most noteworthy was the attempt to give practical definition and expression to the concept of negative eugenics both in the sphere of hereditary

diseases and in that of the so-called 'Social Problem Group'.

That characteristic of Sir Bernard Mallet which will have stamped itself most strongly on the minds of all his friends is the charm of his personality. He was a gentleman in the very highest sense of the word. He was always courteous and most helpful to his colleagues. Eugenics as an applied science demands not only theoretical knowledge but also the power to judge between conflicting human motives, needs and prejudices, with the result that the task of its leaders is at times one of extreme difficulty. The Eugenics Society was fortunate in securing the services of a president with such varied experiences, all of which helped him to fill with success the place which he only consented to occupy out of a sense of duty.

Prof. K. K. Gedroiz

Soil investigators all over the world will learn with deep regret of the death on October 5 of Prof. K. K. Gedroiz of the Dokuchaiev Soil Institute, Leningrad, and until lately president of the International Society of Soil Science. He was born in 1872 in Bessarabia, was educated in Kief and graduated in 1897 as a forest engineer at the School of Forestry in Leningrad. He then became assistant to Kossovitch at the Agro-chemical Laboratory of the Ministry of Agriculture. In 1915 he was appointed editor of the Russian *Journal of Experimental Agriculture*, and in 1919 was made professor of soils at the School of Forestry: later on, in 1922, he became lecturer in agricultural chemistry at Nossov, and after Glinka's death in 1928 he was elected a member of the Russian Academy of Science and director of the Dokuchaiev Soil Institute, where he was specially concerned with the laboratory investigations of the soil and also with the soils of the podsol zone.

Prof. Gedroiz for many years carried out important investigations on the process of absorption by soil, attributing it, as van Bemmelen had previously done, to complex reactive substances produced by weathering. Both in their composition and their interaction with dissolved salts these substances were generally so similar in type that he felt justified in speaking of a reactive 'soil complex' modelled on the same lines as a salt, in which the cations could be replaced by other bases or by hydrogen. In the 'complex' of a normal fertile soil the predominant cation is calcium; in other soils it might be sodium, magnesium or hydrogen. In developing these ideas he was able to give a rational explanation of many of the phenomena associated with acid and alkaline soils, and to clear up many obscurities in what had previously been a very difficult subject.

Prof. Gedroiz's work was long unknown to British and American investigators owing to its publication in Russian. A summary issued in an abstract journal attracted the attention of one or two United States soil workers and they arranged for a translation of all of his papers into English. The volume was widely circulated among other soil investigators and at once ensured the recognition of the high merits of his work.

Gedroiz did much to make Russian soil science famous throughout the civilised world. His investigations into the soil complex and the phenomena of absorption fell easily into line with the studies on soil formation and classification initiated by Dokuchaiev and continued by a group of brilliant successors, Glinka, Neustruev and other workers still surviving: it gave a new and permanent direction to soil science. Gedroiz was of a modest and retiring disposition, rarely appearing at scientific gatherings: many soil investigators who visited Russia in 1930 were disappointed that they were unable to meet him and pay their respects to him. His work had sterling qualities which will ensure its place among the classics of modern science. E. J. Russell.

Dr. William Garnett

The death of Dr. William Garnett on November 1, at the ripe age of eighty-one years, will cause a feeling of the very deepest regret to those of his contemporaries and coadjutors who knew and appreciated the man and his genius.

Dr. Garnett was born at Portsea on December 30, 1850, and was the son of William Garnett of that town. He received his early education at the City of London School, and continued it at the Royal School of Mines, having taken the first place among the Whitworth scholars in 1869. He afterwards proceeded to St. John's College, Cambridge, of which he was later elected a fellow, having been bracketed fifth wrangler in 1873. He was the first demonstrator of physics in the Cavendish Laboratory under James Clerk Maxwell, whose biographer he became.

Fortunately for the cause of technical education, Dr. Garnett left Cambridge and associated himself with the developments of education which were then taking place. He was exceptionally well qualified to take up the position of a leader in the movement which was then developing throughout the length and breadth of the country for the advancement of what was termed 'technical education'. He held the position of professor of mathematics, physics and mechanics at University College, Nottingham, and later became principal and professor of mathematics in the Durham College of Science, Newcastle-upon-Tyne. Here he did splendid work. Realising that it was most important to associate the educational authorities with the development of technical education, he to some extent laid on one side his teaching duties at Newcastle-upon-Tyne with the view of obtaining an association between his college and the education authorities. He likewise found time during this period to write on behalf of technical education in the *Technical World* and other journals.

It was only natural, therefore, that Dr. Garnett

should be appointed secretary and educational adviser to the London County Council Technical Education Board in 1893. In this position, he probably achieved his most important work. He was largely responsible for the development of the London polytechnics and worked in harmony with both the City Parochial Charity Trustees and the great City companies. When the old Technical Education Committee was superseded by the London County Council Education Committee, Dr. Garnett was appointed educational adviser, and although this position relieved him of the responsibility of much educational routine, he exercised a great influence.

Dr. Garnett had a personality which was felt by all who were brought in contact with him. In his presence, none could fail to realise that they were dealing with a man of force of character, ideals and originality. He had, moreover, the power of inspiring devotion in those with whom he was associated. J. L. S. H.

WE regret to announce the following deaths:

Prof. U. S. Grant, professor and head of the Department of Geology and Geography at Northwestern University, Evanston, Illinois, who has done much work in economic and petrographic geology, on September 21, aged sixty-five years.

Prof. A. B. Hill, emeritus professor of hygiene and public health at the University of Birmingham, president of the Society of Medical Officers of Health in 1911–12 and of the Association of County Medical Officers in 1917–1924, a leading authority on national public health, on November 5, aged seventy-eight years.

News and Views

Royal Society Medallists

HIS MAJESTY THE KING has approved of the following awards this year by the President and Council of the Royal Society in respect of the two Royal Medals: A Royal Medal to Prof. R. Robinson, for his distinguished work in organic chemistry; A Royal Medal to Prof. E. Mellanby, for his distinguished work on dietary factors, especially in connexion with rickets. The following awards of medals have also been made by the President and Council: Copley Medal to Dr. G. E. Hale for his distinguished work on the magnetic field of the sun; Rumford Medal to Prof. F. Haber for his distinguished work in the application of thermodynamics to chemical reactions; Davy Medal to Prof. R. Willstätter for his distinguished researches in organic chemistry; Darwin Medal to Dr. C. E. Correns for his distinguished researches in genetics; Buchanan Medal to Prof. T. Madsen for his distinguished theoretical and practical work on immunity, especially in relation to diphtheria antitoxin; Hughes Medal to Dr. J. Chadwick for his distinguished researches on radioactivity.

Barnaba Oriani, 1752–1832

THE centenary falls on November 12 of the death of the eminent Italian astronomer, Barnaba Oriani, who for many years was director of the Milan Observatory, and to whom Piazzi communicated his discovery of the minor planet Ceres. Piazzi first observed the planet on January 1, 1801, and a few weeks later he wrote to Oriani and Bode, the former of whom calculated its orbit. Oriani was born near Milan on July 17, 1752, and was educated by the Barnabites. He was made a priest at the age of twenty-three years and almost immediately entered the Observatory, which had not long since been founded at the College of Brera, Milan. He soon attained a recognised place among Italian astronomers and was among the first to publish tables of the planet Uranus, discovered by Herschel. In 1786 he was sent to London to obtain instruments from Ramsden. At this time he became acquainted with Herschel, with whom he afterwards corresponded. With his colleagues, Francesco Reggio (1743–1804) and Angelo Cesaris (1750–1832), he carried out geodetical operations in northern Italy. He published various works on the motion of the planets. Although, during the greater part of Oriani's life, Milan formed a part of the Austrian dominions, it was seized by the French in 1796, and in 1802, the year in which Oriani was made director of the Observatory, it became the capital of the Cisalpine republic, with Napoleon as first president. On this occasion, it is said, that on Oriani's refusing to take the oath swearing hatred against monarchy, the wording of the oath was accordingly altered for him. Oriani's successors at Milan have included Carlini, Schiaparelli and Celoria.

Atomic Projectiles

ATOMIC projectiles and their applications formed the subject of the nineteenth Thomas Hawksley lecture delivered by Lord Rutherford on November 4 before the Institution of Mechanical Engineers. At present the maximum velocity that can be communicated to matter in bulk is not more than two miles a second. This is of the same order of magnitude as the average speed of the molecules of gases under ordinary conditions. But if we turn to individual charged atoms, methods have been developed which enable us to produce atomic projectiles moving with enormous speed. When the velocity becomes comparable with that of light, we have to take into account the change of mass of the particle with speed. As the velocity is generally produced by the acceleration of the particle in an electric field, it is convenient to speak of a thousand-volt particle, meaning thereby that the particle has the speed and energy equal to that gained in passing freely between two points differing in potential by a thousand volts. In the experiments of Cockcroft and Walton in the Cavendish Laboratory, Cambridge, a steady difference of potential up to 600,000 volts can be

maintained in the accelerating tube, thus producing a stream of swift protons corresponding to a current of 20 micro-amperes. By the multiple acceleration of charged atoms, Lawrence and Livingston in California have been able to obtain a stream of protons of energy so high as 1,200,000 volts by the use of a voltage so low as 4,000 volts.

Effects of Atomic Bombardment

IN the second part of his address, Lord Rutherford described the applications of atomic projectiles. After considering the way in which swift α-particles from radioactive substances have been used for throwing light on the dimensions of the atomic nucleus, he gave an interesting account of experiments on the transmutation of matter. This has been effected by the bombardment of matter by swift atomic projectiles of different kinds. In 1919, Rutherford was able to demonstrate the disintegration of the nitrogen nucleus as a result of a close collision with an α-particle in which a swift proton was expelled. The discovery of the 'neutron' followed upon experiments by Bothe, who observed a very penetrating type of radiation when beryllium was bombarded by α-particles. Chadwick carried out further experiments by counting methods, and concluded that the radiation consists of a flight of material particles which are supposed to be close combinations of a proton and an electron. Within the last year, Cockcroft and Walton have obtained definite evidence that certain atoms can be transformed by a stream of fast protons produced artificially in a discharge tube. This new method of attack, so successfully begun, is certain to give us much new information on the structure of nuclei and the problem of the transmutation of the elements.

Egypt and the Nile

THE presidential address delivered by Sir Murdoch Macdonald to the Institution of Civil Engineers at the first meeting of the session on November 1 was almost entirely devoted to a consideration of the engineering development of Egypt and the Sudan, with which his life work has been closely associated, and, in particular, to the measures taken to bring into cultivation vast areas of waste land which have lain unproductive for centuries. Of the 360,000 square miles over which the King of Egypt rules, 95 per cent is desert. The combined area of the two cultivated districts of Lower and Upper Egypt is only about 12,000 square miles, one tenth of the area of Great Britain and Ireland; and the narrow strip of cultivated land, running for some 550 miles on each side of the Nile from Cairo to Assuan, has an average width of not more than 6 miles. Referring to the geological history of the country, Sir Murdoch said that, on the supposition that the Delta of the Nile lay in an ancient bay of the Mediterranean now filled with silt, the original mouth of the river was at Cairo. The depth of silt and sand in that locality indicates that the river once ran at a much lower level than it does now. From records of water levels on the Roda gauge, near Cairo, extending over many hundred years, it has been deduced that the bed of the river and the general level of the cultivable land must have been raised at the rate of 1 mm. a year and the process has been going on probably for 20,000 years.

Irrigation Schemes in Egypt and the Sudan

AFTER alluding to ancient indigenous methods of providing water for crops, Sir Murdoch Macdonald proceeded to discuss the modern system of perennial irrigation (under which provision has also to be made for drainage) adopted in consequence of the introduction of cotton cultivation by the Khedive, Mohammed Ali. The first work of construction in that connexion was the Delta Barrage, completed in 1861, but, owing to defects in the foundations, not brought into effective use until the British occupation, when the works were strengthened. The succeeding structures of the same type at Assuan, Asyut, Esna and Nag Hammadi were historically noticed, and then reference was made to various schemes put forward from time to time for impounding the water of the Blue Nile and the White Nile above Khartoum. Figures were quoted to show the benefit to Egypt of the Assuan Dam. The 1,000 million cubic metres of water originally impounded would be increased by the re-heightening to at least 4,800 million cubic metres and the normal summer supply would be increased by about 66 per cent. The contemplated Gebel Aulia reservoir would contain about 3,000 million cubic metres and would possibly be able to pass 2,500 million into the river. A Lake Albert Dam, only 8 metres in height, would impound about 40,000 million cubic metres, but would require to be coupled with works which would conserve the waters as they passed down the river and prevent their being wasted as at present in the Sudd region. Sir Murdoch touched upon the schemes put forward for preventing the immense loss of water due to evaporation from the marsh formed by the main stream between the Sobat and Bahr-el-Ghazal. The whole territory including the marsh region has an area of about 90,000 square miles and might become a wonderful timber growing country. Summing up the position between Egypt and the Anglo-Egyptian Sudan, he said that the large volumes of water passing in flood, of which Egypt can only use a small part, would make it possible for the Sudan to divert a great quantity without detriment to her neighbour. All the conceivable diminution by future reservoirs would not be sufficient to reduce the flood volume below the known requirements of Egypt for the fertilisation of its flood crops.

Telephony and Telegraphy in Great Britain

SIR THOMAS PURVES, engineer to the Post Office, contributes to the British Industries Number forming a supplement to the *Times* of November 1 an interesting article on the industries connected with telegraphy and telephony. In the earlier days of telegraphy, Great Britain was pre-eminent in the manufacture of high quality Morse and Wheatstone automatic apparatus. The very fact of the excellence

of this equipment somewhat delayed the adoption of type-printing telegraphs in Great Britain, but the whole supplies of the telegraph system are now being manufactured at home. It is hoped that the establishment of the teleprinter exchange service which is being introduced by the Post Office as an adjunct to the public telephone switching system will produce a further extensive demand for these ingenious machines. Before the year 1912, when the telephone service of Great Britain was transferred to the Post Office, a large portion of the equipment was purchased from abroad. Now the proportion of foreign material purchased by the Post Office is less than one per cent of the whole. A great impetus was given to the mass production of apparatus on precision principles in 1922 by the general adoption of standardised types of automatic exchanges. This policy encouraged other nations to follow suit and export markets to several countries were opened up for automatic telephone equipment manufactured in Great Britain. The circuits and mechanisms developed for automatic exchanges opened up independent fields of application in other directions, such as the supervisory control of electrical power plant, centralised railway control and the electrical equipment of the totalisators now operating on racecourses. Telephone manufacturers were quick to take advantage of these applications.

Telephone Development

THE economic blizzard from which the world is now suffering has affected the rate of telephone development in Great Britain to a smaller extent than in any other of the principal nations. Sir Thomas Purves states that the net increase per annum in Great Britain in recent years has been about 125,000 stations. In the last complete year (1931–32) it fell to 84,000. Nevertheless, it is the largest increase recorded in any country of the world for the same period. For the whole of Europe, outside of Great Britain, the net increase was less than 200,000. In some countries the number of cessations of service exceeds the number of new subscribers and a net loss is registered. In North America, for example, the net loss is about 550,000 stations. For the current year, it is probable that there will be a net increase in Great Britain of about 80,000 and that many of the countries of Europe will show actual losses. In America there will be a large loss. If a revival of trade occurs, the telephone development of Great Britain will go forward by leaps and bounds. In the matter of underground, telegraph and telephone cables, Great Britain has been from the first a pioneer. For building open telegraph and telephone lines it is still necessary to depend on Norway and Sweden for slow-grown raw timber. English and Scottish mountain pine and Canadian and Australian timber have proved disappointing. The use of poles of metal and concrete has been investigated on numerous occasions, but so far the cost of these alternatives has proved prohibitive. The timber used for general construction purposes is obtained entirely from home and Empire sources. The whole of the extensive radio plant and apparatus for long-distance communication used by the Post Office is of British manufacture.

Recent Developments in the Utilisation of Electricity

IN his inaugural address as chairman of the North-Western Centre of the Institution of Electrical Engineers, Mr. G. F. Sills discussed a very large number of recent developments in the utilisation of electricity. One of the most important and most promising of electric devices is the mercury arc rectifier. When supplied with direct current, it can be made to generate alternating current voltage at any frequency. It can also supply direct current when supplied with alternating current. It provides a link between a.c. and d.c. systems which works either way. Batteries can thus be used as a reserve on a.c. systems. One of the most important applications is to feed single-phase railways from a three-phase system at a different frequency. The standardisation of systems of supply for electric railways is thus not likely to lead to much trouble, as by the aid of the rectifier any kind of electric supply can be converted into any other. By its use it will soon be possible to transmit power by high-voltage direct current and this will lead to considerable economies in transmission. Obstruction lights are now being placed on power lines for marking obstacles along airways. They generally consist of neon tubes operated either at high or low voltages. They are used also to indicate high buildings and wireless masts. The light gives a large splash of red colour and is easily distinguished from other lights near the ground. Another interesting application is the reading of consumers' electric meters by means of telephone lines, the connexion being made through the power company's connexion with the telephone exchange. A device for indicating the presence of a dangerous amount of coal gas is also described. It works automatically, closing an alarm circuit, and it can be made to switch on an electric fan to clear the dangerous area.

Manufacture of Lenses

THE presidential address of Mr. W. Taylor to the Institution of Mechanical Engineers on October 28 was mainly devoted to the application of mechanical engineering to the production of lenses, particularly photographic lenses, which to-day are made by the tens of thousands. One of the characters of mechanical engineering, he said, is the extraordinary accuracy regularly attained in its best products. One thousandth of an inch is approximately the limit of accuracy which can be attained in the ordinary machining of metal with cutting tools, one ten thousandth the order of accuracy by grinding and lapping; but in making the best photographic lenses and other optical instruments of precision, the accuracy of the surfaces of the elements, such as lenses, prisms and mirrors, must be from one hundred thousandth to a few millionths of an inch, and this accuracy is attained in everyday working, not only by skilled artist craftsmen, but also by less skilled

persons doing repetition work by the aid of special appliances, the products of mechanical engineering. In the course of his address, Mr. Taylor referred at length to the functions and designing of lenses, the properties and the production of optical glass and the various workshop processes by which lenses are cut, ground, polished and tested. It was in connexion with work on photographic lenses that the need was felt for screw-threads much more accurate in form, more free from pitch and periodic error, and this in turn led to improved technique of screw-thread measurement, gauging and generation.

Andrew Laing Memorial Lecture

THE winter session of the North-East Coast Institution of Engineers and Shipbuilders was opened on October 21 by the delivery at Newcastle-upon-Tyne of the presidential address by Mr. R. J. Walker, who since 1899 has been associated with the Parsons Steam Turbine Co., Ltd., of which after the death of Sir Charles Parsons he became chairman and managing director. At the following meeting of the Institution, held on October 28, Engr. Vice-Admiral Sir R. W. Skelton, the Engineer-in-Chief of the Fleet, delivered the first Andrew Laing lecture. Laing, who was born in Edinburgh on January 31, 1856, and died in Newcastle on January 24, 1931, from 1877 until 1896 was connected with the Fairfield Shipbuilding and Engineering Co., Govan, and from 1896 until the time of his death was managing director of the Wallsend Slipway and Engineering Co. His life's work was mainly connected with the design and construction of the machinery of Atlantic liners, his most famous ship being the *Mauretania*, built in 1907, which for twenty-three years held the 'blue ribbon' of the Atlantic. The construction of this vessel and her ill-fated sister ship the *Lusitania* was due to circumstances somewhat akin to those existing to-day, when the fastest vessels in the mercantile marine are not registered as British vessels. The initial step was the formation of an Admiralty committee in 1902 which was directed to inquire into the principles on which subsidies were being given and to consider how and at what cost vessels could be secured which should combine great speed with a large radius of action. The outcome was an agreement between the Government and the Cunard Co. whereby the Government agreed to advance a sum of money at 2¾ per cent interest for the construction of two ships and to increase the annual subsidy. The bold step of adopting steam turbines for the vessels was due to the report of a technical committee on which Laing served.

Memorial to Sir Gregory Foster, Bt.

A FUND has been raised for the establishment of a memorial to the late Sir Gregory Foster, at College Hall, London, a hall of residence for women students in the University with which he was connected for more than thirty years, during twenty-one of which he was chairman of the Council. The memorial has taken the form of the provision of teak doors throughout the public rooms of the new building for the Hall recently erected in Malet Street and to be opened by H.M. the Queen on November 10. A memorial tablet designed by Mr. Brook Kitchin has also been placed in the entrance hall and bears a record of the services rendered by Sir Gregory Foster. A portrait painted by Mrs. Macleod has now been finished and has been hung in the council room of the Hall. It represents the sitter not as his friends knew him in the last years of his life, but as he will be remembered by those who knew him in the fullness of his strength and vigour, thus providing an interesting comparison with the portrait recently painted by Sir William Orpen which hangs in University College. The memorial tablet was unveiled on November 4 by Sir Alexander Gibb, who succeeded Sir Gregory Foster as chairman of the Council of College Hall. About a hundred or so of those who had subscribed to the memorial fund were present, and for the greater number of these the occasion presented the first opportunity of seeing the new building, which in itself is the greatest and most lasting memorial to Sir Gregory Foster's work in providing increased residential accommodation for the students of the University of London.

Huxley Memorial Medal and Lecture

THE presentation of the Huxley Memorial Medal of the Royal Anthropological Institute for 1932 to Prof. C. G. Seligman will take place on November 29, when Prof. Seligman is to deliver the Huxley Memorial Lecture at 8.30 P.M. Prof. Seligman is already a medallist of the Royal Anthropological Institute, having been awarded the Rivers Memorial Medal for 1926 in recognition of his work in the field in New Guinea, among the Veddas of Ceylon and in the Sudan. Prof. Seligman gained his first experience of field work as a member of the Cambridge University Expedition to the Torres Straits in 1898 under Dr. A. C. Haddon. He visited New Guinea again as joint leader of the Cooke-Daniels Ethnographical Expedition in 1904, publishing his results in "The Melanesians of British New Guinea" (1910). His studies of the Veddas in 1907, in which he was assisted by Mrs. Seligman, were published as "The Veddas" in 1911, while the results of his investigations among the Sudanese tribes on several occasions, on which he has again been accompanied and assisted by Mrs. Seligman, are announced for publication at an early date. The study in the University of London of the customs and races of man has made substantial advances during Prof. Seligman's occupation of the chair of ethnology at the London School of Economics, especially in the promotion and organisation of training for colonial officials.

Scientific Expedition to Tibet

IN February 1933 Capt. F. Kingdon-Ward is setting out to explore what is perhaps the least-known part of Tibet—the arc of mountainous country which lies between the bend of the Tsangpo-Brahmaputra and the bend of the Salween. The route to be followed is: the Assam valley, Sadiyà, Lohit valley, Rimà, up the Rong Thod Chu, over the Ata Gang Pass (16,000 ft.)

to Shurdin Gornpa, in lat. 29° 30′ N., long. 97° 0′ E., where a base camp will be established at 13,600 ft. altitude. From here the collecting work will be done. This is the cross-roads of Asia, the meeting place of four floral regions, the Central Asian, Sino-Himalayan, Indo-Malayan, and Eastern Asiatic ; and it harbours the richest alpine flora in the world. The flora of this area should in fact throw light on both the earlier east and west distribution of plants across south-eastern Asia, and on the later north and south distribution, down the Malay Peninsula, brought about during the last glacial epoch. The predominance of the former is difficult to account for if we assume the Himalayan uplift to stop short at the Tsangpo bend, or to curve southwards at this point. On the other hand, if the Himalayan axis is prolonged eastwards, the Salween River must cut across it in a very deep gorge, and should moreover cross at a point of maximum elevation, precisely as the Indus and Tsangpo do. These are matters for investigation. Thus both botanical and geographical work will be done. These are closely related, and each illuminates the other. The botanical collecting will be done on behalf of the Department of Botany of the British Museum.

Weather Information to Aviators in India

THE India Meteorological Department has set out a complete account of the arrangements in force for the supply of reports on existing weather and of anticipated weather to aviators flying over any part of an immense area which includes not only India but also the Persian Gulf coast east of Bushire, Baluchistan and Burma (India Meteorological Department. Meteorological Organisation in India for the Supply of Weather Information to Aviators. Pp. iii+27. (Calcutta : Government of India Central Publication Branch, 1932.) 12 annas ; 1*s*. 3*d*.) There are five main forecasting centres, at Karachi, Calcutta, Poona, Peshawar and Quetta. The first three centres are organised with a view of issuing reports and forecasts to civil aviators, and the last two deal mainly with the requirements of the R.A.F. The local centres also number five, namely Rangoon, Akyab, Dum Dum, Allahabad and Jodhpur. There would normally be available at such local centres information about the force and direction of the wind up to a height of 10,000 feet. There is another type of distributing centre—the pilot balloon station—of which there is a relatively large number. These are aerodromes or landing grounds with observers who make soundings of the upper atmosphere with pilot balloons, and are able to supply the information about upper winds so obtained to aviators on request, and presumably are also largely responsible for supplying such local information on this subject as is required at the more important centres. The information given in this pamphlet appears to include everything that can possibly be required by aviators, including the times of issue of the regular broadcasts, all necessary codes, and the wave-lengths, together with detailed instructions as to the procedure for obtaining special reports while in flight.

Galvanometer Mirrors for Sound Recording

IN the variable width method of recording sound on film, a galvanometer is used in which a loop of metal ribbon, 0·005 in. broad and 0·0005 in. thick, is placed between the poles of a permanent magnet, a small mirror being cemented across the two arms of the loop. When speech currents from the microphone and amplifiers pass along the ribbon, the mirror vibrates and causes the reflected beam of light to traverse a narrow slit at right angles to the direction of motion of the film, and thus trace a graph of the sound waves. Since the upper limit of reproduction from the ordinary talking film projection apparatus is about 6000 cycles per second, the natural frequency of oscillation of the galvanometer must be at least as great as this. The inertia of its moving parts must, therefore, be low. The mirror must be as light and small as possible. It should also be accurately surfaced and silvered in order to ensure uniform reflection. The production of such mirrors is an interesting piece of optical work involving manipulative processes on a different scale from that employed for the usual products of the manufacturing optician. Mirrors made by Messrs. Taylor, Taylor and Hobson, Ltd., Stoughton Street Works, Leicester, specially suitable for these galvanometers, are rectangular in shape and measure 0·032 in. by 0·018 in. by 0·004 in. The glass from which they are made is first cut to the correct size and then optically worked on both sides. The back surface is silvered by cathode sputtering and is protected by a suitable varnish. The finished mirror weighs 0·0001 gm.

Memorial to Laplace

L'Astronomie for September contains a panegyric on Laplace, delivered by Dr. E. Esclangon, director of the Paris Observatory, on the occasion of the unveiling of a statue of the famous astronomer at Beaumont-en-Auge on July 3. Dr. Esclangon observes that Laplace is justly called the French Newton ; while basing his work on Newton's law of universal gravitation, he carried the results of this law very much further than any of his predecessors. Special mention is made of his detection of the cause of the lunar acceleration arising from the diminution of the eccentricity of the earth's orbit. He also made useful researches on the theory of the tides ; and his famous nebular hypothesis, though no longer held in its original form, at least as regards the solar system, was a valuable contribution to cosmogony, and formed the starting-point of many other theories.

Reversion in a Hybrid Macaw

WHAT appears like a very striking case of reversion in a species-hybrid is related, in the *Avicultural Magazine* for September, p. 220, by A. Anderson, who describes a hybrid macaw bird in New Zealand this year between a male of the red-and-yellow and a female of the blue-and-yellow species. As one parent is red and the other yellow below, it is not surprising that the hybrid young bird shows both

these colours on the under-surface; what is strange is that the back is bluish-green, for the male is red here and the female blue, so that the green tint must be due to a return to a coloration ancestral in macaws, most of which are as a matter of fact green, though the more sensationally coloured species are those familiar in captivity. The case is similar to the appearance of a rufous-coloured and more ordinary bird resembling Hume's pheasant when the copper-red, white-pied Elliot's pheasant has been crossed with the Mikado pheasant, which is mostly black, and to the production of sheldrakes showing much smoky-grey pencilling similar to that on the Australasian farms when the rufous South African grey-headed sheldrake was crossed with the mainly-white European species, in both cases a more primitive and plain coloration appearing.

Announcements

THE following awards have been made by the Royal Aeronautical Society: Taylor Gold Medal to Dr. G. V. Lachmann for his paper entitled "Control Beyond the Stall", and the Busk Memorial Prize to H. Constant for his paper entitled "Aircraft Vibration".

THE following appointments have recently been made by the Secretary of State for the Colonies in the Colonial Forestry Services: Mr. D. Kinloch, to be assistant conservator of forests, Gold Coast; Mr. P. C. Randell, to be assistant conservator of forests, Nigeria.

THE following is a list of those recommended by the President and Council for election to the Council of the Royal Society at the anniversary meeting on November 30:—*President:* Sir Frederick Hopkins; *Treasurer:* Sir Henry Lyons; *Secretaries:* Sir Henry Dale and Sir Frank Smith; *Foreign Secretary:* Lord Rayleigh. *Other Members of Council:* Dr. J. A. Arkwright, Prof. W. L. Bragg, Prof. C. H. Desch, Dr. G. M. B. Dobson, Mr. A. C. G. Egerton, Dr. J. Gray, Prof. A. V. Hill, Prof. A. Hutchinson, Prof. J. E. Littlewood, Prof. E. Mellanby, Prof. R. Robinson, Dr. N. V. Sidgwick, Prof. A. G. Tansley, Prof. D'Arcy W. Thompson, Dr. W. Trotter, Mr. G. Udny Yule.

THE fourth of the series of exhibitions: "Photography in the Service of Mankind", at the house of the Royal Photographic Society, 35 Russell Square, London, W.C.1, will be devoted to kinematography. The exhibition will be opened on November 14 and will remain open until December 10. Much of the space available will be occupied by apparatus illustrating the historical development of kinematography and the various outstanding achievements on the mechanical side of the science. In addition to the exhibition proper, however, a series of eleven meetings has been arranged. These will illustrate, through the medium of films, the immense variety of ways in which kinematography touches modern life: salesmanship, medicine, natural history, general scientific research and education are among the subjects to be illustrated.

THE British Social Hygiene Council has arranged a national conference on "The Place of Biology in Education" to be held at the British Medical Association House, Tavistock Square, London, W.C.1, on November 30 and December 1 and 3, under the presidency of the Right Hon. Viscount Chelmsford. During the first morning session, besides the inaugural addresses of the president and patrons, the national and imperial need for a biological outlook will be considered. In the afternoon and on December 3, the promotion of the teaching of biology by local authorities and biology in training colleges, central, senior and elementary schools and in public, secondary and preparatory schools will be discussed. On December 1, a joint session will be held with the Central Association for Mental Welfare to discuss the problem of the social control of the feeble-minded child leaving the ordinary elementary school.

A CATALOGUE of an unusual sort of collection has been issued by Messrs. Dulau and Company, Ltd., 32 Old Bond Street, W.1. It contains lists of old prints in colour and line chosen chiefly for their decorative charm, and includes many items of interest to naturalists and others. Many are plates from standard works by such as Buffon, Levaillant, Pennant, Gould, at prices varying from 1*s.* to 30*s.*; hand-tinted sporting prints published between 1805 and 1807, at 35*s.* each; Loggan's copper-plate views of Oxford (1675) at 5*s.*–20*s.*; old maps, old coloured lithographs of the mansions of England by Joseph Nash (1869), portraits by Bartolozzi (1793–99), and sundry other prints making an interesting series of 353 items.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior assistant in the Museum and Art Gallery of the County Borough of Reading—The Curator (Nov. 12). A second engineering assistant in the Waterworks Department of the County Borough of Brighton—The Waterworks Engineer, 12, Bond Street, Brighton (Nov. 16). Examiners in practical mathematics, practical drawing and science of the preparatory senior technical course of the Union of Lancashire and Cheshire Institutes—The Secretary, 33, Blackfriars Street, Manchester (Nov. 21). A full-time assistant for electrical engineering courses at the Crewe Technical College—The Director of Education, Dept. 'C', County Education Offices, City Road, Chester (Nov. 23). Five assistant engineers in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Nov. 24). An assistant lecturer in physics at King's College (University of London)—The Secretary, King's College, Strand, W.C.2 (Nov. 28). An instructor in manual work and engineering at the King's School, Pontefract—The Headmaster. Grocers' Company research scholars in sanitary science—The Clerk, Grocers' Company, Grocers' Hall, London, E.C.2. A lecturer in elementary electrical engineering at the Borough Polytechnic, London, S.E.1—The Principal.

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.*]

A Down Pelage in the Ovidæ

THE woolly covering of the adult sheep, the fleece, is often considered to differentiate the Ovidæ from other mammals, and not less distinctive is the coat of the lamb. In most breeds of sheep the lamb is closely covered with a birth coat of small spiral tufts of fibres (Fig. 1). The tufts vary in size, the number and closeness of the spiral turns and their distance apart, all of which are characters having a bearing upon the fleece grown later. In addition, long hairy

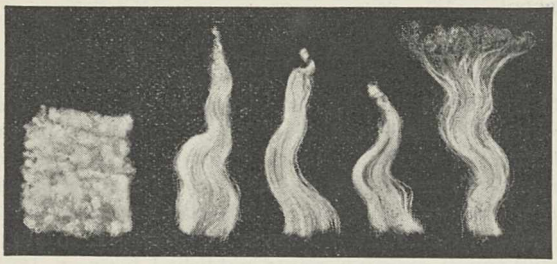

FIG. 1. Portion of skin of new-born Welsh Mountain lamb showing spiral tufts; also two-month staples of South Devon lamb with spiral tufts at apex, right staple opened out to show prototrichs.

fibres protrude beyond the level of the tufts and, where plentiful, partly obscure or even replace them, as over the face, the under surface and down the legs. With the later growth of the fleece the spiral tufts are carried upwards, for the most part preserving their form and distinctness (Fig. 1), maybe until the first shearing at about fifteen months. In some cases, however, small successive fragments break away at the tip, particularly in the merino, where the identity of the tuft is lost within three or four months. The coarse hairy fibres are

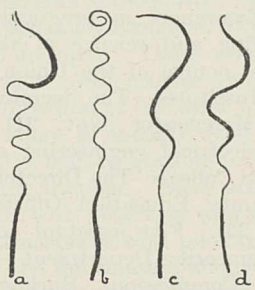

FIG. 2. Diagram of various forms of prototrichs continued into the thicker definitive fibre.

shed within the first months of the lamb's existence, and are generally replaced by fibres of a different type.

Attention has recently been directed to the constituent fibres of the spiral tufts, as possible guides to the later wool production. Different forms occur, some of which are shown diagrammatically in Fig. 2. Fig. 2*a* represents the most characteristic form. The fibre is at first sickle-shaped and thickens below the tapering tip, being medullated for a short distance. It then becomes very fine and curly before passing into the definitive fibre, which is usually thicker. The curls follow very closely the spiral turns of the tuft, as if moulded thereby. Fig. 2*b* shows another frequent form where the sickle thickening is wanting, and the whole fibre is fine and curly to the tip. All intermediate stages between the well-defined medullated sickle tip and the curly tip can readily be found, even in the same tuft, and the one can only be regarded as an attenuation of the other. The aggregate of sickle tips gives a stiff, beak-like apex to the tuft while the other has only a flat ending.

Among the coarse fibres of the belly and legs the tufts are more or less wanting and the sickle often assumes a whip-lash effect (Fig. 2*c*). Again, the thick medullated part of the sickle may, as it were, encroach to a greater or less distance on the fine part below (Fig. 2*d*) and even for the whole distance, appearing of the same thickness as the definitive fibre itself. Fibres of this character are to be found on the legs where the wool is largely replaced by coarse kemp fibres, and all transitional stages from true sickle fibres to kempy fibres are met with. Beneath the characteristic forms above described very fine short woolly fibres everywhere occur. The sickle tip of the fibres is doubtless to be associated with the fact that the new fibre does not at first emerge in a straight line with the follicle, but passes horizontally for some distance along the epidermis in the canal produced in connexion with the sebaceous gland. In general, the medullated sickle tips are followed by kemp fibres while the curly tips are continued as heterotypes and wool.

Sickle tipped medullated fibres from the birth coat of the merino were first described by me[1] and have since been found in the primitive coat of the Blackhead Persian and elsewhere,[2] while Dry has recently described both sickle tipped and curly tipped fibres from the Romney Marsh.[3] In the course of the present study they have been found on the birth coat of practically all the British breeds. Manifestly, in their different expressions, they are a truly distinctive feature of the birth coat, to be considered apart from the definitive fibres into which they are continued. It is submitted that they are best regarded as down fibres or prototrichs, comparable in many respects with the down which occurs at the apex of the definitive feathers in birds. The entire covering on the lamb at birth, the spiral tufts as well as the hairy fibres (halo fibres), would then be regarded as a down coat composed of prototrichs or down fibres, persisting for a time at the tip of the staples of the later woolly coat.

The constancy with which the medullated sickle tipped prototrich occurs suggests a phylogenetic significance. It is a fibre essentially coarse above and fine below and, having been produced *in utero*, the difference can scarcely be interpreted as a response to conditions other than those genetic in their nature. Fibres of the same differential character, which I have elsewhere termed heterotypes,[1] prevail among mammals generally. Thus mature fibres of the various mountain and long-woolled breeds among sheep show a greater or less indication of coarseness above and fineness below, to repeat itself year by year. Similar differences are found among most other domestic animals, dog, cat, horse, cattle and camel, and in the yak, jackal, seal, hare,

deer and bison. The coat tends to be coarse on the outside and fine below, but for the most part the change is effected in the individual fibre. It is manifest that heterotypism is to be regarded as the primary condition of the hair fibres in most mammals, carrying with it a physiological significance, and it is repeated in a simplified form in the down fibres or prototrichs of the Ovidæ. The curly tipped prototrichs are merely those which have lost their medullated thickening, and all stages are forthcoming from one extreme to the other, just as we have all stages towards complete medullation of the sickle fibre.

We thus arrive at the conception that the birth coat in the Ovidæ is a true down coat, a separate pelage of spiral tufts. The constituent fibres are distinct from the later definitive fibres, and are to be contrasted as prototrichs or down fibres. The stages shown by the prototrichs towards fine woolliness on one hand and coarse kempiness on the other establish the close relationship of the many different types of fibres met with in the Ovidæ (wool, heterotypes, gare, kemp) with those in other mammals where the pelage comprises gradations of only one type of fibre. The distinctive coat of the Ovidæ is brought into direct relationship with that of mammals generally; the component fibres of the two are but differentiations of a single type, even though for classificatory needs they may be grouped separately.

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Wool Industries Research Association,
Torridon,
Headingley,
Leeds.

[1] *J. Text. Inst.*, **18**, 1927.
[2] Bull. No. 82, Dept. of Agric. S.A., 1930.
[3] Bull. W.I.R.A., vol. 2, No. 2, 1931.

Weather Maps of the World

IN connexion with the special investigations arranged for the polar year, it is proposed to collect observations from sea and land in order to obtain effective charts for the whole of the northern hemisphere and perhaps, in time, of the southern hemisphere too.

The invitation to contribute observations is accompanied by an excellent outline chart of the northern hemisphere with contours of the land surface for 500, 1000 and 2000 metres.

The charts carry also, as specimens, meteorological information for the first week of March 1931, which includes isobaric lines over the sea, continued over the land as *sea-level* isobars. The practice of drawing isobars which, over the land, are merely hypothetical, has been customary in meteorological work now for some seventy years. Perhaps it began with north-western Europe where sea level is at least a near neighbour; but it has developed until, in the proposed charts, sea-level isobars are shown over the contours of the Rocky Mountains, the Alps, the Himalaya and Greenland, although sea level has a very restricted meaning for those countries and the change in the distribution of the meteorological elements with height is a primary meteorological problem.

The enterprise is a repetition, on a more advanced scale, of one which was undertaken by the Meteorological Council in connexion with the original polar year, 1882–3. All the available information for the Atlantic and adjacent continents was collected and plotted on well-known charts, published by the Council.

Incidentally, that enterprise led to a mistrust of the closed isobars round cyclonic and anticyclonic centres as the controlling powers in weather; a mistrust which in Great Britain we have never been able to shake off. It will be interesting to learn whether the jubilee of the polar year will reconstitute them or discredit them further.

A real question about weather charts for the world turns, however, upon sea-level isobars carried over the land irrespective of its elevation above sea level. It is undeniable that, by that practice, pressure is separated from its associates temperature, humidity and wind, and the student of weather is left more or less 'in the air' while space on the map is occupied by lines without any definite meaning.

The contours on the outline charts suggest that the enterprise offers a golden opportunity for a definite step in weather study.

The contour line of 500 metres rails off the enclosures in the northern hemisphere within which sea-level isobars are ineffective. Would it not be possible to prepare the maps in the usual way for the region outside those enclosures and invite the denizens of the several regions inside: France, Austria, Switzerland, Italy and the Balkans for one, India, Persia, Russia and China for another, the United States, Canada and Mexico for a third, each to contribute a map for their enclosure that they would think most appropriate for a region above 1 km. level?

Such an opportunity may never recur; and what would be a rather questionable enterprise for an individual member of the international partnership would be real generosity on the part of each group, contributing to the advancement of knowledge for the benefit of the whole.

It might even result in changing the choice of level for charts over the sea itself, and choosing 106 metres, where the normal pressure is 1000 millibars, as suggested years ago by Köppen, for we all know that the surface is apt to mar the effective features of the atmospheric circulation.

NAPIER SHAW.

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Oct. 24.

Heat Distribution in a Uniform Bar

THE theory of the potential distribution in a long cable when the head end is insulated after being maintained for some time at a steady potential has been given recently.[1] It was pointed out that the reasoning would apply equally well to the case of a long uniform bar which is allowed to cool after one end has been heated. The experimental confirmation of the theory is not easy in the electrical case owing to the fact that it is not possible to tap a long laid cable at intervals for the observation of the potential, and artificial lines are not available with the leakance sufficiently uniformly distributed. Moreover, the changes are very rapid, and in the practical example which was worked out in the above-mentioned paper, all transients had practically died away after the expiry of two seconds. In the heat analogue, on the other hand, the changes are very much slower and

the necessary apparatus (an ordinary 'Forbes bar') available in almost any laboratory.

In this case the expression for the temperature at any point distant x along the bar at time t after removing the source of heat is:

$$T_{x,t} = 2\,T_0\,l\sqrt{(RG)}\tanh l\sqrt{(RG)} \sum_{m=0,1,2\ldots} \frac{\cos\{(1-x/l)\,m\pi\}.\exp\left(-\frac{m^2\pi^2+GRl^2}{CRl^2}.t\right)}{(m^2\pi^2+GRl^2)(\cos m\pi+\sin m\pi/m\pi)}$$

where T_0 is the initial steady temperature at the end of the bar, R the heat resistance per unit length of bar, C the heat capacity per unit length of bar, G the rate of heat loss from surface per degree per unit length of bar, l the length of bar, and m is zero or any integer.

The bar used was of brass, and was furnished with eight holes, distant apart 10·15 cm. between centres. At one end there was a right-angled elbow joint, so

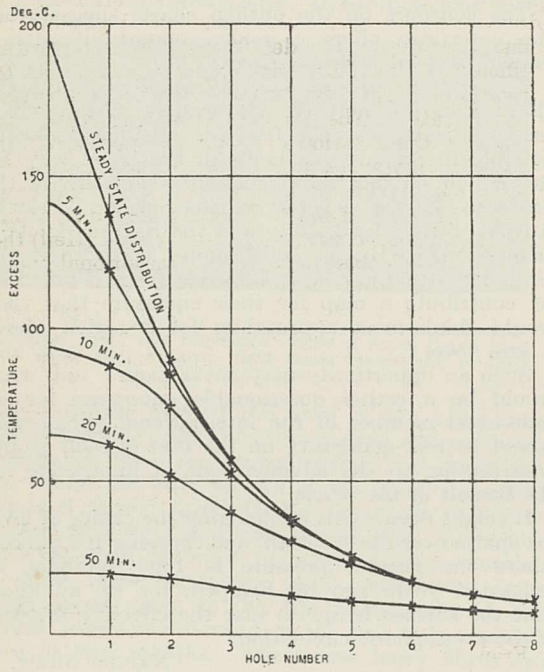

FIG. 1

that this end could be dipped vertically into a bath of molten solder while the main part of the bar was horizontal. The temperature observations were made on ordinary thermometers dipping into mercury contained in the holes along the bar. The mean distance from the centre of the first hole to the solder level was 9·4 cm. and the length of bar immersed 9·5 cm. The section of the bar was a square of 2·50 cm. side.

After keeping the end immersed for three hours in the solder bath, a uniform heat distribution was obtained and the heat source was withdrawn. The temperature at the various points along the bar was observed at regular intervals, giving the results shown in Fig. 1. This family of curves is of the same form as that obtained from theoretical considerations and shown in Fig. 1 of the paper referred to above.

D. K. McCLEERY.

Woolwich Polytechnic, S.E.18.
Sept. 19.

[1] *Proc. Phys. Soc.*, **44**, 494; 1932.

Radiations from Radium D and E

DURING the past eighteen months, experiments have been carried out by Mr. W. J. Henderson and myself, so designed as to give us certain information about the radiations emitted by radium (D + E).

The first experiment, the initial results of which were reported at the 1931 meeting of the Royal Society of Canada, has shown that there is no evidence, in the case of radium E, for what have been called β-rays of high energy. We have used a suitable mixture of cardboard and lead, of total mass/cm.[2] somewhat greater than the range, in order to reduce the ionisation in a cardboard-lined electroscope to one ninety-thousandth of its initial value. It is not a difficult matter to show that less than one per cent of this ionisation can be due to primary β-rays and hence that not one β-ray in 1,500,000 can belong to the group, with values of HR between 7000 and 10,000 reported by Curie and D'Espine.[1] This result gives a strong indication that β-rays of high energy are not emitted by any substance.

Henderson has examined the ranges of the β-rays of radium E in various substances and has found much larger values than previous observers. In cardboard the range is 0·52gm./cm.[2] and in aluminium, tin and lead somewhat greater than 0·60gm./cm.[2]. Among other things, these results indicate that if β-ray ranges are to be used to determine the end points of β-ray spectra, some convention must be adopted. One that might be useful would be to use aluminium as absorbing material and take the range as that mass/cm.[2] which reduced the ionisation due to β-rays to one fifty-thousandth of its initial value and then calculate the end point from the data of Varder[2] on homogeneous rays. Applying this to radium E, the end point comes out at about HR = 5500. Further work is being done on this problem.

We have measured the absorption of the γ-rays in lead and have obtained estimates of the relative numbers of atoms emitting the different types of radiations, using the method of Gray and O'Leary[3]. A very soft type of γ-ray, presumably the M rays characteristic of atomic number 83, has been detected. L rays are emitted by about thirty per cent of radium D atoms and primary rays by somewhat less than four per cent, a value in fair agreement with those obtained by Bramson and Stahel and Sizoo[4]. The primary rays consist apparently of a band extending from $\lambda <$ 0·28A. to $\lambda >$ 0·30A., the average mass absorption coefficient in lead being 12. An initial attempt to detect this band by crystal reflection was unsuccessful. The bearing of our results on problems connected with the emission of β-rays from radium D will be discussed elsewhere.

The properties of the hard γ-rays of radium E are so similar to those of the X- or secondary γ-rays produced in other elements by the β-rays of radium E that I am of the opinion that they are entirely secondary in character, that is, that they are excited by some of the β-rays after their escape from the nucleus. They are emitted by about one per cent of the disintegrating atoms.

J. A. GRAY.

Queen's University,
Kingston, Ontario.
Oct. 6.

[1] *C. R.*, **181**, 31; 1925.
[2] *Phil. Mag.*, **29**, 726; 1915.
[3] NATURE, **123**, 568, April 13, 1929.
[4] *Z. Phys.*, **66**, 721, 741; 1931.

Mercury Traps

THE interesting investigations of Messrs. Hughes and Poindexter [1] showed that a trap lined with alkali metal is as satisfactory as a liquid air trap, for preventing mercury vapour diffusing back into a vacuum system from a mercury pump. This method offers several advantages, with one disadvantage: it is difficult to clean commercial alkali metals and to avoid the introduction of various impurities (for example, organic vapours, hydrogen, carbonic dioxide) in the vacuum system. However, there exists one method —the glass-electrolysis—which enables very clean sodium to be introduced into closed glass vessels. This elegant method can be easily applied to any normal glass or pyrex glass apparatus by providing the mercury trap with an incandescent cathode and immersing it partially in molten sodium salt. We have already used a similar method in the manufacture of photoelectric cells.[2]

Mr. Ansiau, of this University, is at present experimenting with this method; the results will be recorded later.

L. MARTON.

University of Brussels.
Sept. 12.

[1] F. E. Poindexter, *J. Opt. Soc. Am.*, **9**, 629; 1924. A. Ll. Hughes and F. E. Poindexter, *Phil. Mag.* (6), **50**, 423; 1925.
[2] L. Marton and E. Rostas, *Zeit. f. Techn. Phys.*, **10**, 52; 1929.

Dispersion of Sound in Several Gases, and its Relation to the Frequency of Molecular Collisions

MEASUREMENTS on carbon dioxide, carbon disulphide, sulphur dioxide, and ethylene show that the dispersion of sound in these gases is sensitive to pressure. In each case the dispersive region shifts to higher frequencies with increasing pressures or, conversely, the velocity of sound at a given frequency increases as the pressure is diminished until a constant value is attained. At 30° C. and 451,000 cycles sec.$^{-1}$, for example, the velocity of sound is constant in carbon dioxide below about 350 mm., in carbon disulphide below about 100 mm., and in ethylene below about 40 mm. The corresponding heat capacity ratios are 1·4 for carbon dioxide,[1] 1·4 for carbon disulphide, and nearly 1·33 for ethylene; thus in each case only translational and rotational terms continue to participate in the sound wave under these conditions. In sulphur dioxide at 200 mm. the dispersion between 94 and 451 k.c. is only about 1·2 m. sec.$^{-1}$ at 30° C., indicating that frequencies above the present experimental range are necessary to demonstrate by the acoustical method that sulphur dioxide is not a linear molecule.

The temperature dependence of the dispersion of sound in carbon dioxide and carbon disulphide has also been studied. In carbon dioxide at 770 mm. the difference between the velocity of sound at 92 and at 9 k.c. is negligible at 60° C., whereas at 10° C. it is about 5·0 m. sec.$^{-1}$. Similar behaviour is manifest in carbon disulphide at about 320 mm.

The dispersion of sound in binary mixtures of ethylene with argon and nitrogen is exactly that calculated from pure ethylene at a corresponding partial pressure. It is concluded from this that the vibrational energy of ethylene is not excited by collisions with molecules of these gases. In hydrogen-ethylene mixtures, on the other hand, the effective heat capacity of ethylene rises sharply on the introduction of small quantities of hydrogen, and it is necessary to suppose that a collision with a hydrogen molecule is about ten times as likely to excite ethylene as a collision with another ethylene molecule. The analogy of this result to recent chemical evidence on the decomposition rates of the ethers is striking.

Because air, nitrogen, argon, propane, and pentane appear to be without dispersion (+0·2 m. sec.$^{-1}$) between 9 and 451 k.c. in the same apparatus it is believed that the measurements reported above are free from serious errors due to tube effects.

A quantitative description of the dependence of the dispersion of sound on pressure, temperature, and frequency has been obtained by incorporating in the dispersion theory of Einstein[2] the suggestions of Herzfeld and Rice[3] and of Heil[4]. If it is supposed that equilibrium between translational and internal energies is incomplete in high-frequency sound waves (H and R) and that only molecules of exceptionally high translational energy can excite molecular vibrations (H), an expression results which closely resembles that given by Einstein (and consequently that of Kneser[5] but which involves two additional constants. The first may be called the collision energy, and determines the temperature coefficient of the dispersion of sound much as the activation energy determines that of a chemical reaction rate. The second is dimensionless, and represents the fraction of collisions possessing the collision energy which result in vibrational excitation. For carbon dioxide these quantities are respectively about 4×10^{-13} ergs and 0·01. These magnitudes may be understood when it is remembered (Heil) that on collision less than half of the translational energy may be converted into vibrations, and that the type of collision necessary to excite a transverse vibration must be directionally extremely specific.

It is possible that a small potential energy wall may also impede the energy transfer. The two constants cannot be separated without assumption if more than one vibrational state of the molecule contributes to its heat capacity. Under these conditions a fine-structure should appear in the absorption band or, conversely, points of inflection should be manifest in the dispersion. These may be studied at constant frequency by lowering the temperature or pressure in the dispersive region.

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JAMES A. REID.

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Princeton University,
Princeton, N.J.

[1] In agreement with Kneser, *Ann. Phys.*, **11**, 777; 1931.
[2] *Sitz. ber. Akad.*, 380; 1920.
[3] *Phys. Rev.*, **31**, 691; 1928.
[4] *Z. Phys.* **74**, 31; 1932.
[5] *Ann. Phys.*, **11**, 761; 1931.

Spectrum of Trebly Ionised Lead

THE spectrum of trebly ionised lead, which has been studied by several authors ending with S. Smith[1], requires modification in several respects. I have shown that $7p\,^2P - 7d\,^2D$ is really $7p\,^2P - 8s\,^2S$ and confirmed this by obtaining further combinations with the $8s\,^2S$ term. This provides a series of ^2S terms the values of which can be accurately calculated by Hicks's formula. $6s\,^2S$ comes out equal to 340180, giving an ionisation potential of 41·9 volts.

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Lahore.
Oct. 12.

[1] *Phys. Rev.*, **36**, 1; 1932.

Structure of Line Spectra in Crystals

NEW investigations of the spectra of chromium in crystals[1] have rendered very probable the surmise expressed by Saha[2] as to how these spectra originate. The possibility is thus afforded of enlarging the explanation proposed previously[3] resulting in the main characteristics for a transition of an electron and its change through the crystal lattice, inasmuch as now also the laws of the various transitions of electrons for the spectra of phosphorescence of the rare earths can be investigated. The explanation of transitions $4f^z \longleftrightarrow 4f^{z-1}\ 5d$ offered by Laporte[4] should come into consideration only for the diffuse spectra of the rare earths, for example, of neodymium (also of samarium[5]).

In analogy with chromium we might attribute the sharp spectra to transitions without change of the electronic configurations. Then the principal transitions of electrons appearing in the respective spectra must be attributed to the multiplets produced by the combination of the possible terms of the unchanged electronic configurations. The separation of these terms has been calculated according to a method indicated by Goudsmit[6], and the single term intervals have been fixed according to the Landé interval rule. A very good concordance of the values calculated with the strongest lines of the emission spectrum, for example, in CaO, becomes manifest, as shown by Fig. 1 with the example of praseodymium and erbium, the values of which are indicated according to my own investigations and those of Evert and Fagerberg. The remaining lines originate in accordance with the former explanation partly from lattice oscillations and perhaps also molecular oscillations, partly also from Stark effects.

As these lengthy calculations of the splitting of the terms have not yet been carried out for all electron arrangements, the following combinations have been found up to now:

Pr: $^3F-{}^3H$, $^1G-{}^3H$, $(^1S-{}^3P)$
Nd: $^2I-{}^4I$, $^2G-{}^4I$
Sm: $^6F-{}^6H$
Er: $^2G-{}^4I$, $(^2K-{}^4I)$

The transitions without change of the spin are situated at longer waves than the corresponding ones with change of the spin. The screening constants are $\sigma_2 = 33{\cdot}0 \pm 0{\cdot}2$ for praseodymium, neodymium, samarium and erbium without appreciable direction of the different values.

The possibility of such transitions corresponds very well to the oscillator strength of the corresponding spectra of absorption determined by J. Becquerel, as I gather from a discussion with Mr. Gorter, of Harlem. The temperature behaviour of the lines is as expected (strong dependence on temperature of $^3F-{}^3H$ in relation to $^1G-{}^3H$ in praseodymium). Also the appearance of the transitions leading to the deepest level in absorption is fulfilled. As regards the intensities of the single lines, the transitions $\Delta J = \Delta L$ are, so far as it is possible to judge qualitatively, mostly the strongest, even when $\Delta J = \Delta L = \pm 2$.

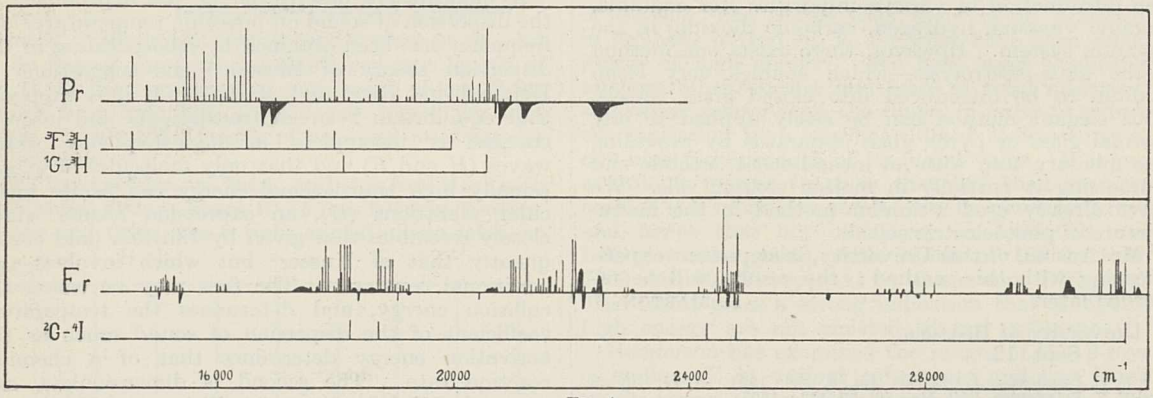

FIG. 1.

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Sept. 26.

[1] O. Deutschbein, Z. *Phys.*, **77**, 492; 1932.
[2] NATURE, **125**, 163, Feb. 1, 1930.
[3] R. Tomaschek, *Z. Elektrochemie*, **36**, 737; 1930.
[4] *Phys. Rev.*, **35**, 30; 1930.
[5] R. Tomaschek, *Phys. Z.*, 1932.
[6] *Phys. Rev.*, **31**, 946; 1928.

Anomalous Behaviour of Methane in the Raman Effect

DICKINSON, Dillon and Rasetti,[1] who examined the Raman spectrum of methane, did not report the presence in it of any pure rotational lines accompanying the Rayleigh scattering. To decide whether indeed the rotational scattering is absent in the case of this gas, spectrograms were obtained by giving prolonged exposures up to a week, but without recording even a trace of such scattering by way of either discrete lines or unresolved bands alongside the undisplaced lines of the mercury spectrum. Special devices for eliminating stray light and weakening the Rayleigh scattering with the aid of a nicol were employed in order to secure the most favourable conditions for the observation, but these made no difference to the result stated.

The absence of a rotational scattering, which is thus indicated in the case of methane, is an extremely surprising result, as it is well known that the Rayleigh scattering by the molecules of this gas is depolarised to an appreciable extent[2] (1·14 per cent), and theory indicates a direct connexion between the magnitude of such depolarisation and the intensity of the rotational Raman lines. Moreover, gases such as hydrogen chloride, ammonia, and carbon monoxide which show comparable or even smaller depolarisation values have been observed to exhibit strong rotational scattering.

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Oct. 8.

[1] *Phys. Rev.*, **34**, 582; 1929.
[2] *Ind. J. Phys.*, **7**, 139; 1932.

Fixation of Mitochondria

THE importance of always omitting lipide solvents from fixatives for mitochondria has, I think, been exaggerated. I find that mitochondria are readily demonstrable in the liver of the newt and the kidney of the mouse even after fixation with Carnoy's alcohol-chloroform-acetic, which should certainly remove all lipides. Bouin's fluid preserves the mitochondria in the liver of the newt as well as the standard mitochondrial fixatives. When in Dalmatia in the summer I put the testes of some Hemiptera (*Syromastes marginatus*) into Bouin's fluid and left them in it until my return to England. On sectioning them I found the filamentous mitochondria of the primary spermatocytes well preserved.

Although mitochondria are in certain cases preserved by these methods, they are not thereby mordanted for subsequent staining. It is best to bring the sections to water and then leave them overnight in three per cent potassium dichromate in a paraffin oven. Next morning they are washed in running water for five minutes, and then stained by Altmann's technique or one of its modifications.

Champy[2] mentioned in 1911 that mitochondria are sometimes preserved by Bouin's fluid, and Romeis[3] in 1913 saw them, somewhat distorted, after Carnoy's fluid without chloroform. It seems that when there is a large protein component in mitochondria, there is no necessity to omit acetic acid and lipide solvents from fixatives used to show them.

I wish to retract my recently published remarks[1] on the fixative action of quinone. I placed tissues in quinone solutions and then transferred them to Carnoy's fluid. Mitochondria were not dissolved. In view of the current opinion regarding the action of Carnoy's fluid on mitochondria, I concluded that quinone was a powerful fixative for them. It is now clear that the evidence for this conclusion was insufficient.

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Oct. 8.

[1] Baker, J. R., NATURE, **130**, 134, July 23, 1932.
[2] Champy, C., *Arch. d'Anat. micr.*, **13**, p. 55; 1911.
[3] Romeis, B., *Arch. mikr. Anat.*, **81**, p. 129; 1913.

Factors Determining the Distribution of *Apion ulicis*

IN connexion with the noxious weed control investigations at Farnham Royal Laboratory on behalf of the New Zealand Government, an experiment has been carried out in order to throw light upon the nature of the factors limiting the distribution of *Apion ulicis*; for this weevil is not found throughout the areas occupied by its host plant, *Ulex europæus*. Its abundance on the Moray coast, for example, and its absence from the Aberdeen district suggest the possibility that climatic factors in the north may only be suitable in the warmer districts.

The experiment consisted of the introduction of 25,500 mature insects, beaten off bushes, to an island in the River Don near its mouth at Bridge of Don, Aberdeen. This island is several acres in extent and has many large clumps of gorse upon it. Careful search was made previously to ascertain that no *Apion ulicis* was there. In November 1929, 500 Apions, collected from Nairn, were liberated; in January 1930, 5,000 from Buckinghamshire were liberated, and in April 1930 Dr. Guy Morrison liberated 20,000 from Buckinghamshire after making another search on the island for *Apion* and finding none. The gorse was in full bloom at the time of this last liberation. In April 1931 half an hour's beating of the bushes resulted in the finding of 15 live specimens of *Apion*, so that a considerable number must have survived the winter. In August 1932 another search was made and although only one dead *Apion* was beaten off the bushes, there were well developed *Apion* larvæ in four pods out of 300 examined, the total number of pods present being probably 1–200,000. Thus there is evidence that both winters must have been survived by many of the weevils and that normal breeding had taken place this year and probably last year also.

It may be, then, that the limited distribution of *Apion ulicis* is attributable to inadequate dispersal, but observations over a longer period are necessary before it can be definitely attributed to this cause rather than to the occurrence of occasional devastating conditions, such as long-continued low temperatures during the breeding season.

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Undeciphered Scripts

REFERRING to the note in NATURE of October 1, p. 502, on the similarity of ancient scripts found in the Indus Valley and in Easter Island, it may be mentioned that Prof. Herman Wirth, of Marburg, has also directed attention to a number of similar symbols that have been found in North and South America, Sweden, Southern Andalusia, Mesopotamia, Africa and Oceania. He explains some of these signs on the usual lines of literal interpretation; but the fact that so many ideographs, "even [!] the *Svastica*" as Sir Denison Ross observes, are found in diverse parts of the world suggests that a certain class of archaic symbol cannot be interpreted as mere pictographs of material objects and local events. They obviously constitute the elements of a universal 'language' the symbols of which represent functions of Nature. The practical scientific knowledge of prehistoric civilisations implies some familiarity with the operations of the dual, positive and negative principle in Nature.

The knowledge of the physicist and biologist, hitherto neglected in palæographical research, may be required for the interpretation of some of these undeciphered 'scripts'. The geometrical and algebraical 'functions' of stresses, strains, and transformations of 'lines of force', do not vary from age to age; and, although the symbols for these in one era may seem abitrary to the savants of another age, the man of science is much more likely to find the 'key' than the man of letters.

W. W. L.

Photochemical Synthesis of Vitamin B_1

[BY CABLE]

ADENINE SULPHATE has been activated into vitamin B_1 by irradiation with ultra-violet light. Guanine chloride could not be activated similarly. Tests were carried out on rats according to the technique previously described. Details will appear elsewhere.

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Research Items

Stone Circles in Tongareva.—In an account of the ethnology of Tongareva, commonly known as Penrhyn Island (Bull. 92, Bernice P. Bishop Museum, Honolulu), by Te Rangi Hiroa (Dr. P. H. Buck), reference is made to two roughly circular arrangements of limestone pillars. Nothing is known of their uses and no name is applied to them by the islanders. It has been stated that stone circles of a Stonehenge type are present in Tongareva—an erroneous interpretation of the word 'encircled' used by Lamont loosely in describing a marae which in reality was rectangular. The stones are not to be ascribed to an archaic civilisation ; they are of the same type as those used in marae construction, and sun worship was unknown to the Tongarevans. The pillars, including the bilateral notched pillar of the Atutahi ellipse, are trimmed in the same way as the marae pillars. They must have been made by the ancestors of the present population. They are in fact extra-marae pillars set up near the marae for some subsidiary purpose which, it is suggested, were social gathering places on the way to or from the marae. Women and children were not allowed to enter the marae. The secular use of the circle may be borne out by the discovery of a partly worked shell fish-hook in one enclosure. The circle may have been used as the place in which was performed the dance and the wailing ceremony, an accessory performance outside the marae that required a clear space not far away. The circle probably arose from a desire to embellish the clear space where such dances were held. In function it would be subsidiary and complementary to the marae and not taboo.

Cherokee Medicine.—The late James Mooney left unfinished a study of a manuscript of Cherokee sacred formulæ and medicinal prescriptions, which has been completed, edited and checked in the field by Dr. Franz M. Olbrechts and is published as Bulletin 99 of the Bureau of American Ethnology. The Cherokee original has disappeared. While the Cherokee recognise that natural causes, much as the fall of a branch of a tree, may bring about an injury, they may still explain it as due to the machinations of an enemy, while disease in general is attributed to the action of spirits, anthropomorphic or zoomorphic, out of revenge for a slight. A rival spirit will then be called in to drive the attacking spirit away. Spirits cause disease not only of their own volition, but also by being invoked by witches or a man-killer. Such spirits are the sun, the moon, the river, which is the central object of an important cult, thunder (more of a disease expeller than a cause of disease), the two sons of thunder, known as the two Little Red Men, the Purple Man, the Blue Man, the Black Man, etc., and the Little People, who act in groups rather than individually. The animal spirits are prototypes of the common animals, but exceed them in their qualities. To these must be added human and animal ghosts. Dreams may also cause definite ailments. Cherokee medical art does not aim at curing disease or allaying pain, but at removing the cause, which it is the first duty of the medicine man to ascertain, in the first place by interrogating the patient as to whether he has infringed any taboos or has had any dreams. Great as is the number of spirits causing disease, the number of those who drive it away is even greater. If a disease is thought to be caused by worms, worm-eating bird spirits will be called in. If the disease is of a very tenacious nature, the spirits of rats, beavers or weasels will be called in, because they also are tenacious and will gnaw and tear the disease-causing spirits.

Californian Shrimp Industry.—In the Fish Bulletin No. 38 of the Division of Fish and Game of California, Bureau of Commercial Fisheries, 1932, Mr. Paul Bonnot deals with the Californian shrimp industry in San Francisco Bay, both historically and statistically. Three shrimps make up the commercial catch, all species of *Crago* : *C. franciscorum*, *C. nigricauda* and *C. nigromaculata* in order of their abundance. These are all large animals measuring $2\frac{1}{2}$–3 in. in length. Their life history is little known. Eggs may be found attached to the females throughout the year at various stages of development but there are no records of young shrimps being taken in the catches. Presumably they pass through the nets. Besides shrimps, *Pandalus danæ*, *Spirontocaris cristata* and *Upogebia pugettensis* are occasionally taken and large numbers of *Euphausia pacifica*, with numerous fishes of many varieties. The Chinese shrimp net and the shrimp trawl are both used and appear to be equally efficacious as the amounts of the catches from each differ little. The shrimps are for the most part boiled and put into barrels to be sent away to the dried shrimp market in China. The catches have greatly increased in the last fifteen years, rising from 200,000 lb. in 1915 to 3,000,000 lb. in 1929. The largest numbers were in July to October. Sun-dried shrimps lose three-fifths of their weight in the process. The dried material yields one-third shrimp meats and two-thirds shrimp meal by weight.

The Peritoneal Melanophores of Fishes.—The dermal chromatophores of fishes have been much studied but relatively little is known of the internal chromatophores present in the peritoneum, the pericardium, the walls of the larger blood vessels, the membranous coats of the central nervous system and elsewhere. In common cyprinoid fishes two kinds of peritoneal chromatophores are present, namely, melanophores and guanophores (or iridocytes) but there are no xanthophores. In the small Japanese species of minnow, *Acheilognathus intermedia*, selected for study by K. Yamamoto (*Mem. Coll. Sci.*, Kyoto Imp. Univ., Ser. B, vol. 7, No. 4, Art. 9, 1931) internal melanophores are plentiful ; each is a minute stellate cell with numerous peripheral processes rich in dark brown or black pigment. It differs in shape from the dermal melanophore, for the latter has longer peripheral processes, and in distribution, for the peritoneal melanophores are more densely crowded so that they more readily join to form a continuous black screen. A single large peritoneal melanophore is surrounded by ten to thirty smaller ones all of which react together in expansion or in contraction. The dermal melanophore expands when the fish is kept in the dark and contracts when the fish is kept in the light ; the peritoneal melanophore reacts in the opposite manner. Damage to the brain does not change the reaction of the peritoneal melanophore. In general the reaction time of this melanophore is slower than that of the dermal.

Hybrids of the Grass *Phalaris*.—Crosses have been made between *Phalaris arundinacea*, a grass of wide distribution in the northern hemisphere, and *Ph. tuberosa*, a Mediterranean species (T. J. Jenkin and B. L. Sethi, *J. Genetics*, vol. 26, No. 1). More seeds and a higher percentage of germination are obtained when *Ph. arundinacea* is the female parent. Both species are found to have $2n=28$ chromosomes, and hence are tetraploid, but in the hybrid meiosis 12 pairs of chromosomes are formed and 4 univalents. In both parent species there are 14 pairs of chromosomes in meiosis, but one or two bivalents may lag on the heterotypic spindle. The hybrids are functionally male-sterile, but a few good pollen grains are probably produced. They are vigorous and set seed freely in proximity to the parent species. Later generations showed considerable variability. On the basis of these results the theory of the hybrid origin of the Australian Toowoomba canary grass, which is also variable, is revived. It is suggested that this form, the status of which has been disputed, resulted from natural crosses in Australia between the introduced species, followed by back-crossing to *Ph. tuberosa*. It cannot be proved, however, that *Ph. arundinacea* was growing in Toowoomba at the time these crosses are supposed to have arisen.

Kimberlite in Tanganyika Territory.—The Shinyanga diamond fields have already been described by Dr. E. O. Teale in Short Paper No. 9 of the Geological Survey of Tanganyika Territory. Kimberlite occurrences have more recently been discovered on the Iramba Plateau, south-east of the former area, and these are now described in Short Paper No. 10, also by Dr. Teale. At Kisiriri the kimberlite occurs in sheet-like intrusions penetrating the granite along flat-lying joint planes; most of the sheets have chilled margins, the thickness ranging from thirty feet down to mere threads. At Kiomboi an irregular elliptical pipe occurs and other occurrences of kimberlite that probably lie over pipes are known in the Songeli and Mtawira districts. In some of these areas pitting and washing have been carried out, both on superficial gravels and on weathered kimberlite, but so far without encouragement except in the Songeli region, where two diamonds are reported from the river gravels. All the typical minerals such as ilmenite, garnet, olivine, diopside and zircon are found, and the Kiomboi pipe contains eclogite and numerous blocks of sandstone like that of the Upper Karroo. No outcrop of the latter is now present in the vicinity and the inclusions must have fallen in from a former capping of the formation.

Room Comfort.—It is now nearly twenty years since Sir Leonard Hill introduced the cooling of a thermometer bulb at body temperature as an indicator of the comfort of a room. The smallness of the instrument has been found disadvantageous and a committee of the Medical Research Council and of the Department of Scientific and Industrial Research has adopted a comfort-measuring device which was described briefly by Mr. A. F. Dufton of the Building Research Station in the *Philosophical Magazine* for May 1930 and is now described in detail by him in Technical Paper No. 13 of the Building Research Board entitled, "The Equivalent Temperature of a Room and its Measurement". It consists of a cylindrical vessel of thin copper painted black, 56 cm. high and 19 cm. in diameter, the temperature of which is maintained at 75° F. by a bi-metallic thermostat and a relay mercury switch which control the electric current through two electric lamps in the vessel, on a 200-volt circuit. A portion of the current flows through a coil which heats a thermometer, or a thermo-junction if a continuous galvanometer record is required. The indications of the instrument are thus proportional to the excess of 75° F. above a temperature for which the term 'equivalent temperature of the room' is proposed. The device is to be called a 'eupatheoscope'.

Polarity of Thunderclouds.—Experiments have been made in South Africa (E. C. Halliday, *Proc. Roy. Soc.*, October) to investigate the structure of thunderclouds by studying the changes in the atmospheric potential gradient accompanying different types of flash. The capillary electrometer invented by C. T. R. Wilson for such work was used, and an observer wrote notes on the flashes, at the same time marking the electrometer record. In some cases photographs of the flashes were taken. In 283 cloud-to-ground flashes, nearly all were accompanied by positive charges of the electric field. When the flashes took place within clouds, they usually produced negative field charges when distant and positive field charges when near. These results are consistent with Wilson's view that thunderclouds are charged positively above and negatively below. A number of simultaneous earth-cloud and within-cloud flashes were also observed.

Experiments with High-Speed Protons.—Chr. Gerthsen describes in *Die Naturwissenschaften* for September 30 an ingenious method for multiplying the energy of hydrogen positive ions. The ions are accelerated *in vacuo* and passed through a chamber filled with hydrogen where a process of exchange of charge takes place and fast neutral hydrogen atoms are produced. The neutral particles pass through a region of reversed potential into a second exchange chamber where fast positive ions are produced and these are accelerated by a potential derived from the same source as before. The arrangement tried gave proton currents of 10^{-8} amp. at velocities corresponding to 2×70 kilovolts, and the experiments of Cockcroft and Walton on lithium disintegration were repeated. The repeated application of the process is hindered only by intensity considerations, particularly as the probability of exchange of charge decreases with increasing particle velocity.

Sub-boundary Structures in Metals.—Deeply etched iron not infrequently shows within the crystals of ferrite a network the nature of which has been very obscure. Hitherto the general explanation has been that such sub-boundary structures were evidence of minute crystals the orientations of which varied very slightly. Similar effects have been noted in cast nickel and copper. In a paper to the Iron and Steel Institute (September, 1932), L. Northcott advances the view, which is supported by considerable experimental evidence, that oxygen in the metal is the cause. Iron which had not previously shown this structure did so when heated in contact with iron oxide, while a veined structure was removed by annealing in hydrogen within a certain range of temperature. The two other metals mentioned gave similar results.

Atomic Weights of Selenium and Tellurium.—The values obtained by Aston by the mass-spectrum method in the case of selenium and tellurium differ appreciably from those adopted in the International Tables of Atomic Weights. A revision of the chemical determinations has been carried out by Hönigschmid, who reports in *Die Naturwissenschaften* (1932, p. 659) that the analysis of silver selenide gives Se = 78·962 ± 0·002, coinciding with Aston's result, whilst the analysis of $TeBr_4$ gives Te = 127·587 ± 0·019, differing by 0·4 from Aston's value but agreeing with the International value and with a combination of Aston's results with the more recent mass-spectrum experiments of Bainbridge (*Phys. Rev.*, 1021, 1932), which disclosed some new lighter isotopes. A combination of the two spectra gave Te = 127·58 ± 0·15, in correspondence with the chemical value.

Mechanism of Flame Movement.—In the *Journal of the Chemical Society* for July, 1932, Coward and Hartwell, of the Safety in Mines Research Laboratories, describe experiments on the uniform movement of flame in mixtures of methane and air, with particular reference to the effect of the diameter of the tube on the rate of propagation. They confirm the fact that the speed of flame increases with increase in tube diameter; in a tube of 100 cm. diameter, a 10 per cent methane — air mixture would be propagated at about 250 cm./sec., whereas in one of 2·5 cm. diameter at only about 65 cm./sec. For tubes between 10 cm. and 20 cm. in diameter, there appears to be an inflection in the curves representing the speed. The authors explain this by reference to the nodular appearance of the flame, which is due to convection in the flame front, and does not occur in tubes of small diameter. The enlargement of the flame surface increases the mass of the gas burnt in unit time, and the speed of flame increases accordingly. Even in the case of downward propagation of flame in wide tubes, these irregularities in the flame front are visible, and the authors plead that 'uniform movement' of flame may be regarded as an early phase of sensibly uniform speed usually observed in the propagation of flame (through a quiescent gaseous mixture) from the open end of a straight tube towards the closed end, but not as resulting from a particular mode of heat transference, representing the normal speed of propagation of flame by conduction of heat.

Astronomical Topics

The Leonid Meteors.—A Science Service Bulletin, by James Stokley, points out that even people who have no astronomical training can do useful work in observing the Leonid meteors. It will help to determine the time of maximum if they count the numbers seen during each hour of the night. If the meteors are too numerous for all to be counted, the count may be limited to a definite region of the sky, bounded by known stars, which should be noted in making a report; a region should be chosen that will remain in sight throughout the watch. An alternative study is that of the brightness of the meteors. The planets Jupiter and Mars, and the star Regulus will be suitable for comparison. Each observer should limit himself to some definite field of work. The most probable nights are those between November 15 and 16, and between November 16 and 17. The moon will prevent observation of faint meteors, but there should be many bright enough to be seen.

The observatories of Kodaikanal and Helwan have been asked to telegraph to the B.B.C. if they see a rich shower, so there is a possibility of receiving warning before the radiant point rises (a little before 11 P.M.). As the rich portion of the shower takes about four hours to be crossed by the earth, it is more or less an even chance that some portion of the rich shower may occur in the interval between 11 P.M. and sunrise. In 1866 the nodes of Tempel's comet and the meteors were practically identical (231° 26′ comet, 231° 28′ meteors). The calculations of the B.A.A. Computing Section give 233° 54′ for the comet's node this year; if we assume the same for the meteors, the maximum would be about noon on November 16. The most hopeful time appears to be just before dawn on November 16. The sun rises at $7^h\ 19^m$ in London.

A Perplexing Variable Star.—The variability of the star R Scuti was discovered by Piggott in 1795, but the law of its variation defied analysis for more than a century. A special study of the star during the period 1911–1931 has been carried on at the Observatory of the University of Michigan, first under Dr. R. H. Curtiss, and after his death by Mr. D. B. McLaughlin. The results are contained in *Publications* of the Observatory, vol. 9, Nos. 9 and 10. It may be described roughly as of the β Lyrae type, with two unequal minima, the average length of the double cycle being 143 days; on the average the B minima occur 62 days later than the A minima. The brightness at maximum is fairly constant at mag. 5 or slightly fainter; that at minimum is very irregular. Sometimes it does not fall below mag. 6, while early in 1925 it fell below mag. 8. The most curious feature is that sometimes the A minimum, sometimes the B minimum, is the deepest; there is a suggestion that these disturbances of sequence occur at intervals of nine cycles, or about 1300 days. The 143-day period is also subject to cyclic variations. The paper does not attempt to give any physical explanation of the star's curious behaviour.

Total Solar Eclipse Observations.—It was mentioned as a 'novel resource' in a paragraph in the columns of "Astronomical Topics" in NATURE of October 1 on the total solar eclipse of August 31, that some parties of observers had dashed by motor cars to places where the clouds were less dense. Dr. Elihu Thomson, director of the Thomson Research Laboratory, General Electric Company, Lynn, Mass., writes: "In observing the eclipse of June 6, 1918, in Colorado, U.S.A., I secured an automobile for the very purpose of following the blue sky, and after making two shifts, reached a high ridge under blue sky just three minutes before totality and had an excellent view in consequence. I believe this process was novel at the time and was referred to in the Harvard Observatory Annals. In the last eclipse, I, with friends accompanying me, repeated the same process and saw the total phase of the August 31st eclipse, which would otherwise have been missed."

The Origin of Igneous Rocks

A DISCUSSION on the origin of igneous rocks was held in Section C (Geology) of the British Association at York on September 7. The discussion was opened by Prof. Arthur Holmes, who sketched out a general scheme of petrogenesis in the light of our present knowledge concerning the geological history, structure and thermal condition of the earth's crust. In certain continental regions the sedimentary and granitic layers appear to be separated from a deeper 'basaltic' layer by one which is probably composed of both acid and basic materials. The 'basaltic' layer is itself composite, a tentative interpretation being that amphibolite (a potential source of oversaturated basalts) is succeeded in depth by more basic granulite (a potential source of undersaturated basalts). Beneath these layers peridotite probably comes into place, merging within a few tens of kilometres into the glassy state regarded as characteristic of the substratum. Given some such setting of materials, igneous activity could arise, either by the ascent into the crust of heat from the feebly radioactive substratum, or by the accumulation of heat in specially thickened belts of the more strongly radioactive crustal rocks. The latter process fails, however, to account for the flooding by plateau basalts of regions where the crust has been thinned by denudation, and also for the ascent of granitic magma *during* orogenesis instead of long afterwards. The hypothesis of refusion of the crustal layers by heat from the substratum, with successive production of peridotitic, basaltic and granitic magmas, therefore seems to be worthy of special consideration.

From the fact that the basaltic magmas of the Inner Pacific differentiate towards trachyte and fail to produce rhyolites and dacites, it is possible to infer that the latter could be developed in quantity only where pre-existing granitic material has been available for refusion. To test the validity of this inference, which is supported by many other lines of circumstantial evidence, Prof. Holmes suggested a method based on the generation of Ca^{41} from K^{41} and its accumulation during geological time. If a Tertiary granophyre or other acid rock had been produced by refusion of pre-existing granite, then its Ca^{41}/Ca ratio should be of the same order as that for, say, Lewisian granite-gneiss. If, on the other hand, the granophyre had been a differentiate from basaltic magma, the Ca^{41}/Ca ratio should be of the much lower order characteristic of basalt. Determinations of Ca^{41} by Dr. F. Allison, who has devised an extraordinarily sensitive magneto-optic method of isotope detection, are now in progress with the view of trying out the practicability of the proposed test.

Attention was directed to the results of much recent work supporting the view that in both kratogenic and orogenic regions many 'intermediate' rocks have been generated as a result, not of differentiation acting alone, but of differentiation superimposed upon (*a*) the hybridisation of granitic magma by relatively basic igneous, metamorphic and sedimentary rocks, or (*b*) the acidification of basic magma by sialic materials. Turning to the consideration of ultrabasic rocks, Prof. Holmes suggested that in addition to peridotites representing accumulations of early-formed crystals from basaltic magmas there are others that have been intruded as peridotite magmas. It was maintained that the conditions favourable to the refusion of crystal-accumulates from basaltic magma would also suffice to generate magma from the peridotite layer at the base of the crust. The genesis of felspar-free alkali-rocks can be plausibly explained by assuming a peridotitic parentage for these rocks. It is not denied, however, that in some of its local applications the 'limestone assimilation' hypothesis has many attractive features.

From each of the different types of parental magmas—acid, basic and ultrabasic—a wide variety of rock-types can be produced by additive and subtractive differentiation, by assimilation, by the mixing of, and reaction between, various products (lamprophyres ?) and by all these processes acting concomitantly. Further possibilities of variation are introduced by differential fusion, and Prof. Holmes pointed out that magmas generated under stress are likely to be of abnormal composition (spilitic ?) as compared with those due to passive refusion.

Prof. A. Brammall examined evidence for the syntectic origin (as opposed to 'pure-blooded' descent from primary basic magma) of saturated and oversaturated magmas, with special reference to quartz-monzonites, hornblende-biotite-syenites, diorites, granodiorites and granites. He endeavoured to liberate the general genetic problem from what he aptly termed "the tyranny of the silica percentage". By eliminating normative quartz from analytical data for igneous, metamorphic and sedimentary rocks and plotting the results in triangular diagrams, he focused attention on progressive variation in the ratios of (*a*) salic to femic constituents, and (*b*) Ab to Or + Cor, in a theoretical differentiation suite. From this standard trend of variation the rock-types mentioned appear to be markedly aberrant. Not only does such aberration, in itself, logically hint at contamination, but also the rock-types displaying it are those for which a syntectic origin has been frequently asserted on first principles and convincingly demonstrated by field and geochemical evidence. Moreover, the crustal rocks actually assimilated in particular cases are of the general composition predicable from the 'overlap' of composition-fields plotted. Both the basification of acid magma, and the converse process, may be regarded as comparatively simple cases of the kind to be expected. The analytical and graphic methods outlined may afford some lead in the difficult problem of assessing probabilities concerning the fact of assimilation, and the composition of material which may have been assimilated at inaccessible depths before the consolidation of coarse-grained and essentially homogeneous rocks.

Prof. Brammall urged the need for intensive geochemical work on country-rocks—directed, in particular, to the study of 'consanguinity' as a further and possibly decisive criterion. Citations included progress reports on (i) the basic sills intrusive into Cambrian Shales flanking the Malverns near Eastnor, by Mr. F. G. H. Blyth, and (ii) hornblende-gabbro intrusive into Malvernian Schists at Hollybush, by Miss A. E. Cook and Prof. A. Brammall.

Dr. G. W. Tyrrell discussed the nature, mode of occurrence, and origin of basaltic magmas. He regards the existence of two main types of basaltic magma as established : the oversaturated or tholeiitic, and the undersaturated or crinanitic. In relation to geological environment three groups can

be distinguished: (*a*) *flood-basalts* (mainly oversaturated); (*b*) *oceanic basalts* (largely undersaturated); (*c*) *cone-basalts*, including those of rift valleys, horsts and troughs (dominantly undersaturated and notably felspathoidal). It was pointed out that the oversaturated type of magma has appeared at infrequent intervals but in enormous volumes, and that its chemical composition, as represented by basalts and quartz-dolerites, has been remarkably constant in space and time. While deriving undersaturated magmas directly from the basaltic layer, Dr. Tyrrell suggested that the oversaturated type may have originated by selective fusion of the peridotite or 'stony-meteorite' zone underlying the basaltic layer.

Dr. A. K. Wells expanded the evidence favouring refusion of ultrabasic material, with special reference to the dunite pipes of the Bushveld Complex. He endorsed the opinion that these 'carrot-shaped' intrusions are magmatic infillings, but regards them as re-fused differentiation products from the noritic magma of the Complex. Slides were shown demonstrating that both chromitite and magnetite-rock (presumed to have been derived from the norite) have behaved as fluids towards the associated silicate rocks. This striking reversal of the usual relations makes it not unreasonable to postulate refusion of early segregations. In connexion with the origin of the alkali rocks, Dr. Wells regrets that most British petrologists seem loth to accept the 'limestone-assimilation' hypothesis. He thinks the chain of circumstantial evidence cited by Prof. Shand is sufficiently strong to carry conviction, and he deprecates any suggestion that ijolite cannot be derived from basaltic or granitic magma, on the ground that it unfairly rules out the 'limestone-assimilation' hypothesis altogether.

Prof. H. H. Read examined the quality of the field-evidence connected with petrogenic theories. The rapid changes in the fashionable theories are clearly due to imperfections of field-knowledge. Arguments based upon badly exposed igneous bodies, such as the alkaline mass of Loch Borolan and Cnoc na Sroine in Sutherland, are obviously of little value. If petrologists endeavoured to assess the quality of their field-evidence we should have a guide to the order of validity of their conclusions. In Prof. Read's opinion, the field-evidence for refusion and palingenesis is entirely inadequate. In the case of contamination and hybridisation, however, the presence of discontinuities, and the complex and variable nature of the products, make the field-evidence of great value; but even here, the application of knowledge gained in these obviously mixed rocks to the interpretation of rocks about which no such field-evidence is forthcoming should be made with caution. The most important testimony in favour of assimilation as a petrogenic process is that read from field-evidence.

Mr. S. I. Tomkeieff presented an interim report of an investigation carried out in collaboration with Mr. C. E. Marshall on the Tertiary dykes of north-east Ireland, with special reference to 130 dykes of the Mourne swarm. These included olivinic types, but a majority belonged to the oversaturated and 'intermediate' types (andesitic variolites, leidleites, innimorites, etc.). The 'intermediate' types invariably contain half-digested xenocrysts of felspar and quartz, while xenoliths of partially fused granitic rocks are generally abundant. The field and petrographic evidence was found to be in perfect agreement with the views expressed by Prof. Holmes as to the origin of the similar suite of andesitic tholeiites occurring in the north of England. Mr. Tomkeieff outlined the igneous history of the Mourne centre as a whole and showed that the details are those to be expected on the theory of successive refusion advocated by Prof. Holmes.

Mr. W. Campbell Smith, in commenting on the views expressed by the previous speakers, pointed out that, from the nature of the case, field evidence of palingenesis was not to be expected on anything more than a very limited scale. He is disposed to counsel caution in extending the explanation offered for the evolution of leucitic rocks to the still less tractable problems of the soda-rich rocks.

Dr. H. Jeffreys said that the origin of the crustal layers themselves had not been touched upon, though he contends that this is the fundamental problem. He considers that the granitic and basaltic layers probably represent the products of residual magmas left over from the crystallisation of the material of the Lower Layer, and suggested the possibility that the process may still be going on.

International Institute for Documentation

THE eleventh Conference of the International Institute for Documentation was held in the Bibliothek für Kunst und Technik, Frankfurt am Main, during the week which ended on September 3. Great credit is due to Dr. Walter Schürmeyer, Director of the Bibliothek, for the excellent manner in which the Conference was planned and carried out. It is of interest to note that this Conference was the first held under the Institute's new title of "Documentation", which at the Tenth Conference (of the "Institut International de Bibliographie", as it was then called), held at the Hague on August 24–29, 1931, was chosen as a more appropriate title, in view of modern developments in the collection and classification of the records of intellectual activities.

On the first day, members of the Conference were received by the mayor and municipal authorities of Frankfurt, and by the Rector of the University, in the historical Kaisersaal des Römers; after which, a public assembly was held in the town hall, when Dr. J. A. Prins, director of the Dutch Patent Office, delivered his presidential address. All papers presented at the Conference were issued in two bound volumes[1] to participants in advance. M. Paul Otlet, one of the founders of the Institute in Brussels, spoke on the history and fundamental principles of documentation, and Dr. Ehrenfried Pfeiffer[2] described the technical documentation service of the Verein deutscher Ingenieure in Berlin.

There was a short discussion of the joint paper, "Systematic Subject Indexes to Periodical Volumes" by Prof. A. F. C. Pollard and Dr. S. C. Bradford[3], in which is described the method of the subject-matter index to volume I (1931) of the *Power and Fuel Bulletin*,[4] a notable development of indexing practice.

In Great Britain, where an undecimalised and therefore troublesome system of measures and money is still patiently endured, one would least expect to find the decimal system extensively adopted in the classification of literature; but Dr. S. C. Bradford[5] quotes a list of 28 important British scientific

institutions which, even in the year 1930, had decimalised and thus simplified their documentation. The fundamental value of decimal classification lies in its mechanical simplicity, its universal application, and its 'pure' numerical symbolisation which overrides all language barriers and opens up wonderful possibilities of international co-operation. The enthusiasm of all who have adopted the system and proved its worth, shows it to be a vital factor in modern librarianship.[6]

Abbreviated editions of the "Classification Décimale Universelle, Table systématique complète" have appeared in German[7] and in Spanish,[8] and a Danish edition is now in preparation. All such editions will be faithful translations of the French, and will follow the German in respect of abbreviation. The "Index Alphabetique de la Classification Décimale", a comprehensive alphabetical subject-matter index to the whole of the decimal classification system, can now be obtained from the Institut International de Documentation, Palais Mondial, Bruxelles.

In the course of the Conference, an exhibition was set out in the Bibliothek für Kunst und Technik, to illustrate modern library equipment, such as visible file indexes, photostat apparatus, and the application of the 'Adrema' system in mechanical selective documentation, which has been adopted with considerable success in the Bibliothek der Technischen Hochschule, Berlin,[9] for example. The Adrema Co. has now worked out in detail a scheme for the direct mechanical selection of decimal references to six places (that is, up to 999,999 or a million classification sub-divisions[10]).

At the conclusion of the Conference, a dinner was held in the clubhouse of the Frankfurter Gesellschaft für Handel, Industrie und Wissenschaft, a feature of which was the decimalised menu card. This was the work of Dr. Julius Hanauer, who threatened that at the next Conference he would produce an international menu card of decimal numbers without words. It was provisionally decided that the next Conference of the Institute should be held in Paris next summer, in collaboration with the Institut International de Co-opération Intellectuelle.

H. P. SPRATT.

[1] "I.I.D., Vorträge der 11. Konferenz". Bibliothek für Kunst und Technik, Frankfurt am Main. 6 gold marks the two volumes.
[2] "Der Literaturnachweis des Vereines deutscher Ingenieure". I.I.D., Vorträge der 11. Konferenz, vol. 2, p. 243.
[3] "I.I.D., Vorträge der 11. Konferenz", vol. 2, p. 121.
[4] Published monthly by the British National Committee, World Power Conference.
[5] Bradford, Dr. S. C.: "Die Entwicklung der wissenschaftlichen Bibliographie und des bibliographischen Quellennachweisdienstes in England". Minerva-Zeitschrift, Jahr. 7 (1931), Heft 1–2, p. 10.
[6] Spratt, H. P.: "Scientific (Technical) Libraries". Chapt. iii, The Year's Work in Librarianship, vol. 4 (1931).
[7] "Dezimal-Klassifikation, Deutsche Kurzausgabe", bearbeitet im Auftrage des Deutschen Normenausschusses von Dipl.-Ing. Heinrich Günther. Beuth-Verlag G.m.b.H. Berlin, 1932.
[8] "La Clasificación Bibliográfica Decimal", por Luis Mèndez Albarrán. Badajoz, Antonio Arqueros.
[9] Predeek, Dr. A.: "Die Adrema-Maschine als Organisationsmittel im Bibliotheksbetriebe." 20 pp. Berlin, "Organisation" Verlagsges. m.b.H. (S. Hirzel), 1930. 1 gold mark. See also: "Die mechanishe Herstellung und Auswertung des technischwissenschaftlichen Literatur-Nachweises." 's-Gravenhage, Nederlandsch Instituut voor Documentatie en Registratuur, 1930, Publicatie No. 51, p. 31.
[10] Predeek, Dr. A.: "An Ever-ready Printed Catalogue." Report of Proc. 8th Conference (1931), p. 47, A.S.L.I.B., London.

Structure of Solid Bodies

AN important symposium on the elementary structure of solid bodies (chiefly non-metallic), at which many distinguished foreign savants participated, was held in Leningrad on September 13–18 at the physico-technical institute.

In an introductory paper, A. F. Joffe (Leningrad) discussed the permanent distortion of crystals and pointed out that structurally perfect crystals offer least resistance to distortion. W. L. Bragg (Manchester) described the results of X-ray analyses of substances of more complicated structure, such as silicates. V. Heitler (Göttingen-Moscow) dealt with a semi-classical theory of the homopolar valence forces. Mrs. M. Classen (Leningrad) described the measurement of the limit of elasticity in perfect crystals and indicated that non-metallic crystals show annealing effects similar to those of metals. J. Frenkel (Leningrad) analysed the concepts 'solid' and 'liquid', pointing out that many properties which used to be considered characteristic of solids are shared to some extent by liquids, and vice versa. Liquids, for example, have a measurable rigidity under high-frequency mechanical oscillations. B. K. Fredericks (Leningrad) discussed the 'swarm theory' of liquid crystals. J. D. Bernal (Cambridge) considered the rational classification of crystals according to the nature of the weakest bonds and the rotation of molecules or radicals present.

J. Errera (Brussels) spoke on the dielectric polarisation of solids, distinguishing between ionic polarisation due to high frequency in substances far from their melting point (sodium chloride), and dipole polarisation due to low frequencies in substances near their melting point (water). A. V. Kurtchatov (Leningrad) dealt with the dielectric properties of Rochelle salt and explained the occurrence of the upper Curie point by the Lorentz interaction of rotating dipoles. The nature of the lower Curie point remains obscure, some ascribing it to the 'freezing' of the dipoles and others to a depolarising action determined by the symmetry of the crystal. N. Achulov (Moscow) considered magneto-striction and explained the abnormal character of the mechanical properties of ferro-magnetic bodies in terms of electronic orientations under the influence of mechanical stresses. He gave, further, a new method for calculating the magnetic susceptibility in crystals. P. L. Kapitza (Cambridge) spoke on magneto-striction in non-ferromagnetic bodies (bismuth and others).

R. H. Fowler (Cambridge) presented a report on Wilson's theory of semi-conductors which attributes their electrical properties to the thermal excitation of a very few electrons into states of motion which enable them to move freely through the crystal. In contrast to metals, the electrical properties of semi-conductors are classical. E. Tamm (Moscow) read a paper on the peculiar 'surface-bound' electronic states in non-metallic crystals and another paper on the calculation of the work-function for metals; in this he showed that the work depends solely on the polarisation of the metal (though the notion of the corresponding 'image-force' is not valid). Finally, J. E. Mayer (Baltimore-Göttingen) dealt with new developments of Born's theory of ionic forces in crystals, based upon the wave-mechanical conception of interatomic forces, and on electrical polarisation.

In connexion with the above symposium, a discussion was held on Dirac's electrodynamic theory to which Fock (Leningrad), Podolsky (Pasadena-Kharkov) and Shubin (Sverdlovsk) made interesting contributions. Nuclear phenomena, especially the

analysis of atomic structure in terms of protons and neutrons, and the repercussion of those phenomena upon the law of conservation of energy, also came in for a fair amount of discussion. Fowler and Dirac (Cambridge), Tamm, Frenkel and others joined in this discussion; its general tone differed from that of the similar discussion which took place at the recent York meeting of the British Association in that the unexplained behaviour of the energy distribution in the β-ray emission of radioactive bodies did not appear to shake the confidence of the speakers in the utility of the postulate of the conservation of energy when applied to subatomic phenomena.

VICTOR COFMAN.

Iron-cored Coils for Radio Frequencies

FOR several years past iron-cored coils for oscillatory circuits have been used by telephone engineers at audio frequencies and at the low radio frequencies which are used in carrier current telephony. In order to reduce the losses which would accompany the use of iron at frequencies of the order of 50,000 cycles per second, the magnetic material was made up in the form of iron dust or filings embedded in a wax or cement in such a way that each particle of iron was insulated from its neighbours. In this way the eddy currents were very restricted in their paths, and the resulting iron losses were reduced to a minimum, so that the presence of the iron increased the inductance of the coil to a much greater extent than its resistance. When attempts were made to use such cores for coils required for higher radio frequencies, however, they were found to be a disadvantage, and the best design of coil for use in the medium broadcasting band of frequencies has been found to be a single-layer air-core solenoid of suitable proportions of length to diameter.

In the *Wireless World* of September 16 an announcement was made of the production in Germany of a new magnetic material named "Ferrocart", which may have a considerable influence on the design and construction of inductance coils for, at any rate, moderately high radio frequencies. Details as to the exact composition and the mode of manufacture of this material are not yet available, but paper laminations appear to be used to carry the dust core, and the result is a decided improvement upon the old form of core with iron particles. Also a considerable advantage is obtained from the fact that "Ferrocart" can be made up in the form of annular rings for use in the toroidal type of inductance coil. In this manner the air path of the magnetic field of the coil is reduced to a minimum; and since there is less external stray field, the screening of coils in a receiver or other piece of apparatus is rendered an easier problem. In the "Ferrocart" coil the inductance is obtained with considerably fewer turns than is necessary when an air core is used, so that it becomes possible to make the coils quite small while still retaining thick or multi-stranded wire to ensure low copper losses.

Later issues of the *Wireless World* have contained the results of comparison tests of typical air-core coils with two coils of the new type, the larger of which was enclosed in a screening box about 2 inches long and 2 inches in diameter. At frequencies corresponding to the medium broadcast band of wavelengths, each of the coils gave a considerably better performance than two typical commercial coils of greater dimensions, as used in modern broadcast receivers.

The better of the two "Ferrocart" coils was, indeed, only surpassed by an unusually well-designed air coil using stranded wire wound on a three-inch diameter former, containing two or three times the amount of copper wire and presenting considerable difficulty in screening it without loss of efficiency. It is understood that a firm has already arranged to develop the applications of "Ferrocart" in Great Britain.

Weather Charts of the Northern Hemisphere

THE Deutsche Seewarte, Hamburg, has undertaken to produce on behalf of the International Meteorological Organisation, daily synoptic weather charts covering the whole of the northern hemisphere. It is not intended to produce a synoptic chart differing from those published daily by the British Meteorological Office merely in the size of the area dealt with—the British charts cover only a small portion of the large area between the equator and the northern tropic—but one which shall contain the maximum possible amount of detail. For this purpose, it will be necessary to use more material than is provided by the ordinary international exchange of weather reports by wireless, and consequently these extended weather maps will not be available soon enough for direct use in daily short period weather forecasting. Their indirect value in forecasting may, on the other hand, be very great.

It is the view of many meteorologists that an understanding of the causes of long spells of abnormal weather can only be arrived at by the study of charts of this kind, a study which can be pursued at leisure, working on past weather situations. In the future such extended charts will be available in time for direct use in daily forecasting, but meanwhile the knowledge gained from the study of those now to be prepared should prove valuable in interpreting existing charts in much the same way that knowledge gained from a study of the synoptic weather charts of Europe and the North Atlantic solved some of the difficulties of forecasting from charts covering only a portion of Europe such as were used in most countries until recent years. But it is in the further development of long range forecasting that they are likely to be of the greatest utility. Seasonal forecasting of rainfall has been carried out with some measure of success in India and some other countries by means of equations derived from the theory of correlation, the future rainfall being correlated with various antecedent values of meteorological elements in distant countries. It is possible that the new charts may cause this method to be replaced by other more scientific methods based on a better understanding of the general circulation of the atmosphere.

It is hoped to begin the series with the period

of the International Polar Year 1932–33. In order that an idea of the probable number of purchasers may be gained, and that matters may be so arranged that the publication shall be developed into a permanent institution, the Deutsche Seewarte, Hamburg, would be glad to hear in advance from anyone who is likely to place orders for the new charts, and is prepared to submit sample charts and supply any information required. The cost of publication has to be covered by the sale of the charts, and the enterprise therefore depends for its success upon there being a sufficient number of purchasers to keep the price of the individual charts reasonably low.

University and Educational Intelligence

CAMBRIDGE.—Dr. H. R. Hulme, of Gonville and Caius College, has been elected to an Isaac Newton studentship, and W. E. Candler, of Trinity College, and R. H. Stoy, of Gonville and Caius College, have been elected to additional Isaac Newton studentships tenable for one year.

OXFORD.—The electors to the Hope professorship of zoology propose shortly to proceed to the election of a successor to Prof. E. B. Poulton, who has resigned as from January 1, 1933. The resignation of Prof. Poulton, who has held the chair for forty years in succession to the first Hope professor, the late J. O. Westwood, is greatly regretted. It is understood, however, that he intends still to carry on in the Hope Department those researches which have had such fruitful results, especially in the field of insect bionomics.

WALES.—It is stated in the annual report of the Council of University College, Swansea, that the capital deficit of the College has now been extinguished. There is urgent need for a new library, and the Council has decided to raise funds for the provision of a permanent building. It is proposed to issue private appeals for this purpose. The College has established a metallurgical research council to conduct investigations into problems which concern the chief industries of the region.

A STUDY of the place of physical education and hygiene in the curricula of teacher-training institutions has been published as Bulletin No. 10 of 1932 of the United States Office of Education. It is increasingly recognised that the effectiveness of teaching is dependent on the physical health of both teacher and taught, and in about half of the States teacher-training institutions are required by law to include physical education in their general curricula. In some of the States all applicants for teaching positions are required by the State boards of education to present credentials in physical education and health education. In West Virginia physical education is given a prominent place in all types of certificates granted by training colleges. The report directs attention to the fact that a successful programme of health education and physical education is not easily organised or measured in terms of clock hours of instruction or semester hours of credit and that nearly all training colleges provide opportunities for additional physical activities other than those prescribed, including 'hikes', week-end excursions and camping expeditions.

Calendar of Geographical Exploration

Nov. 13, 1876.—Doughty's Wanderings in Arabia

Charles M. Doughty started from Muzeyrib on his two years of wandering in Arabia. His "Arabia Deserta" has been described by D. G. Hogarth as the "Georgic of the Desert"; he characterised surely, sensitively and for all time the immemorial tribal life of the steppe and desert. He wandered as the poorest of the poor among the Bedawin tribes and faithfully and in minutest detail recorded their life and that of the oasis towns. He had been fired with ambition to visit Arabia when wandering in 1875 in the country beyond Jordan. Refusing even to pretend to forswear his faith, he openly travelled as a Christian and, though often persecuted, yet achieved his aim and attained the last station on the pilgrim route to Mecca. His unique journey resulted in contributions to geographical knowledge and to literature; it also gained for him a great reputation with Semitic scholars for the copies and drawings of the Nabathaean and Himyaritic scripts which he obtained.

Nov. 14, 1770.—Sources of the Blue Nile

James Bruce reached the source of the Blue Nile. In June 1768 he arrived at Alexandria, thence he visited Thebes and crossed the desert to Kosseir. He sailed to Jidda and after a stay in Arabia re-crossed the Red Sea, landed at Massawa and finally reached Gondar, the capital of Abyssinia. There his medical skill procured him the support of the Queen Mother, a very useful ally during his troubled stay in Abyssinia. On October 28, 1770, he left Gondar and, from the top of a gently rising hill on which was the church of St. Michael of Geesh, viewed the sources of the Blue Nile. On his return to Gondar political difficulties detained him until December 1771, but then he was allowed to return by Sennar to Nubia. In the Nubian Desert, sand storms and thirst so oppressed the party that the notes and observations of his journeys were discarded, though fortunately Bruce later recovered them. He reached Cairo in January 1773. Bruce was disappointed that the source of the Blue Nile was not considered, as he himself considered it to be, the real source of the Nile. Moreover, the source of the Blue Nile had been previously visited by the Jesuits. Thus the importance of his journey was rather that he re-discovered these regions and in so doing attracted the attention of his generation to African exploration. The five volumes in which he gave his experiences remain a vivid picture of travel in these regions and give much information about the geography, history and social customs of Abyssinia.

Nov. 14, 1805.—Finding a Route Across the Rockies

Capts. M. Lewis and W. Clarke reached the mouth of the Columbia River. They had left the Missouri in May 1804, wintered with the Mandan Indians, resumed the journey up the Missouri, crossed the Rockies and reached the Columbia River, where they wintered. In March 1806 the party divided, Lewis going via the Lolo Pass and thence carrying out certain explorations, while Clarke proceeded to the Yellowstone at its nearest approach to the three forks of the Missouri. They met again on the Missouri and reached St. Louis in September, 1806. The outward journey was calculated at 4134 miles, and Lewis's shorter return journey at 3555 miles from the mouth of the Missouri to the Pacific. They had been

commissioned to explore the Missouri from the point of view of the most direct and practicable water communications across the continent to the Pacific for commercial purposes. They achieved this object and also helped to attract traders to the regions west of the Mississipi by their accounts of possibilities of development.

Nov. 14, 1917.—Philby in Arabia

H. St. J. B. Philby arrived in the Gulf of Bahrain on a political mission to Riyadh, in the course of which he crossed the country from Ojair to Jedda, returned to Basra and once more set out to Riyadh. Thence he journeyed south to Wady Dawasir, thus penetrating some distance into the Nejd. In 1920–22, Philby crossed from Amman to Kabala near the Euphrates. With him went Major A. L. Holt, who had already made extensive surveys between Bagdad and Haifa. Philby's greatest Arabian exploit, however, was the crossing of the Rub' al Khali, the great waterless southern desert, in the early months of 1932. Starting from Hufuf on Jan. 7, he succeeded in reaching Sulaiyil, covering 1800 miles in 90 days. Finds of flint implements and freshwater shells indicated the site of an old river-bed or lake at Bir Maqran, and at Wabar craters of meteoritic origin were discovered. The first crossing of this desert, though by a different route, was in 1931, by Mr. Bertram Thomas.

Societies and Academies

London

Royal Society, Nov. 3.—J. Mellanby: Secretin. Secretin may be prepared from the duodenal mucous membrane by (*a*) extraction with absolute alcohol, (*b*) precipitation by dilute acid, and (*c*) resolution of the precipitate in acid alcohol and precipitation by acetone. The product has the percentage composition of a sulphur-containing protein. It is soluble in water but insoluble in dilute acid. The physiological actions of secretin are: (*a*) the production of a copious secretion of pancreatic juice, (*b*) the contraction of intestinal muscle, and (*c*) the secretion of a small quantity of bile.—Margaret Hill and A. S. Parkes: Studies on the hypophysectomised ferret (1, 2, 3). Hypophysectomy of the male during the breeding season (June) caused regression to the anœstrous condition in about a month; the regression being characterised by decrease in testis weight and by aspermatogenesis. The experimentally produced degeneration is about three times as rapid as the normal decline into anœstrus. In the female ferret, removal of the pituitary body about two hours after the beginning of copulation did not inhibit ovulation, which occurs in the normal animal about 36 hours after mating. It would thus appear that some ovulation-producing substance is secreted by the anterior pituitary body within two hours of the beginning of copulation. The corpus luteum, however, failed to develop, and there were no signs of pregnancy or pseudo-pregnancy.—J. D. Gillett and V. B. Wigglesworth: The climbing organ of an insect, *Rhodnius prolixus* (Hemiptera; Reduviidæ). It is present in both sexes of the adult, but is absent in the nymphs. It occurs on the distal end of the tibia of the anterior and middle pairs of legs. It enables the insect to climb upwards on clean glass at almost a right angle, but it is of little use in the reverse direction. The organ is a little oval sac of pliant chitin filled with blood. On its lower surface it bears about 5000 tubular hairs, 1 μ in diameter, which appear to be the outlets of unicellular glands producing an oily secretion. At their free ends the anterior surface of these hairs is cut away obliquely so that only their hind margin comes in contact with the surface as the insect climbs. Among these hairs are about 50 delicate tapering hairs arising from large sockets and projecting slightly beyond the others. These appear to be sense organs. They are surmounted by a spindle-shaped mass of cells giving off a nerve fibre.

Physical Society, Nov. 4.—M. Fahmy: A further point of analogy between the equations of the quantum theory and Maxwell's equations. A previous paper (*Proc. Phys. Soc.*, 43, 124; 1931) dealt with an analogy between the electromagnetic equations in free space and the equations of the quantum theory, exhibited by means of five-dimensional geometry. In the present paper the analogy is pursued further and leads to the Eddington relation between the number of electrons in the universe and its radius.—Lewis F. Richardson: Time-marking a kathode-ray oscillogram. Time-marks have been arranged as little blurs or gaps in the trace, by periodically unfocusing the electron stream. The current in, and voltage across, a conductor can thus be recorded together with the time on a single oscillogram.—T. C. Richards: The elastic constants of rocks with seismic applications. The results of a geophysical survey by means of the seismic method over a large oil-bearing limestone structure in south-west Persia indicate that the limestone possesses a higher elastic velocity at its lower boundary than at its upper. Specimens of the limestone at different depths obtained by 'coring' do not give the same elastic constants when measured by a simple optical method, and the bearing this result has on the practical seismic observation is discussed.—L. R. Wilberforce: A common misapprehension of the theory of induced magnetism. It is usually stated that if any given magnet is immersed in a medium of permeability μ the magnetic field around it is similar to that in a vacuum, but diminished in strength in the ratio of 1 : μ. This statement is inconsistent with the ascertained experimental laws of induced magnetism.

Paris

Academy of Sciences, Oct. 3 (195, 565–588).—Ernest Esclangon: The total eclipse of the sun of August 31, 1932, observed in the United States and in Canada. In spite of some cloud, good spectrographs of the corona were obtained, also some excellent general photographs of the corona.—Lucien Daniel: The experimental production of small bulbs in the leek.—Claude Chevalley and André Weil: An arithmetical theorem on algebraical curves.—Nikola Obrechkoff: A general method of summation of divergent series.—D. Riabouchinski: Some considerations on the hydrodynamical interpretation of the periodicity of sunspots. An account of experiments with a glass globe containing water, rotating on its axis and containing a stirrer rotating in the same direction, but faster than the globe. Some air was admitted to the globe and photographs are reproduced showing the internal movements. The theory of J. Wilsing on the constitution of the sun is discussed from the point of view of these experiments.—Louis de Broglie: Remarks on the magnetic moment and moment of rotation of the electron.—

J. Gilles: The intensities of the components of the hyperfine structure of the most intense lines of the visible spectrum Hg I. The hyperfine structure of the term (Hg 199)7^3D_2.—J. Durand and E. Raguin: The granite of the region of Pinet (Aveyron).—D. Montet: The action of radioactivity in plant physiology. The experimental conditions necessary to prevent confusion between the effects of catalysis and radioactivity are indicated. The use of a salt possessing manurial effects, such as a nitrate, should be avoided.—René Petit: The magnification of correcting glasses.—F. Vles and A. de Coulon: New experiments on the rôle of the electrostatic conditions in the appearance of spontaneous cancers in mice.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 525–565, Aug. 15, 1932).—Lester S. King and Clyde E. Keeler: Absence of corpus callosum, a hereditary brain anomaly of the house mouse. Preliminary report. The character segregates sharply, is probably inherited as a unit character, is not sex-linked and is not due to the presence of the rod-less gene.—T. R. Hogness and R. Ruth Comroe: A search for evidence of the radioactive decomposition of barium. Working on the idea that barium might dissociate into xenon and helium, five rock specimens, all probably of Palæozoic age, were disintegrated and the residual gases examined. No xenon was found spectroscopically. By the method used, 10^{-7} c.c. or about 3×10^{12} atoms of xenon could have been detected. Hence it is calculated that, if barium is radioactive, its half-life period is not less than $10^{15}-10^{18}$ years.—W. H. Rodebush and W. C. Klingelhoefer: The reaction of chlorine with hydrogen. Atomic chlorine has been prepared and its reaction with hydrogen gas investigated at low temperature.—James H. Hibben: An investigation of intermediate compound formation by means of the Raman effect. Evidence was obtained for the formation of compounds in solution between aluminium chloride and ethyl alcohol, and zinc chloride and methyl alcohol, and for polymerisation of aluminium chloride in water.—Sylvia M. Mills: (1) Double innervation of melanophores. When an area on a specimen of *Fundulus heteroclitus* was denervated, a few of the melanophores which expand over a black background fail to contract over white. Response to electrical and mechanical stimulation also suggests double innervation.—(2) Neuro-humoral control of fish melanophores. The melanophores of a denervated region show a progressive lag, greatest at the centre of the region, in their responses to stimulation. Similar results were obtained with an isolated tail. It is suggested in explanation that melanophore nerves, when stimulated, produce a secretion causing melanophore contraction; this secretion is probably not carried in the blood system.—Arthur Bramley: Gamma radiation. A theoretical discussion using an oscillator which accounts for the needle-like character of the radiation field for very high frequencies.—Chester Stock: An Upper Oligocene mammalian fauna from southern California. The fauna of the Sespe beds of Kew Quarry, which occurs to the west of the Simi Valley, Ventura County, California, is more advanced than that from the Sespe beds north of the Simi Valley (NATURE, 130, 675, 1932). Its age is considered to be not later than Lower Miocene or earlier than Upper Oligocene.—A. D. Michal and J. L. Botsford: (1) An extension of the new Einstein geometry. Developments of the paper by Einstein and Mayer on "Unified Field Theory" (1931).—(2) Simultaneous differential invariants of an affine connexion and a general linear connexion.—S. S. Wilks: The standard error of a tetrad in samples from a normal population of independent variables. An exact expression is derived but it is said to lead to very complicated results.

Forthcoming Events

MONDAY, Nov. 14

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. H. Swinnerton: "Fossil Clues and Hereditary Problems".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—"Early Maps of Great Britain". E. Heawood: "The Tschudi Map"; Miss J. B. Mitchell: "The Matthew Paris Maps"; R. A. Pelham: "The Gough Map".

TUESDAY, Nov. 15

CHADWICK PUBLIC LECTURE, at 5.15—(at the Royal United Services Institution, Whitehall).—Sir Pendrill Varrier-Jones: "The Employment of Tuberculous Patients".

BRITISH INSTITUTE OF PHILOSOPHY, at 8.15—(at University College, Gower Street, W.C.1).—Sir Arthur Eddington: "Physics and Philosophy".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. E. J. Garwood: "Kangchinjunga".

BRITISH PSYCHOLOGICAL SOCIETY, at 8.30.—A. H. Seymour: "The Borderland between Education and Industry".

WEDNESDAY, Nov. 16

BRITISH ACADEMY, at 5—(Annual Lecture on a Master-mind).—Prof. James Gibson: "Locke".

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark, I. D. Margary, R. Marshall and C. J. P. Cave, "Report on the Phenological Observations in the British Isles, December 1930 to November 1931".

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.30.—Discussion on "The Law of Priority in Nomenclature," to be opened by Prof. W. A. F. Balfour-Browne.

THURSDAY, Nov. 17

CHEMICAL SOCIETY, at 8.—Discussion on "Combustion of Gases in Electric Discharges", to be opened by Prof. G. Ingle Finch.

BEDFORD COLLEGE FOR WOMEN, at 5.15—(Stevenson Lecture).—Sir Josiah Stamp: "The Relation of Finance to Rationalisation".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Sir Charles Sherrington: "Reflex Action" (succeeding lecture to be announced later).

FRIDAY, Nov. 18

ROYAL INSTITUTION, at 9.—Dr. R. G. Canti: "Cultivation of Living Tissue Cells".

Official Publications Received

GREAT BRITAIN AND IRELAND

Report for 1931 (No. 40) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Annual Report of the Marine Biological Station (No. 45) at Port Erin, Isle of Man. Edited by Prof. James Johnstone and Dr. R. J. Daniel. Pp. 169+7 plates. (Liverpool: University Press of Liverpool.) 6*s*.

Third Annual Reports of the National Radium Trust and Radium Commission, 1931–1932. Pp. 43. (London: H.M. Stationery Office.) 9*d*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1471 (T.3247): A Flight Path Recorder suitable for Performance Testing. By R. P. Alston, D. A. Jones and E. T. Jones. Pp. 8+8 plates. 9*d*. net. No. 1473 (T.3250): Graphical Solutions for Inviscid Flow. By Dr. H. F. Winny. Pp. 16+4 plates. 1*s*. net. No. 1462 (Strut. 68): Method of Testing Strength and Stiffness of Large Wing. By I. J. Gerard. Pp. 5+5 plates. 6*d*. net. No. 1467 (T.3255): Applications to Aeronautics of Ackeret's Theory of Aerofoils moving at Speeds greater than that of Sound. By Prof. G. I. Taylor. Pp. 7+5 plates. 6*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Society for Psychical Research. Vol. 41, Part 127, October. Pp. 61–88. (London: Society for Psychical Research.) 3*s*.

Eton College Natural History Society. Annual Report 1931–32. Pp. 44+5 plates. (Windsor.)

Proceedings of the University of Durham Philosophical Society. Vol. 9, Part 1, June. Pp. iv+46+viii. (Durham.) 5*s*.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 221, B479: A Persian *Sigillaria*. By Dr. A. C. Seward. Pp. 377–390+plates 34–35. (London: Harrison and Sons, Ltd.)

University of London: University College. Calendar, Session 1932–1933. Pp. lxxviii+xii+561. (London: Taylor and Francis.)

Journal of the Royal Microscopical Society. Series 3, Vol. 52, Part 3, September. Pp. xvi+253–342. (London: Royal Microscopical Society.) 10*s*. net.

The North Staffordshire Field Club. Transactions and Annual Report, 1931–32. Vol. 66. Edited by the Rev. E. Deacon. Pp. 203+A51–A74+8 plates. (Stoke-on-Trent.) 7*s*. 6*d*.

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Trials with Pedigree Strains of Herbage Grasses. (Series H, No. 13, Seasons 1926–1931.) Pp. v+121+8+3 plates. (Aberystwyth.) 5*s*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1466 (Ae. Techl. 616: F.M.71): Velocity Distribution in the Neighbourhood of a Corrugated Sheet. By R. Houghton. Pp. 5+4 plates. (London: H.M. Stationery Office.) 6*d*. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 9, September. Abstracts Nos. 1530–1761. Pp. 291–326. (London: H.M. Stationery Office.) 1*s*. net.

National Laboratory for Psychical Research. Bulletin 3: The Identification of the "Walter" Prints. By E. E. Dudley. Pp. 16+3 plates. (London: National Laboratory for Psychical Research.) 2*s*. net.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1931–32. Pp. 43. (London.)

Ministry of Agriculture and Fisheries. Salmon and Freshwater Fisheries: Report for the Year 1931. Pp. 48+2 plates. (London: H.M. Stationery Office.) 1*s*. net.

The Choice of a Career. Pp. 16. (London: National Institute of Industrial Psychology.) 3*d*.

Ordnance Survey. Professional Papers, New Series, No. 14: Paper read at the British Association Meeting of 1932 on The Subsidence of London. Pp. 13+17 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Proceedings of the Geologists' Association. Edited by G. S. Sweeting, Vol. 43, Part 3, 25th October. Pp. 201–276. (London: Edward Stanford, Ltd.) 5*s*.

Census of Nigeria, 1931. Vol. 4: Census of Lagos. By H. N. G. Thompson. Pp. ii+53+3 maps. (London: The Crown Agents for the Colonies.) 6*s*.

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1930–1931. Pp. 377. (London: Ministry of Agriculture and Fisheries.)

Other Countries

Scientific Publications of the Cleveland Museum of Natural History. Vol. 4, No. 1: Descriptions of New Birds from Oregon, chiefly from the Warner Valley Region. By Harry C. Oberholser. Pp. 12. (Cleveland, Ohio.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 99: The Swimmer Manuscript; Cherokee Sacred Formulas and Medicinal Prescriptions. By James Mooney. Revised, completed and edited by Frans M. Albrechts. Pp. xvii+319+13 plates. Bulletin 108: A Dictionary of the Atakapa Language, accompanied by Text Material. By Albert S. Gatschet and John R. Swanton. Pp. v+181+1 plate. Bulletin 109: A Dictionary of the Osage Language. By Francis La Flesche. Pp. v+406. Bulletin 110: Yuman and Yaqui Music. By Frances Densmore. Pp. xviii+216+31 plates. (Washington, D.C.: Government Printing Office.)

Archiv der Deutschen Seewarte. Band 49, Nr.6: Die Niederschlagsverhältnisse des alten deutschen Schutzgebietes Togo. Von Dr. Raoul Pignol. Pp. 62+3 Tafeln. (Hamburg.)

Survey of India. Map Publication and Office Work, 1930 to 1931: from 1st April, 1930, to 31st March, 1931. Pp. vii+22+5 maps. (Calcutta.) 1 rupee; 1*s*. 9*d*.

Transactions of the Mining and Geological Institute of India. Vol. 27, Part 2, September. Pp. 87–153. (Calcutta.) 4 rupees.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 26, 1930, No. 2: Numismatic Supplement for 1930. Pp. 60+5 plates. (Calcutta.) 3.6 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 65: Downy Mildew (Blue Mould) of Tobacco in Australia. By Dr. H. R. Angell and A. V. Hill. Pp. 30+4 plates. Pamphlet No. 31: A Preliminary Report on Investigations on the Buffalo Fly (*Lyperosia exigua* de Meij.) and its Parasites in Java and Northern Australia. By Prof. E. Handschin. Pp. 24. (Melbourne: H. J. Green.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 377–378: Studies on the Constituents of "*Ginkgo Biloba* L." Leaves, Parts 1 and 2. By Shu Furukawa. Pp. 27–42. 15 sen. No. 379: Direct Titration Method on a New Principle. 1: Principle and Procedure. By Shôichirô Saitô. Pp. 43-48. 10 sen. Nos. 380–382: Preliminary Report on Microscopic Cracks upon the Surface of Dielectrics, produced by Gliding Sparks, by Torahiko Terada, Morisô Hirata and Ryûzô Yamamoto; Experimental Studies on Cracks produced by Gliding Spark—Effect of Tension, by Morisô Hirata and Ryûzô Yamamoto; Feeding Experiments with Decomposition Products of Proteins, by Shiro Maedo. Pp. 49–78+13 plates. 45 sen. (Tôkyô: Iwanami Shoten.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 78: An Improved Form of Jack for use in the Load Test of Aeroplanes. By Mineo Yamamoto. Pp. 341–359. 25 sen. No. 79: Studies on the Sounds emitted by Revolving Airscrews, Part 1. By Jûichi Obata, Yahei Yosida and Sakae Morita. Pp. 361–387. 38 sen. No. 82: On the Transmissibility of the Visible Light through a Cloud of Particles, Part 1. By Daizô Nukiyama and Atusi Kobayasi. Pp. 18. 23 sen. No. 83: Hôbutumen no Onkyôgakutekino Seisitu ni tuite, Sono 1 (On the Acoustical Properties of Parabolic Reflectors, Part 1). By Kôzi Satô and Masaaki Sasao. Pp. 19–63. 49 sen. No. 84: Stresses in a Plate with a Flanged Circular Hole. By Katsutada Sezawa and Kei Kubo. Pp. 65–114. 54 sen. (Tôkyô: Koseikai Publishing House.)

New Zealand State Forest Service. Circular No. 33: The Pine-Bark Beetle, *Hylastes ater*, in New Zealand. By Arthur F. Clark. Pp. 20. (Wellington, N.Z.: W. A. G. Skinner.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 79: Über das Kohlensäuresystem im Meerwasser, bericht über die Untersuchung einer Arbeitskommissionen. Pp. 70. 3.25 kr. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol. 20, pour l'année 1930. Pp. 91+12 planches. 4.50 kr. (Copenhague: Andr. Fred. Høst et fils.)

Memoirs of the Peabody Museum of Natural History. Vol. 4, Part 1: Brachiopod Genera of the Suborders Orthoidea and Pentameroidea. By Prof. Charles Schuchert and G. Arthur Cooper. Pp. xii+270 (29 plates). (New Haven, Conn.: Yale University.) 6 dollars.

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 459: Notes on the Orifice Meter—The Expansion Factor for Gases. By Edgar Buckingham. Pp. 61–79. (Washington, D.C.: Government Printing Office.) 5 cents.

University of Washington Publications in Anthropology. Vol. 4, No. 3: Plains Indian Parfleche Designs. By Leslie Spier. Pp. 293–322. (Seattle, Wash.: University of Washington Press.) 35 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 9, No. 3, September, Research Papers Nos. 471–481. Pp. 279–455. (Washington, D.C.: Government Printing Office.) 25 cents.

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning, År 1931. Pp. 43. (Göteborg.)

Consiglio Nazionale delle Ricerche: Comitato Nazionale per la Biologia. Convegni Biologici. 1° Convegno: Biologia marina, Napoli, Dicembre 1931. Pp. 148+4 tavole. (Napoli.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, Dominica, April–December 1931. Pp. iii+16. (Trinidad.) 6*d*.

Malayan Forest Records. No. 11: The Damars of the Malay Peninsula. By T. A. Buckley. Pp. iii+94. (Kuala Lumpur: Forest Department.) 1.50 dollars; 3*s*. 6*d*.

Japanese Journal of Botany. Transactions and Abstracts, Vol. 6, No. 2. Pp. vii+139–305+27–62. (Tokyo: National Research Council of Japan.)

Memoirs of the College of Science, Kyoto Imperial University. Series, A, Vol. 15, No. 4, July. Pp. 203–291. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.80 yen.

Journal of the Faculty of Science, Hokkaido Imperial University. Series 2: Physics. Vol. 1, No. 4, August. Pp. 121–147. (Sapporo.)

Proceedings of the United States National Museum. Vol. 81, Art. 15: A Miocene Mollusk of the Genus Haliotis from the Temblor Range, California. By W. P. Woodring. (No. 2938.) Pp. 4+1 plate. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Technical Bulletin No. 306: Biology and Control of the Corn Leaf Aphid, with Special Reference to the Southwestern States. By V. L. Wildermuth and E. V. Walter. Pp. 22. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 12: A Spectrophotometric Development for Biological and Photochemical Investigations. By F. S. Brackett and E. D. McAlister. (Publication 3176.) Pp. 7+3 plates. (Washington, D.C.: Smithsonian Institution.)

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 68, Abh. 1: Untersuchungen über den Bau normaler und durch calcium- und phosphorarme Nahrung veränderter Rinderknochen. Von Arnold Theiler. Pp. x+154+22 Tafeln. (Zürich: Gebrüder Fretz A.-G.)

Twelfth Annual Report of the Research Council of Alberta, 1931. Report No. 27.) Pp. 53. (Edmonton, Alba.: W. D. McLean.)

U.S. Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 399: Standard Time throughout the World. Pp. 18. (Washington, D.C.: Government Printing Office.) 5 cents.

Agricultural Experimental Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 144: Flies and Mosquitoes commonly found about Michigan Homes. By E. I. McDaniel. Pp. 25. Circular Bulletin No. 146: Three Virus Diseases of the Peach in Michigan. By Donald Cation. Pp. 11. Special Bulletin No. 226: Activities of Churches in Town–Country Communities. By C. R. Hoffer. Pp. 27. Technical Bulletin No. 124: The Various Effects of Frost Protectors on Tomato Plants (A Physiological Study). By R. P. Hibbard. Pp. 36. Technical Bulletin No. 127: On the Control of Caecal Coccidiosis in Chickens. By W. L. Chandler. Pp. 24. (East Lansing, Mich.)

Cornell University: Agricultural Experiment Station. Belletin 534: Relation of Daily Prices to the Marketing of Hogs at Chicago. By Howard J. Stover. Pp. 97. Memoir 140: Carbohydrate and Nitrogen Metabolism in the Celery Plant as related to Premature Seeding. By H. Platenius. Pp. 66. (Ithaca, N.Y.)

Catalogues

Watson's Microscope Record. No. 27, September. Pp. 24. (London: W. Watson and Sons, Ltd.)

Quartz Mercury Lamps: Lumsden Lamps. (Catalogue No. 80.) Pp. 12. (Almondbank, Perth: D. M. Lumsden.)

Sotheran's Price Current of Literature. No. 834: Catalogue of Two Thousand Three Hundred Books, Pamphlets and Autograph Letters on Political Economy and kindred Subjects. Pp. 144. (London: Henry Sotheran, Ltd.)

Geology, Zoology, Conchology, Entomology, Ornithology. Catalogue No. 203.) Pp. 12. (London: Dulau and Co., Ltd.)

The New "Sunic" Dental X-Ray Unit (Mark III). Pp. 24. (London: Watson and Sons (Electro-Medical), Ltd.)