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CONTENTS

Peace and War

RECENT events have suggested that the modern organised State, closely linked as it is with the highly emotional concepts of the new nationalism, might prove a danger in the way of the free pursuit of scientific inquiry, and that it has already affected the international standing of science. It may be argued with equal justice that such a State is also a menace to the present nicely adjusted equilibrium of forces between the Powers which we call by the name of peace. The responsibility for the feeling of instability in the present international situation, of which every nation is conscious, is to be attributed, not so much to the activities of Herr Hitler and President Roosevelt in the political and economic fields—though these may seem to run counter to any progress towards a solution of world-wide problems on a world-wide basis—as to the spirit of aggressive self-expression and integration characteristic of present-day nationalism. This spirit emphasises and glorifies national distinctions, oblivious of the consciousness of a common humanity, to which much is forgiven and in which differences are composed rather than made the cause of offence. By the stress laid on nationality the urge towards the larger unity is repressed.

Many have asked why mankind for ages should have lived under the constant menace of war. War has been sung by the poets and glorified by the historians; and for certain individuals, and perhaps even to whole hordes which have been dignified by the title of races, the career of arms has represented the fullest expression of man's essential nature. Yet it may be questioned whether the adventurous spirit and the joy of battle are commonly the obstacles in the way of peace they are sometimes said to be, especially when the conditions of modern warfare are kept in mind.

If there is one thing that may be affirmed with certainty to-day, it is that a majority of the nations of the world do not desire war. Yet all are watching anxiously for the spark which may light a conflagration destined in all probability utterly to destroy the civilisation of the western world; and beyond disarmament no suggestion is put forward as a remedy. It is, therefore, all the more an urgent necessity, as Lord Raglan points out in his recently published book, "The Science of Peace",* that the underlying forces operative in bringing about wars should be

* The Science of Peace. By Lord Raglan. Pp. x+165. (London: Methuen and Co., Ltd., 1933.) 3*s*. 6*d*. net.

understood. For neither pacifists nor the League of Nations will ensure peace until the factors by which it is endangered have been eliminated, even though the facile argument of despair may reiterate its belief that the situation is brought about inevitably by man's instinctive tendency to pugnacity.

Modern Germany—unfortunately specific reference in this context is inevitable—has glorified and idealised war. Although the Chancellor has expressed his devotion to the cause of peace, and the recently concluded agreement with Poland, which apparently would eliminate the Polish Corridor as a *casus belli* for a period of at least ten years, is an earnest of good intention, nevertheless the youth of Germany is disciplined in the belief that war, rather than peace, is the arena for the fullest exercise of civic virtue, as well as the noblest training ground of the citizen. A war-like and aggressive spirit which fights blindly for its tribe is displayed for emulation as the Aryan's virtue. If by 'Aryan' we are to understand 'Nordic', as presumably we must, it is a strange turn of the wheel that has made a nation, which only a short while ago claimed to have led the world in philosophy, science and certain branches of the arts, now seek to mould itself on the pattern of peoples who were the destroyers and not the founders of civilisations. But neither physical nor cultural anthropology endorses the exclusive ideal of 'Aryanism' as having a basis in historic fact; and a patriotism which pursues its end without regard to considerations of logic or common sense may in the long run be as destructive of the Fatherland as treason. For good or for evil, Germany affirms her belief in the struggle for existence as a conflict among nations, and in survival as determined by the arbitrament of war.

The fighting qualities of the Nordics cannot be quoted in support of any theory of the innate pugnacity of primitive man, for they were barbarians rather than primitive. Dr. W. J. Perry has collected a considerable body of evidence to show that the peoples of the lower culture are essentially peaceable, and Lord Raglan accepts this view, while pointing out that organised aggressive warfare begins at a later stage of social development, in which ritual ceremonial requires a periodical, and often considerable, supply of captives to provide for human sacrifice. There are others, however, who view the primitive state and the evolution of man at a different angle. The life of primitive man, like that of modern man, is many-sided, and each observer is apt to regard it from the point of view of his own special interest.

Sir Arthur Keith, for example, essentially a Darwinian, like Hobbes of 'Leviathan' fame, sees Nature as a state of war. For him the advance from primitive to civilised has been achieved in a struggle for existence by which peoples have been welded into nations—races in process of becoming. Warfare, in fact, he holds, is one of the forms of machinery whereby Nature works in the satisfaction of a biological urge towards the establishment of the more highly specialised type, a position which it must be admitted is not unlike that of Hitler himself. Here indeed the difference between Sir Arthur Keith and Lord Raglan becomes most apparent, for while the latter, viewing the situation as a social anthropologist, arrives at the conclusion that the obstacle in the way of peace and of peaceful mindedness in the peoples of the world to-day is the concept of nationality, Sir Arthur sees in the nation a stage, achieved by struggle, on the way to peace—to be more fully attained by the apotheosis of the nation in a federation such as the British Commonwealth of Nations.

It may seem that Sir Arthur Keith's patriotic enthusiasm for the British Empire has warped his sense of logic; but the fallacy is formal rather than material. If we could look on the hideous slaughter, the cruelty and brutalities of war, which have disfigured the history of mankind, with the same detachment as we view the survival of the fittest among the millions of the lower organisms, would it be possible to say that the results of war have not been beneficial and in the long run have conduced to the advancement of mankind—as, for example, in the conquests of Alexander and Julius Caesar? To deny it would be to affirm that the peoples then drawn into the main stream of history would have developed along lines equally or more conducive to progress without the intervention of conquest—a contention incapable of proof, however high may seem the degree of its probability. On the other hand, to admit the validity of the argument is not to deny the advantage, indeed, we may even say the necessity, of peace for the future. War has become an anachronism, in which the wastage of life and material are more than the belligerents, and often in these days of universal reactions, more than the world at large, is able to endure.

The predominant characteristic in modern

civilisation is its constant advance towards a more complete scientific understanding of conditions in all departments of human life. It would be an ironical commentary on man's ability to control the material conditions of existence if he were unable to understand and guide forces within himself which threaten him with destruction.

The one essential factor is not so much the elimination of the causes which have led, and may still lead, to war, though naturally this has its importance, as the creation of a peace which is a habit of mind among peoples and not as it now is, a state of unstable equilibrium, maintained by the sanction of force, in which the nations are on the alert for the outbreak of war.

How this habit of mind is to be attained is a problem which should not be beyond the possibility of solution. Obviously that solution does not lie in disarmament alone. Disarmament, however attractive in theory, may become a forcing house for jealousies, rivalry and suspicion. Nor does experience endorse the claim of the League of Nations. If we may rely upon the evidence of man's social development in the past, it would seem that we must look rather to a general and widely-distributed consciousness of group-solidarity; but it must not be the narrow group-consciousness of 'nationalism'. The *Pax Romana* is an obvious analogy. The *Pax Romana* endured in the consciousness of a common citizenship which embraced all but the outer fringes of the then known world. The studies of the social anthropologist tell us of the homogeneity which rules within the primitive social group. He shows us how its extension may be followed in the development of the social organism by aggregation as family group merges into tribe, tribe into people and people into nation. Within these groups and between their members, as a normal condition, there is peace. Broadly speaking, and in general terms, this has been the rule in the modern State. Only on rare occasions has social unrest produced disturbance sufficiently serious to amount to war.

It is obvious that the larger the proportion of the world's peoples to be brought within the political unit, the greater the possibilities of a permanent peace. By 1914 the nation, in the traditional form in which it had existed in the previous hundred years, had outgrown its utility in relation to the needs of international politics, commerce and finance. It was this which, by restricting Germany's power of expansion, was in part responsible for the War of 1914–18; and now, after that War, the problem of peace is even more closely bound up with the necessity for developing some new and more elastic form of political aggregation. We are, as it would appear, moving towards new political forms; but whether in the present temper of the nations they will conduce to peace or lead to a war more catastrophic than the last, seems to be left to blind chance. Russia and Italy have each applied a new spirit within old political boundaries, while America, southward of the Canadian line, stands aloof behind the possibilities of a revitalised Monroe Doctrine. France in its colonial policy of citizenship for its subject races, and Great Britain in the Statute of Westminster and the inauguration of Dominion status have each made their contribution to the future development of the political organism. The crux of the situation is Germany. Will the historian of the future write down the 'tribalism', which would substitute tribal for State boundaries within the Reich and proposes to overleap political frontiers, as a mere reactionary archaism or as a stage towards the formation of a great pan-Teutonic union of the peoples of Central and Northern Europe on 'racial' lines, towards which the approach to Austria marks an attempt to take the first step?

Goodyer's Dioscorides

The Greek Herbal of Dioscorides. Illustrated by a Byzantine A.D. 512, Englished by John Goodyer A.D. 1655, Edited and first printed A.D. 1933 by Dr. Robert T. Gunther. Pp. x+701. (Oxford: Dr. Robert T. Gunther, 5 Folly Bridge, 1934.) n.p.

IN 1909 the late Canon Vaughan of Winchester, having seen the collection of books on botany bequeathed to Magdalen College, Oxford, by Mr. John Goodyer (1592–1664), described Goodyer as "a forgotten botanist of the seventeenth century". The Canon was Rector of Droxford: we know that many of the plants the descriptions of which by Goodyer were printed by Dr. Thomas Johnson in 1633 in his revised version of the rather unsatisfactory "Herbal" which Mr. John Gerard (1525–1612) published in 1597, were grown in Goodyer's garden at Droxford. But as one of these plants was the "edible Sunflower", the first tuber of which Goodyer had planted by March 25, 1617, and as Goodyer was able to report on October 17, 1621, that he had already "stocked Hampshire" with "this wonderfull increasinge plant", we know that,

whatever may have been the case with botanists, the memory of Goodyer has survived among gardeners interested in the history of their craft. In his introduction to the revision of Gerard's "Herbal", Johnson informed his readers that Goodyer was the friend who had rendered him most assistance in that undertaking, and declared that his friend was "a man second to none in his industrie and searching of plants, nor in his judgment or knowledge of them". The trifling amount of editorial modification bestowed on some of the descriptions with which Goodyer supplied him, suggests that Johnson was as much struck by the judgment his friend showed in recording his observations as by the knowledge these observations had yielded.

In the "Sketch of the Progress of Botany in England" published in 1790, Dr. R. Pulteney (1730–1801), on the authority of Johnson, who died in 1644 of wounds received during the defence of Basing, and of Mr. John Parkinson, who died soon after the publication of his "Theatrum" in 1640, regarded Goodyer as entitled "to the most reputable rank among those who have advanced the botanical knowledge of this kingdom"; and added, on the evidence of a "curious communication" which had struck himself, that Goodyer must be inferred "not only to have been what may be called a *practical* botanist, but learned and critically versed in the history of the science".

In 1919 Dr. R. T. Gunther, as librarian of Magdalen, began an exhaustive study of the books and papers which reached the College in 1665, and in 1922 placed his results at the service of botanists in the charming volume entitled "Early British Botanists". From its pages we learn that by 1616, Goodyer had already begun the formation of a botanical library; that he may have been in personal touch with Johnson in November, 1618; that during the period of June–October 1621, he wrote some ninety descriptions of plants for his friend, and during the next ten years he prepared some thirty more; that Johnson and Goodyer were in London together in November, 1631; and that the one hundred and twenty descriptions he had drawn up for Johnson were sent to his friend in three instalments on March 5, March 12 and March 19, 1632. These facts may explain the origin of the misleading tradition that Johnson revised Gerard's "Herbal" in the short period of twelve months.

Among the volumes Goodyer had already acquired in 1621 appears to have been his copy of the Aldine "Theophrastus" of 1497. By way of relaxation after the spell of descriptive drudgery during the summer and autumn of 1621, he devoted the winter of that year as well as the winter of the following year to the translation, first of "De Plantis", and then of "De Causis Plantarum". Goodyer's English version of "De Plantis" was the only one known to exist until the publication in 1919 of that by Sir Arthur Hort: so far as is known, the manuscript translation in the library of Magdalen College prepared by Goodyer in 1622–23 is still the only English version of "De Causis Plantarum".

Thirty years later, Goodyer began at 10 a.m. on April 29, 1652, to prepare an English version of Dioscorides. This task was completed in the forenoon of August 29, 1655, and at 2 p.m. on that day he began to transcribe the Greek text corresponding with the English translation. This supplementary task was completed on March 17 following and, three days later, at 11 a.m. on March 20, he began a translation of the "Scholia" on Dioscorides which A. Saracen dedicated to Henri IV and published at Lyons in 1598. In the preparation of the English version of Dioscorides, Goodyer had the assistance, apparently subsidised, of another scholar, possibly his friend and neighbour, the Rev. John Heath. That this arrangement subsisted in connexion with the "Scholia" seems clear; that, in this case, the assistant was Heath is almost certain, for the translation of the "Scholia" ended abruptly on October 2, 1656, to be followed by an entry intimating that the Rev. John Heath had died on November 25, 1656. The facts adduced by Dr. Gunther, if they do nothing else, at least show how fully warranted was the inference drawn by Dr. Pulteney in 1790.

In his "Dioscorides: illustrated by a Byzantine: Englished by John Goodyer" Dr. Gunther has now (1934) further safeguarded the "pious memory" of a remarkable Englishman and supplied botanists with a gift that, through no fault of Goodyer, has been withheld for two and a half centuries from those Goodyer wished to benefit. The illustrations bear no direct relationship to Goodyer's version of the text. They reproduce the drawings in the Codex of Dioscorides prepared in A.D. 512 for the Lady Juliana Anicia, daughter of Olybrius, the head of the Anician house who was Emperor of the West for a few months in A.D. 472. Some figures may, it is thought, be copies of plant-portraits approved by Crateuas, a century and a half before Dioscorides became an army surgeon in Nero's

reign: some, it is clear, can only be drawings of plants which herbalists contemporary with the lady for whom they worked thought might be those Dioscorides had in mind. In quality they vary from portraits that would do credit to a Renaissance herbal, to caricatures that the editors of the "Hortus Sanitatis" might have rejected.

As Dr. Gunther showed in 1922, Goodyer in his later years took to prescribing for sick domestics and neighbours: it is possible that this new interest may have led him to consult the herbal of Dr. William Turner (1515–1568) and to note Turner's remark regarding an item "whiche a lytle before I have taken out of Dioscorides and translated unto you". In any event, Goodyer in 1652 followed the example of the Dean of Wells and began to translate Dioscorides.

The fact that Goodyer translated Theophrastus when he was thirty-two and did not begin to translate Dioscorides until he was sixty-one, is not the only reason we have for thinking that Goodyer was not, at heart, a herbalist. A popular work published at Oxford in 1659 shows that the herbalist relied on phytology: "the Art of knowing and finding out the Temperature, Vertue and Use of Plants, as serving to the Curation and Sustentation of the Body": empirical acquaintance with the qualities of plants determined his efforts at classification and guided his attempts at identification. But in Central Europe the portraits of plants in herbals were gradually becoming more reliable, and in Southern Europe the discriptions of plants were becoming more methodical. As a result it was being realised that it was easier to identify plants by their characters than by their qualities, and though classification by qualities still remained in vogue it was safer to identify plants first and study their qualities after their identity had been determined: Botany, "the Science of knowing and naming Plants" was recognised as a safer guide than "the Art of Phytology".

That Goodyer was a master of method his plant-descriptions show, though he did not, like the Rev. John Ray (1628–1705), employ method as an aid to classification. Nor can we venture to say of Goodyer as the Rev. Gilbert White (1720–1793) said in 1771, that "our countryman, the excellent Mr. Ray, is the only describer that conveys some precise idea in every term or word". But we can say of Goodyer what Dr. Gunther's eminent father said, a century after Mr. White, of "a forgotten zoologist of the eighteenth century", that he was "one who recorded, in absolute truthfulness, the results of his own observation and nothing more or else". This trait is as marked in Goodyer's English version of Dioscorides as in his descriptions of plants: he did not, like the Dean of Wells, interpolate his own remarks in the matter translated from Dioscorides, nor did he substitute a synonym for a "caption" selected by Dioscorides himself. For this reason botanists may regret less than scholars must, the fact that Dr. Gunther has not been able to include in his pleasing volume the Greek text of Dioscorides transcribed by Goodyer in 1655 after his English version was finished. That text, which should correspond with the English version, was the result, as Dr. Gunther explained in 1922, of a study of eighteen texts of Dioscorides. Botanists and scholars alike would have been glad of an opportunity to compare the recension made in 1830 by a scholar so eminent as Sprengel with the one effected in 1655 by so competent a botanist as Goodyer. For if Rousseau "had reason" when he said that Theophrastus was the one *real* botanist the ancient world produced—other classical authorities on plants being only phytologists—we with equal reason are entitled to say that Goodyer was the first *real* English botanist.

Dr. Gunther can feel assured that botanists are deeply indebted to him for the services he has already rendered them, but he must be prepared to find that they resemble Oliver Twist and that they will appeal to him to favour them one day with Goodyer's English version of "De Causis Plantarum", while scholars will join with them in begging him to give them, if possible, at the same time Goodyer's recension of the Greek text.

Light and Health

The Physiological Effects of Radiant Energy. By Prof. Henry Laurens. (American Chemical Society Monograph Series, No. 62.) Pp. 610. (New York: The Chemical Catalog Co., Inc., 1933.) 6 dollars.

THE recent widespread interest in the therapeutic effects of ultra-violet radiation has led to the publication of so many original papers, that it is difficult to form any clear picture of the data as yet ascertained. Hence a summary of this type is welcome, and will give many research workers yet another reason for gratitude to the American Chemical Society for the series of monographs of which this is the sixty-second.

The book is confined almost entirely to radiations of medium wave-length, from ultra-violet to infra-red, and thus omits the important but very different effects of X-rays, and those of the relatively long-wave electromagnetic radiations of which the biological application has only begun in the last few years. However, the field covered is quite wide enough for one volume. A chapter on the physics and measurement of the radiation concerned is followed by chapters on the effects on the skin, on wounds, on the eye, and on the circulatory system. The effects of radiation on metabolism are given 224 pages of discussion, which include a detailed account of the work leading to the preparation and isolation of vitamin D. Later chapters include an account of the striking phenomena of photodynamic sensitisation, and of a study of the results of heliotherapy in tuberculosis. The book ends with a useful bibliography of about 900 references.

The reader is left with a feeling of disappointment that in spite of so much study, so few conclusions can be drawn with any certainty. As the author says in an admirable preface, "Many readers will be annoyed at the inconclusiveness of some of the statements". This is so true that one wishes that the author had added to each section a summary showing what conclusions could be drawn with safety from the rather confusing mass of data presented to the reader. Such summaries, if made with the sound judgment shown in the preface and introduction, would have added much to the value of the book.

Much of the uncertainty is due to the exceptional difficulties met by research workers in this subject. Physicists, who are accustomed to have some control of the major variables concerned in their experiments, might well be appalled at the difficulties met with in studying such a problem as 'the therapeutic effects of ultra-violet light'. In this work, almost the only major variables that can be controlled accurately are the time of exposure to radiation and the sex of the persons receiving it. A host of other variables escape control to a greater or less extent, such as the source of radiation, the degree of disease in different patients, the blood supply to the skin, the diet, and even the regularity of attendance at the clinic. All these may form serious sources of error, and it is because of such difficulties that the author can sadly remark, "The real mode of action of radiant energy and its component parts is still unknown".

Modern Research in Astronomy

The Universe Around Us. By Sir James Jeans. Third edition, revised and enlarged. Pp. x + 380 + 30 plates. (Cambridge : At the University Press, 1933.) 12*s.* 6*d.* net.

THE three years which have elapsed since the publication of the second edition of this book have been fruitful in discovery in both physics and astronomy. To the two fundamental units of which matter was believed to be composed, the proton and the electron, have been added the neutron and the positron. The exclusion principle has assumed great prominence and many investigations have been concerned with the properties and nature of the highly penetrating or cosmic radiation. Much attention has been given to the theory of the expansion of the universe and to the question whether the observed rate of expansion, indicating a relatively short time-scale for the age of the universe, can be reconciled with the much longer time-scale which many lines of evidence point to for the evolution of the stars ; or whether, on the other hand, previous conceptions must be abandoned and the short time-scale adopted for the stars also.

These new problems are all dealt with in the third edition of Sir James Jeans's well-known book, which has been at the same time thoroughly revised. The arguments for and against both the short and long time-scales of stellar evolution are discussed in some detail. Sir James favours the long time-scale ; this time-scale can be harmonised with the observed data as to the velocities of recession of the spiral nebulæ if, as de Sitter has shown, the universe is supposed to be either in a state of pulsation or to have undergone in the past a single contraction from an expanded state, followed by the expansion which is now in progress.

The new material makes the present edition substantially longer than the previous editions. The book retains its place as the best account available, in simple language, of the results of modern astronomical research and of their interpretation. The book is so free from mis-statements that attention must be directed to the statement on p. 277, repeated again on p. 290, that Nova Aquilæ when at its brightest had an effective temperature of 65,000°. It was only in the later stages of its outburst, long after maximum brightness had passed, that Nova Aquilæ or any nova attained temperatures of this magnitude.

Short Reviews

All about Fish and other Denizens of the Seas and Rivers. By W. S. Berridge. Pp. 254+63 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1933.) 7*s.* 6*d.* net.

MR. BERRIDGE fills his pages with a large amount of interesting information concerning marine animals. There are chapters on fish in general, fish that make nests, the food of fish, luminous fish, electric fish, goldfish, and many other animals including invertebrates such as oysters and cockles, lobsters and shrimps, corals and sponges. The book is amusing and the original photographs are good, sometimes very good, but it is a pity that they do not match the text, for when reading about a basking-shark or a sea-serpent we find pictures of goldfish, and a remora illustrates the remarks on oysters.

Much that is instructive is included in the accounts of the habits and peculiarities of marine animals, some of world-wide distribution. However, there are a few statements which might be altered to advantage. For example, one would certainly infer from the author's notes that *Noctiluca* is rare off British coasts when in reality it is common but erratic in its appearances, and although it is extremely important as a light-giving organism, there are many other minute members of the plankton which may cause phosphorescence, or luminescence, in the sea. Again, the British squid may breed in almost any month of the year and not in May and June only, and the pea-crab, which is stated to be fairly common off the Irish coast, may be found in mussels on almost any suitable bed.

Mimicry. By Prof. G. D. Hale Carpenter. With a Section on its Genetic Aspect by E. B. Ford. (Methuen's Monographs on Biological Subjects.) Pp. ix+134. (London: Methuen and Co., Ltd., 1933.) 3*s.* 6*d.* net.

THIS little book is intended to present the theory of mimicry as developed by natural selection. All those who accept the theory and delight in finding new proofs for it will welcome the book, since the author has produced a clear and concise summary of the main facts and arguments in its favour. On the other hand, the treatment accorded to criticisms of the theory is very inadequate, and some of the most serious objections to it are dismissed in a few words; while the opinions of some well-known critics of the theory cannot be found in the text, and their works do not appear in the list of references. The latter is very complete with regard to some authors but it is surprising not to see in it any works except in English. This may create an impression that the mimicry theory has no followers and supporters outside Great Britain. Actually, this is not so, and it would strengthen the case of mimicry if at least the outstanding Continental and American contributions to it were quoted.

Causality: a Law of Nature or a Maxim of the Naturalist? Lecture delivered at the Royal York Hotel, Toronto, on May 14th, 1932, much enlarged. By Dr. Ludwik Silberstein. Pp. viii+159. (London: Macmillan and Co., Ltd., 1933.) 4*s.* 6*d.* net.

As a forceful defence of the principle of determinism in Nature, as against the current interpretations of the new physical theories, this book needs careful thought. The author believes that the menace to determinism is rather premature and marks only a provisional stage in the re-shaping of the foundations of physical science. A correct interpretation of the principle of causality would show that Nature is not necessarily left to chance. This interpretation consists in considering the principle of causality as a maxim of the naturalist rather than a law of Nature. In this heuristic capacity, the principle is used to supplement, with other fragments of Nature, every incomplete system encountered, until it is amplified to a complete, undisturbed whole. T. G.

Geschlechtsgebundene und geschlechtskontrollierte Verebung. By Björn Föyn. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Band 1, Lief. 17.) Pp. iv+122. (Berlin: Gebrüder Borntraeger, 1932.) 25.20 gold marks.

THIS is a summary of recent knowledge of sex-linked and sex-controlled, or sex-limited, inheritance, including the recent genetical and cytological studies of sex-linked inheritance in *Abraxas*, *Drosophila*, *Sciara* and *Phytodecta* among insects; *Lebistes* and *Aplocheilus* among fishes; and *Melandrium* among plants. Each case is carefully elucidated, with a free use of illustrations. Many other animals are considered in the special part, and there is a brief statement concerning the sex-chromosomes and sex-linked inheritance in man. A bibliography of twenty pages completes a very useful summary of this field of heredity.

The Aquarium. By E. G. Boulenger. Pp. 71. (London: *Poultry World*, Ltd., 1933.) 1*s.* 6*d.* net.

THOSE who wish to keep a fresh-water aquarium would do well to provide themselves with this little book, which contains a large amount of useful information. First comes the making of the aquarium and the plants which are most suitable for it; following this there are chapters on goldfish, cold-water fish and tropical fish, with notes on the habits, food and proper treatment of each species. These notes are interesting and amusing, and one can learn much from such a short survey. The illustrations, figuring most of the best-known aquarium fish, are by Mr. L. R. Brightwell, who always imparts an individuality to every creature he draws.

The Indian Earthquake (1934) Area

By DR. J. DE GRAAFF HUNTER, C.I.E.

MUCH attention has been recently focused on Bihar and Orissa Province as a result of the disastrous earthquake of January 15, and some facts about the condition of the earth's crust in that region have an enhanced interest. It is, of course, no consolation to those who have suffered by the earthquake to be told that there were good reasons for it. These reasons have been in existence for a long time and yet, so far as I am aware, no earthquake of any magnitude has occurred there during the previous century.

The area roughly bounded on the north by the Himalayan foothills, on the south by the Ganges River and stretching from Meerut to beyond Darjeeling, between longitudes 78° and 89° is one of excessive underloading in the earth's crust (Fig. 1). The average underloading of this area of about 100,000 square miles is on the average equivalent to a thickness of rock of more than 3,000 ft.; or, put otherwise, the deficiency of pressure in the crust is above 200 tons per square foot. This underloading arises from abnormally low densities in the crust. It is in part accounted for by the low density of the alluvium of the Ganges valley; but unless this alluvium extends to a greater depth than most geologists would believe, the explanation is not wholly there.

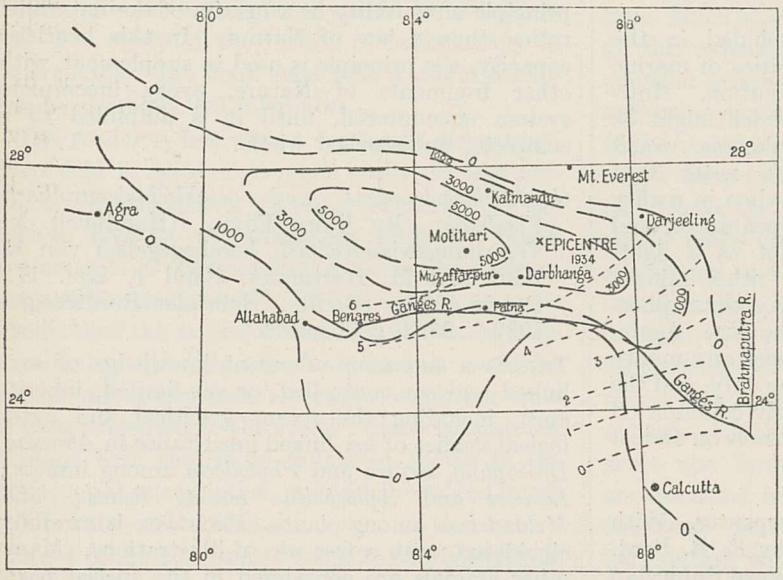


FIG. 1. Sketch map showing main region of underload in Bengal, Bihar, etc. and secular changes of level in Bengal.
——— ——— ———, contours of underload in feet of equivalent thickness of rock, density 2·67.
– – – – – – –, generalised contours of secular change of crustal level in feet per century.

The presence of this region of underloading is revealed by measurements of the shape of the earth which have been accumulated during the past century by the Survey of India. The area of underload is flanked both on the north and on the south by regions of overload; and the total overloading of the two outer regions is roughly equal to the underloading of the Ganges valley. Both the underload and overloads are reckoned from a state of isostatic compensation; so the northerly area of overload is not to be thought of as the weight of the Himalaya but something much smaller, as a considerable degree of compensation of the Himalaya is existent.

These regions of great loading anomaly must cause very great stress-differences in the earth's crust which supports them. The region of underload and the amount of underloading are very much of the order which has been estimated by Dr. H. Jeffreys to be sufficient to cause fracture in the lithosphere. Now these stresses have no doubt been in existence for a long time. In so far as the land level has been rising from sedimentation, known to have been in progress, some measure of relief has been afforded; but this has not been more than a small palliative. Meanwhile, evidence of another kind has recently come to light—again from the measurements of the Survey of India.

In 1858, spirit-levelling operations on a comprehensive scale were begun in India by General Walker. In 1862 work was carried out in Bengal, and since then measurements of this kind have accumulated. This accumulation gave rise to some embarrassment a few years ago, in that the newer lines of levelling gave results at variance with those of the older lines. After the whole system of lines had been carefully scrutinised, it was found that the apparent discrepancies would all be accounted for on the hypothesis that the land level had been rising so much each year, the rate of rise varying from place to place in a nearly uniform manner. Thus along a line passing a little north of Benares and directed towards east-north-east an annual increase of elevation of 0·06 ft. was found; and other lines, approximately evenly spaced and roughly parallel to the first, showed rates of increase of 0·05, 0·04, 0·03, 0·02, 0·01, 0·00, the last being some fifty miles from Calcutta.

It will be seen that this rising of the land is occurring in the south-east quadrant of this area of excessive underloading in the earth's crust. It is not necessarily confined to that quadrant. Evidence of change of level from spirit levelling results elsewhere has not yet been so carefully analysed, being not sufficiently complete. None

the less, revision levelling in the present century shows a persistent rise from Dhulia (lat. 20·9°, long. 74·7°) to Cawnpore (which also shows a small rise from Benares); and this, so far as it goes, confirms the Bengal results, which in turn are closely in sympathy with the underloading of which they are a natural consequence.

Before the earthquake occurred, the relevant facts accordingly were (*a*) that there was a large area of serious underloading, flanked by areas of overloading; (*b*) that in the part of this region where spirit levelled heights had been determined in sufficient detail at sufficient time intervals, the results indicated that the land has been rising steadily where the underload occurs, the rate of rise increasing as the centre of that region is approached.

A slow but continuous yielding of the crust has been in progress. When a material is stressed beyond its elastic limit, it yields in a non-elastic way and eventually fractures. In the present case, the earthquake gives evidence of fracture having occurred; and the floods which have followed the earthquake indicate the resulting rising of some portions of the area.

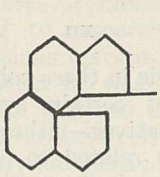
In the case of such a large area, fracture is not likely to extend throughout the entire region of stress, but it occurs at the position where the relation of stress to strength is most severe, and leads to a modification of the general stress distribution. There is no question of one earthquake of the magnitude of that which has recently occurred entirely relieving the stress differences. To do that an uplift amounting to thousands of feet would be necessary. I have little doubt that spirit levelling will show that there has been some sudden rising of the land. Were this of the order of tens of feet, it would immediately be made apparent by a wholesale change in the courses of the local rivers; and indeed, a recent report in the Press states that one of the most impressive features of the disaster has been such changes in river courses.

As stated earlier, the area from Meerut to Darjeeling is one of excessive underloading. A smaller amount of underload exists over a much larger area—a strip skirting the Himalaya from the Punjab to Bengal of width varying from 150 miles to twice that amount. We have so far discussed the eastern portion which provides the area of most acute underloading; but there is another region, roughly centred on Lahore (31·6°, 74·3°) where underloading of very considerable amount—about 2,000 ft. of rock-equivalent—exists. This region is not completely defined, as in the north-west it passes out of the area for which the necessary geodetic observations have been made. It is just in this neighbourhood that the last serious Indian earthquake—Kangra (32°, 77°)—occurred in 1905. Eight years previously, in 1897, there was the Shillong earthquake, with epicentre at 26°, 91°. Unfortunately, this is outside the area of full geodetic survey, and spirit levelling was not commenced in that region until 1900, so as yet we have no knowledge of what anomalies of loading exist there or of the secular changes of ground height.

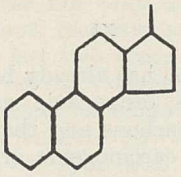
Recent Developments of Sterol Chemistry in Relation to Biological Problems

By JOHN PRYDE

ONCE again there has been demonstrated in striking fashion the impetus which organic chemistry gains from biology, and how a field of organic research, formerly of purely academic interest, enters on a fresh phase of development in virtue of a new correlation with biological problems. The field in question is that of the sterols and the polycyclic aromatic hydrocarbons.

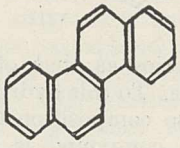


I

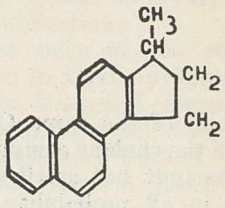


II

It is well known that the fundamental researches of Wieland, Windaus, Mauthner, Borsche, Diels and others on the sterols and bile acids received a new interest on the isolation of calciferol (vitamin D) from the products of irradiation of ergosterol, $C_{28}H_{44}O$, with which the vitamin is isomeric, and that our conceptions of the structure of these, and of other members of the cholane series to which they belong, have been re-oriented by the new formulæ advanced by Rosenheim and King[1]. The structures below show the old (I) and the now accepted representation (II) of the cholane nucleus. The new, and at the time somewhat revolutionary, formulæ conferred a great stimulus on the investi-



III



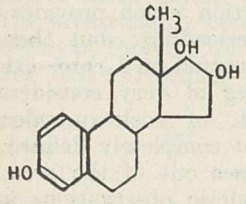
IV

gation of the whole series of compounds. They are based upon evidence which cannot be detailed here, but some of the more salient of the recent observations can be summarised.

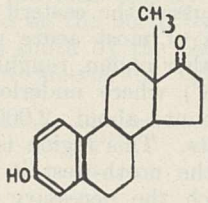
Thus, on drastic dehydrogenation with palladium-charcoal or zinc, cholesterol and cholic acid yield the fully aromatic hydrocarbon chrysene (III)[2], whilst less drastic dehydrogenation of these

compounds and of ergosterol using selenium yields an interesting hydrocarbon of the composition $C_{18}H_{16}$, first obtained by Diels and his associates[3]. For this latter the constitution IV was suggested by Rosenheim and King[4]. Kon[5] has very recently proved the correctness of this suggestion by a synthesis yielding the desired 3-methyl*cyclo*pentenophenanthrene. It is therefore clear that the formation of chrysene in the more drastic process is due to ring enlargement associated with the migration of a methyl group, and the revised cholane formula of Rosenheim and King becomes firmly established upon fact.

Secondly, the recent isolation and investigation

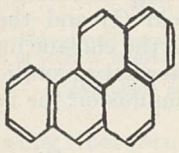


V

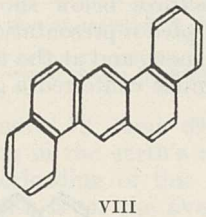


VI

of the female sex (œstrous-producing) hormone, mainly due to the efforts of Doisy in the United States, Marrian in Great Britain, and Butenandt in Germany, show that the hormone occurs in two forms—œstriol (V) and œstrone (VI), to adopt the nomenclature recently advanced in NATURE by workers in this field[6]. Evidence is available which amply establishes the close relationship of the œstrane and cholane series, which may be inferred from the isolation of the same 1 : 2-dimethylphenanthrene from œstriol and from ætiobilianic acid of the cholane series[7]. Mention may also be made of the isolation from œstrone, after dehydrogenation in the presence of zinc, of a hydro-



VII

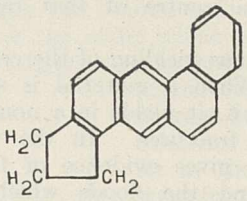


VIII

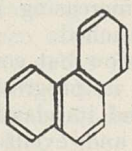
carbon of the same C_{18} series as that obtained from the cholane compounds. To this hydrocarbon Butenandt has ascribed the composition $C_{18}H_{14}$, but in all probability the compound is impure chrysene $C_{18}H_{12}$.

Thirdly, it has been known for many years that the tars and pitches resulting from the pyrogenic decomposition of coal and other organic products frequently possess carcinogenic properties. Much patient work in Great Britain, with which the names of Kennaway and Cook and their collaborators are associated, has culminated in the isolation[8] from a soft coal-tar pitch of a pure actively carcinogenic hydrocarbon, namely, 1 : 2-benzpyrene (VII). This, together with certain other but somewhat less active carcinogenic hydrocarbons [for example, 1 : 2 : 5 : 6-dibenzanthracene (VIII) and 5 : 6-*cyclo*penteno-1 : 2-benzanthracene (IX)][9] has been synthesised and the peculiar biological properties of these compounds have been amply proved.

It will therefore be realised that calciferol, œstrous-producing hormones, and carcinogenic hydrocarbons, all correlated with some phase of growth, all have the phenanthrene nucleus (X) in common. Lastly, the group of the cardiac-stimulating glucosides—strophanthin, digitoxin—yields aglucones in which the phenanthrene nucleus again



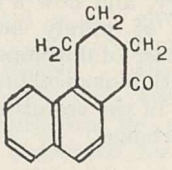
IX



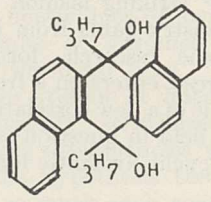
X

occurs[10]. It may also be significant that some of the most powerful alkaloids, such as morphine, codeine, etc., of the opium group, the corydalis alkaloids and colchicine (meadow saffron) contain a phenanthrene nucleus. To this nucleus are added various cyclic and straight-chain substituents which confer on each group its characteristic biological activity.

That these groups of compounds, of such apparently diversified physiological activities, should exhibit such fundamental constitutional similarities is sufficiently striking, but the story does not end here and indeed it would be bold to attempt to predict where it will end.



XI



XII

Mention has already been made in these columns[11] of the œstrogenic action of certain synthetic hydrocarbons and their derivatives—either themselves carcinogenic or closely related to carcinogenic compounds—and of the similar activity of some of the sterols and calciferol. Amongst the former are 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene (XI) and 1 : 2 : 5 : 6-dibenz-9 : 10-di-*n*-propylanthraquinol (XII). In reference to the activity of the latter compound, it is of interest to note that a series of diols derived from 1 : 2 : 5 : 6-dibenzanthracene was investigated[12]. Of these the dimethyl, di-*n*-amyl, and di-*n*-hexyl compounds are inactive, whilst the intermediate diethyl,

di-*n*-propyl and di-*n*-butyl compounds are all highly active, the propyl derivative showing the maximum activity. The compounds mentioned above are the most active of those so far investigated; then follow in order of activity neoergosterol, 5 : 6-cyclopenteno-1 : 2-benzanthracene, 1 : 2-benzpyrene, calciferol and ergosterol. That behaviour characteristic of a specific hormone should be shared by other compounds of related structure, some possessed of physiological activities of their own, provides a remarkable extension of our conceptions of biological specificity. It suggests future developments of great interest in the chemistry and biology of the sterols and the polycyclic hydrocarbons.

[1] *J. Soc. Chem. Ind.*, **51**, 464, 954; 1932.
[2] Diels and Gädke, *Ber.*, **60**, (B), 140; 1927.
[3] *Annalen*, **459**, 1, 1927; **478**, 129; 1930.
[4] *J. Soc. Chem. Ind.*, **52**, 299; 1933.
[5] *ibid.*, 950.
[6] NATURE, **132**, 205, Aug. 5, 1933.
[7] Butenandt, *J. Soc. Chem. Ind.*, **52**, 268, 287; 1933.
[8] Cook, Hewett and Hieger, *J. Chem. Soc.*, 395; 1933.
[9] *Proc. Roy. Soc.*, B, **111**, 455, 485; 1932.
[10] Jacobs and Fleck, *J. Biol. Chem.*, **97**, 57; 1932.
[11] NATURE, **132**, 1933.
[12] Discussed at a meeting of the Royal Society on Nov. 16, 1933.

Obituary

PROF. ERWIN BAUR

BY the sudden death of Prof. Erwin Baur at the early age of fifty-eight years the science of genetics, and particularly plant breeding, has lost one of its foremost exponents. Having gone to Berlin to give an address at Harnack House on December 2 in commemoration of Correns, whose death was recorded only a year ago, he was suddenly struck down with angina pectoris and died within a few hours.

Baur was born in 1875 at Ichenheim in Baden, the son of an apothecary. He studied medicine in several German universities and was for one year assistant in the Botanical Institute at Kiel, receiving the degree of doctor of medicine in 1900. He served as ship's doctor on a voyage to Brazil, followed by a year of service in the navy. He was afterwards assistant physician in the psychiatric clinic of the University of Keil and physician to an institute in Baden for the insane. In 1903 he returned to botany and received the Ph.D. at Freiburg under Oltmanns, his thesis being on the development of the apothecia in lichens. Apparently his first botanical paper was on the sex organs of the lichen *Collema* (*Ber. deut. bot. Gesells.*, 16, 1899), the figures from which have frequently been reproduced in textbooks. Baur now migrated to Berlin as assistant in botany, where he became full professor and director of the Botanical Institute of the Königliche Landwirtschaftliche Hochschule in 1911.

The rest of Baur's life was not only actively devoted to research in plant genetics and its applications (except for the last two years of the War, when he was transferred to Potsdam with his staff), but also in this period he founded and directed successively a new Institut für Vererbungslehre in Berlin-Dahlem in 1922 and a still larger Kaiser Wilhelm Institut für Züchtungsforschung at Müncheberg, some distance from Berlin, in 1929.

Erwin Baur was a man of tremendous energy and vigour, but overwork brought his life to an all too early end. His well-known genetical investigations of *Antirrhinum* were begun about 1904, and already in 1910 he was growing some 30,000 antirrhinums a year. He also made the early studies of infectious chlorosis in Malvaceæ, *Ligustrum*, *Fraxinus* and other plants, and his investigations of graft hybrids and chimæras in *Pelargonium* and other plants were notable. His "Einführung in die experimentelle Vererbungslehre", first published in 1911, has passed through eleven editions, and fulfilled somewhat the same functions in Germany that Bateson's well-known "Mendel's Principles of Heredity" did in England.

In a series of classical researches, Baur first investigated the large number of colour factors and other mutational differences in the garden snapdragons. Later his interest in the evolutionary aspects of the genus developed. He collected and studied the wild species of *Antirrhinum* from Spain and other Mediterranean countries, finding throughout the genus that the specific differences behaved as Mendelian characters in crosses. At the Müncheberg Laboratory the same genus was extensively used by Baur, Stubbe and other colleagues in the production of an extraordinary series of mutations in flower and leaf form by the use of X-rays, ultra-violet light, temperature shocks and a wide range of chemical substances. These substances were forced into the leaves through the stomata by centrifuging seedlings which were inverted in tubes containing the solutions. The plants were then set out and allowed to flower. Baur's great knowledge of the wild forms of *Antirrhinum*, their distribution and genetics, will unfortunately be lost, as it had not been put in a form for publication.

Baur's interests lay not only in the wider aspects of genetics but also in their application. This was exemplified in the Masters Lectures of the Royal Horticultural Society, which he gave in 1931. His general evolutionary outlook was that of Darwinian natural selection based on mutational variations, but the aims of the Müncheberg Institution were immediately economic. Baur set about to produce a wheat suitable for light soils in Germany in place of rye, by crossing and selection on a huge scale. By the testing of one and a half million lupins, plants were found in both the yellow and the blue species which were devoid of alkaloid and could be propagated as a forage field-crop. By similar large-scale selection a variety of *Melilotus alba* was obtained free from cumarin, and a tobacco

free from nicotin. Efforts were being made to produce a grape which was resistant to *Phylloxera* and *Peronospora*, by extensive crossing with North American varieties and subsequent selection. Baur visited Peru and Bolivia, bringing back many native varieties of potato for use in plant breeding. Other large-scale crosses were made for the improvement of gooseberries, raspberries, blackberries and tomatoes.

In 1908, Baur founded and edited the *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, which has remained one of the standard journals for genetical researches and publishes a comprehensive classified bibliography of the world literature. He also founded the *Bibliotheca Genetica*, *Der Züchter*, and was joint editor of the *Zeitschrift für Pflanzenzüchtung Gartenbauwissenschaft* and *Berichte über die gesamte wissenschaftliche Biologie*. With Dr. M. Hartmann he had produced since 1928 the "Handbuch für Vererbungswissenschaft". He was thus instrumental in giving publication to a very large amount of important genetical work. Baur, with Fischer and Lenz, wrote the well-known "Menschliche Erblichkeitslehre und Rassenhygiene", which has seen several editions. At the fifth International Congress of Genetics, held at Berlin in 1927, he was a leading spirit and gave the opening address as president of the local committee.

Prof. Baur was an honorary member of many scientific societies and was elected a foreign member of the Linnean Society of London in 1933. An indefatigable worker, his results have been among the most fruitful in modern plant genetics. R. RUGGLES GATES.

PROF. W. E. GIBBS

IT is with great regret that we record the death on January 18 of Prof. William Edward Gibbs, at the early age of forty-four years. Prof. Gibbs was the Ramsay professor of chemical engineering at University College, London, having been appointed to that post on the resignation in 1928 of Prof. E. C. Williams. At the time of his appointment a large extension of the Department of Chemical Engineering had been planned, as the result of generous donations from various important British chemical firms, obtained through the energetic propaganda of his predecessor. The extension was designed and carried out by Prof. Gibbs with conspicuous ability and success, and within a few years his genial personality, combined with his deep interest in research, his organising power and his practical knowledge of industrial methods and processes, had filled the much enlarged laboratory with a band of enthusiastic students drawn from many sources—young British university graduates, experienced men from various industries, and foreign students.

Prof. Gibbs was a graduate of the University of Liverpool, and obtained his first post as assistant chemist to the Straits Trading Company at Singapore. Having held this post for a few years, he returned to the University of Liverpool, and the present writer recollects the enthusiasm with which he attacked the problem of the electrochemical recovery of metallic tin from the waste smelter material which he had brought home with him. At Liverpool he was soon appointed lecturer in metallurgy, and he was also made investigator to the Corrosion Committee of the Institute of Metals.

During the War, Prof. Gibbs rendered valuable service to the country, holding successively the posts of chief examiner of the Aeronautical Inspection Department, and chief chemist to the Government Rolling Mills at Southampton. At the conclusion of the War he was appointed chief chemist to the Salt Union, a post which he held until appointed professor at University College. During this period he acquired an extensive practical acquaintance with the technical methods and problems relating to evaporation and crystallisation.

Prof. Gibbs was deeply interested in the properties and treatment of aerosols and aerogels, that is, disperse systems in gases, and wrote two excellent books, "Clouds and Smokes", and "The Dust Hazard in Industry", which are, so far as the present writer is aware, the first scientific expositions of these important subjects in book form in the English language. He was also very much interested in problems relating to heat exchange, the flow of liquids and gases, the fractional distillation of liquid mixtures and the design of gas-scrubbers and rectifying columns. In these and other fields of chemical engineering he understood well how to combine the theoretical basis of design with the practical aspects of construction and operation, and he possessed the supreme gift of awakening and sustaining the intelligent interest of his students and securing their loyal and indeed affectionate co-operation.

Prof. Gibbs was a man of high, unselfish and sterling character, combined with an endearing charm and simplicity of personality not often encountered in this world. His untimely death is a severe loss, not only to his colleagues and students at University College, but also to the Institution of Chemical Engineers and the science and practice of chemical engineering throughout the world. F. G. D.

DR. HERMANN CHRIST-SOCIN

BARELY three weeks before his hundredth birthday, and still fully in possession of his physical and mental faculties, Dr. Hermann Christ, the Nestor of European botanists, had the misfortune to slip on the polished floor of his study and to fracture his leg. Unfortunately, too, complications set in and he died on November 24 at his home in Riehen near Basle.

Though known throughout the world as a botanist, Dr. Christ was by profession a lawyer, for which career he prepared himself by studies in the Universities of Basle and Berlin. But, interested

since his boyhood in natural history, Dr. Christ took the opportunity while in Berlin to attend the excursions of Prof. Alexander Braun, and his natural inclinations were greatly stimulated by his intercourse with that eminent botanist. In his reminiscences, written on the occasion of his ninetieth birthday, Dr. Christ relates with what great interest he read von Humboldt's works on the geographical distribution of plants, and on returning to Basle, he began to devote himself to this field of botany, publishing several short papers on special aspects of the flora of Switzerland, the substance of which he gathered together with further observations in his "Pflanzenleben der Schweiz" published in 1879.

Dr. Christ's interest in systematic botany was equally keen and his legal training seemed, as has been the case with other eminent botanists, to be of distinct help to him in sifting scientific evidence. He occupied himself with the difficult genus *Rosa* on which he published his account of "Die Rosen der Schweiz" in 1873, and sixty years later, in his hundredth year, he published a further paper on this favourite subject of his dealing with the roses of the Canton Valais. Other contributions to systematic botany dealt with the European conifers and with the European sedges, another difficult genus. But it is with the group of ferns that Dr. Christ's name will remain most closely associated. "The Ferns of Switzerland", "The Ferns of the World" and the "Geographical Distribution of Ferns" are three standard works which will always be consulted by pteridologists. His industry as a botanist can be gauged from the fact that his botanical publications amount to more than three hundred and these were written during the time he could spare from his many professional activities as a lawyer, for he held an important legal post in connexion with the Swiss railways.

Neither scientific nor professional preoccupations dimmed Dr. Christ's humanitarian feelings, and on the occasion of the revelation of the Congo atrocities, he joined with Morel in organising the universal protest against the cruelties of the slave trade in Africa, and was one of the founders of the Swiss league for the protection of the natives in the Congo State.

The influence of a man of such wide interests and insatiable activity carried on during an exceptionally long life has been felt far beyond the limits of his beloved town and country, and his untimely death, as one may call his passing away so near to the completion of his centenary anniversary, will be mourned by all his admirers, who will however keep him and his labours in grateful remembrance.

WE regret to announce the following deaths :

Dr. Lilian J. Clarke, for several years head science mistress at James Allen's Girls' School, Dulwich, and member of many committees on the teaching of biology, on February 12, aged sixty-eight years.

Dr. D. W. Freshfield, president of the Royal Geographical Society in 1914–17, of Section E (Geography) of the British Association in 1904, and of the Association of Geographical Teachers in 1897–1910, on February 9, aged eighty-eight years.

Dr. Bernard Hollander, a well-known authority on diseases of the nervous system, and author of books on psychology, eugenics, and related subjects, on February 6, aged sixty-nine years.

Sir Lionel Jacob, K.C.S.I., chief engineer and secretary to the Government of Burma in 1903–5 ; inspector-general of irrigation ; and secretary, Government of India (Public Works Department) in 1905–11, on February 9, aged eighty years.

News and Views

Evolution of the Mind

WITH his customary lucidity, Prof. Elliot Smith has presented, in the Royal Institution discourse which accompanies this issue of NATURE as a special supplement, an account of the present position of his researches in organic neurology in conjunction with the results of other workers, particularly Campion and Le Gros Clark. The result is not only a notable step forwards towards an understanding of the complex temporo-spatial relationships which from one point of view are designated the brain and its related mechanisms, and from another mental function, but it is also an effective counterblast to recent efforts prematurely to recrystallise Sir Henry Head's outstanding contribution to our understanding of sensory integration in forms of merely clinical application. It is to be hoped that the danger to true progress in neurology resident in these efforts has been, if not averted, at all events withstood for the time being. Poljak's demonstration that even in the simplest act of thought or skill the whole neopallium must participate reinforces the question, in respect of 'localisation'—the concern of clinicians—localisation of what ? The present contribution emphasises again the integrity of the brain as a whole as the effective instrument of a biological objective in action rather than in thought. It may be said that with each advance in the evolutionary scale as well as in our understanding, the number of the neurological constituents of action is seen to increase.

IT is not only that for the acquisition of the characteristic modes of the human *mind* a cognitive is added to an affective experience and to both is added a conative experience ; but also for the development of the characteristic functions of the human *brain* a subtler progression eventuates, having little regard or none for these concepts of the schools. In his most recent revelation of the stages of this

progression, Prof. Elliot Smith deals with those truly neurological 'bricks', the thalamus and the hypothalamus, the seats respectively of emotional formulation and effective expression, in the light of their special linkages with the cortex itself, facilitating a "cortico-thalamic circulation" which finds functional expression in an enrichment of concepts by the gains of experience of failure or success in past action. While this broadening of the issues involved in what is now known of the fibre relationships of the cortical and thalamic organs is the outstanding feature of Prof. Elliot Smith's lecture, a paragraph—all too brief—must not be overlooked which records the evident complexity of the neural machinery of the parts involved and proceeds to assert that "it becomes essential to look at the whole issue from a much broader point of view than the mere connexions of thalamus and cerebral cortex". The 'key' word of the sentence is 'connexions' and 'mere' is there to turn it vigorously. Is it justifiable to hope that the self-sufficiency of the neurone is at last to be called in question and that the truly organic character of the brain may be substantiated 'in our time'? Is this not a case where the answer has long been prepared and only awaits the application of the question to reveal its fruitfulness?

Sir George Buchanan, C.B.

By the retirement of Sir George Buchanan on February 18 from his post as senior medical officer of the Ministry of Health, an association with the public health of Great Britain of nearly forty years is terminated, for Sir George was appointed a medical inspector of the old Local Government Board in 1895. During this period he has accomplished much valuable work over the whole range of public health. In early days he dealt with infectious disease outbreaks, questions of water supply and sewage disposal, housing problems and slum clearance. During the five years 1906–11, he acted as chief inspector of foods, and afterwards was the chief assistant medical officer of the Local Government Board, becoming on the formation of the Ministry of Health its senior medical officer. On the outbreak of War in 1914, Sir George was immediately attached to the Army Sanitary Committee and served on the eastern fronts at Gallipoli and in Macedonia and Mesopotamia, though little mention of the services he rendered there will be found in official records. With the cessation of hostilities commenced his association with the League of Nations. He had been a member of the Health Committee of the League from its foundation, and now became its vice-president, and he also became British representative of the Office International d'Hygiene Publique. In 1919 he was a member of the Poland Typhus Commission instituted by the League of Red Cross Societies, was appointed president of the League of Nations Cancer Commission, and was a member of the League's mission for the public health reorganisation of Greece. In 1926, Sir George was appointed chief British delegate to the International Sanitary Conference. During the last twelve years he has assisted at numerous Government and official investigations. This bare outline of Sir George Buchanan's activities during his official career suffices to show that he has played a part for which he has earned his country's gratitude.

Dr. Thomas C. Porter

By the death of Dr. Thomas Porter, for many years science master at Eton College and one of the founders of the (Public Schools) Science Masters' Association, on March 31, aged seventy-three years (NATURE, 131, 496, April 8, 1933), science teaching in Great Britain suffered a severe loss. An obituary article in the *Journal of the Chemical Society* of December 31 stresses Dr. Porter's influence as a teacher. Though he was gifted with remarkable talent, he never allowed himself to specialise. This wide range of interests was the source of inspiration which many of his pupils gained from him. Porter was born at Bristol and was educated at the Grammar School, from which he gained a scholarship in natural science at Exeter College, Oxford, in 1878. In 1885 he was appointed at Eton, and there he taught for forty-eight years. He was responsible for many improvements and extensions in the teaching of science at the College. Dr. Porter's own investigations covered a wide field. His most serious contribution was on the phenomenon of 'flicker', contributed to the *Proceedings of the Royal Society* in 1898, 1902 and 1912. He was the first to notice the non-homogeneity of X-rays (NATURE, 54, 149, June 18, 1896). Papers on Newton's rings and the use of flames for enhancing the intensity of sound were published in the *Philosophical Magazine*.

British Industries Fair

It has become almost a stereotyped phrase to say of each British Industries Fair that it is larger and more representative than any that have preceded it. The twentieth British Industries Fair to be held in London and Birmingham on February 19–March 2 maintains this tradition. In the London Section the lighter trades and Empire exhibits will be found at Olympia; while the textiles and clothing and the furniture displays will be at the White City. The Birmingham Section at Castle Bromwich comprises hardware, house equipment, engineering and 'heavy' industries generally. At Castle Bromwich there will also be an out-of-doors exhibition for the display and demonstration of agricultural implements, light railways, and quarrying and road-making plant. The trade groups which have shown the most marked growth, judged by the extent of their exhibits at the Fair, are furniture (the biggest section in the Fair) at the White City, electricity and building at Castle Bromwich, and the following groups at Olympia: Government of India, brush-ware and fancy goods; jewellery, pottery and glass-ware; sports goods; stationery, printing and office equipment, etc.; toys and games; chemicals and druggists' sundries. It is interesting to note that the first British Industries Fair, which began as a War-time experiment in 1915, consisted of about 5 miles of stands at the Royal Agricultural Hall, Islington, whereas the stands of this twentieth Fair, in 1934, extend to about 32 miles

or, say, fifteen times the length of Oxford Street. Incidentally, it may be noted that twenty-two Continental countries—another record—have given special travel concessions this year to encourage attendance at the Fair by their trades buyers. In these days of quotas and other forms of restrictions on international trade, it is very significant that twenty-two Continental countries should so appreciate the international importance of the British Industries Fair.

Sale of Contraceptives

ON February 13, Lord Dawson of Penn moved the second reading of the Contraceptives Bill. The provisions of the Bill were dealt with in a leading article in NATURE of February 10, p. 192. Lord Dawson said that birth control is now "part and parcel of our social fabric" and that he wished to identify himself with the view that the way to keep the sale and use of contraceptives on sound lines is "to remove the veil of doubt as to the honesty of contraception". Birth control is already accepted in practice, and if there were only wider acceptance of it in theory, the sale of contraceptives would go into normal channels. Meanwhile, he is of opinion that children and young persons require a certain amount of protection such as the bill would afford. Lord Dawson said that he is quite prepared to accept amendments provided that the principle of the bill is not undermined. The Bishop of London, while not agreeing with Lord Dawson, said he would support the Bill enthusiastically, giving as his reason the moral effect of the indiscriminate advertisement and sale of contraceptives. The Archbishop of Canterbury supported the Bill as being a serious attempt to check in some measure the growth of an evil which is poisoning the moral health, self-control and self-respect of the community. The motion for the rejection was negatived by 45 votes to 6.

Tree-Kangaroos

THE birth of a tree-kangaroo at the Gardens of the Zoological Society of London is an event well worth recording. Another was born at about this time last year. One would have supposed that the drastic change from the tropical forests of New Guinea and North Australia to a relatively small cage in London would have inhibited the reproductive activities. Even without this added interest, the presence of this strange creature in the Gardens is something more than welcome to all who are concerned with the problems presented by anomalous changes of habit and habitat in the animal kingdom. The typical kangaroo is, in itself, a sufficiently remarkable animal. For here we seem to have a convincing example of 'neo-Lamarckian' changes of form. Though how the initial stage of the leaping habit began we are scarcely likely to discover. It is not merely that the hind-legs and tail have grown inordinately large, but we have also to take into account the quite unusual nature of the reduction of the toes; for instead of disappearing on each side of a median axis, the reduction of the second and third toes has taken place on the inner side of the foot, where the claws only are visible in the living animal.

IT seems clear that the tree-kangaroo must have taken to an arboreal life after this specialisation for terrestrial leaping had taken place; though it is to be noted that, as in the wallabys, the hind-legs are shorter, and the fore-legs relatively larger than in the large ground-dwellers of the tribe. Unfortunately, the opportunity of witnessing the actual birth of any of these animals occurs only on the rarest occasions, and it would seem that even then it is by no means easy to interpret what is seen. It used to be believed that the mother seized the infant at the moment of birth in her lips, and immediately transferred it to the teat in her pouch, to which it attached itself forthwith, and retained its hold continuously for some weeks while its further development took place. For the young, in the kangaroos, are, so to speak, prematurely born, with the limbs only slightly developed. A later account gives a very different version, embracing an astonishing degree of activity on the part of this almost embryonic little body. For it is said to make its way up the fur of the parent and into the pouch, and to find the teat unaided; a course of behaviour one would have deemed impossible.

Emigration Schemes in Australia

IN an article in NATURE of November 4 on population problems, reference was made to the failure of emigration for the time being. Commenting on the position, so far as Australia is concerned, Sir James Barrett, of Melbourne, in a letter to the Editor, states that the failure is not so disastrous in Australia as appears on the surface; despite the fact that, in Victoria alone, many millions of pounds will be lost on land settlement schemes. Few people realise that industrial farming requires for success scientific knowledge and training at least equal to that required in any learned profession. In his paper read before the World Population Conference in 1931 the late Prof. J. W. Gregory showed the importance of immigration to Australia in order that a population capable of making the utmost use of railways, etc., should be established in that country as quickly as possible. In Victoria more than £10,000,000 has been spent on irrigation works which, together with railways, were planned in accordance with a far-seeing land settlement policy. In addition, therefore, to the actual cost of land settlement schemes which the taxpayer, as Sir James Barrett says, is now forced to meet, there is this further heavy expenditure, much of which has been incurred directly for immigration and land settlement. Prof. Gregory also made some interesting references to the varying estimates that have from time to time been drawn up as to Australia's capacity for supporting a large population. These range very widely, from about 200,000,000 estimated by Admiral Sir Edmond Slade to about 10,000,000 and other similar low estimates made in Australia itself, for example, by F. C. Benham of the University of Sydney. Prof. Gregory's own estimate was more nearly 100,000,000.

Lord Bledisloe and the Promotion of Science

LORD BLEDISLOE, the Governor-General of New Zealand, has consistently encouraged scientific workers in the Dominion, and has promoted endeavours in all branches of science. As evidence of his keen scientific interest, during the visit of the Byrd Expedition II to Wellington on December 9, Lord Bledisloe promoted a happy scientific colloquium at Government House, when the visiting explorers were entertained along with the permanent scientific workers of the Dominion. It is more than twenty years since so large a number of men belonging to different nationalities, whose researches are outstanding in different branches of science, have been gathered around one table in New Zealand. The function allowed group discussions of all branches of the scientific work of the Expedition, which is probably provided with a larger scientific staff, and has a more extended scientific programme, than any expedition which has so far visited the antarctic. Of outstanding interest is the work projected in cosmic ray determinations, and it is understood that the results on the trip from the United States have verified A. H. Compton's results in the variation with latitude of cosmic ray intensity. The results of observations in the neighbourhood of the magnetic pole and on the polar plateau will be awaited with interest.

The Byrd Antarctic Expedition

AMONG the interesting items in the programme of work of the Byrd Antarctic Expedition are the use of seismic reflection methods for the determinations of ice thickness and depth. For this work, the expedition is well equipped with the latest types of apparatus. Close attention will be devoted to upper air observations as forming a very considerable part of the extensive meteorological research programme which has been outlined. The expedition is also proposing to take the fullest advantage of the opportunities afforded in this region for studying polar aurora. The biological and geological problems associated with Antarctica will also receive close study, and the scientific world should be considerably richer as the result of the labours of the staff of the Byrd Expedition II in the south polar regions.

WE regret that news of the Expedition up to the end of January was not of a wholly reassuring nature. According to the *Times*, the larger of the two vessels of the expedition, *Jacob Ruppert*, was caught in the pack-ice and drifting in the Ross Sea. Apparently the ship had met with much difficulty on account of ice but had reached the proximity of the Ross Barrier by January 27; it began to discharge cargo on to the ice whence it was to be sledged by dogs and tractor to the base at Little America on the Bay of Whales. The following day, however, rifts appeared in the ice and several drums of petrol were saved with difficulty. The ship had to cast off, leaving a large party of men on the ice. The time now available for landing supplies is short since the ice is likely to freeze together at any time now, thus endangering the safety of the ship or at least its chance of getting away before the winter sets in.

Research and the Electrical Industry

THE thirteenth annual report of the British Electrical and Allied Industries Research Association for the year ended September 1933 gives an interesting résumé of the many problems on which it is engaged. In a foreword, Mr. C. C. Paterson, the chairman of the Council, says that the electrical industry has been built up by research, and by research only can it continue to prosper. This research must be made on a scale commensurate with its growth. Some of the researches described have a longer outlook than others, but none of the researches can be abandoned or even delayed without definite loss to the industry as a whole. Much of the work done is in co-operation with other organisations. It is a pity that a number of large authorised electrical undertakings have not yet seen their way to become full subscribing members. The subscription assessment agreed to, at a recent conference, was £10 per £25,000 of revenue. It is certainly not onerous. Research has often the effect of appreciably, and sometimes largely, reducing capital and working costs and hence non-subscribers are benefiting from work, the cost of which has been borne by others. The High Commissioners in London for the Dominions and Colonies have shown an active interest in the work of the Association, particularly the Indian Government. Applications for membership have been received from several local State Governments and Public Works Departments. We are glad to hear that the Association is taking an active part in locating the causes of radio interference. The solution of these urgent problems has involved sacrifices by the staff. They have been able to mobilise a squadron for field work and a mobile laboratory at short notice and are obtaining useful information.

Industrial Health in Japan

IN Japan the pressure of a growing population has focused attention on the further development of industry, since in the next decade Japan has to find food and employment for nearly ten million more people than she does to-day. That the problem of industrial efficiency is being seriously tackled is evidenced in the annual report of the Director of the Japanese Institute of the Science of Labour at Kurasiki. This Institute was founded some years ago to undertake research into the physiological, psychological and environmental conditions affecting workers and their output. Research committees have recently been organised to investigate problems such as the rationalisation of labour, industrial fatigue, factory conditions and the appropriate qualifications to be desired of workers in every branch of Japanese industrial life. This latter investigation has already led to the establishment of standard norms for the mental and physical development of young Japanese workers aged 12–20 years. Occupational diseases

(*Continued on p.* 253.)

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Evolution of the Mind*

By Prof. G. Elliot Smith, F.R.S.

IT may be asked by what right an anatomist, whose proper business is concerned with very concrete subjects, presumes to discuss so elusive and immaterial a subject as the evolution of the mind, even if it be admitted that the evolution of the chief organ of the mind comes within the proper scope of his field of work. I am encouraged, however, to embark on this hazardous attempt by the considered judgment of Prof. S. Alexander, who once expressed the opinion "that we are forced to go beyond the mere correlation of the mental with [the] neural processes and to identify them".

The great physiologist who is most competent to express an opinion on this issue has recently impressed upon us the need for caution in touching it. In the closing passage of his Rede Lecture on "The Brain and Its Mechanism", delivered in Cambridge on December 5, 1933, Sir Charles Sherrington used these words: "I reflect with apprehension that a great subject can revenge itself shrewdly for being too hastily touched. To the question of the relation between brain and mind the answer given by a physiologist sixty years ago was 'ignorabimus'. But to-day less than yesterday do we think the definite limits of exploration yet attained. The problem I have so grossly touched has one virtue at least, it will long offer to those who pursue it the comfort that to journey is better than to arrive, but that comfort assumes arrival. Some of us—perhaps because we are too old—or is it too young ?—think there may be arrival at last." These opinions are even more appropriate to those who lack Sir Charles Sherrington's immense competence.

Hence I seize upon a confession made by Sir Charles elsewhere in his Rede Lecture:

"What right have we to conjoin mental experience with physiological ? No scientific right; only the right of what Keats, with that superlative Shakespearian gift of his, dubbed 'busy common sense'. The right which practical life, naïve and shrewd, often exercises."

If scientific proof, however, is demanded, surely Sir Henry Head's investigation of sensation and the cerebral cortex supplies it by demonstrating in wounded soldiers the concern of the cortex with psychical functions—the dependence of mind on brain ("Studies in Neurology", 1920). Prof. Shaw Bolton, by comparative and clinico-pathological researches, has demonstrated the dependence of mind on the supragranular layer of the cerebral cortex.

With these assurances the mere biologist, while discussing strictly biological issues, can direct attention to certain psychological implications of anatomical facts and comment also on their neurological aspects for the interpretation of the mind and its working. In previous lectures at the Royal Institution I have discussed the significance of the heightened powers of vision in man's ancestors, which conferred upon them the ability to see the world in which they were living and appreciate something of what was happening in it, as well as to guide their hands to acquire skill, by the practice of which fresh knowledge and understanding were obtained.

Significance of Visual Guidance

We know enough of the comparative anatomy and palæontology of the Primates to select a series of animals that can be taken to represent approximately the stages through which man's ancestors passed in their evolution towards man's estate, and by examining the connexions of the optic tracts in the brain, arrive at an understanding of what is involved in the acquisition of higher powers of visual discrimination (Fig. 1).

In this series of diagrams, it will be observed

* Friday evening discourse delivered at the Royal Institution on Jan. 19.

that at first the areas for touch, vision and hearing come into contact with one another but that eventually an area marked *P* (parietal association area) develops between them to provide a more efficient place of blending of the impulses from these three senses. At the same time there emerges from the front end of the brain a prefrontal area (*F*) which is essentially an outgrowth of the motor territory and an instrument whereby the activities of the whole cortex can in some way be concentrated on the process of learning to give motor expression to the total activities of the hemisphere. Certain poisons which exert a destructive influence on the supragranular layer of this part of the

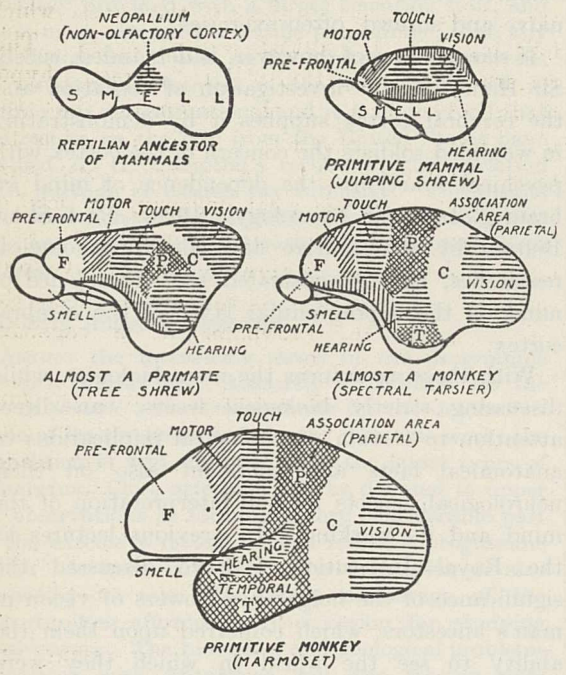

FIG. 1. A series of diagrams to suggest the origin of the neopallium in the ancestor of mammals; the rapid development of this cortical area in mammals, as touch, vision, hearing, as well as control of skilled movements, attain an increasing significance, the growing cultivation of vision which leads to the emergence of the Primates, the increased reliance on vision brings about an enhancement of skill in movement (and a marked expansion of the motor territory) and of tactile and auditory discrimination. (Based in part on the work of Profs. W. E. Le Gros Clark and H. H. Woollard.) From "Human History" (1930).

cortex lead to very significant mental results, such as are displayed in general paralysis of the insane, characterised at first by grandiose delusions and afterwards by a failure of the mental process altogether, profound dementia. The discussion of this evidence by Dr. J. Shaw Bolton ("The Brain in Health and Disease", 1914) affords another precise demonstration of the dependence of the mind upon particular parts of the brain.

This is an example of the means whereby comparative anatomy can throw light upon the process of mental evolution, the structural changes in the eyes and brain which make possible not only the refinement of visual discrimination, but also the increasing participation of visual perception in the conscious life and in the guidance of the instruments (such as the hands) of muscular skill. The latter consideration is one of fundamental importance. For the study of the evolution of the nervous system impresses upon us the fact that one of its essential purposes is to make possible quicker, more complex and more purposive responses to changes in the animal's environment or the conditions in its own body.

It is a matter of real importance, therefore, that every advance in the powers of sensory perception and discrimination should be brought into relationship with this essential biological need of finding expression in action. Each of the major advances in vertebrate evolution is obviously correlated with differences in locomotion and muscular aptitude. When an amphibian emerged from a fish-like ancestor, the most obtrusive change was the substitution for swimming as a means of locomotion, the use of the newly-created 'gadgets' which are represented by the limbs of a tetrapod land-living animal. The attainment of greater competence and agility in the control of the amphibian's four legs led to the emergence of reptiles, from which in course of time birds and mammals were evolved; the former by high specialisation of the forelimbs by flight, and the latter by the acquisition of a cerebral instrument, the neopallium, which conferred the ability to attain unlimited powers of acquiring skill and to profit from experience. The highest powers of skill were made possible by the evolution of greater powers of visual guidance.

It is an obvious truism that man's mental superiority is largely the outcome of the perfection of the co-operation of hand and eye in the attainment of manipulative skill and dexterity. In the use of the hands for the expression of skill, the skin of the fingers acquires heightened powers of tactile discrimination, and thus becomes the special organ of the sense of touch and an instrument of perceptual knowledge second only to the eyes in significance.

The researches of Sir Henry Head and his collaborators have given us a new understanding of what is involved in tactile discrimination. The great sensory pathways in the spinal cord and brain-stem lead up to the thalamus in the forebrain, where they end in its ventral nucleus, the

nerve cells of which transmit impulses in two directions—one to the cerebral cortex and the other to what Sir Henry Head calls the essential organ of the thalamus. The former is regarded by him as the mechanism for sensory discrimination, and the latter as the instrument for awareness to sensation and the appreciation of its affective qualities, its pleasantness or unpleasantness.

Hypothesis of a Thalamo-Cortical Circulation

In the *British Journal of Medical Psychology* in 1932, Mr. George G. Campion discussed the psychological implications of Head's clinical results. Emphasising the impossibility of separating from perception the affective factor, which is continually at work in our thought-processes, Mr. Campion gave expression to the view that the biological purpose of giving a meaning to experience is the essence of the comprehension of the nature of sensation. Mr. Campion has emphasised the further fact that the concept—the ultimate constituent element of what are called our cognitive dispositions—is not fixed and unchangeable, but is "a living plastic mental symbol subject to a process of organic growth, and that its growth is due to an affective factor which is constantly at work determining the selection of new sense data from the perpetual flux, interpenetrating the conceptual contents of our minds, and integrating all these various and varying constituents into the slowly maturing dispositions which constitute organised knowledge. The affective factor involved in this process has been variously called 'libido', 'love', 'interest', 'feeling', 'desire', 'liking', etc."

Mr. Campion further maintains that there is a continuous stream of neural impulses from the thalamus to the cortex and from the cortex to the thalamus, which keeps alive this living process of mental growth—the enrichment of the concept as the result of personal experience, the success or failure of the attempts to do things.

Developing this idea, Mr. Campion directs attention to the various parts of the cortex linked in an incredibly complicated way by association fibres and cortical association areas. The necessary implication of his hypothesis of the thalamo-cortical circulation of neural impulses (by means of the various thalamo-cortical and cortico-thalamic tracts of fibres), involves functional connexions of the various parts of the thalamus with one another by intercommunicating fibres. He predicts that as "the cortical association areas may be assumed to have a counterpart also in the thalami, it will be for neurologists to say whether these hypothetical association areas lie in and constitute a chief part of what Head has called the essential thalamic organs."

Since this prediction was made, Prof. Le Gros Clark, in the course of studies (*Brain*, vol. 55) in the comparative anatomy and physiology of the thalamus, has directed attention to the fact that such elements are actually found in the thalamus of the higher mammalia. There are cell masses (lateral nucleus (Fig. 3)) deriving their impulses from the main sensory part (ventral nucleus) of the thalamus, which merge sensory impulses of different kinds and establish direct connexions with those association areas of the cortex which link together the cortical sensory areas. This remarkable confirmation of Mr. Campion's hypothesis adds force to the argument that the mechanism of correlation in the thalamus is far more complicated than has hitherto been supposed, and represents what, following the lead of Sir Henry Head, one may suppose to be a mechanism for the integration of affective processes in the same way as the cortex effects the integration of the discriminative or cognitive aspects of experience.

In the process of acquiring knowledge and building up these vital mental elements, the concepts, to which reference has already been made, it is obvious that there must be a circulation of nervous impulses such as Mr. Campion assumes to maintain the cohesion and the integrity of the vital processes of thought. This circulation of impulses must be even more complicated than he has assumed, because the hypothalamus undoubtedly enters into the process and influences the activities both of the thalamus and the cortex, adding as its quota the visceral element which confers upon experience an emotional factor which is something more than the affective interest the thalamus is able to provide. Intimately intertwined with the whole of this complicated system —hypothalamus, thalamus and the sensory and association areas of the cortex—we have the complex mechanism for giving expression to their combined activities in actions which represent the biological purpose of the whole process. The powerful instrument of thought represented by speech affords an admirable illustration of the intimate correlation of muscular skill with cognitive aptitude to provide the essential currency of mind.

Almost every part of the cerebral cortex is

intimately connected directly and indirectly with mechanisms in the central nervous system which are concerned with muscular activities, either those which directly effect movements, or on a vastly greater scale those which prepare and co-ordinate the state of the muscles of the whole body in readiness for prompt and efficient action. More than two-thirds of the fibres that leave the hemisphere have as their immediate purpose the establishment of connexions with the cerebellum, and as their function, the rapid distribution of the muscular tone of the body in readiness for such skilled action as lies at the root of the brain's efficiency. The circulation of the thalamic and cortical currents maintains this constant state of readiness and is a vital and essential part of consciousness and mind.

The building up in the brain of concepts is dependent not merely on affective and cognitive experience based upon afferent impulses from the sense organs, but is also brought about as the result of muscular activity, the doing things with the hands, the gradual perfecting of the movements, the results of the success or failure of such efforts, and the afferent impulses which pour into the brain from the joints, the muscles and the skin areas to record the success or failure of particular muscular activities. It is largely by doing things that experience is built up. It is important therefore to recognise the very large part which such conative activities play in the building up of concepts. They are due not merely to the interaction of the affective and cognitive dispositions, but also to the dynamic factor which is conferred upon these processes by attempting to express in action the result of the discriminative activities of the cortex.

The Neopallium as the Essential Mental Instrument

More than thirty years ago, I directed attention to the fact (*J. Anat. and Physiol.*, p. 431 ; 1901) that with the evolution of mammals a new cortical instrument, which I called the neopallium, came into existence, and with its expansion provoked the vastest revolution that ever occurred in the cerebral structure. It came into being to form a receptive organ for fibres coming from the thalamus, whereby touch, vision, hearing and taste—in fact all the non-olfactory senses—secured representation in the cerebral cortex. To express this fact, Prof. Winkler, of Utrecht, calls the neopallium the thalamocortex.

In its earliest form the neopallium consists of a tiny area far forward in the hemisphere, where tactile impulses from the lips and tongue are brought into relationship with olfactory and gustatory impulses, and this area afterwards acquires the ability to control the movements of the lips and tongue. As the neopallium grows it establishes similar relations to the rest of the body and increases the range of its receptive powers not merely to the skin of the whole body, but also to the eyes and ears, and it establishes direct connexions with all the motor nuclei in the central nervous system. The neopallium not only gives the senses other than smell representation in the dominant part of the brain and a part in the control of behaviour, but it also provides a continuous territory in which co-operation between these various sensory influences can be established and their conjoint effects be brought to bear upon the mechanisms that control motor activities.

It is often supposed that there are in the cerebral cortex long association bundles to establish connexions between distant parts of the cerebral cortex. There has recently been published an important memoir by Dr. Stephan Poljak, a Jugoslav neurologist who began the research in question in my laboratory eight years ago, which disproves the existence of such long connexions. An impulse from one cortical area can only reach and influence distant areas by travelling through the cortex itself. The act of correlation involves the whole cortex. Even in the simplest act of thought or skill, the whole neopallium participates. The manifold currents which circulate throughout the brain in the process of regulating muscular activities represent the means of integrating the cognitive, affective and curative activities in thought.

Not only the neopallium but also the brain as a whole adds its quota to the action—in particular the great mass of nervous matter at the threshold of the cerebral hemisphere known as the thalamus. It contributes the affective element, which is the interest, the stimulative of the whole complex process, to which it gives coherence. The cortex not only preserves the records of previous experience which provide the means for comparing present experiences with past happenings, but it also adds the spatial quality to sensation and the means of judging degrees of stimulation, and the afferent impulses which pour into the brain from the joints, the muscles and the skin areas, to record

the success or failure of particular muscular activities. It is by doing things that experience is built up. It is important therefore to recognise the very large part which such conative activities play in the building up of concepts. They are due not merely to the interaction of the affective and cognitive dispositions, but also to the dynamic factor which is conferred upon these processes by attempting to express in action the result of the discriminative activities of the cortex.

For some years I have been attempting to demonstrate how vast a part the cultivation of visual discrimination has played, not simply in making it possible for human beings to see the world in which they live and appreciate some of the activities which are revealed to them by their eyes, but even more in contributing to conscious control of behaviour.

The earliest type of cerebral cortex necessarily has to perform both affective and cognitive functions. It enables its possessor to appreciate the attractiveness or unattractiveness of a particular scent, and to experience an interest in addition to the cognitive recognition of it.

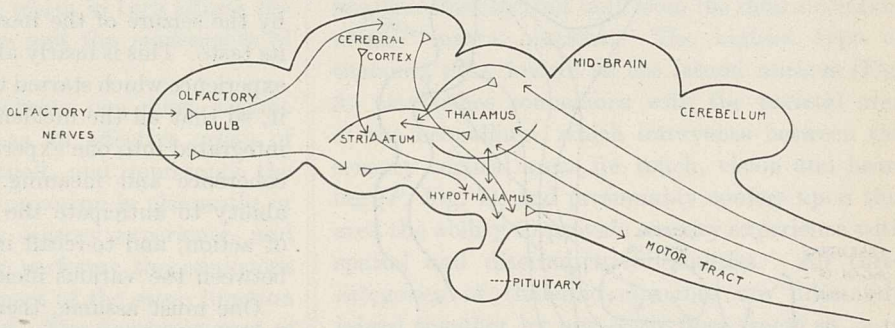

FIG. 2. Diagram of the primitive vertebrate brain to suggest the hypothalmic, thalamic, striatal and cortical connexions.

The cortex, at first, however, exercises no immediate direction over the motor activities of the animal beyond provoking them and providing the initiative to action. This it accomplishes by transmitting to a mass of grey matter in its base (the corpus striatum) impulses which indirectly throw other parts of the brain and spinal cord into action to direct the movements that it starts. It is the impulses from the eyes, skin and "ears" (as yet organs not of hearing, but of recording movements in the water) which consciously direct the animal's movements, while its posture and equilibrium are being maintained by the automatic mechanism of the membranous labyrinth.

The tracts in the brain which convey the impulses from skin, eyes and ears are mainly concerned with transmitting to the various motor nuclei impulses that unconsciously influence and direct reflex movements, but they all send some of their impulses to a mass of grey matter in the forebrain, which lies immediately behind the striatum, to which it is intimately linked by many nerve fibres. This is the thalamus (Fig. 2). It confers upon all the non-olefactory sensory impulses an affective quality which gives them a meaning and an influence in modifying behaviour. In other words, the effects of this sensory experience, when transmitted to the striatum, are to alter the animal's reactions to smell.

Emotional Factor in Mind

The activities of the striatum, when stimulated by the cerebral hemispheres and the thalamus, are expressed in impulses which proceed from it to the hypothalamus, a mass of grey matter lying beneath the thalamus. This surprising arrangement seems to confer upon the hypothalamus the decisive influence in translating into behaviour the initiative to action which lies in the cerebral cortex. The hypothalamus is the part of the brain which controls, by means of the sympathetic and parasympathetic systems, the most vital activities of the body itself, its visceral functions, its growth and metabolism, and even such appetites as those of sex. It is the essential instrument of emotional expression.

As the springs of action are profoundly influenced by hunger, thirst, sexual desire and other appetites and cravings, it is perhaps not surprising that in the most primitive vertebrates the instrument of the animal's vegetative needs should play a crucial part in shaping its conduct. To this part of the brain, impulses proceed from the olfactory tracts so as directly to control the activities of the alimentary and genital systems in anticipation of the realisation of the satisfaction of the respective appetites.

The study of the primitive brain impresses upon us the intimacy of the integration of the functions concerned with affective and discriminative knowledge and the translation of such information into appropriate action.

The higher type of brain distinctive of mammals, which opens up the possibility of the attainment of real conceptual knowledge and its biological application in increasingly complex acts of skill and thought, is distinguished by the growth of the thalamus and the transmission from it to the cerebral cortex of fibres in increasing numbers (Fig. 3).

The recent progress in our knowledge of the structure and connexions of the thalamus and hypothalamus with the cerebral cortex, the hypothalamus and the sympathetic and visceral tracts of the organism had made it possible to carry Mr. Campion's suggestions a stage further than he himself has done. That this is possible is in large

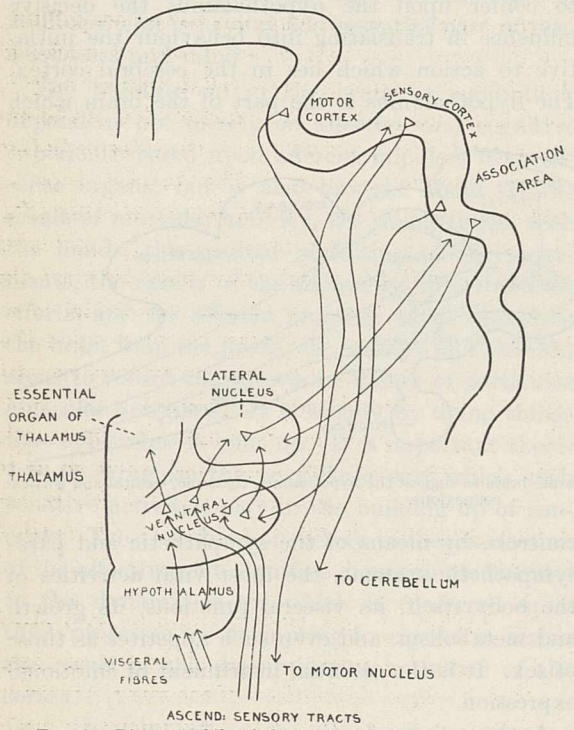

FIG. 3. Diagram of the thalamic, hypothalamic and cortical connexions of the human brain.

measure due to the illuminating researches of Prof. W. E. Le Gros Clark. The intensive studies which have recently been made by scores of investigators on the structure and connexions of the hypothalamus enable us to broaden the issues and consider the part played by these portions of the brain, which control the growth and metabolism of the body, and in particular visceral function, and how they are related to the thalamus and the cerebral cortex and provide the instrument for determining the emotional colour of experience and of regulating the manifestations of the appetites.

If Mr. Campion's views are correct, that the study of this neural machinery is essential for the understanding and interpretation of thought and behaviour, its structure and functions might be expected to be of great complexity. Hence it becomes essential to look at the whole issue from a much broader point of view than the mere connexions of thalamus and cerebral cortex.

Importance of Smell in the Primitive Vertebrate

In the brain of the most primitive vertebrate, the structural pattern is determined by the fact that smell is the dominant sense. The cerebral cortex is essentially a receptive instrument for impressions of smell, and the mechanism whereby consciousness of smell can influence the behaviour of the animal. When a primitive vertebrate such as a dogfish scents attractive food and pursues it, the culmination of the pursuit is represented by the seizure of the food and the appreciation of its taste. This is nearly akin to the initial olfactory experience which started the pursuit and dominated it, so that all the incidents of the pursuit become integrated into one experience, which is thus given coherence and meaning. Thus is initiated the ability to anticipate the result of a given course of action, and to recall in memory the connexion between the various incidents.

One must assume, therefore, that the primitive cortex is concerned not merely with the awareness of smell and the ability to discriminate between different kinds of smells, but also that it is concerned with the affective side of olfactory experience, with the attractiveness or repulsiveness of any scent and the influence of such affective experience in determining the nature of the response an individual odour can evoke. The cerebral cortex in such a primitive animal is incapable of directing movements, seeing that the sense of smell is utterly devoid of any spatial quality. When an animal scents an attractive food, it acquires from the sense of smell no idea as to the position in space of the object which provides the stimulus. It is merely stirred into action, and other neural mechanisms are responsible for controlling and directing the resulting activities. The cerebral cortex, so to speak, is the mere trigger which releases the activity of the brain and provokes and directs the movements.

The part of the cerebral hemisphere which translates these stimuli into action is the corpus striatum, and the striatum is connected with the thalamus, which receives from the body, that is

through the skin, the eyes and the ears as well as the muscles and joints, impulses which modify and direct movements which result when the animal is thrown into action. The thalamus transmits the effects of these stimuli to the striatum and so modifies the motor activities. In the case of organs such as the eyes, the primary functions were concerned not merely with the awareness of illumination, but also of movements in the outside world, or rather movements of objects in the outside world in reference in its own body. The eyes have associated with them, in the brain, a complicated mechanism which enables them automatically to direct the movements of the body in relationship to events in the outside world. But quite apart from this, the eyes transmit to a part of the thalamus (the lateral geniculate body) impulses which are concerned with the awareness of the stimulus of light, and which influence these bodies and through them the thalamus as a whole, which in turn affects the functions of the striatum and the movements of the animal.

In the primitive vertebrate one must assume that the thalamus acts as an affective organ of all senses other than smell, and represents the instrument whereby the organism is pleasantly or unpleasantly affected by sensory experience, and that the cerebral cortex performs the analogous but more dominating aspect of the same function in relationship with smell. The dominant part of the cerebral cortex in the most primitive vertebrate is the hippocampal formation, and if one assumes the supreme function of the cortex is to determine the behaviour of the animal, it is perhaps justifiable to assume that the purpose of the primitive hippocampus is to make possible the adequate association of the affective qualities of smell and to translate them into action by playing a dominant part in determining the animal's behaviour.

It is perhaps not without significance in this connexion that the efferent fibres from the hippocampal formation, after passing out of the cerebral hemisphere, terminate in the hypothalamus, that part of the brain which controls the visceral system (sympathetic and para-sympathetic) and thereby regulates the activity of the viscera. It is, in fact, that part of the brain which is intimately related to the functions of the appetites. Nor is it surprising that the particular part of the hypothalamus in which the hippocampal fibres terminate should be linked up with the thalamus, so as to provide a neural circuit in which the total affective qualities of all the senses are brought into relationship in such a way that they can influence through the striatum the motor responses of the body.

The researches of Prof. Le Gros Clark have established the fact that the thalamus contains three kinds of cell groups (Fig. 2). Those forming the ultimate termini of certain of the sensory pathways, which according to Sir Henry Head form the essential organ of the thalamus, are the instrument whereby we become aware of sensory experience and appreciate its affective qualities. Secondly, there is a group of cells (ventral nucleus) which receives the great sensory paths coming up from the other parts of the brain and the spinal cord, and transmits the impulses either to the corpus striatum or in mammals to the neopallium. In the third place, there is a group of nuclei in the thalamus which become well developed only in the higher mammals. They do not receive afferent impulses directly, but only from the intermediation of the ventral nucleus. The highest type of thalamic cells, known as the lateral nucleus (Fig. 3), establishes connexions with the parietal area of the neopallium, which intervenes between the sensory cortical areas for touch, vision and hearing (*P*, Fig. 1), and presumably confers upon this area the ability to provide sensory experience with spatial and discriminative qualities. All three categories of thalamic elements are intimately joined together by numerous fibre tracts so as to form a closely integrated functional whole the proper working of which is essential for cortical functions.

Integration of the Dispositions of the Mind

The common practice of psychologists of segregating the three dispositions of the mind, cognitive, affective and conative, and attempting to study them as isolated units, is devoid of justification. All three are indissolubly united in the working of the mind. To give them cohesion it is necessary to assume the existence of a circulation of nervous impulses from the thalamus to the cortex and to the widespread and complex mechanisms concerned with muscular activities.

In the growth of a concept conation plays a fundamental part. Man learns from experimentation. By the exercise of his manual dexterity he acquires knowledge of the properties of things, the nature of forces, and the means for interpreting (and in some measure understanding) the world in which he lives. The surprisingly large part of the cerebral cortex that is concerned with the regula-

tion of muscular functions and the multitude of its fibre-connexions with the cerebellum affords an impressive testimony of the vast significance of action in mind-making and emphasises what Prof. T. H. Pear has well called "the intellectual respectability of muscular skill". It is a truism that we learn by doing. In man, thought is a prerequisite for action, and action a corrective of thought. The biological justification for the evolution of the high degree of visual discrimination, whereby man knows the world and the society in which he lives, is the motor efficiency it makes possible.

The most significant factor in the evolution of the mind was effected when the direction of movements was transferred from the midbrain to the neopallium (see NATURE, 125, p. 820; 1930) and from being an unconscious automatism became a consciously directed process. For the neopallium not only established a direct control over the motor nuclei of the whole central nervous system, but it also became linked up with all the complicated machinery in other parts of the brain which are concerned with muscular activities.

This concentration of control in the neopallium implies a circulation of nervous impulses throughout the brain to effect cohesion between the living instruments of the conative dispositions with those of the affective (thalamus) and cognitive (neopallium) dispositions of the mind. A circulation such as Mr. Campion postulates is essential to the working of the mind.

This circulation in turn involves the hypothalamus, which presumably confers the emotional tone that plays a part in all mental and muscular activity, in particular in artistic expression and the self-knowledge which is one of the most distinctive qualities of man and his thinking.

Anthropological investigations, the results of which I have summarised in chaps. v and vi of my "Human History" (1930), suggest that in primitive man there is an innate goodness and truthfulness, the awareness of which we call conscience. These qualities of the mind are responsible for character and personality. The terrible experiments which the incidence of diseases such as sleepy sickness (encephalitis lethargica) provides, has shown that these amiable qualities can be destroyed by minute injuries of certain parts of the brain in or in the neighbourhood of the hypothalamus. We must suppose that these parts of the brain are responsible for the maintenance of the innate goodness of human nature, the goodwill of normal man, seeing that their destruction causes so profound an alteration of character. Mr. Campion's hypothesis of a widespread circulation of nervous impulses provides an explanation of how these various dispositions of the mind and character may be integrated into the living human personality.

Before I close this discourse, I must express my gratitude to Mr. George Campion for his stimulating suggestions and to Prof. J. S. B. Stopford, of Manchester, for help in giving them neurological expression.

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have also been studied, and in this connexion special attention has been paid to skin diseases among typical Japanese manual workers such as stevedores, octopus fishers, plasterers, carpenters and blacksmiths. Every effort is made by the Institute to maintain close contacts with industry, and its *Journal* is now to be issued bi-monthly instead of quarterly, so that the results of its researches may be available as soon as possible. Recently also the Japanese Association of Industrial Hygiene—an organisation which is closely connected with the Institute—has considerably increased its activities.

The Rockefeller Foundation

THE Rockefeller Foundation's report for 1932 is a tale of activities which, in extent, variety and momentum, are probably unmatched by those of any other agency for world betterment. Of the aggregate disbursements during the year, amounting to nearly 14 million dollars, about one fifth was for public health work carried on in almost every country of the globe. The report of the director of the international health division covers some two hundred pages and includes a retrospect of the past ten years. This is followed by reports of the directors for the medical sciences, natural sciences, social sciences and humanities, and in each case the recital of events of the year is elucidated by reference to previous years' achievements. The chapter on the social sciences is of special interest at the present time, showing, as it does, that the framers of President Roosevelt's administration's schemes for national recovery, however handicapped by lack of precedents, were at any rate in a position to draw upon the results of elaborate academic research, to the financing of which the Foundation has for some years made very substantial grants. In addition to grants to various institutions for current expenses, including in 1932 grants amounting to 450,000 dollars to the Social Science Research Council in New York City, the Foundation has recently promoted research in specific fields recognised as of specially vital importance, namely, economic planning and control, international relations, and community organisation. In 1932, substantial grants were made for research in such subjects as industrial hazards, history of prices, unemployment, employment exchanges, the gold standard, cyclical fluctuations and employment stabilisation.

Progress of Agricultural Research in Great Britain

THE collected reports on the work done during the year 1931–32 at agricultural research institutes in the United Kingdom which receive State grants has just been published. The volume contains in addition reports on special agricultural investigations for which funds have been allotted. Among these the following may be cited: investigations on improved grassland management at the Welsh Plant Breeding Station, Aberystwyth, and the University of Bristol, seed potato production at the University College of North Wales, Bangor, land reclamation with *Spartina townsendii* (rice grass) by the Essex County Council, grey squirrel problems at the Department of Zoology, University of Oxford, and the efficacy of chlorates as weed killers at the North of Scotland College of Agriculture. A list of papers published by each research institute or centre and the names and addresses of the directors or persons in charge of the investigations are supplied, so that further information on special points can be obtained if desired. The report can be obtained from H.M. Stationery Office or through any bookseller, price 6*s*. net.

THE Royal Agricultural Society, 16, Bedford Square, W.C.1, has published the eighth of its annual summaries of the research work carried out in the leading branches of agriculture. In previous years the publication has been issued in book form, free on application to members of the Society, and available at a nominal charge to the general public. In the present year, and for the future, "The Farmer's Guide to Agricultural Research" will form part of the Society's *Journal* and will, therefore, automatically be received by every member. A limited number of copies, however, are still being bound separately for distribution to the Press and to agricultural education and research centres. The survey of scientific work which it provides is not limited to research conducted in the British Isles, but also includes references to results obtained in any part of the world which may have a bearing upon the problems of British agriculture. The character of the volume is similar to that of the previous year (1931), except that the section on farm crops which was then omitted has been reintroduced. The other sections, namely, dairy farming, diseases of animals, farm economics, the breeding of livestock, farm implements and machinery, pests and parasites, and soils and manures remain as before. A few copies of previous issues for the years 1925–1931 are stated to be still available.

A Natural History Society in Northern England

WHILE interest in museums appears to be growing, many societies devoted to natural history find it difficult to retain the membership of former years. The Northumberland, Durham and Newcastle-upon-Tyne Society is fortunate in having raised its membership, by a small addition, to 613, but even so the cost of running the Hancock Museum is mainly responsible for a raiding of the Maintenance Appeal Fund to the extent of £245, so that the Fund is on the verge of extinction. The Museum does good work, and under the guidance of T. Russell Goddard and many helpers, is alive to the need for interesting the public by wild-flower exhibits, seasonal exhibitions of Lepidoptera, an observation hive, lectures and the like. Unless further support is forthcoming, it would appear from the financial statement that the activities of the Museum run the danger of curtailment.

First Aid in the Laboratory

WE have received a copy of a pamphlet entitled "Safeguards in the Laboratory", together with a notice suitable for exhibition in the laboratory, both of which are obtainable, price 6*d*. post free, from

Canon Kirkland, The King's School, Ely. The pamphlet contains a number of very useful hints for first aid in the laboratory, which have been compiled by the Science Masters' Association and the Association of Women Science Teachers, and it should be very useful in the school laboratory. It should be noted, however, that the administration of an emetic, particularly salt solution, as stated, is not advisable in the case of mercuric chloride without first giving immediately white of egg: the section on poisons is not sufficiently detailed to be of much real value. The statement that "the naphtha used for storing sodium should be of the native rock-oil variety" is rather obscure.

Ross Institute and Hospital for Tropical Diseases

REPORTS of the annual general and extraordinary general meetings of the Ross Institute and Hospital for Tropical Diseases, held on November 27, have now been released for circulation. At the eighth ordinary general meeting, the chairman, Sir Charles McLeod, surveyed the work of the Institute during the year, and the Council and Executive Committee were re-elected. At the extraordinary meeting, it was resolved to approve and confirm two agreements made between the Ross Institute, of the one part, and the London School of Hygiene and Tropical Medicine, and the Seamens' Hospital Society, respectively, of the other part, whereby the Ross Institute is amalgamated with the London School of Hygiene and Tropical Medicine, and the Ross Hospital is incorporated in the Seamens' Hospital Society by the establishment of a "Ross Ward" in their Hospital for Tropical Diseases. The Court and Senate of the University of London have expressed their satisfaction respecting the arrangement with the School of Hygiene. The Ross Institute thus comes to an end, but the name of Ross will still be perpetuated in the new amalgamations.

Gift to British Association

THE Committee formed in Leicester in connexion with the meeting of the British Association there in 1933 had a surplus of £1,000 in hand after meeting all the local expenses of the meeting. This sum has been handed over to the Association, to form the "Leicester and Leicestershire Fund, 1933" for the assistance of a student or students working for the advancement of science. The fund will be administered by the Council of the Association, and, when possible, assistance will be given preferably to a Leicester or Leicestershire student or worker. The Council, in accepting the gift, has expressed its appreciation of the action of the Committee "in thus confirming, in a manner without precedent in the history of the Association, their interest in the advancement of science".

Continuation of Empire Marketing Board Research Work

MR. G. GLEDHILL, in the House of Commons on February 6, asked Mr. J. H. Thomas, Secretary of State for Dominion Affairs, if any arrangements have been made for carrying on the research work previously undertaken by the Empire Marketing Board. In a written answer, Mr. Thomas stated that such arrangements are being made. It is estimated that the cost of such research work in the financial year 1934–35 will reach £200,000, of which some £85,000 will be borne by other Governments of the Empire or by the institutions or industries concerned.

Announcements

PROF. P. M. S. BLACKETT will give a course of three lectures on "Cosmic Radiation" at Birkbeck College, Bream's Buildings, E.C.4, on Tuesdays at 6 p.m. commencing on February 20. Admission to the lectures will be free without ticket.

THE following appointments in the Colonial Agricultural Service have recently been made: C. A. North-Coombes, to be agronomist, Department of Agriculture, Mauritius; C. J. Lewin, chief agriculturist, to be director of agriculture, Northern Rhodesia; Capt. J. P. A. Morris, deputy director of animal health, to be director of animal health, Northern Rhodesia.

AT the annual general meeting of the Royal Astronomical Society, held on February 9, the following officers were elected: *President*, Prof. F. J. M. Stratton; *Vice-Presidents*, Sir Arthur S. Eddington, Mr. John Evershed, Dr. H. Spencer Jones and Dr. W. J. S. Lockyer; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Mr. W. M. H. Greaves and Dr. W. M. Smart; *Foreign Secretary*, Prof. Alfred Fowler; *New Members of Council*, Prof. H. Dingle, Sir Frank W. Dyson, Prof. H. F. Newall, Mr. W. H. Steavenson.

IN NATURE of December 23, 1933, p. 963, under the title "Study of Canadian Coals", a note appeared referring to a report by R. E. Gilmore and R. A. Strong in the *Canadian Mining and Metallurgical Bulletin* (p. 317, 1933), published by the Canadian Institute of Mining and Metallurgy. The journal was incorrectly quoted as the *Journal of Canadian Mining and Metallurgy*.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at Darlington Training College—The Principal (Feb. 21). A museum assistant (male) at the Leicester Museum and Art Gallery—The Director (Feb. 28). Staff tutors in psychology, political science, etc., at the University of London—The Joint Hon. Secretaries (Tutorial Classes), University of London, South Kensington, S.W.7 (March 1). A Wakefield lecturer in aeronautics at University College, Hull—The Registrar (March 7). A probationary assistant engineer in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (March 8). A Kennedy professor of engineering at University College, London—The Academic Registrar, University of London, S.W.7 (April 11).

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.*]

Occurrence of Antirachitic Vitamin in Green Plants

As is well known, antirachitic substances arise through irradiation with ultra-violet light. It might be presumed, therefore, that green plants, which are constantly exposed to the light of the sun, would become rich sources of the antirachitic vitamin. However, green plants, or parts thereof, have hitherto been found to be poor in the above-mentioned vitamin. This may, perhaps, be ascribed to the fact that the plant material has been prepared in an unsuitable manner prior to examination. It may also be, however, that the irradiation with sunlight has not been so intense as would have been supposed. As the summer of 1933 in southern Norway was unusually rich in sunny days (sunny days recorded in Oslo: May 25, June 28, July 30 and August 30) we considered it of interest to examine whether green plants this summer would show a larger vitamin D content than is usually the case.

For this investigation was used meadow-hay, consisting of Gramineæ and some clover, which was rapidly dried by a special quick-drying process (at 68° C. for 2 hours—a process which it is now intended to use on a larger scale). The hay was afterwards pulverised. The hay powder had a fresh, green colour, and yielded by extraction with ether in a Soxhlet apparatus 4 per cent of a deep green, ointment-like extract. Daily doses of four milligrams of this extract brought about a satisfactory cure of rickets (method: Poulsson and Løvenskiold[1]). The ether extract had, in other words, the same antirachitic effect as a high quality cod liver oil, containing about 250 Oslo units of vitamin D per gram. This corresponds to 0·25 unit vitamin D per gram of hay powder.

Some time ago, Kon and Booth[2] stated that vitamin D in butter showed a marked difference from the vitamin D found in cod liver oil and that obtained by ultra-violet irradiation of ergosterol; whereas 80 per cent of the first was lost by the usual saponification, this is not the case with vitamin D from the other two sources. We considered it of interest to examine whether this also applied to vitamin D in the above-mentioned ether extract of green plants. We brought about saponification by means of alcoholic potash-lye. 8 gm. ether extract yielded 0·508 gm. ether-soluble unsaponifiable matter, that is, 6·25 per cent. This was diluted with inactive arachis oil until a quantity was obtained equal to that of the ether extract from which we started, namely, 8 gm. Of the solution thus obtained, it was necessary to use 20 milligrams in order to obtain the same antirachitic effect as was found in the ether extract before saponification. Vitamin D in green plants shows, accordingly, the same characteristics as Kon and Booth[2,3] have described for vitamin D in butter.

We found it of interest, at the same time, to record the tintometric reading of the above-mentioned solution of the unsaponifiable matter, in arachis oil. This was found to be 10 blue units (which corresponds to a high quality cod liver oil). However, the tintometric reading, thus recorded, is probably not due to vitamin A, but to carotene, the precursor of vitamin A, as the chlorophyll was removed by the saponification, and the unsaponifiable matter showed a very pronounced yellow-red colour. 1,200 yellow and 20 red units were recorded as self-colour on Lovibond's tintometer.

OTTAR RYGH.

State Vitamin Institute,
Skøyen, Oslo.
Jan. 22.

[1] Poulsson and Løvenskiold, *Biochem. J.*, **22**, No. 1; 1928.
[2] Kon, S. K., and Booth, R. G., *Biochem. J.*, **27**, 1189, 1302; 1933.
[3] Zucker and Barnett, *Proc. Soc. Exp. Biol. Med.*, **20**, 375; 1922–23.

Assay of Vitamin A

IN carrying out a series of assays, by the curative method, of the vitamin A content of various samples of fish oils and dried milk, it was found that in a large proportion of cases the weight curve did not give a reliable indication of the state of depletion of the vitamin A stores of the animal, and that increase in weight after administration of a supplement could not always be ascribed to its vitamin A content.

The experimental data obtained in these assays appeared to conflict with current ideas regarding the special influence of vitamin A on growth. An investigation was therefore undertaken to ascertain (1) whether growth does in fact cease in vitamin A deficiency, and (2) the real significance of the loss in weight which is generally described as 'cessation of growth'.

The evidence which has been obtained shows that when vitamin A is the only known factor absent from the diet, there is no cessation of growth, interpreting growth as increase in size. This has been determined by measurements of length of the body in the live animal, and by comparison of the lengths of the bones, measured post-mortem, with Donaldson's values for the standard rat. It would appear that vitamin A has no greater claim to be considered essential for growth *per se* than any other of the many factors which are responsible for increase in weight.

The characteristic loss in weight, which has been termed 'cessation of growth', appears to be due entirely to pathological conditions arising from the vitamin A deficiency. Even in animals killed at a stage when they are still increasing in weight, these conditions may be found on macroscopic examination.

The diversity of the pathological symptoms which may arise during the preliminary 'depletion' period makes it impossible to secure uniformity in the experimental animals at the beginning of the test period. This constitutes a source of error which makes the curative method of vitamin A assay of doubtful value. It seems probable that the various discrepancies so frequently reported in such assays may find their explanation in the above observations.

The results of this investigation, which were presented at a meeting of research workers at Aberdeen on December 18 last, will be published in detail at an early date.

J. B. ORR.
M. B. RICHARDS.

Rowett Research Institute,
Bucksburn, Aberdeen.
Jan. 23.

Designation of Heavy Hydrogen

THE frank acknowledgement of Prof. Urey and his colleagues in NATURE of February 3, p. 173, that the nomenclature of heavy hydrogen should not be decided by the wishes of the discoverers, but by the convenience of physicists and chemists in general, encourages me to say something in reply to their arguments.

To physicists the most important point is perhaps the name to be given to the nucleus. More than one physicist who was at Chicago last summer found it difficult to distinguish the spoken words 'neutron' and 'deuton' or 'deuteron'. The difficulty may be greater in England than in America; all good Americans will realise that in England it always rains and everyone has a cold; but in this country at least the danger of confusion seems to me to be serious, and it is entirely avoided by using 'diplon'.

The names to be employed in chemistry will not be nearly so unpleasant as Prof. Urey and his colleagues suggest. They say that we should call $NH^1H_2^2$ 'di-diplogen mono-hydrogen nitride'; they would presumably say 'di-deuterium mono-protium nitride'. But the chemist would call it 'di-diplo-ammonia', just as he calls $C_6H_4Cl_2$ dichlorobenzene and not di-chlorine tetrahydrogen cyclohexacarbide. 'Di-diplo-' is no more cacophonous than 'di-deutero-'; didymium was accepted for many years as a satisfactory chemical name. Moreover, the compounds of H^2 will not always contain two atoms of it in the molecule.

The objection that 'diplogen' means 'making double' is not really valid; it means 'making diplon', just as oxygen does not mean making sharp, but making acids. Diplon is 'the double thing', just as proton is 'the first thing', and is used in no other sense than as meaning the H^2 nucleus. Deuterium or deutium means the second substance, and deuteron or deuton the second particle; and it may be argued that the second particle after the proton is the neutron, whereas there is no doubt what particle is the double of the proton.

The adoption of a new name to distinguish pure H^1 from the isotopic mixture does not seem likely to be widespread, but if one is needed, the obvious correlative to diplogen is haplogen, as Prof. Urey suggests, and this seems to be a harmless word.

Whatever decision may be reached on this question, we can at least all agree to use the symbol D for H^2.

Lincoln College, Oxford.
Feb. 4.

N. V. SIDGWICK.

Nuclear Spins and Magnetic Moments

A COMPARISON of the two lines of spectroscopic evidence bearing on the properties of the atomic nucleus raises some interesting questions and suggests new directions of research. The magnetic moment of the nucleus can only be evaluated from hyperfine structure observations, and then only in favourable circumstances. The spin quantum number I can sometimes be obtained by both methods: by the hyperfine structure method if the magnetic moment and its interaction with the optical electrons is sufficiently large, and by the band spectrum method if the atom is one which forms an elementary diatomic molecule, provided also that this gives rise to a band spectrum of which the rotation structure can be analysed. Although each method is thus restricted in the scope of its application, there are a number of cases in which both are applicable, for example, Li^7, F^{19} and Na^{23}, for each of which the two values obtained for I are in agreement. On the other hand, P^{31}, Cl^{35} and K^{39} are amenable only to the band spectrum method, the magnetic moment being presumably too small to give observable hyperfine structure, whereas for many other nuclei (for example, $Cu^{63, 65}$, $Cd^{111, 113}$, Cs^{133}, $Hg^{199, 201}$, etc.) the latter method only is applicable since no diatomic molecules giving rise to band spectra are known.

The case of nuclei of even mass number is of particular interest. No hyperfine structure has been detected for any of these, although N^{14} shows some slight indications, and such band spectrum observations as are available all give zero values for I with the exception of H^2 and N^{14}, for which $I = 1$. (I is half integral or zero in every other known case.) It would therefore be natural to assume, as has generally been done, that all nuclei of even mass number have $I = 0$, except H^2, N^{14} and possibly also Li^6 and B^{10}, these four being the only nuclei of even mass number but odd atomic number.

Such an assumption would, however, be quite unjustified on the basis of the present experimental evidence. A zero value for I can only be established by band spectrum methods, since the absence of hyperfine structure might alternatively be due to a small magnetic moment. It is therefore unfortunate that the number of nuclei of even mass number for which diatomic band spectra are known is very small. There are in fact only six, four of which, He^4, C^{12}, O^{16} and S^{32}, have mass numbers of the type $4n$, where n is integral, and zero spins. The other two, H^2 and N^{14}, have been referred to above. They have $I = 1$, but may very well be anomalous. There are no others having mass numbers $4n + 2$ for which the band spectrum method is practicable at present. The most promising appears to be Li^6, the difficulty here being the weakness of the Li_2^6 bands in comparison with those of Li_2^7 and $Li^6\,Li^7$, among which they lie. The highest possible dispersion, applied in a carefully selected region, might offer some prospect of success.

A survey of the remaining elements of this type shows that in every case one or more of the following obstacles bars further progress:

(1) The isotope in question is too rare (for example, O^{18}).

(2) There are too many isotopes (for example, $Te^{126, 130}$), giving rise to extreme complexity of band structure.

(3) No suitable bands are known (for example, Zn^{66}, Se^{78}).

(4) No bands at all are known (for example, B^{10}, Ne^{22}, Ni^{58}, Zr^{90}, Ba^{138}).

(1) and (2) would seem to be insuperable unless the technique of isotope separation can be greatly improved. As to (3) and (4), the great variety of methods of excitation now available and the wide spectral range now open to photographic investigation give ground for hope that some of these band spectra may yet be discovered. Whether or not an exhaustive search for them would be worth undertaking, it is at least very desirable that spectroscopists working with such elements and their compounds should be on the look-out for new band systems, and should endeavour to ascertain the origin of any which may be found.

Armstrong College, Newcastle-on-Tyne.
Jan. 12.

W. E. CURTIS.

X-ray Spectra of the *L*-series of Silicon and Silica

In a preceding letter[1] we have shown that the *K*- and the *L*-spectra from aluminium in the metallic state are definitely different from those found with the non-conducting compound Al_2O_3. Analogous phenomena were found by Siegbahn and Karlsson also in the *K*-series of magnesium with the pure element and magnesium oxide (Mg O) (in publication elsewhere). The metals in these cases give broad bands with a sharp edge towards the shorter wave-lengths, which may be explained as transitions from the levels of the conduction electrons. The widths of the bands correspond fairly well with those calculated from the theory.

As it was of interest to see how the next element, silicon, which is a semi-conductor, behaves in this respect, we have taken spectrograms of the element

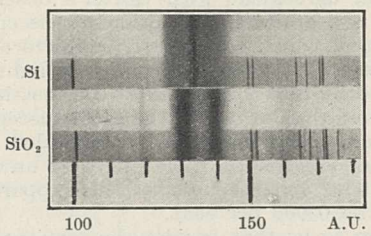

FIG. 1. *L*-Series of Si and SiO_2

and the oxide SiO_2. As is seen from Fig. 1, here also a broad band with a sharp limit towards the shorter wave-lengths is found for the element. In the band two maxima are visible, which are well pronounced and measurable in the photometric registrations. The wave-length of the edge is $125{\cdot}5 \pm 0{\cdot}5$ A., the maxima are at $134{\cdot}3 \pm 0{\cdot}5$ and $138{\cdot}2 \pm 0{\cdot}5$ A. The non-conducting compound, SiO_2, gives a spectrogram of quite another character, with two strong lines at 130·7 A. and 139·5 A. (and a broader, fainter line at 162 A.) as seen in the figure. This corresponds with the spectra of aluminium and the oxide Al_2O_3, where the oxide shows two well-marked maxima instead of the band at the pure metal.

MANNE SIEGBAHN.
TORSTEN MAGNUSSON.

Physics Laboratory,
Uppsala University.
Dec. 22.

[1] NATURE, 132, **895**, Dec. 9, 1933.

Speed of 'Uniform Movement' of Flame in Mixtures of Carbon Monoxide and Oxygen

In the year 1931[1] Prof. W. A. Bone and Mr. R. P. Fraser published figures for the speed of the 'uniform movement' of flame in moist (stated to be 'saturated' at 12°–13°) mixtures of carbon monoxide and oxygen. Their values are represented by the crosses in the accompanying diagram (Fig. 1). In a paper published in 1932[2] we challenged both the absolute and the relative correctness of those values. Our results, for mixtures saturated at 13·1°, are indicated by circles in the diagram. Prof. Bone and Mr. J. Bell have repeated the experiments[3] and, whilst unable to confirm the earlier determinations, have obtained some (for mixtures saturated at 15°) that correspond with ours, within the limits of reasonable experimental error, as is shown by their curve reproduced in the diagram.

There remains, however, an outstanding difference. Prof. Bone and his colleagues consider that the maximum speed of 'uniform movement' of flame in moist mixtures of carbon monoxide and oxygen is obtained with a mixture of the composition

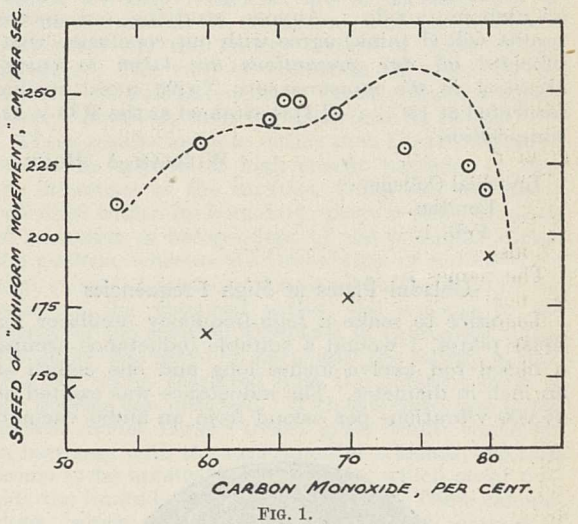

FIG. 1.

$3CO + O_2$, whereas our results show that it is obtained with the mixture $2CO + O_2$. We do not offer any explanation for this difference, but suggest that a third party, sufficiently interested in the problem, should reinvestigate it.

W. PAYMAN.
R. V. WHEELER.

The University,
Sheffield.

[1] *Proc. Roy. Soc.*, p. 542, 1931.
[2] *J. Chem. Soc.*, p. 1835; 1932.
[3] *Proc. Roy. Soc.*, **143**A, 1; 1933.

SEEING that on p. 1836 of their paper (*loc. cit*) Dr. Payman and Prof. Wheeler rightly stressed the fact that "with moist carbonic oxide the speed of flame varies considerably with the concentration of water vapour and is therefore subject to alteration from day to day if the temperature of saturation alters", it is curious to find them now citing an alleged 'correspondence' between some of two sets of flame-speed measurements for moist $CO - O_2$ media saturated at 13·1° and 15·0° (water vapour = 11·3 and 12·75 mm.), respectively, as confirming the former. For when the difference between the two saturation temperatures is allowed for, the seeming 'correspondence' vanishes.

In repeating the earlier Bone and Fraser determinations—which, however, were for media containing 10·9 mm. only of water vapour—Mr. Bell and I discovered, what had not been recognised before, the importance not only of accurately controlling the hygroscopic condition of the moist $CO - O_2$ media, but also of ensuring a sufficiently large difference (at least 10°) between their saturation temperature and the temperature of the walls of the tube in which they are inflamed; and having taken special precautions to ensure this most necessary condition, we consider our results more reliable than any previous ones.

Seeing that they are largely influenced by environmental factors, the *absolute* values of such initial flame speeds in moist CO — O_2 media are of no fundamental import, the real question being where, under given conditions, the maximum speed-point lies on the speed-composition curve. In view of the considerable CO_2-dissociation in CO-oxygen flames, the maximum speed is to be expected with an excess of carbonic oxide. Anyone studying our recent results will (I think) agree with our conclusion that, *provided all due precautions are taken to ensure accuracy in the measurements*, "with moist media, saturated at 15° . . . [it] is attained at the 3CO + O_2 composition".

WILLIAM A. BONE.

Imperial College,
London.
Feb. 1.

Chladni Plates at High Frequencies

IN order to make a high-frequency oscillator for brass plates, I wound a suitable inductance around a nickel rod twelve inches long and one eighth of an inch in diameter. The inductance was excited at 15,000 vibrations per second from an audio vacuum

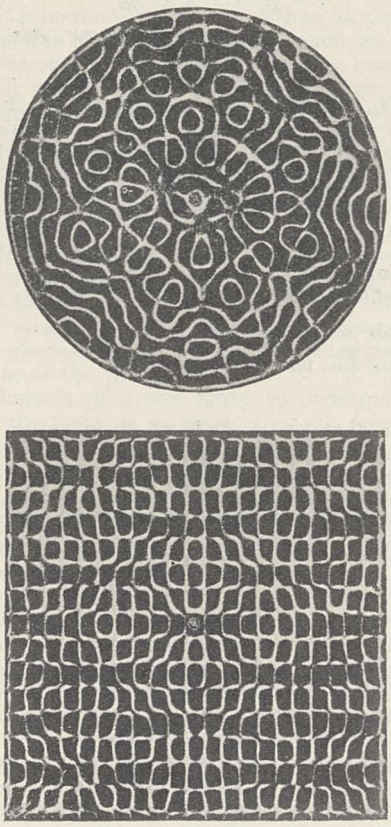

FIG. 1.

tube circuit connected through a power amplifier. The nickel rod was in a vertical position and the square Chladni plates were balanced upon it. The figures shown in the photographic reproductions (Fig. 1) were formed in this way.

When a circular plate was balanced on the rod, only circular nodal lines were formed. I therefore clamped the circular plate at the centre and pressed the oscillating nickel rod against the under side of the plate near the edge.

Calculation shows that the plates oscillate at a submultiple of the oscillation in the rod. They cannot take up such a high vibration as 15,000 per second.

R. C. COLWELL.

Department of Physics,
West Virginia University.
Dec. 15.

Influence of Light on Paramagnetic Susceptibility

SELWOOD[1] has recently published the result of his investigation on the influence of the absorption of light on the paramagnetic susceptibility of certain solutions, in which he fails to confirm our observation of the increase of susceptibility under such conditions. He finds, in agreement with Gorter's observation, that there is a gradual diminution of susceptibility of the solution which can be attributed to a rise of its temperature, due to absorption of light. The method used by him is that due to Decker, in which a test piece of glass of nearly the same susceptibility as the paramagnetic solution is suspended from a torsion head between the pole pieces of an electromagnet. The sensitiveness of his apparatus is claimed to be 0·005 per cent.

It appears to us that besides the sensitiveness of the apparatus used in measuring the change in susceptibility, there is another factor involved, namely, the magnitude of the change ΔK produced by absorption of light. If n_2 is the number of ions per c.c. in the excited state and p_1 and p_2 are the magnetic moments of the ion in the ground and excited states respectively, then

$$\Delta K = \frac{2p_1}{3kT} n_2 (p_2 - p_1);$$

and n_2 will be proportional to the amount of light energy absorbed. In the modified 0-tube method used by us in our recent experiments, an account of which has been sent to the *Philosophical Magazine* for publication, we used a solution of $CrCl_3$ containing 0·078 gm. of Cr+++ per c.c. with $K = 13{\cdot}42 \times 10^{-6}$; the horizontal portion of the 0-tube is a capillary tube of bore 1·8 mm., which was filled partly with the solution, and the meniscus placed between the poles of an electromagnet of field strength of about 40,000 gauss, and the light from a mercury arc was focused on it. About 81 per cent of the light was absorbed in the solution and the change of susceptibility produced was equivalent to an increase of volume susceptibility of air due to an increase in pressure corresponding to a 2·4 cm. column of water; that is, $\Delta K = 7 \times 10^{-11}$ C.G.S. units. The rise of temperature of the solution was about 0·001° C. per sec.

From our experience, it appears that in Selwood's experiment the amount of light energy absorbed by the solution at the boundary of the test piece, where the magnitude of the change ΔK alone is of importance, was too feeble to produce any measurable deflection with apparatus of the sensitiveness of that used. In the course of our investigation, we have employed a similar type of apparatus to that described by Selwood, but we enclosed the paramagnetic solution in the glass test piece and the outer solution was of colourless $CeCl_3$; with this arrangement we obtained negative results.

Selwood's remark about the difficulty of explaining the increase of susceptibility observed in didymium nitrate as due to a temporary breakdown of l-coupling is justified. We ought to have mentioned specially that our theory applies only to ions of the iron group.

The writing of this letter was delayed due to the absence of one of us in Europe.

D. M. BOSE.
P. K. RAHA.

Department of Physics,
University College of Science,
Calcutta.
Dec. 11.

[1] NATURE, **131**, 761, May 27, 1933.

Modulation of Very Short Radio Waves by Means of Ionised Gas

ION densities of the order of 10^{11} ions/cm.^{3}, such as occur in gases in glow discharges under the usual conditions, are of the correct magnitude to affect very considerably the index of refraction and absorption of these media for ultra-short radio waves. It has been found that the intensity of a beam of radiation of wave-length 9·5 cm. can be easily modulated by causing it to traverse such an ionised gas in which the ion density is caused to vary.

A glow discharge tube of dimensions equal to several wave-lengths was used to provide the ionised medium. It was connected to a direct current supply in series with an audio frequency voltage. The D.C. supply was used to maintain the discharge at the required level and the audio frequency to provide the variations of ion density for modulation purposes. This tube was placed in the radio beam between the transmitter and receiver while music or speech modulation were impressed on it. The fidelity of the sound thus received was, as closely as could be noted by the ear, a good replica of the output of the audio amplifier which was impressed on the ionic modulator.

Modulation was obtained also by causing the beam to be reflected from an approximately flat surface built up of glow discharge tubes in the form of concentric rings. However, the degree of modulation was not as great in this case as when the beam was made to traverse the ionised medium. It appears that the modulation is due principally to absorption, although reflection, scattering and refraction also play a part.

This method of modulation yields more pure amplitude modulation than does direct modulation of the oscillator, since the frequencies of ultra-short wave generators, such as Barkhausen-Kurz tubes and magnetrons, are quite susceptible to variations in the applied voltages.

The oscillator used in this work consisted of a small split-anode magnetron, the split anode being 4 mm. in diameter and 7 mm. in length. The receiver was a crystal detector coupled to an audio amplifier. Parabolic reflectors were used with both transmitter and receiver.

Further details will be given in other publications.

ERNEST G. LINDER.

Research Division,
RCA Victor Co., Inc.,
Camden, N.J.
Jan. 4.

Radiation and Ionisation produced by High Energy Electrons

ON the basis of Dirac's theory, Heitler and Sauter[1] have calculated the probability that high energy electrons in their passage through matter emit a quantum of energy comparable to their own. These results, as they recognise, are in contradiction to the measurements of Anderson[2] and Blackett and Occhialini[3] on the energy losses of high energy particles. The rate of ionisation of a gas by an electron as calculated from Dirac's theory agrees closely, however, with the experimental results.

These results indicate either that Dirac's equation cannot be applied to high energy particles or that the structure of the nucleus, finite size and finite potential within its boundary, plays a rôle. The rate of ionisation is independent of the potential within the nucleus, whereas the probability of radiation for high energy electrons is decreased in the ratio of the value of the potential within the nucleus to the energy of the electron expressed in equivalent units. The finite size plays no part until the energy is such that the waves scattered from the different parts of the nucleus can interfere. With this correction to the nuclear model, Dirac's theory gives results which are in harmony with the experimental evidence, and thus seems to be applicable to processes which occur outside the limited region of the nucleus. These calculations, which were made by the Born method of successive approximations, were carried to a first order.

This decrease in the rate of radiation by high energy electrons, compared to that calculated on the assumption of a Coulomb field for the nucleus, is accompanied by a corresponding decrease in the rate of production of pairs, electron and positron.

ARTHUR BRAMLEY.

Bartol Research Foundation,
Pa.
Jan. 8.

[1] NATURE, **132**, 892, Dec. 9, 1933.
[2] *Phys. Rev.*, **44**, 406; 1933.
[3] *Proc. Roy. Soc.*, A, **139**, 699; 1933.

The Term 'Mesolithic'

FOR many years it was the custom to regard the line of separation of the Palæolithic and Neolithic periods as roughly corresponding to the geological division between the Pleistocene and Holocene; and even Mr. Peake's excellent historical summary (NATURE, Jan. 20, p. 104) does not make it clear why this position was ever abandoned. It is unsatisfactory, and a source of confusion, that the term 'Neolithic' should be used in a broad sense by one generation, and in a very narrow one by the next—that in one case it covers several thousand years in many different lands, while in the other it varies enormously in length in different countries, and in England (where the term originated) it is whittled down to a few decades, with some risk of complete disappearance.

Of course, no one questions that the cultures of Tardenois, Maglemose, etc., are very distinct from that of the 'Age of Polished Stone'; but that could easily have been overcome by a division into Early and Late Neolithic, or, for those who are not happy without new names, into 'Mesolithic' and 'Metalithic' periods. We could then have gone on applying 'Neolithic' in a comprehensive sense to submerged forests, the lower strata of Tilbury and other docks,

the Blashenwell tufa of Dorset, and other cases in which no precise dating is at present possible.

Is it altogether too late to return to this convenient arrangement? Such a conservative course may not commend itself to those professional archæologists to whom even such a sesquipedalian invention as 'Epipalæolithic' has no terrors; but it would be a comfort to the general reader, and to those who, like myself, occasionally wander over the border between geology and archæology.

The Gate House, Bournemouth West. HENRY BURY.

I AM grateful to my friend Mr. Harold Peake for dealing with this question of the term 'Mesolithic' so fully. Unfortunately, I am unable to doubt that this term has now received wide acceptance among archæologists. But this cannot alter the fact that from the point of view of a correct nomenclature it must be wrong to designate as 'mesolithic' specimens which are agreed on all sides to be referable to the latter part of the Stone Age. It is as if I were to be asked to acquiesce in calling 'mid-Victorian', circumstances, or objects, relating to the end of that epoch. I cannot believe that it is beyond the wit of archæologists to find some term, descriptive of the period and artefacts in question, which will not violate common-sense. Mr. Peake will perhaps allow me to express doubts as to whether I am the only archæologist who objects to the term 'mesolithic'. But, even if his dire prophecy is true, I am cheerfully prepared to remain in a minority of one in this matter.

One House Lane, Ipswich. J. REID MOIR.

Inheritance of Egg-Colour in the 'Parasitic' Cuckoos

PROF PUNNETT[1] has suggested that Prof. Wynne-Edwards' ingenious hypothesis[2] for explaining how the *gentes* of 'parasitic' cuckoos may be kept distinct despite their promiscuous or polyandrous mating habits could be replaced by the assumption that it is the *Y*-chromosome of the mother which carries the factor assumed to determine the *gens* to which the offspring belong. It is not clear that such an alternative theory has any advantages over the original one (though it might have, were the degree of mimicry invariable). It seems slightly less plausible genetically owing to the paucity of known *Y*-chromosome genes, and has the distinct disadvantage that it involves the offspring all belonging to the same *gens* as the mother; the "mechanism . . . provided for stabilising the population by damping the fluctuations caused by the host species" which is inherent in Prof. Wynne-Edwards' theory is therefore lacking.

Both Prof. Wynne-Edwards and Prof. Punnett assume that the different *gens* factors postulated comprise a single series of multiple allelomorphs. The latter stresses this as an essential corollary, and considers as an objection to the hypothesis the fact that in the domestic hen egg-colour is determined by several independent autosomal genes. But the assumption of several pairs of sex-linked factors would explain the observations even better than a single multiple series, since it would account for the imperfection of mimicry found in areas where one species of cuckoo 'parasitises' several hosts. Further, Prof. Wynne-Edwards mentioned the probability that autosomal modifiers also exist. Prof. Punnett has cited one of many cases in which genes presumed to be phylogenetically homologous are situated on different chromosomes in different species. The assumption of a limited number of sex-linked pairs of genes rather than a single series would therefore seem to remove the only genetical objection raised by Prof. Punnett.

C. LEONARD HUSKINS.

McGill University, Montreal. Dec. 22.

[1] NATURE, 132, 892, Dec. 9, 1933.
[2] NATURE, 132, 822, Nov. 25, 1933.

Possible Chemical Nature of Tobacco Mosaic Virus

DR. J. CALDWELL[1] has criticised some of our statements on the possible chemical nature of the virus of tobacco mosaic. We must point out that the essential precipitant used in the Vinson and Petrie method is not basic lead acetate but neutral lead acetate. We are also quite aware of the fact that the addition of two volumes of acetone to one of aqueous *M*/1 KH_2PO_4 solution produces a heavy precipitate of white rhombic crystals, but as Vinson and Petrie and ourselves were concerned with an *M*/15 solution of this salt, Caldwell's criticism is irrelevant. If acetone (two volumes) be added to an aqueous *M*/15 solution of KH_2PO_4 or to an eleuate prepared from healthy sap, only a faint white opalescence makes its appearance and a slight precipitate settles after many hours.

It is mentioned in our communication that the crystalline fraction of the acetone precipitate is mainly composed of phosphate, but we still maintain that, although infective, it contains no nitrogen. The statement that the *N. glutinosa* method is a quantitative one for determination of virus is misleading, as at best the method can only give a very rough approximation of the relative concentration of the virus in samples of high dilution.

E. BARTON-WRIGHT.
ALAN M. MCBAIN.

Scottish Society for Research in Plant Breeding, Craigs House, Corstorphine, Edinburgh, 12. Feb. 6.

[1] NATURE, 133, 177, Feb. 3, 1934.

A Tame Platypus

WITH reference to the platypus mentioned in NATURE of September 16, 1933, p. 446, Mr. R. Eadie, who has attended to the animal, informs me that it is still alive and has been, at the date of writing, in captivity for 282 days.

The references to diet require modification. The daily ration is at present 10 ounces of worms, 50 small tadpoles, wood grubs two or three times a week, and 2 eggs—usually duck eggs—every night. The eggs are prepared in the form of a batter and then steamed. When cold the mass is stirred with a fork until it consists of pieces the size of a large pea. Mr. Eadie estimates the quantity of food consumed at fourteen ounces daily. The weight of the platypus at the time of writing is three and a quarter pounds.

JAMES W. BARRETT.

103–105 Collins Street, Melbourne, C.1. Nov. 21.

Research Items

Mental Tests of the African. The difficulties and special methods requisite in the study of the African by the employment of intelligence tests are discussed by Dr. R. A. C. Oliver, Carnegie fellow for educational research in Kenya, in *Africa*, vol. 7, pt. 1. Dr. Oliver has been engaged in the study of general intelligence, and in a lesser degree of musical talent, in Kenya natives. His general tests were devised to measure the intelligence of natives who had received some schooling, and were non-verbal tests, the problems being presented in pictures and other symbols. The kind of test to be used varies with the feature of African mentality in which we are interested ; but we ought to know more about the African's abilities in specific activities and their special strength or weaknesses. The type of test will also depend on education and the language situation. Two lessons are suggested by experience : first, that it is highly desirable to precede the test with a demonstration and practice ; and secondly, that the time allowed should be unlimited or ample. An application of a general intelligence test to 124 pupils of a secondary school for European boys and 93 pupils of a secondary school for African boys in Kenya produced two main facts. The average mark of the African was 85 per cent of the average mark of the European ; secondly, 14 per cent of the Africans gained a mark as high or higher than the average European mark. This leads to a conjecture that, comparing the variability with that of Europeans, a small percentage of Africans might be capable of a university education ; a larger percentage might complete the secondary school course ; a still larger percentage might undertake a few years in the secondary school and the mass of the African people might take a full primary school course.

European Bitterling spawning in American Mussels. The bitterling (*Rhodeus amarus*), a European minnow, was introduced into Sawmill River, New York, in or before 1925, and after surviving for a few years disappeared. The suggestion was made that lack of suitable mussels, within which the eggs might be deposited, determined the disappearance of the bitterling. C. M. Breder, however, has made special observations of bitterlings and American mussels, kept together in an aquarium (*Copeia*, 1933, p. 147). Although actual oviposition was not observed, the courtship behaviour of the fishes agreed with the descriptions in European aquarium journals, and when one of the mussels was opened four days later, seven bitterling embryos were found in the gill folds, embedded as described for European mussels. The first opened mussels belonged to the species *Unio complantus*, but two specimens of another species, *Anodonta cataracta*, contained three and ten embryos respectively. Since in Europe *Rhodeus* is known regularly to use both *Unio pictorum* and *Anodonta cygnea*, it would seem that a considerable variety of mussels is available for the peculiar reproductive habits of the bitterling, and that other causes than the unsuitability of the mussels must be sought to account for the disappearance of the specimens set free in an American stream.

Fossil Insects from the British Rhaetic and Lias. The Trustees of the British Museum issued during 1933 the third of their series of publications on fossil insects. The present work is in the form of a small handbook entitled "The Panorpoid Complex in the British Rhaetic and Lias" by Dr. R. J. Tillyard. The material upon which it is based consists of nearly one hundred specimens, contained in the British Museum, with a further eleven specimens in the Museum of Practical Geology. It includes examples belonging to the orders Neuroptera, Mecoptera, Paratrichoptera, Trichoptera and Diptera. These groups, along with the Lepidoptera (not represented among the material) form a related assemblage of orders which constitute what Dr. Tillyard has termed the Panorpoid Complex. They centre around the primitive order Mecoptera, and it is to this group that most of the specimens dealt with in this memoir belong. The Mecoptera in the collection include nine species, embracing four genera, of which three of the latter were previously undescribed. The Neuroptera comprise two new species, each representing an already known genus, while the only Paratrichopteron forms the type of a new family—the Liassophilidæ. The Trichoptera are represented by fourteen specimens, all pertaining to species (mostly new) of the genus *Necrotaulius*. Of the Diptera there are only three examples : these are Tipaloid forms which are referred to the new genus *Liassotipula* and the new species *anglicana*. As is usual among British Museum publications, this work is well printed and admirably illustrated. It is obtainable through booksellers or from the Museum, price 5*s*.

Studies on Cuticle. V. B. Wigglesworth has recently recorded observations on the cuticle of the blood-sucking bug, *Rhodnius* (*Quart. J. Micr. Sci.*, **76**, Part II, 1933). The cuticle consists of two primary layers—a very thin epicuticle and a relatively thick endocuticle traversed by fine pore-canals. The epicuticle is composed of material (cuticulin) the chemical properties of which are like those of the cutin or suberin of plants. The endocuticle is composed of protein and chitin, and is made up of two layers. The nymphal stages of *Rhodnius* ingest from six to twelve times their weight of blood at a single meal and the adults may take three times their own weight. The abdomen is therefore capable of great distension, which is accomplished in the nymph and the adult in a different way. In the former the endocuticle is flexible and free from cuticulin, and in the fasting nymph the overlying epicuticle is thrown into deep folds. When the abdomen is distended with blood the endocuticle is stretched and attenuated and the folds of the epicuticle are smoothed out. In the adult the outer part of the endocuticle is permeated with cuticulin, is rigid and can not be stretched. A deep longitudinal fold or pleat in the lateral wall of the abdomen permits distension of this region. The dermal glands and their ducts, the structure of the epidermis, including the cells crowded with spheres of uric acid, the process of moulting and the formation of new cuticle are described. It is suggested that the œnocytes, a new generation of which arises at each moult (except the last) from embryonic cells in the epidermis, synthesise some of the nonchitinous constituents of the cuticle during moulting and of the egg-shells during maturation of the ova.

Research on Lichens. A paper by Miss A. Lorrain Smith in vol. 18, pt. 2, of the *Transactions of the British Mycological Society* reviews recent lichen literature (pp. 93–126). The author describes several works on lichens which have appeared during the last two years. Perhaps the most monumental of them is Zahlbruchner's "Catalogus Lichenum". Contributions to our knowledge of gonidia, parasymbiosis, lichen structure, soralia, isidia, cephalodia, and apothecial reproduction are reviewed critically. The section on physiology collects some very useful knowledge about lichen acids, and paragraphs on the rate of growth, lichens as pests and gall formations are very interesting. Systematy and ecology are treated at considerable length, and a bibliography of nearly three hundred references is of great benefit to all students of lichens.

Entomogenous Fungi of Egypt. A short bulletin (No. 120) of the Technical and Scientific Service of the Ministry of Agriculture for Egypt deals with some entomogenous fungi in Egypt (by Dr. R. M. Nattrass, pp. 1–9, Cairo, 1932). The paper describes various fungi which attack Egyptian insects. Species of the genera *Empusa*, *Aspergillus*, *Beauveria*, *Metarrhizum* and *Mucor* are involved, and some of their cultural characters are given. Inoculation experiments are described, but there seems little likelihood that fungi may be used as a method of control for insect pests. The work is admittedly of a preliminary nature, but warrants extensive investigation for the sake of the mycological problems involved.

West Highland Tectonics. At the meeting of the Geological Society on January 10, Prof. E. B. Bailey presented a valuable paper on the structure of the Loch Leven to Glen Roy district. Study of the current-bedded quartzites of Loch Leven has confirmed various deductions previously recorded and has led to certain new conclusions. T. Vogt, S. Buckstaff and O. N. Rove are found to be correct in claiming the Eilde Flags as the oldest member of the Eilde Flag–Cuil Bay succession. R. G. Carruthers is correct in placing three quartzites and three mica-schists between the Eilde Flags and the Ballachulish limestone. The gigantic recumbent folds of the district tend to retain their inverted limbs intact and to lose their normal limbs by drag. The Am Bodach quartzite is found to belong to the Eilde, and not to the Glen Coe, quartzite ; it occurs in a recumbent fold that has its roots four miles farther east. The quartzite of the eastern Stob Coire Easain, above Loch Treig, is also Eilde quartzite and marks another large-scale inversion. The strong folding of the Fort William slide in Glen Roy, first recognised during a preliminary traverse by R. G. Carruthers, has now been established in detail.

The Quinhydrone Electrode. The increasing use of the quinhydrone electrode makes a study of its normal potential of importance, and in this connexion some experiments by Harned and Wright (*J. Amer. Chem. Soc.*, December 1933) are of interest. The cell : Pt / Quinhydrone, HCl(0·01*M*) / AgCl / Ag, without liquid junction was used, and details as to the preparation of the materials and the technique, the cell being operated in vacuum (a necessity for the silver electrode), are given. By combining the results with those for the cell H_2(1 atm.)/HCl(*m*)/AgCl/Ag, previously investigated, the electromotive forces of the important cell Pt/Quinhydrone, HCl(*m*)/H_2(1 atm.) are calculated, and thence the normal potential of the quinhydrone electrode. Values were found at temperatures from 0° to 40°, although side reactions quickly destroy the equilibrium at temperatures above 30°. The values for the normal potential of the quinhydrone electrode are expressed in a quadratic equation as regards dependence on temperature, and it is shown that they agree to 0·2 millivolt with those interpolated from the earlier measurements of Biilmann and his collaborators, who measured the potentials directly against the hydrogen electrode. The new results are considered the best available at the present time. Some peculiarities in the behaviour of the cells are of interest.

Vitamins from Egg Yolk and Fish Oil. Dr. N. K. Basu, working in Calcutta, reports in communications to the Editor that he has obtained vitamin A by irradiation of a sterol isolated from egg-yolk, and also that he has succeeded in isolating crystals of vitamin D from a fish oil. The egg-yolk sterol has a melting point of 62°–67° C. : on irradiation with ultra-violet light of wave-length 2750–3000 A., a substance reacting strongly with antimony trichloride was obtained. Spectroscopic examination of the product showed the maximum absorption to be in the ultra-violet at 3280 A., and the blue colour developed with antimony trichloride showed absorption bands at 5720 A. and 6200 A. Crystalline vitamin D was isolated from the oil of *Notopterus chital*, a fish common in Bengal. A concentrate obtained from the oil was distilled at a temperature of 120°–140° C. and at a pressure of 1 mm. On cooling, this crystallised in the form of needles having a melting point of 117°–120° C. and showing maximum absorption at 2650 A. : the crystals gave no precipitate with digitonin. The final confirmation of the identity of these two products with vitamins A and D respectively will, of course, depend on the results of the biological tests, which are not reported. The properties of the crystals obtained from the fish oil agree fairly well with those of calciferol. It is more difficult to correlate the production of vitamin A from a sterol with the fact of its formation from carotene in the body.

Radiation from Variable Stars. The very delicate operation of measuring the radiation from stars with the aid of specially constructed thermocouples attached to the 100-in. telescope at Mount Wilson has previously been mentioned in NATURE (123, 425). The results of observations by E. Pettit and S. B. Nicholson on variable stars during the period 1921–27 have now been published in the *Astrophysical Journal* (78, 320). Observations were made on twenty-one long-period variables, nine irregular variables, two Cepheids, and on Algol. In the case of the long-period variables, it was found that on the average the real energy maximum occurs about 50 days later than the visual light maximum, though the variations of temperature are approximately in phase with the light curves. The average temperature range is from 1800° K. to 2350° K., and the coolest star observed (χ Cygni) varies from 1630° K. to 2260° K. In the case of the two Cepheid variables η Aquilae and δ Cephei, as well as in Algol, the changes in radiometric magnitudes are in phase with their light curves. This result is to be expected, since the maximum of energy for stars of this class is in the visual region of the spectrum.

A Velocity-Modulation Television System

MANY of the investigators who are seeking at the present time to develop a practical system of television make use of the cathode ray oscillograph tube in one form or another, since the electron beam in such a tube provides an easily controlled means of scanning the picture to be transmitted. At the receiving end, the cathode ray tube is employed to build-up the received picture by varying the intensity of the beam in accordance with the light and dark portions of the picture. The ordinary type of cathode ray tube, however, gives only a small range of intensity control without the accompaniment of loss of focus of the spot on the fluorescent screen, and special electrode systems have to be arranged to obtain good intensity modulation in this manner. As an alternative to this method, the intensity of the cathode ray beam may be kept constant but its tranverse velocity may be varied as it moves over the picture, the beam being speeded up over the dark portions of the picture and slowed down over the light portions. The corresponding motion of the cathode ray beam at the receiving end thus gives varying illumination according to the speed of travel of the spot on the fluorescent screen, and with the aid of the phenomenon of persistence of vision, a true impression of the shades and contrasts in the picture received is obtained.

The conception of this velocity-modulation principle, or variable-speed cathode ray television, dates back to 1911, when it was described in a British patent by B. Rosing. Since that date the principle appears to have fallen into oblivion until it was revived in Germany by R. Thun in 1929. The first practical realisation of the method was achieved by M. von Ardenne in 1931 and reference was made to this work in NATURE of October 7 last (p. 573).

During the development of cathode ray oscillograph tubes for general scientific and technical purposes, the staff of Messrs. A. C. Cossor Ltd. realised the possibilities of the above system of television, and an account of the development work carried out during the past eighteen months was presented in a paper entitled "A Velocity-Modulation Television System", read before the Wireless Section of the Institution of Electrical Engineers by Messrs. L. H. Bedford and O. S. Puckle on February 7.

Consideration of the basic principles outlined above shows that it is impossible to realise a velocity-modulated picture from a uniformly scanned object; the scanning at the transmitter must also be of the variable-speed or velocity-modulated type, and must therefore be carried out by a cathode ray. It follows that a cathode ray oscillograph must serve as the source of light at the transmitting end, and, with oscillographs of the ordinary low-voltage type, the conditions of scanning-light economy will restrict the picture subject matter to cinematograph film material. This, however, is not considered to be a disadvantage of the method; many of the television systems being developed at the present time make use of a film as an intermediary, and processes are being devised in which the interval between the photography of the subject and the projection of the picture through the transmitter is reduced to the bare minimum.

The transmitting arrangements described by Messrs. Bedford and Puckle comprise the projection of light from the fluorescent screen of the oscillograph through the film picture on to a photoelectric cell. The output of the photo-cell amplifier operates, through a screen-grid valve and a thyratron, an electrical time-base circuit which supplies the potential difference to one pair of the deflecting plates of the oscillograph. The light from the cathode ray tube is thus swept in a straight line across the picture with a velocity which varies according to its transparency at different points. At the end of each scanning line, the discharge of the thyratron provides a 'fly-back' action to the spot sufficiently rapid to be invisible. Simultaneously with this operation, a second valve and thyratron circuit provides a traversing time-base potential difference to the second pair of deflecting plates of the oscillograph tube. By this means the scanning line is traversed across the picture in successive steps.

From this description it will be realised that an image of the picture being transmitted is built up on the fluorescent screen of the cathode ray oscillograph, and this is found to be a useful feature of the system for monitoring purposes. Furthermore, for the reproduction of the image on the screen of another oscillograph tube at a distant receiving station, it is merely necessary to transmit to the second tube the voltages being applied to the two pairs of deflecting plates of the first tube. If these voltages are sent through two separate channels, the received picture is automatically synchronised with that at the transmitting end.

The authors of the paper referred to above have modified this arrangement to some extent, however, to enable all the intelligence to be sent along a single channel. Using a picture frequency of 25 per second with a detail corresponding to 120 or 160 scanning lines, the transmitted signals require a frequency band of the order of 240 kilocycles per second; and special amplifiers have been developed to give uniform amplification over this range. The size of the picture received depends upon the deflector voltages which may be applied to the oscillograph electrodes, and it is anticipated that future design and manufacture will enable a suitable receiver tube with a 9-inch screen to be produced. Among the advantages of the method described above over that employing intensity-modulation are the increased picture brightness for a given receiving oscillograph and the concentration of detail in the light portions of the picture.

Although Messrs. Bedford and Puckle's experiments have so far been limited to transmission over wire lines, no particular difficulty is anticipated in applying the necessary signals to radio transmission, at least on the ultra-short wave-length of a few metres where such a large frequency band as 240 kc./sec. may be permitted. At the reading of the paper, a cinematograph film was shown illustrating typical pictures received in a laboratory test of the whole system. Among the features brought out in this demonstration was the fact that, when required to obtain a better contrast ratio in the received picture, intensity modulation may be superimposed with advantage upon the velocity-modulation signals, and means of achieving this very satisfactory combination are being investigated.

Astronomy and International Co-operation

IN his presidential address to the Royal Astronomical Society at its annual meeting on February 9, Prof. F. J. M. Stratton sketched the development of schemes of international co-operation in astronomy during the last hundred years. The first such scheme was that of the Berlin Academy for a chart and catalogue of stars down to the 10th magnitude, to be completed by a number of continental astronomers by 1828; it was actually not completed until 1858. Along the same lines were the plan of the *A.G.* zone catalogues drawn up in 1869, and later still the more ambitious photographic "Carte du Ciel" set on foot in Paris in 1887 and not yet completed. The founding of the "Centralstelle" for astronomical telegrams and the various activities of the Astronomische Gesellschaft kept the Germans for many years the chief organisers of joint astronomical schemes, but after the Permanent Commission of the Carte du Ciel had been established with its occasional gatherings of astronomers at Paris, the headquarters for international astronomy of position shifted to France.

In Paris were held conferences on fundamental stars and on co-operation in the work of preparing national ephemerides; there too were established the Bureau de l'Heure and the Bureau des Poids et Mesures. The United States became active in this sphere at the Washington Conference of October 1884, when the meridian passing through the centre of the transit instrument at the Observatory of Greenwich was adopted as a single prime meridian for all nations. From the United States, too, came the impetus which founded the International Solar Union; this body performed for solar and stellar physics the same function as that of the Permanent Commission of the Carte du Ciel for the older astronomy.

The War cut right across the older organisations, and in 1919 the International Astronomical Union was founded in an attempt to start once again the sadly crippled forces of co-operation. The new body set up more than thirty committees to deal not only with the work inherited from the earlier organisations but also with many branches of astronomy, such as double stars, which had remained unprovided for owing to the casual way in which the earlier schemes had come into being. Over the whole field of astronomical research the Union, without in any way interfering with individual liberty, has endeavoured to provide a common meeting ground for the discussion of problems and the preparation of schemes of mutual co-operation. Valuable reports from the various committees have been published, notably on standard wave-lengths, stellar photometry and stellar classification; these have been published in the volumes of transactions freely distributed to observatory libraries.

Grants in aid have been made by the Union for the publication of tables and observations, for printing volumes of the "Carte du Ciel", for the Bureau de l'Heure at Paris and the Bureau of the Variation of Latitude at Mizusawa, for computations in connexion with the recent opposition of Eros. (The Astronomer Royal gave an account of the progress of this work at the same meeting of the Royal Astronomical Society—a valuable illustration of the work of the Union.) In all, grants of more than £14,000 have been made by the Union to its committees. The present financial world crisis has not left the Union unscathed, but it is continuing "alive and responsive to new needs and changing conditions, a powerful support of astronomy in all its branches and a centre of co-operative good-will among the astronomers of the whole world".

History and Management of the Hope Farm, Jamaica

TO the British Empire, the problem of milk production in the tropics is of paramount importance. It is a problem which at the present moment faces both the administrators and their agricultural advisors in each one of the British tropical dependencies and in India. The "History of the Hope Farm and Part 1 of the Jamaica Herd Book of Pure Bred Cattle" by H. H. Cousins, is an outstanding contribution to this subject (Pp. vi + 308 + 59 + 54 plates. Kingston, Jamaica: Government Printing Office, 1933). This Jamaican estate, becoming derelict, passed in 1909 into the hands of the Government and represents a somewhat unusual incident in Government operations by which an officer was called upon to justify, as a commercial concern, the acquisition of land as public property, practically without capital and dependent upon the earnings of the enterprise for its development. The assets of the Farm now show a gain of nearly £16,000, or an annual increase averaging £751 from 1910 until 1931.

What will mostly appeal to livestock men in the tropics is the detail which has been put forward concerning the productivity of cows of many pure breeds and of their crosses. Many of the imported cows were of British breeds and came from Great Britain or North America. From India came the Nellore, Sahiwal and other Zebu cattle. The lifetime history of each cow is clearly set out. Several experiments in inbreeding were attempted, but the only one which appears to have had any measure of success involves the mixture of the Zebu with the Jersey. The excellent photographs, studied in conjunction with the records of the animals concerned, provide useful information.

An interesting point in the organisation of this farm, and one which may be commended to the attention of Colonial administrators, relates to its finances. It was recognised from the start that this enterprise should be operated on a separate account at the Treasury. The approval of the Secretary of State was obtained for this departure from the usual system of departmental finances, whereby expenditure was 'debited' and the revenue 'credited' to the general account without any direct connexion between the two. The method adopted for Hope Farm allows that freedom of decision which is essential for the proper conduct of a farm.

More important still is that where genetic experiments with cattle are concerned, the financial establishment of a farm should be along these lines, in order that there may be continuity in method over that period of years which is demanded by the nature of the investigation. Too often has a change in the

policy of the Government resulted in the 'axing' of an inquiry of this nature. Twenty-five years is not too long for such an experiment, upon which it may be a waste of time and money to embark unless there is some guarantee that the work will be carried forward. Mr. Cousins has achieved this and it is greatly to his credit and to his foresight at the time the Farm was established. After serving the Colony for a quarter of a century, he is now retiring from the post of Director of Agriculture. This report represents an important section of his work and he must indeed be a proud man who can leave such a memorial of service behind him.

University and Educational Intelligence

CAMBRIDGE.—Dr. P. E. Vernon, of St. John's College, has been appointed to the Pinsent-Darwin studentship for three years.

J. A. Steers, of St. Catharine's College, has been appointed to represent the University at the International Congress of Geography to be held in Warsaw in August–September of the present year.

At Pembroke College, J. W. F. Rowe, University lecturer in economics, has been elected to a fellowship.

SHEFFIELD.—Mr. Arthur Pool has been appointed lecturer in mental diseases.

The Council has received a gift from Dr. Foggo of old medical books, anatomical plates, surgical instruments, etc., belonging to the late Dr. Rooth, of Dronfield.

DR. H. E. C. WILSON, lecturer in physiology in the University of Glasgow, has, with the approval of the Government of India, been appointed professor of biochemistry and nutrition at the All-India Institute of Hygiene and Public Health, Calcutta.

APPRAISEMENT of fitness for admission to secondary schools is a task which each year taxes the ingenuity of local education authorities. The technique evolved in grappling with its difficulties in the West Riding of Yorkshire is set forth in some detail in a report by the Education Officer, on the examination for county minor scholarships of some fourteen thousand children of ages 10–12 years, of whom about one seventh were successful. To the written examination in English and arithmetic there was added this year a group intelligence test taken by all candidates in place of an oral test. This was favourably reported on by Prof. G. H. Thomson and was found helpful in dealing with 'border line' cases. The chief examiner's report includes a careful estimate of the evidence afforded by the answer papers in arithmetic of divergence in mental capacity between boys and girls and an expression of a fear "that too often the girls' natural clinging to painstaking methods is reinforced by their training, instead of being to some extent supplanted by the development of that initiative so necessary—even for women—in every walk of life". The report on the examination in English quotes a number of surprising and psychologically interesting 'howlers'. The following essay on "The Importance of Little Things" affords (with many others) evidence, the examiner believes, of ill-assimilated health talks: "An atom is a small animal. It has no legs or arms but has a mouth and means of indigestion. Without these we cannot live: scientists have proved it".

Science News a Century Ago

Baldwin's Locomotive *E. L. Miller*

On February 18, 1834, Matthias W. Baldwin, the founder of the Baldwin Locomotive Works, Philadelphia, completed his second locomotive, the *E. L. Miller*. His first locomotive, *Old Ironsides*, completed in November 1832 for the Philadelphia, Germantown, and Norristown Railroad, was a four-wheeled engine modelled on the plan of Stephenson's engines. The *E. L. Miller*, built for the Charleston and Hamburg Railroad Co., however, was a six-wheeled engine with two driving wheels 4½ ft. in diameter and four smaller wheels attached to a swivelling or 'bogie' truck similar to that first introduced into the locomotive *Experiment* in 1832 by John B. Jervis. The *E. L. Miller* had two cylinders of 10 in. diameter, 16 in. stroke, and it weighed about 7½ tons. Baldwin, who was born in Elizabeth, New Jersey, on December 10, 1795, began life as a jeweller and silversmith. In 1825 with David Mason he set up as a machinist and soon began the construction of small stationary steam engines. With the advent of the steam railway in England, Franklin Peale, the proprietor of the Philadelphia Museum, commissioned Baldwin to make a miniature locomotive. With imperfect sketches of the engines which had taken part in the famous Rainhill trials of 1829, Baldwin made a small engine which drew two cars around a track in the Museum, and it was the success of this model which led to his receiving the order for the *Old Ironsides*. Baldwin died in 1866, by which time he had built more than 1,000 locomotives.

Prediction of the Tides

In 1833 our knowledge of the tides was very imperfect. Bernouilli and Laplace had attempted to formulate rules for prediction on theoretical grounds but without much practical success, and although several tide-tables were published annually, they differed considerably from one another. Sir John William Lubbock had for nineteen years been collecting tide observations for the Port of London, and on February 20, 1834, in a paper "On the Tides" read before the Royal Society, he included tables for the prediction of the tides at London, far more accurate than any previously available. He also described numerous observations on the influence of the wind, which is of considerable importance in limiting the accuracy with which tides can be predicted. The analysis of Lubbock's great mass of data was mainly due to the Rev. William Whewell, who introduced new mathematical methods into the problem. His results were published in a paper read before the Royal Society on January 9, 1834: "On the empirical Laws of the Tides in the Port of London, with some Reflections on the Theory".

Anniversary Meeting of the Geological Society

The anniversary meeting was held on February 21 at the Society's apartments in Somerset House; Mr. Greenough was continued president, and R. I. Murchison and H. Warburton were elected to succeed Dr. Fitton and Prof. Sedgwick, the retiring vice-presidents. It was announced that the proceeds of the Wollaston donation fund had been awarded to M. Agassiz in testimony of the high opinion entertained of his work on fossil fishes, and to encourage him in the prosecution of his important undertaking. The Society dined at the Crown and Anchor Tavern,

and afterwards adjourned to their own apartments to hear the remainder of the president's anniversary address.

Ashmolean Society, Oxford

At a meeting of this Society held on February 21, 1834, P. Duncan, of New College, exhibited part of the contents of a mummy of a crocodile, recently presented to the museum by Mr. Munro ; and gave some account of crocodiles from Cuvier and other writers. Dr. Daubeny exhibited Daniell's pyrometer, and made some observations on the influence of light on animal life ; and concluded by proposing the following query : "Is it reasonable to suppose (with Dr. Edwards) that the singular animal called the *Proteus Anguinus*, which occurs in the dark caverns of Carniola, is a reptile whose form has never been developed, bearing the same relation to some unknown species which the tadpole does to the frog ?"

Agricultural and Horticultural Museums and Gardens

Agricultural Museum, Edinburgh. Prof. Law, the scientific teacher of agriculture in the University of Edinburgh, has long been engaged in forming, at his own private expense, an agricultural museum ; and we are most happy to learn, from the Scotch newspapers, that government has lent pecuniary aid to so useful an undertaking. Whether any exhibition of the kind instituted at Stirling, and followed by Mr. Lawson of Edinburgh, and Dickson of Perth, is to be combined with this museum, we have not learned ; but we are most happy to see the government of the country taking an interest in such national objects. We hope the time is not far distant when a sum will be advanced to complete the Thames tunnel, and another to establish the Horticultural Society's garden at Chiswick on a permanent footing. If this is not done by government, we hope that, when the metropolis and its environs are put under one system of self-government, they will have a metropolitan garden, either at Chiswick, or elsewhere, worthy of the first city in the world, and open to all its citizens. (J. C. Loudon, in the *Gardener's Magazine* of February 1834.)

Brunel's Thames Tunnel

In February 1834, a collection of models of buildings and public works was on view in King William Street, West Strand, London, the most important exhibit being a model of the Thames Tunnel from Rotherhithe to Wapping. The model, which was on a scale of $\frac{1}{8}$ in. to a foot, was described by the *Times* as doing great credit to the ability, ingenuity and taste of the artist and as an exceedingly accurate representation in miniature of what the tunnel would be when completed. Begun in 1825, the tunnel, for which the elder Brunel was the engineer, had attracted a great deal of attention and on one occasion the Duke of Wellington said : "Of my own knowledge I can speak of the interest excited in foreign nations for the welfare and success of this undertaking ; they look upon it as the greatest work of art ever contemplated". As in the case of Trevithick's tunnel of 1808, immense difficulties were encountered during its construction. In May 1827, when a distance of 544 ft. had been excavated, there was an irruption from the river. This was overcome, but in January 1828 a more serious irruption occurred, which nearly cost the younger Brunel his life, and as funds were then exhausted, work ceased for the time. Various efforts were made to obtain funds from the Government for the completion of the work and the negotiations which finally proved successful were in progress when the model of 1834 was on exhibition to the public. The tunnel, which was 1,300 ft. long, 20 ft. high and 35 ft. wide, was closed to the public in 1866, when it was purchased by the East London Railway Company.

Societies and Academies

LONDON

Royal Society, February 8. G. SALT : Experimental studies in insect parasitism. (1) Introduction and technique. (2) Superparasitism. Statistical analysis of field data relating to natural parasitism by *Collyria calcitrator*, *Ibalia leucospoides* and *Limnerium validum* shows that the parasites were not distributed at random among their hosts. A female of *Trichogramma evanescens* placed on a group of hosts can be observed to avoid ovipositing in hosts already attacked. Females of *Trichogramma* are able, at least for a time, to retain their eggs rather than deposit them in parasitised hosts. This restraint leads to the deposition of fewer eggs than the parasites are actually capable of laying. Females of *Trichogramma* are able to distinguish between large and small hosts and, when the number of hosts is limited, lay two, three or even four eggs in some of the larger ones. The hypothesis that the progeny of parasitoids are distributed at random, without reference to the previous parasitisation of the host, is untenable for the species considered. MISS D. E. SLADDEN : Transference of induced food habit from parent to offspring (1). Previous experiments with the stick-insect (*Carausius morousu*) in 1912–15 tended to indicate the inheritance of an induced food-habit. With the object of testing this possibility a series of experiments was devised. In the first generation few insects took ivy at all readily, only 10 per cent at the first presentation, 32 per cent at the second, 21 per cent at the third, 12 per cent at the fourth and so on for as many as ten presentations before the whole 125 insects being tested were induced to accept ivy. These insects were then grouped according to the presentation at which ivy was taken and reared to maturity on that food-plant. In the next generation 78 per cent took ivy at the first presentation. Other insects of the second generation were tested for preference. An insect on hatching was given both privet and ivy, being required to show its preference at three successive feeds. Some insects took only privet, others only ivy and yet others showed no preference. These were regarded as neutral. Offspring of privet-fed parents, 44 per cent privet, 35 per cent neutral, 21 per cent ivy. Offspring of ivy-fed parents, 28 per cent privet, 37 per cent neutral, 35 per cent ivy. MISS P. A. CLAPHAM : Experimental studies on the transmission of gapeworm (*Syngamus trachea*) by earthworms. *Eisenia fœtida*, an earthworm commonly found in contaminated soil, is an important intermediate host of *Syngamus trachea*, the common gapeworm of birds. *Lumbricus terrestris*, another earthworm, may also act as intermediate host, but is much less efficient. The third stage larva of *S. trachea*, which hatches from the egg, is ingested by the earthworm ; it migrates to the muscles of the

body wall, where a thin hyaline cyst is developed around it. It remains dormant in this position, undergoing no further morphological development, until the earthworm is taken in by a chicken or other suitable host. The *Syngamus* larva then hatches, finds it ways to the lungs and trachea, where it settles down and grows to an adult gapeworm. *Syngamus merulæ*, the gapeworm of blackbirds, has been transmitted to chickens by means of infected *Eisenia fœtida*.

PARIS

Academy of Sciences, January 3 (*C.R.*, 198, 1–128). E. LECLAINCHE: Notice on Charles Porcher. J. COSTANTIN: Cultural experiments on the potato in the Pyrenees. As in previous experiments in the Alps, the yield increases with altitude. At a height of 1,400 metres the number of tubers on each plant is higher. A higher altitude diminishes the tendency to disease. P. VIALA and P. MARSAIS: *Court-Noué*, a parasitic disease of the vine. J. CABANNES and J. DE RIOLS: The Raman spectrum of water. Diagrams of the Raman spectra of water in the gaseous, liquid and solid states are given, together with the spectra of some salt solutions. E. J. GUMBEL: The mathematical expectation of the *m*th value. P. VINCENSINI: The successive transformations of Ribaucour. Families of concurrent cyclic systems. BERTRAND GAMBIER: The theorems of Meusnier and Moutard: algebraical surfaces osculating at a surface. GEORGES GIRAUD: Certain mixed problems relating to linear equations of the elliptic type. F. LEJA: A limit function connected with Lagrange polynomials and with closed ensembles. ARNAUD DENJOY: A function of Minkowski. A. KOSTITZIN: Hereditary elastic phenomena and the principle of the closed cycle. MAX SERRUYS: The rôle of peroxides in the knocking of petrol motors. Correction to an earlier communication, of December 18, 1933. P. DUMANOIS: Concerning combustion in motors. Discussion of the possible effects produced by the formation of peroxides in petrol motors. A. ETÉVÉ: A low velocity vane for windmills. PAUL BOURGEOIS and J. F. COX: The distribution of the inclinations and eccentricities of the orbits of the minor planets. AL. PROCA: The quantic mechanics of protons. PIERRE VERNOTTE: The measurement of the thermal conductivity and specific heat of insulators. V. POSEJPAL: The materialisation of the ether. A. COTTON: Remarks on the preceding paper. MAURICE ROBERT and RENÉ OZOUX: A new amplifying voltmeter. J. CAYREL: Remarks on the note by Anastasiadès on the mechanism of rectification in magnesium–copper sulphide rectifiers. The author holds, contrary to the view of Anastasiadès, that the sulphide (CuS) plays the principal part in the rectification and that the effect of the cuprous sulphide is secondary. PAUL JANET: Remarks on the preceding communication. It is pointed out that Anastasiadès and Cayrel are practically in agreement so far as their experimental results are concerned, but differ in their hypotheses regarding the respective actions of cuprous and cupric sulphide in the rectifying effect. Further work on the question is necessary. JEAN LECOMTE: The infra-red absorption spectra of the monohalogen derivatives of the saturated fatty hydrocarbons. There is, on the whole, good agreement between the positions of the maxima measured and those predicted from the Raman effect. D. SÉFÉRIAN: A method of producing the spectrum of atomic nitrogen (NI). The arc is formed between two tungsten wires in an atmosphere of nitrogen. The lines due to neutral atomic nitrogen are given and compared with the wave-lengths given by Duffendack and Wolfe. A. GRUMBACH and MLLE. M. RIBAILLIER: The photoluminescence of potash and soda. The fluorescence of these alkalis is due to the presence of traces of an organic compound, probably a formate: it is not due to the water present. RENÉ LUCAS, MARCEL SCHWOB and ANTOINE GOLDET: The thermal variation of the magnetic double refraction and dispersion of ethyl phenylsuccinate. The results, given in both tabular and graphical forms, can be interpreted by the hypothesis of molecular polymorphism. P. JACQUET: The structure of the electrolytic deposits of copper obtained in the presence of certain colloids. The deposited copper was examined by metallographic methods. Colloids differ in their effects; gelatine and serum albumen are very active, gum arabic and tragacanth are less active, dextrin and glycocoll are almost inactive. MLLE. Y. CAUCHOIS: Focalisation of X-rays by plane crystalline sheets. HORIA HULUBEI: Methods of focusing [of X-rays] in the analysis of crystalline powders. F. JOLIOT: The dematerialisation of pairs of electrons. PARISELLE and DELSAL: The polarimetric study of the ferri-tartaric complexes. J. COURNOT, M. CHAUSSAIN and H. FOURNIER: The behaviour of some light alloys towards marine corrosion. The degree of resistance to corrosion varies considerably with what would at first sight appear to be very slight changes of chemical composition, the presence of an additional 0·3 per cent of manganese reducing the loss of weight by corrosion to one half. LOUIS MÉDARD and MLLE. THÉRÈSE PETITPAS: Observation of the Raman OH band of nitric acid. MLLE. B. GRÉDY: The spectra of some acetylenic alcohols. ANDRÉ CHRÉTIEN and RAYMOND ROHMER: The hydrates of nickel sulphate.

(*To be continued.*)

VIENNA

Academy of Sciences, Nov. 2. EMIL DITTLER and J. SCHADLER: The meteorite of Prambachkirchen (Upper Austria). This meteorite, which fell on November 5, 1932, weighed 2,125 gm. and had a density of 3·583 at 4° C. It was composed largely of iron, silica and magnesia, and mineralogically consisted of 5·77 vol. per cent of troilite, 4·27 of nickel-iron, 0·18 of ilmenite, 0·97 of merrilite, 16·92 of oligoclase and oligoclase-masktelynite, 44 of olivine with about 25 per cent of fayalite, and 27·86 of bronzite with 24 per cent of hypersthene. ALEXANDER KÖHLER and HANS LEITMEIER: Results of investigations on natural thermoluminescence in minerals and rocks. Of about a thousand specimens examined, 19 mineral species almost always showed characteristic thermoluminescence. In some cases, but not all, the thermoluminescence was accompanied by radioactivity. GEORG STETTER and JOSEF SCHINTLMEISTER: Method for investigating corpuscular rays with a double chamber and a double-tube electrometer. GEORG KOLLER, KARL PÖPL and ERICH KRAKAUER: Ramalic acid. This acid, which is shown to be identical with protocetraric acid, yields cetraric acid on alcoholysis. HERMANN TERTSCH: Results of cleavage measurements on anhydrite. THEODOR PINTNER: The excretion system of cestodes. FRANZ GRIENGL, FRITZ and KARL STEYSKAL: Conductivity and solubility relationships in the two ternary systems $Na-K-NH_3$ and $Na-Li-NH_3$

between − 40° and − 70°. The conductivity of K−Na and Li−Na alloys in dilute solution in ammonia is virtually additive, and gives no indication of the formation of compounds. In the first case, the solubility curve is composed of three branches, corresponding respectively with the solubilities of sodium, the compound Na_2K, and potassium, but in the second, transition from the solubility of lithium to that of sodium is scarcely discernible.

Nov. 9. JULIUS ZELLNER: (1) Chemistry of lichens (3): *Parmelia* (*Hypogymnia*). A practical method for separating lichen acids is given. Substances not hitherto observed include ergosterol, a hydrocarbon, solid and liquid fatty acids, amorphous lichen acids, two new indifferent lichen compounds (hypogymnoles), amorphous polysaccharides, erythritol and lichenin. (2) With JARA BISKO: Contribution to comparative plant chemistry (25): Chemistry of barks. The bark of *Zizyphus* contains ceryl alcohol, fatty acids, amorphous resin acids, a compound of the platanolic acid type, phlobaphens, tannins and invert sugar. The following new compounds have been found in the bark of *Fraxinus*: ceryl alcohol, a sterol, fatty acids, tannins and invert sugars; real bark substances were lacking. LUDWIG LÄMMERMAYR: Floral results of an inspection of the magnesite strata of Dienten (Salzburg). Of interest is the occurrence of *Calluna vulgaris* and *Erica carnea*, the former predominating where humus is plentiful and the latter where it is scarce. RUDOLF WAGNER: Methodics of prefloration investigation.

Nov. 16. ARTHUR HAAS: Energy-balance of the radiation in the universe. The displacement of the red in the spectra of the extra-galactic cloud indicates that all light quanta undergo regular diminution of their frequency and energy. It seems possible that such diminution in energy is counterbalanced by the continual new radiation of the cloud. JOSEF HOFMANN: Varying β-γ-colorations of the $Na_2O : 2SiO_2$ glass, and the causes of the pure violet colours in manganese-free glasses. HANS MOTZ and FRANZ PATAT: Ortho and para states of hydrogen of mass 2; the temperature course of the heat of rotation of H_2^2. E. CHWALLA: The general stability problem of thin plates strengthened by edge-angles. KARL FRITZSCH: Observations on flower-visiting insects in Styria, 1914.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, February 19

UNIVERSITY COLLEGE, LONDON, at 5.30.—Mr. K. de B. Codrington: "India, the Village as a Social Unit".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A. R. Glen: "The Oxford University Expedition to Spitzbergen".

Tuesday, February 20

KING'S COLLEGE, LONDON, at 5.30.—Dr. H. J. Gough: "Fatigue of Metals—A Survey of the Present State of Knowledge" (succeeding lectures on February 27 and March 6).*

BIRKBECK COLLEGE, at 6.—Prof. P. M. S. Blackett: "Cosmic Radiation" (succeeding lectures on February 27 and March 6).*

Thursday, February 22

CHEMICAL SOCIETY, at 8.—(in the Lecture Theatre of the Royal Institution, Albemarle Street, W.1).—Prof. Hans Fischer: "Chlorophyll" (Fourth Pedler Lecture).*

Friday, February 23

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30.—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Capt. F. G. Ramsay: "The Laying and Maintaining of Submarine Cables".*

ASSOCIATION OF TECHNICAL INSTITUTIONS, February 23–24. Annual meeting at the Draper's Hall, London, E.C.2.

February 23, at 10.45.—W. Spens: Presidential Address.

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Departmental Committee on Sterilisation. (Cmd. 4485.) Pp. 137. (London: H.M. Stationery Office.) 2*s*. net.

The Journal of the Institute of Metals. Vol. 52. Edited by G. Shaw Scott. Pp. 255+50 plates. (London: Institute of Metals.) 31*s*. 6*d*.

British Standards Institution. No. 526: British Standard Definitions of Gross and Net Calorific Value. Pp. 5. (London: British Standards Institution.) 1*s*. net.

Hastings and St. Leonards Natural History Society. Report and Balance Sheet for the Session 1932–33, with List of Officers and Members, etc. Pp. 16. (St. Leonards.)

War Office. Report on the Health of the Army for the Year 1932. Vol. 68. Pp. iv+155+6 charts. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

OTHER COUNTRIES

Bulletin of the National Research Council. No. 90: Physics of the Earth, 6: Seismology. Pp. viii+223. 2 dollars. No. 91: Industrial Research Laboratories of the United States, including Consulting Research Laboratories. Fifth edition. Compiled by Clarence J. West and Callie Hull. Pp. 223. 2 dollars. No. 92: Numerical Integrations of Differential Equations. Report of Committee on Numerical Integration. Pp. 108. 1 dollar. No. 93: Systems of Electrical and Magnetic Units. Papers presented before the American Section, International Union of Pure and Applied Physics, Chicago, June 24, 1933. Pp. vi+112. 1 dollar. (Washington, D.C.: National Academy of Sciences.)

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 3: Malayan Agricultural Statistics, 1932. By D. H. Grist. Pp. iv+64. 50 cents. General Series, No. 16: List of Experiments at present in Progress at the Government Experimental Plantation, Serdang. Pp. iii+29. 50 cents. (Kuala Lumpur.)

Report on the Administration of the Meteorological Department of the Government of India in 1932–33. Pp. 39. (Delhi: Manager of Publications.) 12 annas; 1*s*. 3*d*.

Smithsonian Miscellaneous Collections. Vol. 88: Smithsonian Physical Tables. Eighth revised edition. Prepared by Frederick E. Fowle. (Publication 3171.) Pp. liv+682. (Washington, D.C.: Smithsonian Institution.)

Department of Agriculture: Tanganyika Territory. Pamphlet No. 10: The Red Locust. By W. V. Harris. Pp. 10+1 plate. (Dar es Salaam: Government Printer.) 50 cents.

Association of Mine Managers of the Transvaal (Incorporated). Some Aspects of Deep Level Mining on the Witwatersrand Gold Mines, with Special Reference to Rock Bursts. Pp. 198+15 plates. (Johannesburg.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 20: Pliocene Bird Remains from Idaho. By Alexander Wetmore. (Publication 3228.) Pp. ii+12. (Washington, D.C.: Smithsonian Institution.)

Memoirs of the Peabody Museum of Natural History. Vol. 3, Part 3: A Revision of the Ceratapsia or Horned Dinosaurs. By Prof. Richard Swann Lull. Pp. xii+175+17 plates. (New Haven, Conn.) 4 dollars.

CATALOGUES

Microscopes and Accessories. 35th edition. Pp. 116. (London: W. Watson and Sons, Ltd.)

Insulin—Boots. Pp. 46. (Nottingham: Boots Pure Drug Co., Ltd.)

Rapid Testing by Fluorescence. Pp. 16. (Slough: The British Hanovia Quartz Lamp Co., Ltd.)

Vacuum Thermocouples. (Vac 34.) Pp. 2. Electrometer Triode. (Trio 33.) Pp. 2. Pointer Galvanometer. (Na 34.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

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