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Race and Creed in the Problems of India

SINCE our issue of Jan. 23, when the problem of India was last the subject of comment in these columns, the progress of events has been far from reassuring. It is no exaggeration to say that the results of the deliberations of recent years seem to be well on the way to the melting-pot. It is true that the pledge of Britain to India to press on constitutional reform still stands; but India, on its side, has made little contribution towards a settlement. The problem of the communities remains unsolved; yet this is the problem for which, it has been laid down, a satisfactory solution must be found in the settlement of the franchise as a pivotal and precedent condition of all reform.

When the delegates to the Round Table Conference returned to India, early in the year, they felt able to speak with some assurance of the possibilities of reform. They were inspired with a confidence born from the expressions of goodwill to which they had listened in London. That confidence has now vanished; and it has vanished at the bidding of their own people. It is apparent that there is little inclination in India towards that compromise between diverse interests which, with all the goodwill in the world, is inevitable in any formula of government that aims at securing a justly representative character in the institutions it regulates. The course of affairs in India is again approaching a deadlock.

It must be pointed out once more—and apparently it cannot be pointed out too often—that the situation in India, which becomes a deadlock when an attempt is made to come to grips with practical measures, is not a political crisis which can be resolved on the lines of compromise and arrangement possible in a western civilisation. The attempt to mould the oriental mind to western ideals has produced the present difficulties in India; those ideals have not permeated Indian life and thought to the degree necessary to make it possible to deal with these difficulties on western lines. Social and political compromise as the result of a voluntary approach one to another, which is of the essence of western political life, is impossible between race and creed in India.

To admit this factor in the situation is not necessarily to adopt a counsel of despair; but it is necessary that it should be clearly understood. The spectacle of a united but shackled India, debarred from self-government by the British *raj*, has vanished. The British Government has declared its willingness—and even India must

admit its sincerity—to grant self-government to the Indian people. It is the Indian peoples themselves who stand in the way. Their attitude of mind is not one that is readily comprehensible to the average western; but it is from the point of view of the oriental mind that the problem must be attacked. Notwithstanding India's advanced civilisation and the long history of its culture, the problems of its government must be studied by its administrators, and by those who ultimately will have to submit its fate to the arbitrament of the British Parliament and the British people, in the light of principles formulated by anthropological science and after consideration from the trained and sympathetic point of view of the anthropologist, just as much as the social organisation and the religious beliefs of the Negro races have been studied and taken into account in the administration of West African affairs. India must be governed according to Indian ideas, but not the ideas acquired by a western veneer.

What are the racial or sectarian ingredients of the problem? Hindus, Sikhs, Moslems, all are animated by an antagonism one to another, which is capable at any moment of bursting into a flame, all the more intense because it is nearly akin to religious fanaticism. The recently issued report on the trouble between Hindu and Moslem in Kashmir describes the latest and by no means the least disturbing of these outbreaks—disturbing not merely on account of its extent, but also because it is one of a series of disturbances differing in character from the faction fights in which Moslems previously had been concerned. Hitherto, at periods of political difficulty and stress affecting the Moslem communities, the authorities had always been able to rely on their loyalty. They can rely upon them no longer.

To this list of inflammable material must now be added the outcastes, and, above all, the untouchables, the depressed classes, bitterly resentful of the attitude of the castes—Hindus, who ostracise them, while at the same time claiming, for political reasons, that they must count as Hindus without rights to separate consideration. Each of these groups, however, is vocal. It may hope for an expression of its views and aspirations, if only after filtration through a disproportionately small selection of its numbers. But what of those who are classified by the Census authorities as animists, the wild tribes who fit into no category, but whose beliefs and whose village godlings are slowly being assimilated to the Hindu pantheon? Are they to be absorbed into the Hindu community? Their claims are least likely to be heard; yet to the scientifically trained observer their institutions and their beliefs demand the most careful consideration, lest injustice may follow under even the most benevolent of administrations.

Each of these sectional interests has its own traditions and its own outlook, to which deference must be paid. A recent case which has attracted much attention may serve to illustrate the pitfalls of action and reaction between these sectional differences in outlook. This is the case of the two Moslem youths condemned to death for the murder of a Hindu bookseller. The exaggerated and highly inflamed state of sectarian feeling was, no doubt, largely responsible for their act; but its immediate cause was the fact that the bookseller had displayed a portrait of the Prophet in his store. This was a gross offence to the Moslem creed. In this connexion the incident carries its own moral and needs no elaboration.

It cannot be said that the situation has been seriously affected in an adverse sense by the drastic action of the executive in the suppression of disorder. In fact, the result, on the whole, has been rather the reverse. The ingrained inclination of the Oriental to hold in respect the strong hand, without too much regard to the motives with which it is exercised, has tended to weaken the position of the Indian Congress. Especially is this apparent in rural areas. Here, indeed, the position of the Congress was by no means too strong. Although its propaganda among the peasant cultivators was a serious source of danger, the 'no dues' campaign and the claim to decide upon the readjustment of terms of land tenure were, naturally, by no means so popular among the landholders as they were among the peasants. The fact that an 'unofficial' pamphlet advising the payment of government dues, which has been circulated among the peasant tenants in one area, has not been repudiated is surely indicative of a weakening in the position of the Congress.

In the meantime, the attitude of the native princes has not been without its effect in obscuring counsel. Their acceptance of the principle of adherence to an 'All-India' federation appears to have been by no means so generally agreed among them as was stated; and the pending election of a chancellor of the Chamber of Princes added a measure of uncertainty as to their ultimate decision. After a period of vacillation, it became apparent that they had in mind a degree of co-operation in a federated India as essential to their interests, though it was by no means evident that

they had any very clear idea as to the form or extent of their adherence. Discussion of the report, which had been prepared for the consideration of the Chamber, evoked something more nearly approaching the nature of a definite policy. At the time of writing it seems possible, however, that they will for the present go little beyond their original expression of adherence, subject to the safeguarding by the Crown of all treaty rights and rights of internal sovereignty. Once more the real difficulty, as always in India, that of practical detail, is likely to be left untouched.

All things considered, the work of the advisory committees, from which so much was expected, has not been pursued in the happiest of circumstances. It was thought that, while they considered specific problems on the spot, intimate contact with local conditions would assist them in arriving at their decisions. Unfortunately, it has proved once more that distance not only lends enchantment but also adds perspective. Quite early in the discussions it became evident that there was a strong inclination among the Indian members of the committees to refer back the more difficult problems for consideration and decision in London. The Consultative Committee, in fact, when it adjourned late in February, pending the submission of reports from the other committees, had accomplished little.

So far as one of the committees is concerned, the Franchise Committee, it is evident that delay is inevitable before the report can be considered. An attempt was made to stampede the Moslem Congress, which was held at Lahore on March 21, into a boycott of the Round Table Conference and the withdrawal of the Moslem delegates, on the ground that towards the end of February the Moslems had asked Lord Willingdon to submit the communal question to the British Government for decision, in view of the impossibility of arriving at a solution in India, but that apparently nothing had been done. Actually the request had been transmitted to the British Government by the Consultative Committee through the Governor-General; and an announcement was issued at Delhi on March 19 by the British Government, acknowledging with regret the notification of the Consultative Committee and reiterating the statement made in December last that, in the event of no communal agreement being reached, this failure would not be allowed to stand in the way of reform and a provisional solution would be imposed by the British Government from above. Although the Moslem Congress was by no means united, and the action taken was due to the more extreme members, in view of this announcement it was decided that the matter of the boycott should not be pressed, at least for the present.

Once more the ball rests with Great Britain. It cannot but be felt that the occasion, if on one hand an embarrassment, on the other offers a great opportunity. The Government, it is true, has nothing in the nature of a mandate from India, but it has behind it the cogency of facts and the request of a not inconsiderable section of the community—in influence, if not in numbers. It is justified in taking the view that, in dealing with a practical problem such as the communal question, the political sense of the Indian peoples has proved itself utterly sterile. The natives of India, like other oriental peoples, can appreciate and render loyalty to a strong leader; they understand and accept domination of the weaker by the strong, provided the policy of non-interference with custom and belief is followed. They do not as yet understand, and cannot yet of their own initiative contribute towards, a settlement on the give-and-take lines of western democracy. The imposition of a settlement from above, however provisional in character, and always assuming that its adoption and observance are pressed with firmness, will constitute a greater advance towards the ultimate reform than all the endless and fruitless discussions by which an attempt has been made to elicit a common denominator for the aspirations of the people themselves. Stress has sometimes been laid on the measure of success in administration achieved in present conditions. This very fact is not without its significance, for it has been achieved under the ægis of restraining authority, which has given to sectarian feeling the balance it has not been able to attain by itself.

India, it may be recalled, is a great and growing industrial and commercial community. While this complicates, it does not alter the fundamental character of the problem. Its solution lies not with the urban but with the rural population, to which the predominant number of the Indian peoples belong. Reform will come not from above by the imposition of western institutions in the hope that their influence will permeate downwards, but by building up from below, by the careful scientific study of village institutions and their gradual modification to meet the strain of changing conditions as standards change, as change they must inevitably in the end. To take the first step in this direction the British Government has now been given the opportunity and the occasion.

Berkeleian Biology

The Philosophical Basis of Biology: Donnellan Lectures, University of Dublin, 1930. By Prof. J. S. Haldane. Pp. x + 169. (London: Hodder and Stoughton, Ltd., 1931.) 7*s.* 6*d.* net.

PROF. J. S. HALDANE'S Donnellan lectures at Trinity College, Dublin, are here offered to the public in the form of a small book of some 170 pages. Biologists will read them with that extraordinary mixture of admiration for the author and exasperation at his views which they have now long been accustomed to experience.

The book is divided into three sections, the first of which bears the challenging title "The Axiom of Biology". As Berkeley inquired whether there is any meaning in the physical universe apart from its being perceived, so Prof. Haldane wishes to inquire whether any meaning can be attached to the concept of an organism apart from its environment. It is obvious, he says, that in the biological sciences we are always making use of words such as 'function', 'organ', 'species', which are quite peculiar to biology and have no analogy in the physico-chemical sciences. These words cover a residuum (the major part of biology) for which no physico-chemical description has ever been found. Indeed, "the more we discover as to physiological activity and inheritance, the more difficult does it become to imagine any physical or chemical description or explanation which could in any way cover the facts of persistent co-ordination". (p. 12). We cannot separate organic from environmental structure, for no sharp line of demarcation can be drawn between the organism and the environment. So we come to Prof. Haldane's axiom: "The active maintenance of normal and specific structure is what we call life, and the perception of it is the perception of life. The existence of life as such is thus the axiom on which scientific biology depends."

It seems profitless to criticise this point of view, for scarcely any modification has taken place in Prof. Haldane's opinions since the days of his paper in Andrew Seth's collaborative "Essays in Philosophical Criticism" (1883). His brilliant physiological researches have been carried on side by side with an attitude to biological phenomena which can only be likened to that of Frascatorius of Verona—"The heart's motion God alone can comprehend". Time after time Prof. Haldane in these lectures appeals to the argument from inconceivability, thus joining hands with a thinker from whom he is usually careful to dissociate himself, namely, Prof. Hans Driesch. With respect to environment, his demand for the unification of organism and surroundings is surely a methodologically impossible aim, for if no line can be drawn between organism and immediate surroundings, no better line can be drawn between immediate surroundings and far-off surroundings. Biology is thus brought under the rule not only of Berkeley but also of Plotinus, and we are invited to contemplate the whole universe in its axiomatic wholeness, analysis of living things being laid aside.

The solid foundation for Prof. Haldane's position, the real burden of his emphasis during so many years, is of course that the problem of organisation is the central problem of biology. "When we discover, for instance", he says on p. 79, "the existence of an intraprotoplasmic enzyme or other substance on which life depends, we are at the same time faced by the question how this particular substance is present at the right time and place, and reacts to the right amount to fulfil its normal functions." Or again (p. 16), "Physical or chemical mechanisms within the living body are actively maintained at the right places and in the right functional states". But to take organisation in biology as axiomatic is as fruitless as it would be to take the chemical elements as axiomatic in physics, and to make no attempt to go behind the periodic table into the realm of the electronic structure of atoms.

It is, no doubt, metaphysically true to say with Dr. Tennant, that "the illogical core of the world is not a mere residuum of haze which science, when ideally perfect, shall have dissipated"; the arbitrariness of the universe is indeed irremediable, but the worst mistake that can be made in scientific methodology is to introduce this arbitrary element at a higher level than absolutely necessary. If we take living organisation as axiomatic, that is, as an essential part of the impenetrable illogical core of the world, we at once discourage such investigations as the X-ray analysis of the relation of protein molecules one to another, which seems at present so likely to afford us an insight into the mechanism of cytoplasmic differentiation. Can we suppose that the students of colloidal physics have as yet said their last word (or even their first word) on the subject of protoplasm? The sublime expression "I am that I am" is well suited to the manifestation of a deity, but when applied to the immediate problems confronting scientific workers, its use becomes nothing more than the frank confession of intellectual bankruptcy.

Characteristic of Prof. Haldane's self-contradictory position is the contradiction between p. 11 and p. 22. On p. 11 we are told that the central facts relating to the specificity of a species are part of the residuum which physico-chemical biology is powerless to touch. Yet on p. 22 "the constitution of proteins, including hæmoglobin, which can be separated from the bodies of different individual men, varies appreciably between different individuals; and this is no mere accidental circumstance, but is as characteristic for the individual as the shape or size of his hands or face, or the colour of his hair". Two thinkers struggle perpetually for the possession of Prof. Haldane: one, the exact biologist, full of desire for the metrical description of phenomena, and for their causal explanation; the other, the idealist philosopher, primarily concerned with making the world safe for the spirit, and not averse from immediate appeals upon emergent occasions to the illogical core of the universe. It is for failure to differentiate between the two constituents of this dual personality that successive generations of biologists have been vexed and irritated by the counsels of one of the greatest among them.

One of the points upon which Prof. Haldane lays much emphasis in these lectures is the fact that the assumed basic conceptions of Newtonian physics have been shown not to be in reality basic; and that instead we are presented with facts (for example, the intense co-ordinated specific activity within the atom, which does not become dissipated in its environment, and upon which its mass and other properties depend) which bear some resemblance to those with which biologists are familiar. This is undoubtedly very important, and no one is yet in a position to say what the influence of the quantum theory and wave mechanics may be upon biology; but Prof. Haldane, curiously blind to these possibilities, can only infer from the breakdown of Newtonian physics the breakdown of physico-chemical biology. To more unbiased observers, the vanishing crudeness of chemistry seems to make the future of biochemistry all the more hopeful.

Another matter upon which Prof. Haldane has a methodological theory all his own is the omission of 'essential' facts from scientific hypotheses. "Consciousness", he writes on p. 87, "can certainly be treated from a purely mechanistic standpoint if we pay no attention to essential facts, just as other sides of physiology can be so treated when essential facts are left out of account." The only thing lacking here is a definition of the word 'essential', and there seems no logical distinction between Prof. Haldane's position and that of a theologian who would object to the discussion of consciousness without reference to the facts of religious experience. This leads to an underestimate of the work of Prof. Pavlov and his school, as several students of Prof. Haldane's writings have recently remarked. To make use of an Eddingtonian phrase, when Prof. Haldane says "mind" he means "mind (loud and prolonged applause)", that is, "mind" in the sense of Berkeley and Bosanquet, not in that of Herrick and Pavlov.

At the conclusion of his book, Prof. Haldane devotes a special appendix to the discussion of Mr. Woodger's "Biological Principles", Dr. Russell's "Interpretation of Development and Heredity", and Prof. Hogben's "The Nature of Living Matter". On the last named he pronounces an expected excommunication, on the second he sets the seal of probable orthodoxy, and the first he lays aside as a doubtful case, with a recommendation to mercy. It would scarcely be possible here to criticise the critic, and a mere reference to the appendix must suffice.

Prof. Haldane is assured of an honourable place in the history of biology in the late nineteenth and early twentieth centuries. But this will always be in spite of, and not because of, his presentation of his case. It will be said of him that he took biological organisation seriously when no other biologist would, but perhaps this recalcitrance on the part of his colleagues was partly due to his own inability to distinguish between the conflicting claims of science and philosophy, and, we may add, of religion also.

Joseph Needham.

Technical Education in the Soviet Union

Industry and Education in Soviet Russia. By J. G. Crowther. Pp. xi + 94 + 16 plates. (London: W. Heinemann, Ltd., 1932.) 7*s.* 6*d.* net.

With the publication of his "Outline of the Universe", J. G. Crowther may be said to have arrived as a writer of popular science. Contemporary writers on science for the general public expound their views on the assumption that the layman can be beguiled into an anæmic interest in the discoveries of scientific workers, if first convinced that nothing he learns will be likely to compel him to revise a neolithic ideology. With the elder Huxley, Mr. Crowther holds that scientific progress is most interesting to the layman when, and because, it does challenge his complacency.

This sadly old-fashioned tradition, upheld in the recent broadcast addresses of Prof. Levy, has only one other surviving representative in Great Britain. In the Soviet Union it is taken for granted. Perhaps his frequent visits to Russia in recent years have hardened Mr. Crowther in the archaic conviction that science does not require a coating of saccharine mysticism to establish its cultural credentials.

Mr. Crowther's latest book is in the form of an itinerary. If for this reason it is, conventionally speaking, without form, it is certainly not void. It is a mine of intimate and painstaking observation, annotated with copious statistics, embellished with a minimum of propaganda for or against the political practice of the Soviet regime. The bulk of the material is based on a visit to Moscow and Leningrad during 1931, when he accompanied the Principal of the Manchester College of Technology, Mr. Mouat Jones, who was invited by the Supreme Economic Council to discuss with them problems of technical education. Technical education is an issue of vital importance to the success of the Five Year Plan, on account of the shortage of highly trained technical workers in a country which has previously lagged behind western Europe in the development of urban industry.

Perhaps the outstanding difference between the present tendency of higher education in the Soviet Union as contrasted with western institutions is specialisation. Courses of theology, anthropology, psychoanalysis, and biophysics do not appear side by side in the calendar of a single institution.

"Soviet technical colleges have been organised on the monotechnic principle. Polytechnics have been dissolved into groups of monotechnics, which probably helps to explain the extraordinary number of colleges with courses of university standard. There are monotechnics for turbine engineering, for building, for margarine manufacture, for central power station engineering, etc. Each college is run in close connexion with some factory, the students gaining shop experience in the factory, and sometimes the factory staff doing some teaching in the college. The relations between the college and the factory with which it is associated are organic and not casual."

One of the grave defects of educational progress in America and western Europe is prodigal expenditure on buildings destined to outlive the usefulness of their design. A guiding principle in the development of the monotechnic policy is the concentration of technical institutes in suitable situations, where associated industries are concentrated. Since the Soviet Union anticipates immense changes in the localisation of industry, expenditure on buildings is kept at a minimum. The claims of adequate equipment come first.

"There is much lavish equipment. We saw at least two college laboratories better equipped than anything of the kind in Britain; these were for artificial silk technology and machine tools. The exterior of buildings is often deceptive. One may go up to an old building whose outer walls are peeling and surrounded by appalling bogs of mud, walk into the entrance hall through crazy swing doors into filthy corridors, and enter a spotless laboratory shining with distemper and light, and fitted with the latest apparatus."

In Great Britain a similar policy of development carried out under present conditions would entail a considerable restriction on the choice of available students. Doubtless this consideration has reinforced other factors tending to strengthen our own policy of founding new provincial universities with inferior equipment in mushroom-like profusion. The Soviets have met this difficulty in their own way. Technical students are paid wages by the State.

"As the student is not economically dependent on his parents he can afford to ignore their probably conservative tendencies. As his living is guaranteed he can live anywhere in Russia, at the most convenient place. In Britain we take the colleges to the student to save his parents and himself trouble and expense; in Russia the student receives a wage and is as mobile as a journeyman artizan."

The number of higher technical institutions in the Soviet Union is expanding with remarkable rapidity under the impetus of the enthusiasms which the Five Year Plan has engendered. Of the higher technical institutions with courses of university rank Mr. Crowther states:

"there are 188 of them in existence in U.S.S.R., though doubtless they vary in standard and degree of development. The population of U.S.S.R. is 160,000,000, so there is approximately one technical high school to each million of the population. The various institutes and parts of institutes in the British Empire, including India, which might be considered as parallel to the U.S.S.R. technical high schools, total perhaps 240, for a population of 500,000,000, *i.e.*, one to about every 2,000,000 of the population. The figure 240 is arrived at by counting up the number of universities and university colleges and multiplying by three to allow for the multiplication made by the subdivision of polytechnics into monotechnics in U.S.S.R. It is almost certainly unduly favourable to the British Empire, but helps to express the proportion."

An integral part of the policy of Soviet technical education is to link the forces of productive work

with the system of instruction at every stage. Of special interest in this connexion are the *Rabfacs* and branches of the Central Institute of Labour.

"The Rabfacs, or 'workers' faculties', are a system of secondary schools for adults of 18-30 years of age. They prepare intelligent workers for admission to the technical high schools. There are 321 of them, and those we saw seemed good and filled with earnest students, some recently demobilized from the Red Army and still in their uniforms. Only the three R's are required for entry; students are expected to leave after four years with a knowledge higher than matriculation standard. These institutes are the product of the backwardness of elementary education and the nature of social organisation. The Central Institute of Labour, or C.I.T., gives six-month courses on manual operations. The courses have been worked out scientifically on the time-and-motion principles made familiar by Owen, Taylor, Ford, and others. The Russians have evolved their own system. They say a raw worker can become as skilled in six months by this training as he would in four years' casual work as an artizan's mate in the shops. They propose to put 700,000 workers through such courses in 1931."

It is not surprising to learn that the Russians have their own way of meeting the claim that a 'liberal' education fits the student to take an interest in the government of the country. "Besides his technical studies, the student has to do much social work. He must attend heavy courses in political science in which he learns the philosophy of communism and the ideas of Marx and Lenin."

Judging from the syllabuses of the qualifying examinations (p. 55 *et seq.*) for entrance to the higher technical schools—especially those in mathematics and physics—the teaching of Marx and Lenin does not exert any appreciable influence on the teaching of science at present. The requirements of materialist examiners seem to be substantially identical with those of examiners in western universities where the official philosophical point of view is idealistic. Pure mathematicians will be reassured and experimental educationists will be disappointed to learn that there is little evidence of any attempt to link the teaching of elementary mathematics with the practice of the workshop or to break away from the tradition of formalism which we ourselves have inherited from classical idealism.

According to Mr. Crowther there is immense enthusiasm among the students. Their enthusiasm is instructive in its bearing upon the place of competition in a scientifically planned economy.

"Many of the students we saw were more enthusiastic than any groups of students we had seen anywhere else in the world. Perhaps they were enthusiastic for technical education because life in Soviet Russia offers so few luxurious distractions. Interest in work is stimulated by competitions between the students of institutes. Two institutes sign an agreement to compete with each other in academical prowess. We attended an impressive ceremony for the signing of the agreement for one of these 'Socialist competitions' as they are called."

The Study of the Soil

Soil Conditions and Plant Growth. By Sir E. John Russell. (Rothamsted Monographs on Agricultural Science.) Sixth edition. Pp. viii + 636 + 7 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 21*s.* net.

IT is difficult to realise to-day how recent is the study of the soil as an entity. The earliest contributors to what was later to develop into soil science regarded the soil almost as an inert vehicle for the supply of some active principle essential to plant growth. For van Helmont this principle was water, for Glauber saltpetre, and for Kulbel a product of the organic matter. At the end of the seventeenth century, Woodward, it is true, had shown that both soil and water are alike essential for plant growth; but that air is also a necessity was not demonstrated until the classical researches of Hales in 1731. It was not until the early part of the nineteenth century that Humphry Davy, and later Schübler, stressed the importance of the physical properties of the soil. By the middle of the nineteenth century the controversy between Unger and Thurmann, *inter alia*, as to whether the physical or chemical properties of the soil are the more important for plant life, served to stimulate further inquiry into the needs of plants.

The complexity of the physical and chemical problems involved was not, however, adumbrated until van Bemmelen demonstrated the colloidal properties of the soil, in 1878, and Way, in 1850, the phenomenon of double decomposition, leading in recent times to the researches of Knop, Gedroiz, and Hissink on exchangeable bases. In the late 'seventies, Schloesing, Muntz, and Warrington were laying the foundations of soil bacteriology, but yet it is perhaps true to say that, whilst up to the end of the nineteenth century many investigators had utilised the soil as a medium for analytical research, the synthetic concept was almost entirely lacking. With the present century came a definite recognition of the interdependence of the various soil conditions and the importance of their interaction for plant life.

The work at the Rothamsted Station by a co-ordinated team of investigators, first under Sir Daniel Hall and since 1912 under Sir John Russell, epitomises the changed method of inquiry into soil problems, and though the actual synthesis of a soil eludes us, the synthetic attitude of mind has in no small degree mitigated the evils of analytical abstraction.

The successive editions of the work before us, from the slim volume of 1912 to the present robust tome of nearly four times the size, constitute a record of the development of soil science in relation to plant growth during this modern period. The last quarter of a century has not only witnessed detailed investigation of the organic population of the soil at Rothamsted, initiated as the result of Russell and Hutchinson's classical researches on partial sterilisation of the soil, but, also, the studies of plant ecologists, which emphasised the properties of natural soils and their correlations with plant successions, inevitably led to the recognition that the soil is a dynamic and not a merely static complex. Owing to the continued action of climatic and biotic factors, a soil can thus pass from an immature to a mature condition.

One of the most important additions in this volume treats of this dynamic aspect, and deals with the changes which the composition of the soil undergoes and the climatic classification of soil types. Here the inclusion of the results of Russian investigators will be the more welcome from the relative inaccessibility of some of the original publications. The two chapters dealing with the soil in Nature, of which the first is concerned with the changes in mineral composition and the second with the changes in the organic matter, replace the former chapters on the chemical and physical relationships of the soil and the carbon and nitrogen cycles. The essentials of the previous text are retained, but the new form with additional matter extends to a further thirty-two pages. The general character of the work, which remains unaltered, is too well known to require indication, whilst the smaller additions throughout are too numerous to specify. It must therefore suffice to say that the present edition has been brought thoroughly up to date, and is consequently even more indispensable than heretofore as a handbook alike for the agriculturist, the botanist, or indeed anyone interested in the problems concerned with the complex relations between plants and the medium in which they grow.

E. J. SALISBURY.

Short Reviews

Engineering Geology. By Prof. H. Ries and Prof. Thomas L. Watson. Fourth edition. Pp. vii + 708. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 25*s.* net.

THE appearance of a fourth edition of Ries and Watson's "Engineering Geology" is an indication of continued appreciation of a useful work which covers a good deal of ground and provides the civil engineering student, for whom it is intended, with a very fair and reasonably adequate survey of the manifold aspects of the subject. Written by professors of geology attached to two universities (Cornell and Virginia) in the United States, the basis of illustration is mainly North American and, for that reason, may be none the less attractive to the European student, as widening the range of his knowledge. The photographic views are excellently reproduced, and the diagrams generally are very clear and distinct, as also is the text. There is, however, an unfortunate omission of a decimal point in a table on page 446 *l*, and the index, though fairly full, is not helpful in tracing information—about permissible foundation pressures, for example.

In a manual of this kind, which touches on a great variety of matters germane to the subject in varying degrees, it would be easy to make carping criticisms as to omissions and inadequacies of treatment. Mining, quarrying, tunnelling, water supply, building, embankment, harbour work, and road construction are all engineering operations requiring a knowledge of geology, and 700 pages do not provide any excess of space for so extensive a purview. Probably, here and there, some fuller treatment might be felt desirable, but, on the whole, it will be admitted that it would be difficult to compile a textbook on lines to which unqualified agreement could be secured. The authors avow that their aim throughout has been to emphasise the practical application of geology to engineering work, and it is in regard to this practical side that the book will make its most effective appeal.

B. C.

The Examination of Fragmental Rocks. By Prof. F. G. Tickell. Pp. x + 127 + 12 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1931.) 23*s.* net.

THE physical examination of rocks and their component minerals, with which this book deals, forms part of many technical investigations. Among the substances which may profitably be tested by methods here described are: sedimentary rocks in geological studies, particularly in connexion with oil geology; building stones; sands intended for specific industrial purposes; raw materials for the ceramic industry, and soils. Prof. Tickell has incorporated in his manual those methods of investigation which are likely to be of common interest and utility. The treatment presupposes a knowledge of scientific fundamentals.

The first part of the book describes methods for the size analysis of grains, and for the determination of the porosity and permeability of rocks. This is succeeded by a chapter dealing with the preparation of samples for optical examination. A knowledge of optical mineralogy is not assumed, and in Chap. v. full instructions are given for the identification of minerals by their optical properties, with the aid of the petrographic microscope. The treatment here is practical rather than theoretical, being aided by explanatory plates and diagrams. The book concludes with a descriptive list of minerals commonly occurring in sedimentary rocks, a determinative table of the non-opaque minerals of the same group (unfortunately printed in such small type as to hinder rapid reference), and a bibliography. In view of the varied materials to which the practical methods elaborated may be applied, these latter three sections are not perhaps so exhaustive as might be desired. The value of the book, however, lies in its description of laboratory methods, and for this purpose it can be recommended.

High Speed Steel. By Marcus A. Grossmann and Edgar C. Bain. Pp. ix + 178. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 17*s.* 6*d.* net.

The practical importance of the high-speed steels in the engineering industry, coupled with their interest from the metallographic point of view, renders any account of these materials of wide appeal. English readers should perhaps be warned that, so far as the manufacture is concerned, the treatment of this applies specifically to American practice, which for many reasons would not be followed in its entirety by producers in Great Britain. It is of interest, for example, that the authors do not even mention the use of the induction furnace as a melting appliance for such alloys. Further, except for special purposes, smaller ingots would be cast here than apparently are usual in America. These smaller ingots are less subject to serious heterogeneity than larger masses would be, but of necessity result in a considerable reduction in the amount of work which can be put upon them.

The second section of the book is devoted to an account of the properties and metallographic characteristics of the alloys. A quite considerable amount of information has been concentrated into these pages, and on the whole the existing state of knowledge is fairly summarised. The position is such, however, that differences of opinion are not surprising. Most metallographers would hesitate to be quite so dogmatic as the authors on many points regarding, for example, the exact composition of the constituents which occur in these steels, or respecting the exact function of each of the elements which are present. The work is, however, of considerable interest and value; it deals with a most complex alloy system, and if, from its very nature, it emphasises the necessity for further research of a definitely fundamental type, it will perform a still more useful purpose. F. C. T.

Recent Advances in Microscopy: Biological Applications. Edited by Dr. A. Piney. Medicine, by Dr. A. Piney; The Living Eye, by Basil Graves; Zoology, by Dr. E. W. MacBride and H. R. Hewer; Botany, by E. C. Barton-Wright. Pp. vii + 260. (London: J. and A. Churchill, 1931.) 12*s.* 6*d.*

The four chapters within the covers of this book are so diverse in their subject matter—and even more in their method—that it seems scarcely worth while to make them into a volume. The chapter on the microscopy of the living eye, though written with expert knowledge, stands apart from any field in which the others might be included. The first chapter is essentially a short account of recent advances in human histology, but is entirely undocumented. The last two chapters purport to deal respectively with animal and plant cytology. The former chapter, however, deals almost entirely with the cytoplasm. The reason given for practically omitting attention to the nucleus is that the cytologist's work in this field is "practically at a close" since the general correlation of Mendelian laws with chromosome behaviour. This view leaves out of account the recent work on nuclear structure. The chapter gives, however, a very good survey of investigations on such cytoplasmic structures as Golgi apparatus and mitochondria, which will be found very useful for reference. The last chapter is too limited in outlook to be of much value, although much of the material included is of extreme interest, if adequately presented and discussed.

Patterns for Eight Simple Relief Models illustrating Geological Structures. Designed by Dr. Frank Smithson. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., Inc., 1930.) Patterns, 5*s.* 6*d.*; Cards specially suitable for mounting the patterns, 3*s.* 6*d.*; Models made-up, uncoloured, 45*s.*; Models made-up, hand-coloured, 63*s.*

The patterns prepared by Dr. Smithson are printed in black and white on paper of excellent quality for taking water-colour and varnish. The models they are destined to form differ from those previously issued in that they illustrate the relation between surface relief and outcrop. The structures illustrated are as follows: 1, escarpment with tilted strata; 2, hills and valley with horizontal beds; 3, beds dipping up a valley; 4 and 5, beds dipping down valleys, sloping respectively at angles more and less than the dip (these two models placed together give a valley inlier); 6 and 7, folded beds with axes running respectively across and parallel to the valleys; 8, unconformity. Full instructions for making the models, with an illustration and description of each model, are included. When made up, the models are three or four inches high on a base ranging from 6 in. × 4½ in. to 6 in. × 9 in. They may be strengthened by coating with size and varnish. The models are clear and simple, and should prove valuable as an aid to the elementary student in understanding geological maps.

The Zoological Survey of India *

By Lieut.-Col. R. B. SEYMOUR SEWELL, I.M.S., Director, Zoological Survey of India

IN the year 1784 the Asiatic Society of Bengal or, as it was then called, the Asiatick Society, was founded by Sir William Jones. The formation of a Museum was not definitely stated to be one of the objects of the Society, but specimens were frequently sent to the Society, either for examination and report or for safe custody, and in 1796 a definite proposal for the erection of a suitable building, to house the collections that had thus accrued, was first mooted. It was, however, not until 1808 that the Society came to possess its own building, which it still occupies to-day, but from then on definite efforts were made to establish a Museum and this was finally achieved in 1814.

Although Sir William Jones, the founder, was opposed to the collection of zoological objects, on the ground that it entailed the destruction of life, there was, nevertheless, from the very inception of the Museum a quite definite biological bias. At the outset the Museum was subdivided into two parts, (*a*) comprising archæology, ethnology, and technical exhibits, and (*b*) including geology and zoology. The former section was placed under the care of the Society's librarian, and the latter under a special curator, the first to be appointed being Dr. Nathaniel Wallich, who presented to the Museum duplicate specimens from his own collection in order to form a nucleus.

Up to 1836 the Museum was supported entirely from the funds of the Society, but in that year, owing to financial troubles and losses, consequent on one of the Calcutta banks closing its doors, the Society was compelled to petition the East India Company for assistance in maintaining the Museum and the necessary staff, and in 1839 the Company sanctioned a grant of Rs. 300 per mensem for this purpose. The first curator to be appointed under the changed conditions was Dr. J. T. Pearson of the Bengal Medical Service, thus commencing the close association between the Museum and the Government medical services that has continued to the present time. The continual growth of the collections in due time again caused a strain on the Society's resources, and in 1856 the Government of India was petitioned to found an Imperial Museum for India; the outbreak of the Indian Mutiny caused matters to be postponed for a few years, but in 1862 the Government announced its intention of founding such a Museum in Calcutta, and by the Indian Museum Act of 1866 definitely provided for its establishment and created a Board of Trustees for its management. The actual construction of the building naturally took some time, and it was not until 1875 that the Museum was ready for occupation, and the first two galleries, namely, those of archæology and the mammalia, were thrown open to the public in 1878.

A study of the records of the Society shows that during these early years a number of distinguished zoologists had contributed to the collections, and among these one may perhaps mention Dr. J. Anderson, who had made two collecting expeditions into Yunnan and China, in 1868 and 1875, and later became the first curator of the Indian Museum. Various other collections came from regions so far apart as Abyssinia, Persia, Tibet, different parts of India, Assam, and Burma; and in addition the Society received very valuable collections that had been made during the Persian Boundary Commission (1870–72), the second Yarkand Mission (1873–74), and the Dafla Expedition (1874–75). All these collections were handed over by the Asiatic Society to the Indian Museum to form the nucleus of the zoological collections.

The next stage in the evolution of the Zoological Survey of India may be said to have begun in 1875 with the opening of the Indian Museum as a State museum, and the appointment of a permanent staff, entirely maintained by funds provided by the Government of India. During the preceding few years the Asiatic Society had been taking a very keen interest in the schemes that were being put forward in other parts of the world for the investigation of the deep-sea fauna, and it felt that India should also play its part in these investigations; the Government was at this time considering the formation of a Marine Survey of India, and in consequence of the representations made by the Society it determined to appoint to this survey a special officer, the surgeon-naturalist, whose duty it would be to carry on investigations on the Indian deep-sea fauna, at the same time ruling that the collections thus made should be the property of the Asiatic Society of Bengal and, after identification, should be incorporated in the collections of the Indian Museum. The first appointment to the post of surgeon-naturalist to the Marine Survey of India was made in 1875, and in 1881 the Royal Indian Marine Survey ship *Investigator* was launched.

At its inception the Indian Museum included sections dealing with zoology, geology, and archæology, and it was not until twelve years later, in 1887, that the section of art and economics was added. From the very commencement the importance of the zoological section was clearly recognised, and this is shown by the fact that the first three appointments to the staff were given to zoologists, namely: curator of the Indian Museum, Dr. J. Anderson; assistant curator, Mr. J. Wood-Mason; and first assistant to the curator, Mr. G. Nevill. A few years later the surgeon-naturalist was given an unofficial status in the Museum by being appointed an honorary assistant. Thus, very soon after its inception, the Museum staff consisted of four zoologists.

With the creation of a permanent staff, and as a result of a breadth of vision and a true appreciation of the value of zoological research that has ever characterised the Trustees of the Indian Museum, it became a recognised part of the function of the

* Paper read before the Association of British Zoologists, Jan. 9, 1932.

staff to go out into the field and make their own collections, so as to make a study of the living, just as much as of the preserved, animals; it was thus possible for a number of expeditions to be carried out in various parts of the Indian Empire and even beyond its frontiers, and among the latter regions that were visited, mention may be made of the expeditions by the late Dr. N. Annandale to the Lake of Tiberias in Palestine, to the Talé Sap in Siam, and to Lake Biwa in Japan. These activities naturally resulted in large accretions to the collections, and during this second period in the history of the Zoological Survey very considerable further additions were made by a succession of surgeon-naturalists on the R.I.M.S. *Investigator*, pre-eminent among whom stands Col. A. Alcock, I.M.S. During this period large additions of valuable collections of both the land and fresh-water fauna were obtained as the result of systematic collecting during certain political and military expeditions, notably during:

(1) The Afghan Delimitation Commission, 1885;
(2) The Afghan-Baluch Boundary Commission, 1896;
(3) The Tibet Expedition, 1903–4;
(4) The Seistan Arbitration Commission, 1903–6; and
(5) The Abor Expedition, 1911–12.

Numerous additions were also presented to the Museum by friends of the department, such as officers of the Geological and Botanical Surveys of India, the Indian Forest Service, and the Indian Medical Service; by planters in various parts of India; and finally, but by no means the least, by the officers of the Hoogli Pilot Service, to whom the Museum owes a very valuable collection of the fauna of the estuarine region at the mouth of the Ganges. Special mention must also be made of the collections made by the officers of the Fishery Department of the Government of Bengal and by the research trawler *Golden Crown* during investigation into the fishery resources of the Bay of Bengal.

Several very valuable collections, such as the de Niceville collection of butterflies, the Dudgeon collection, etc., were also purchased by the Trustees.

The rapid increase in the size of the collections, and the consequent work of the Zoological and Anthropological Section of the Museum, resulted in a gradual increase in the staff, and in 1916 there were four zoologists on the permanent staff of the Museum, and, in addition, attached to the Museum were one unofficial, though paid, worker, the late Mr. E. Brunetti, and the surgeon-naturalist—the total staff thus being six.

It was in this year, 1916, that the Zoological and Anthropological Section of the Indian Museum was converted by the Government of India into the Zoological Survey of India. The reason of this conversion is not to be found in any change in the duties of the officers of the department, but in the recognition by the Government that the work of the section had been and then was, in all essential features, similar to the work that was being done by the already existing Geological and Botanical Surveys, and the need of placing the head of the section on an equal footing with the directors of these other Surveys as a fellow-trustee of the Museum and not merely a paid servant of the Trustees.

The ever-increasing work of the Survey has from time to time necessitated the creation of additional appointments, and at the present day the full staff as sanctioned by the Secretary of State should consist of a director, two superintendents, and seven assistant-superintendents, the last addition to the staff being the naturalist to the Marine Survey, a post that was previously always held by an officer of the Indian Medical Service. Up to the present time, however, only seven officers have been appointed, and of these one is an anthropologist. In consequence of the policy of the Government of India to indianise the various services, as many Indians as possible have been selected to fill the various posts as they fell vacant or were sanctioned, and to-day the director is the only European in the Survey, the other six officers being Indian.

The conversion of the Zoological Section of the Museum to a Survey gave official recognition to the view that field-work was one of the most important duties of the department, and it thus became possible to formulate definite programmes of work that could be spread over a series of years. A commencement on definite survey lines had, however, been begun some years previously by investigations into the lake fauna of Asia, and this had culminated in the survey of the Chilka Lake, a special volume of the *Memoirs of the Indian Museum* being devoted to the results. The first definite survey of the newly created Zoological Survey was undertaken at the request of the medical authorities in India, who, as the War of 1914–18 drew to its close, became anxious lest the disease schistosomiasis, that was unknown in human beings in India, though present in other animals, might be introduced by troops returning from areas overseas in which this disease is rampant. Systematic investigations were, therefore, undertaken in order to discover whether any of the known mollusc hosts of the Schistosome might be present in India, or, alternatively, whether any of the more common fresh-water molluscs could act as such a host; and, in addition, to determine what species of Cercariæ were already living in the country. As a result of these inquiries, the Zoological Survey was able to inform the Government that, so far as it was possible to judge, there was no fear of an extension of this disease into India; a conclusion that was entirely justified by results, for although the troops from overseas were brought back to India without any precautions whatsoever being taken in the way of quarantine, there has been no spread of this disease in that country.

Our knowledge of the fauna of India is still very incomplete, and in every case in which an officer of the Zoological Survey of India has taken up the study of a group in the animal kingdom it has proved to be necessary that he should first pay careful attention to the taxonomic side, in order

to determine the various species that are present. As a result, considerable progress has been made on these lines, and during the sixteen years that the Survey has been in existence the number of new species that have been described and of 'types' that have been added to the collections of the Indian Museum has averaged some one hundred and twenty-five a year. Up to quite recent times the Survey has not attempted to deal with purely economic problems, unless specially requested to do so; it was rightly considered to be of more importance that their energies should be devoted to purely scientific research, for no zoological research can have any economic value unless it has a scientific basis, and the foundation of all such work is taxonomy. Nevertheless, the Survey has from time to time contributed towards the elucidation of problems of economic importance, and has been consulted by various local governments on such problems as the reorganisation of fishery departments, the institution of biological stations, the preservation of the fauna—as, for example, the Monitor lizards that were being exterminated for the supply of skins for the leather market—oyster fisheries, or the control of various species of animals that were directly or indirectly destroying crops. Within the last two years the Survey has by circumstances been compelled to take up one problem of economic importance, namely, the maintenance and preservation of the *Trochus* and *Turbo* fisheries in the Andaman Islands.

For many years past, each officer has been encouraged to take up two lines of study—one taxonomic and the other general; they are thus brought into touch with some of the wider problems of zoology and are in a better position to take advantage of their opportunities for study in the field, while the department as a whole is in a sound position to undertake team-work and thus to tackle the investigation of any of the more general problems, on the solution of which so much may depend in a country like India, in which agriculture and public health are the two subjects of greatest importance.

The Zoological Survey of India publishes the results of its research work in two serials that are devoted to zoology, namely, the *Records* and *Memoirs of the Indian Museum*, and within the last year has commenced a third, entitled *Anthropological Bulletins from the Laboratory of the Zoological Survey of India*. These publications are very largely composed of original papers by the officers of the Survey, and by a system of exchanges with some three hundred other societies and institutions the Survey is able with comparatively little cost to maintain a very fairly complete and up-to-date library, that without any doubt is the finest zoological library for purposes of research in Asia. This library is at the service of every *bona fide* zoologist throughout the whole of India; a list is kept of all those who are engaged in research work, and every such worker is allowed to have from the library two volumes at a time for a period of a fortnight. In this way workers are able to keep in touch with and consult recent literature, without which it would be impossible for them to carry on their researches. Within the limits imposed on it by space, the Zoological Survey of India also provides accommodation for any research worker who wishes to come to the Museum in order to carry on his work either in the library or in the laboratory, and there is an ever-increasing demand for facilities of this nature, not only from zoologists in India but also from other countries.

It is no exaggeration to say that if the Zoological Survey is in the future to be curtailed, either in its personnel or its financial resources, to such an extent that the continuance of its publications is rendered impossible, such a blow will be dealt to the study of zoology in the whole of India that it will put the country back to where it was in 1875, when the Museum was first started, and will render almost impossible the satisfactory or trustworthy investigation of every problem in which zoology may be concerned. Finally, any drastic reduction of the staff must seriously endanger the collections. Such collections, especially in a tropical climate, require constant attention for their preservation and continuous study and research to maintain them in an up-to-date and scientific condition, so that each animal is correctly labelled and can at once be referred to for comparison and examination; and if in the future these collections are allowed to decay, the loss, not to India alone but to the whole world, will be one of the first magnitude.

Steel in Building Construction

IT is usual to criticise methods of engineering design by calling the engineer's 'factor of safety' a factor of ignorance. In one sense the accusation is true, since the factor is a cover for uncertainties; but, in effect, it is a concise expression of experience and, properly used, is as legitimate as the apparently more rigorous processes in calculation. It is an inheritance. The efforts of progressive engineers are bent towards its improvement. They attempt the reduction of its margins by enlargement of data, perfection of analysis, and advancement of materials. Sometimes a greater precision in things understood leads to a reduction of the factor, only to disclose the increased importance of things less well understood; and thereby to compel a return. The subject of fatigue in materials and the history of the development of high speed machinery provide numerous examples.

It can scarcely be denied, however, that the factor of safety is subject to serious misuse at times. Weak design methods are frequently characterised by a meticulous arithmetical accuracy in inadequate calculation, covered by an arbitrary factor that may make the design quite safe but certainly renders the careful arithmetic ludicrous. Possibly this charge of imperfect calculation and arbitrary safety factors could be

laid against building structure design. At least, building codes vary so widely that there would appear to be justification for the belief that they reflect a very variable standard in the comprehension of data and of method.

The confusion created by varying codes, in conjunction with a feeling that the full value is not being derived from the use of steel in building structures, and that the highly advanced technique of modern steel structural work is not being fully exploited, has led to a general recognition that comprehensive and systematic investigation is required to obtain precise information and thereby facilitate the establishment of economical design and more uniform regulations. While the recognition of the necessity is widespread, it is gratifying to find that the Department of Scientific and Industrial Research in Great Britain has taken first and bold steps towards this end. The first report, now issued, by the Steel Structures Research Committee,* set up by the Department in 1929, shows that a wide view has been taken of the task, and that an ambitious programme of research has been undertaken.

The Committee was appointed to review present methods and regulations for the design of steel structures; and to investigate the application of modern theory to such design with a view towards its improvement by the establishment and definition of the data and processes required. The remit would have been more concise and equally comprehensive if it had called for an investigation of all aspects of the 'factor of safety' in steel building structures. The connexion of theory and practice is essentially implied in 'factor of safety'. The factor of safety may be nominally modified by extended theory without compelling any important alteration in practice. Theory may advance in completeness, but practice can only be modified by research.

The Committee has very completely realised the true interrelations of established practice, advanced theory, and experimental research; and the programme of work reflects this clearly. But, while understanding the necessity of conducting a full survey of existing methods as a guide to research developments, it has been assumed that the nature of the essential problems would not be greatly altered by the examination of a multiplicity of design systems, while research progress would certainly be impeded. The division of the main lines of work is therefore of the order of an 'intelligent anticipation' of the requirements; and the Committee has decided upon schemes that embrace such leading items as floor loads, building strains, stress analysis, materials, welded connexions, and building vibration. Good progress appears to have been made with all of these except the last, which, under modern conditions, may ultimately present a restrictive influence on the easy development of more economical design.

The enormous amount of detail work described in the report forbids even a summarised mention within this space; but the interest of technical structural engineers will be aroused by the design and tests of the new 'micrometer-microscope' strain gauge and the proposed use of such gauges on the five-story framing of the new Geological Museum at South Kensington, to obtain results for the unloaded frame and as the floors are progressively loaded. There are also most interesting test results on the buckling of I-beam webs, following a request by the British Steelwork Association to have the question of web stiffness examined. In a section on materials, Prof. A. Robertson presents the results of an investigation on the use of small turned specimens in steel testing. These display distinct differences when compared with the yield point results for large flat specimens.

Structural steel framing is of an apparently simple rectangular form, but requires an elaborate theoretical development for its stress analysis. The theory is usually based on the assumption that the joints are rigid. This is not actually the case. The report deals with the general theoretical case of non-rigid connexions briefly; but it is clear that all questions of slip and flexibility at joints require extensive experimental work, as well as theoretical investigation. Both theory and experiment have been employed for riveted, bolted, and welded connexions by Prof. C. Batho, whose results and views are given in a lengthy section of the report.

Laboratory tests on joints alone, however, can scarcely promise to give conclusive information. In actual framing, the mysteries of eccentric loading accompany those of joint flexibility. Calculations given in the report with different assumptions as to eccentricity and joint rigidity show remarkable differences. This appears to have prompted the design of a full scale, three-story, experimental frame which has been erected at the Building Research Station and is to be subjected to extensive experiment when loaded by water tanks. This is perhaps the most notable of the Committee's efforts, and represents an exceptional step in structural research.

A full scale experimental research is always impressive but is, unfortunately, seldom comprehensive. The natural desire is, therefore, to extract the most from the expensive large-size equipment and to endeavour to generalise by the aid of model investigations. The recent American research on arch dams is an excellent example of this procedure. The Committee has also model work in hand, which includes the Beggs deformeter method with celluloid models, and slope measurement methods with others. It is to be hoped that the joint conditions in rectangular framing will not prove too much for small scale models.

The last section of the publication is preceded by the report of the panel dealing with the welding of steel structures, which describes tests of welded joints and outlines a future programme of research upon this mode of construction. Welded connexions are not yet widely adopted and a great deal of investigation will probably be necessary before they become generally acceptable; but

* Department of Scientific and Industrial Research. First Report of the Steel Structures Research Committee. Pp. xii+276+11 plates. (London: H.M. Stationery Office, 1931.) 5s. net.

they offer many advantages, and more precise knowledge and methods of control may overcome the hesitancy of responsible authorities.

The first and last sections of the report are widely apart in position and closely related in theme. The first—which includes in one place an account of a most interesting survey of the real loads on office floors—presents the results of a comparative examination of the regulations controlling steel frame building construction in Great Britain, the Dominions, and in some foreign countries. The general comparison of regulations displays extraordinary variations in such matters as floor loads and wind pressure allowances, and in the clauses governing the proportioning of members. On practically every page of this section there is evidence of the confusion and variety that can be introduced by autocratic authorities at work independently.

The last part presents the recommendations of the Committee for a code of practice governing the general use of structural steel. In view of the fact that these recommendations accompany a first progress report, there is always the probability of future amendment in the light of subsequent data. It is understood, however, that the code will be explicitly referred to in the model by-laws to be issued by the Ministry of Health. This may be taken as an augury of the full recognition that will be accorded the completed work of so influential and representative a Committee, the first report of which displays a breadth of vision and power of planning that promises ultimate success in a difficult task.

Obituary

PROF. P. N. KRYLOFF

THE name of Porphirii Nikitich Kryloff, professor of botany and plant geography at the University of Tomsk, who died on Dec. 27, 1931, at the age of eighty-one years, will always be associated with the exploration of the Siberian flora. Born of a poor family, Kryloff had to earn his living ever since he left his school, still a boy in his teens. Becoming an apprentice in a chemist's shop at Perm, young Kryloff became seriously interested in chemistry and medicinal plants, and devoted his spare time to studying for an examination to obtain a pharmacist's degree at the University of Kazan, and to the collection of plants. After obtaining the degree, he continued to work as a dispensing chemist.

The botanical exploration of the Perm province and of the Ural Mountains was now Kryloff's main and only recreation. With very limited resources, often on foot, he wandered over that enormous area, and produced a series of papers on its flora, which was then very little known. In 1874 it became possible for Kryloff to abandon his old profession and to devote himself entirely to botany, by taking a modest appointment as a 'learned gardener' at the University of Kazan. While at Kazan, he made an extensive study of the flora of that province, but dreamed of botanical explorations in wider and less-known regions.

At the foundation of the new University of Tomsk, the first scientific centre in Siberia, Kryloff did not hesitate to take there the same post of 'learned gardener', becoming later the keeper of the botanical museum, which he built up himself. A new, and practically virgin, field was now open before Kryloff, and he threw himself into this congenial task with his usual energy. Most of western Siberia, the Altai Mountains, and northern Mongolia offered an inexhaustible supply of most interesting problems in the systematics and distribution of plants. An enormous herbarium, comprising more than 200,000 specimens of plants, was the result of the journeys of Kryloff himself and of his students, who were attracted by his unaffected and enthusiastic love of Nature. In systematic studies in the herbarium Kryloff was as thorough as in collecting. He prepared detailed descriptions of all the species known to occur in the regions visited, and maps showing areas of their distribution elsewhere. This formed the basis of his well-known "Flora of Altai and of the Tomsk Province", published in seven volumes between 1901 and 1914. The importance of this work for the study of the flora of temperate Asia and even of Europe cannot be overestimated, and it is not surprising that it was soon out of print.

In 1913 Kryloff was invited to take the post of botanist in charge of the Siberian herbarium at the Academy of Sciences in St. Petersburg but the economic difficulties of living in the capital during the revolution induced him to return in 1917 to Tomsk, where he became professor of botany. Here he set himself a new and a very ambitious task of preparing a complete flora of western Siberia, from the Urals to the Yenisei and from the Arctic Ocean to central Asia. It may seem almost unbelievable, but the work was completed, with the usual masterfulness, within six years, after which several years were spent in endless efforts to find the funds for its publication. It was only in 1926 that the great "Flora of Western Siberia" began to come out in parts, and is still continuing to be published.

Prof. Kryloff's interests were not purely floristic, but mainly phytogeographical, and his exceptional first-hand knowledge of Siberia and its plants enabled him to produce a series of most valuable papers on the distribution and past history of the Siberian flora. One of the points particularly well brought out by Kryloff's work was the existence in the Altai Mountains of an ancient centre of the origin of many typical Siberian plants, which later migrated widely and reached European countries. The foundation of a large and very prolific school of Siberian botanists should be considered amongst the most important achievements of this self-made pioneer of botanical exploration of Siberia.

Mr. J. J. Joicey

Mr. James John Joicey, who died early in March, aged sixty-one years, was the founder of the Hill Museum and also a munificent benefactor of the Natural History Museum, South Kensington.

Mr. Joicey started to form a collection of British butterflies and moths at quite an early age, but it was not until his interest in exotics was aroused that there appeared much likelihood of his adding appreciably to the sum of human knowledge. In 1910 he acquired the collection formed by Henley Grose-Smith, an ardent disciple of W. C. Hewitson, and two years later added to it the Herbert Druce collection. These two collections, both rich in type material from all parts of the world, were so extensive that extra accommodation had to be built to house them. The Hill Museum was thus established in 1913. Through the exertions of collectors employed by Mr. Joicey from this time onwards, remarkable collections were sent home to him from Peru, the Amazon valley, Dutch New Guinea, Waigeu, the Schouten Islands, many other of the less-known islands of the Dutch East Indies, Yunnan, Hainan, and Central Africa. All these were rich in new material, or shed light upon the geographical distribution of the Lepidoptera.

The scientific results were published from time to time in various journals, but mainly, from 1921 onwards, in the *Bulletin of the Hill Museum*, which, during its eleven years' existence, has run to four handsome and richly illustrated volumes, to which, no doubt, would have been added many others had not Mr. Joicey's enthusiasm for his subject outrun his ability to meet the expenses. Between 1914 and 1930 about sixty papers by Mr. Joicey, in collaboration with others, were listed in the titles in the "Zoological Record".

Besides employing collectors, Mr. Joicey acquired by purchase many valuable collections, notably those of Roland Trimen, H. J. Elwes, Col. Swinhoe, Hamilton Druce, Wichgraf, Riffarth, and others, all rich in types. A catalogue of the type specimens of Rhopalocera in the Hill Museum had just been completed, and all arrangements made for its publication, a few days before Mr. Joicey's death. This, better than anything else, will indicate the value of the contents of the Hill Museum, at least from a taxonomic point of view; the total number of type specimens enumerated is 2724. In the moths, the types were probably even more numerous relatively, as they had been worked fairly thoroughly by many specialists, but as they have not been catalogued, it is not possible to give definite information. Two years ago it was estimated that Mr. Joicey's museum contained approximately four hundred thousand specimens, including about five thousand types; but for some years prior to that, large sections of it, with which it was found impossible to cope at Witley, had been presented to the British Museum (Natural History) from time to time, with results highly beneficial to the remaining collection, in that the staff under Mr. Talbot's capable direction was able to maintain it in really excellent order and thoroughly up to date throughout.

The closing of the Hill Museum and the disbanding of its staff are events which will have serious repercussions throughout the ranks of lepidopterists in all parts of the world, and will definitely slow up the rate of advance in this much favoured though, we fear, often despised branch of science.

In addition to his intense keenness on butterflies and moths, Mr. Joicey had a wide general interest in natural history, was an excellent game shot, an enthusiastic fisherman, and a very successful amateur gardener. His collection of orchids contained many rarities and had brought him quite a number of prizes.

Sir William Smith

Sir William Robert Smith, who died suddenly on March 17, aged eighty-two years, commenced his career at the age of fifteen years as assistant to a chemist, but so well did he use his opportunities that he was able to enter the medical school of St. Bartholomew's Hospital and later to complete his medical studies at Edinburgh, where he obtained the double qualification of the Colleges in 1871. He afterwards graduated M.D. at Aberdeen and D.Sc. in public health at Edinburgh, and became a barrister-at-law. He was keenly interested in politics—contesting some of the Scottish university seats—and in academic and civic life.

It was in the domain of public health that William Smith made his mark. He was for several years medical officer to the old School Board for London and director of the public health laboratories in King's College, London. He afterwards became professor of forensic medicine in King's College and Hospital Medical School, succeeding the late Sir David Ferrier in this office, and found time to edit the seventh edition of Guy and Ferrier's standard textbook of forensic medicine. He was a member for many years, and vice-chairman 1910–13, of the old Metropolitan Asylums Board.

William Smith will be remembered for his insistence that a special diploma in public health should be a necessary qualification for the medical officer of health of the larger districts, and the institution of the diploma in public health was largely owing to his efforts. For many years he had been principal of the Royal Institute of Public Health, of which he was the virtual founder, and only recently had completed a scheme for the removal of the Institute to a new site in Queen's Square, and had just lived to see the erection of the skeleton of the new building there. He was a good speaker and able controversialist, and the congresses of the Royal Institute of Public Health at home and abroad owed much of their success to his great capacity as an organiser. R. T. H.

We regret to announce the death, at the age of eighty-four years, on March 25, of Prof. Rushton Parker, professor of surgery in University College and the University of Liverpool since 1882. Prof. Parker practised and taught surgery since 1869, and was among the first to practise Lister's system of antiseptic surgery. For many years he was consulting surgeon to the Liverpool Royal Infirmary and Bootle General Hospital.

News and Views

Centenary of James Wimshurst

AMONG the best-known inventors of electrical machines of the last part of the nineteenth century was James Wimshurst, the centenary of whose birth occurs on April 13. The son of Henry Wimshurst (1804–84), the constructor of the pioneer screw-propelled ship *Archimedes*, Wimshurst was born at Poplar, and after leaving school was apprenticed at the Thames Iron Works, Blackwall, then a well-known shipbuilding yard. At the age of twenty-one years he became a ship surveyor to Lloyd's Register, from 1865 until 1874 was chief of the Liverpool Underwriters' Registry, and then for twenty-five years, 1874–99, was chief shipwright surveyor to the Board of Trade in London. Living at Clapham, he had a good private workshop and for twenty years devoted himself to the improvement and construction of electrical influence machines. The early machines of this type had all sprung from Volta's electrophorus and had been built by Lichtenberg, Bennet, Cavallo, Nicholson, and others, but it was not until the work of Töpler (1836–1912) and Holtz and Wimshurst that there was any marked advance in design. The machine with radial strips of tinfoil and contact brushes was described by Holtz in 1881 and again in 1882 and 1883 by Wimshurst, whose improvements were made independently. Altogether he made more than ninety Wimshurst machines. Many of these were presented to hospitals, and two of his very large ones are preserved in the Science Museum. A member of the Physical and Röntgen Societies, and a manager of the Royal Institution, Wimshurst was elected a fellow of the Royal Society in 1898. He died suddenly on Jan. 3, 1903.

The Asiatic Society of Bengal

THE Asiatic Society of Bengal held its 148th annual meeting in its rooms at No. 1 Park Street, Calcutta, on Feb. 1—one of its patrons, Sir Stanley Jackson, the Governor of Bengal, being in the chair. In the unavoidable absence of the president, Lieut.-Colonel R. B. Seymour Sewell, the presidential address was delivered by the senior vice-president, Dr. U. N. Brahmachari. In the address, attention was directed to the proposals put forward by the Government of India for extensive retrenchment in the various scientific services in India, many of which owe their inception to the Society, and in the Indian Museum, in which the Society takes particular interest, since the nucleus around which the Museum has been built up consisted of the Society's own collections that were handed over for safe custody to the Government in 1875. By the terms of the Indian Museum Act of 1910 these collections and all additions thereto, except those purchased afterwards by the trustees of the Museum, must, if the trust ever be terminated, be returned to the Society. It was emphasised that the maintenance of the scientific services is essential for the economic development of India, and that, whereas scientific research is one of the most profitable investments that a government can make, a country that neglects the scientific investigation of its natural resources pays, in the long run, very heavily for its neglect.

THE membership of the Asiatic Society of Bengal shows a decrease during the past three years, largely consequent on the present unsettled state of India. Among the losses that the Society has suffered during the last year by death, we notice the names of three fellows, among them the great scholar Maha Mahopadiaya Dr. Haraprasad Shastri, who was elected to a fellowship in 1910, and five members, one of whom, Mr. James Peddie, met his death by assassination at the hands of the revolutionary party in Bengal. The fall of membership, combined with the present financial depression, has caused the Society anxiety regarding the continuance in the future of its activities, and has emphasised the need of creating and building up reserve funds for such objects as the rebuilding of the Society's premises, their present house having been built in 1808 on land granted to them by the Government in 1804, and for the endowment of the Library, which, by its continual expansion, of necessity imposes a steadily increasing strain on the Society's resources. It is a matter of some surprise to learn that in all the 148 years of its existence, and in view of all that the Society has in the past done for India, no financial benefaction of importance has ever been given to it—a state of affairs that reflects very unfavourably on India when contrasted with the support given to similar societies in other civilised (and especially western or American) countries.

Meteorology in India

A PESSIMISTIC note is sounded in the opening passages of Dr. C. W. B. Normand's recently issued "Report on the Administration of the Meteorological Department of the Government of India in 1930–31". This report, which is dated Sept. 11, 1931, has to record a set-back in the rapid expansion of the Indian meteorological service outlined in the corresponding report of last year. The expansion was due to the legitimate demands of aviation, the set-back to the equally legitimate demands of financial stringency arising from the world's economic blizzard. Dr. Normand states that the schemes connected with aviation had in the year under review reached a stage of completion; but many schemes, some not connected with aviation, have had to be shelved. One scheme that is apparently to proceed unchecked is connected with the development of a special branch of the department to deal with the problems of agricultural meteorology. This practically originated in the Report of the Royal Commission on Agriculture in 1928. It contemplates both statistical and experimental studies, the standardisation of the meteorological and physical data collected at experimental farms, the development and standardisation of methods of measuring radiation, evaporation, soil temperature, and so on,

and the determination of the local weather and climate appropriate to each crop. It is proposed to employ two agricultural meteorologists and subordinate staff for a preliminary period of five years, at an annual cost of Rs. 40,000. The necessary grant has been made by the Imperial Council of Agricultural Research.

The Musk Rat in Europe

Two exhibition cases have recently been placed in the Central Hall at the Natural History Museum, South Kensington, immediately facing the visitor on entering the building, in order to inform the public what kind of animal the musk rat, *Ondatra zibethica*, Linn., is, how it lives, and the damage it does. Better known as musquash, the musk rat has been for many years of considerable commercial value because of its fur, which is very beautiful, being thick, soft, richly coloured, and glossy. Naturally an inhabitant of North America, it has been imported to Europe by misguided people who thought some advantage and profit might result from this step. The experiment provides yet another illustration of the serious danger involved in interference with the balance of Nature. In its original home, the musk rat's increase is controlled by the usual kind of checks, which do not exist or have not developed elsewhere. It is said that in 1905 two males and five females were turned loose in Bohemia; twenty-one years later, in 1926, there were computed to be no fewer than a hundred millions of these animals in Central Europe. Owing to their burrowing habits, the damage that they do to waterways is enormous, and great expense has to be incurred in checking them. In Great Britain the danger has been recognised, and under the Destructive Imported Animals Act, 1932, regulations, which come into force on May 1, have been formulated to control the distribution of the musk rat in this country.

Destruction of Rats

In addition to the British Museum pamphlet on rats, noticed in Nature for Dec. 19, 1931, p. 1036, two others have recently appeared. All deal with the specific characters and the natural history of the black and the brown rat, and with the methods of destroying rats or preventing their ingress, so that there is a considerable amount of overlapping; but each pamphlet has its own particular points of excellence. The Ministry of Agriculture and Fisheries *Bulletin*, No. 30 (price 6*d*. net), repeats in new and much more attractive form the old *Miscellaneous Publication* on rats, and its object is to supply practical information leading to rat-destruction. The second pamphlet, by Colin Matheson, deals with "The Brown and the Black Rat in Wales" (National Museum of Wales, price 6*d*. net), and discusses some very interesting facts bearing upon the occurrence of rats and the rat menace in the Principality. It is surprising to learn that in the years 1922–28 inclusive the rat-catcher in the Port Sanitary Area of Cardiff destroyed of black rats, by far the more rare of the two species in Britain at the present day, 22,036 from ships and 3072 from dock warehouses; and of the brown rat, only 50 and 266 in these areas respectively. But the proportions change as the docks recede, for in Cardiff City, from March 1928 until February 1930, only 78 black rats were caught, as against 1961 brown rats. The menace of such great numbers of the plague-distributing black rat in the Port area is one which the author does well to emphasise.

Implements from the Oldoway Beds

Four original implements and casts of eleven others from the Oldoway beds in Tanganyika have been presented to the British Museum by Dr. L. S. B. Leakey on behalf of the East African Archæological Expedition, and are to be exhibited without delay at the top of the main staircase in the prehistoric section of the Department of British and Mediæval Antiquities. They come from the following beds, beginning at the base: Bed No. 1, associated with *Deinotherium*, a predecessor of the elephant and generally assigned to the Miocene: pre-Chelles types. Bed No. 2, lower part, with *Hipparion* and *Elephas antiquus*: early Chelles types. Bed No. 2, upper part, the horizon of Prof. Reck's Oldoway man, with *Hipparion*, *Elephas antiquus*, and *Hippopotamus gorgops*: late Chelles types. Bed No. 3, with fauna as Bed No. 2: transition Chelles to St. Acheul. Bed No. 4, lower part, with *Elephas antiquus*, *Hipparion*, *Hippopotamus gorgops*, *Pelorovis* and extinct antelopes: early St. Acheul types. Bed No. 4, upper part, with same fauna as lower: advanced St. Acheul types.

Japanese Plants in the Netherlands

The Leyden Branch of the Royal Horticultural Society of the Netherlands, in order to commemorate the founding of the well-known acclimatisation garden for Japanese plants by Dr. P. F. von Siebold, is planning to hold an exhibition, on May 4–8, at Leyden, of living Japanese plants, shrubs, and trees, many of which are descendants of plants imported by von Siebold. Belgian and Dutch horticulturists are collaborating to make this collection as complete as possible. At various other institutes of the University of Leyden, smaller exhibits will be held of the ethnographical, zoological, and botanical material gathered by von Siebold. Biographical materials will be shown in the University Print Collection. In the University gardens, which still contain more than forty of von Siebold's trees and shrubs, a bronze statue, by the sculptor, O. Wenckebach, will be unveiled by the grandson of von Siebold and by the grandson of his head-gardener.

Von Siebold and the "Flora Japonica"

Philipp Franz von Siebold was born at Würzburg on Feb. 17, 1796. He studied at his home university, where he received his doctorate in medicine in 1820. In 1823 he arrived at Decima, Japan, as a military doctor, but he also devoted himself to the natural history, medicine, ethnology, ethnography, and history of Japan. At Nagasaki he founded a medical school and clinic, but for political reasons some of his ever-increasing botanical, zoological,

mineralogical, and geological collections were confiscated by the Japanese authorities in 1828; fortunately, not long before he had sent many specimens to Leyden. He also sent a living tea plant to Java, thus originating tea culture on that island. In 1827, Siebold published a small catalogue of Japanese economic plants. On Dec. 30, 1829, political unrest was so acute that he was ordered to leave Japan, and he then settled in Holland. He met the German singer, J. J. Hoffmann, who was also a linguist. In 1845, Hoffmann published a description of Siebold's books, manuscripts, and maps which he had brought from Japan. Zuccarini, the Munich botanist, helped with the classification of botanical material. Publication of the "Flora Japonica" was begun in 1835 and continued until 1842, but after Zuccarini's death, von Siebold discontinued further publication and the materials became the property of the Government Herbarium at Leyden, where the Von Siebold Collection is still visited and consulted by botanists. Von Siebold's influence on horticulture was even greater. His imported specimens formed a nucleus for horticulture in Belgium and Holland, but the original "Jardin d'Acclimatisation: Nippon" no longer exists. His zoological collections are preserved in the Museum of Natural History at Leyden and his ethnographical material at the Leyden Ethnographical Museum. Von Siebold died at Munich on Oct. 18, 1866.

Decline of Australian Parrakeets

THE re-discovery of a species supposed to have become extinct is especially a matter of congratulation when it has some particular claim to interest, as is the case with the splendid grass-parrakeet (*Neophema splendida*), of which a pair has recently reached England as a present to H.M. The King. Mr. D. Seth-Smith, in commenting on this in the *Avicultural Magazine* for January (p. 36), mentions that a few captured specimens had appeared in Adelaide, and that, always rare, the species, which is found in south and south-western Australia, had completely disappeared for about sixty years, and was supposed to be extinct, until a specimen occurred at Koonibba, crippled by collision with a wire fence. The special interest of the species lies in the very brilliant colouring of the male, which has a blue face and wing-patches, a scarlet breast, and yellow abdomen, contrasting with the green of the upper surface; the female has no red and is generally duller. The length is about eight inches. A whole group of small grass-seed-eating Australian parrakeets like this appears to be on the decline, common species like the turquoisine (*N. pulchella*) suffering as well as this rare one. Fortunately, like so many Australian birds, they are free breeders in captivity, and may possibly be preserved if domesticated as the budgerigar has been.

False Mimicry in Animals

THE short-tailed South American monkeys known as uakaris are never common in captivity, so it is as well to direct attention to the recent acquisition of a specimen of the red uakari (*Cacajao rubicundus*) by the Zoological Society of London, which exhibits it in the Tropical House along with some more familiar American monkeys. The resemblance of this species to an orang-utan in miniature is noticeable, and is paralleled in the Bird House next door by a specimen of the South American magpie tanager (*Cissopis leveriana*), which exhibits an equally striking resemblance in miniature to the magpie. Other more striking examples could be given, in both mammals and birds, of this false mimicry, or resemblance between creatures which do not inhabit the same region, when size as well as general appearance correspond. In the Bird House may also be seen an example of Chaulet's Cissa (*Cissa hypoleuca Chauleti*), which will be interesting to watch, as, like the better-known Indian species (*C. sinensis*), this green bird changes into blue without a moult, the change taking place by a gradual alteration of tint, which reminds one of the fading into blue of green paint.

A Direct Reading Optical Micrometer

A MICROSCOPE for measuring small lengths has recently been put on the market by Messrs. W. Ottway and Co., Ltd., Orion Works, Ealing, W.5. The microscope, which gives a magnification of 25, is about 6·5 cm. long and is mounted on a small tripod. Focusing is effected by sliding the microscope tube through the holder, fine adjustment being made by rotating a milled ring on the stand. Measurements are obtained by a direct reading of a scale on a graticule fitted into the microscope, a screw focusing adjustment being provided to bring the graticule into the focal plane of the eyepiece. Scales reading to 0·01 in. or 0·001 in. are supplied and are easily interchangeable. The instrument can conveniently be used as a linen counter, or for the measurement of Brinell impressions or of small objects up to 0·1 in. in length. For measurements of length up to 10 mm. an alternative objective, fitted with a 0·1 mm. scale and giving a magnification of 15, is obtainable. As the graticules may be ruled to any desired scale or pattern, the micrometer should prove useful as a test instrument in many industrial operations. It can easily be applied, for example, to the testing of screw threads, a graticule with the required thread form being used. Its compactness and the ease and speed with which readings may be made are additional advantages.

Performance of Gears

IN a paper by Messrs. Hyde, Tomlinson, and Allan, of the National Physical Laboratory, read before the Institution of Automobile Engineers on April 4, an interesting account was given of researches which have been in progress at the Laboratory during the past few years on the performance of gears. The best gears are made of special alloy steels, either air or oil hardened, and afterwards finished to an accuracy of a few ten-thousandths of an inch by grinding. The work of the Laboratory shows that such gears can transmit power with the very high efficiency of more than 99 per cent. At the high speeds of rotation to which gears are subjected, a tooth out of its true position by less than a thousandth of an inch may come into mesh with a shock sufficient to double or

treble the normal pressure on the tooth. Although it has ample strength to withstand this augmented pressure as a steady load, if the effect is repeated often enough the metal becomes fatigued, and the tooth may ultimately break off as a result of this fatigue. Thus the fatigue strength should be the criterion employed in design, rather than the more usual considerations of static strength and durability. The experiments further showed that this type of gear can be run under load for many millions of revolutions with scarcely any appreciable wear of the tooth faces, presupposing the best conditions of lubrication. It appears as though the lubricating oil, when functioning efficiently, almost completely holds the steel surfaces apart by a highly tenacious film. Another feature of interest is that even ideally perfect gears must lose some of their running perfection when it is necessary for them to transmit power under heavy loads. This is due to the small elastic bending of the teeth caused by the heavy load, which has the effect of disturbing the perfect uniformity of the motion which the gear would otherwise transmit.

Earthing Radio Sets

In the wiring rules issued by the Institution of Electrical Engineers, it is recommended that every radio-receiving set actuated by electric power taken from the public supply mains should be effectively earthed at certain specified points. The obvious way of doing this is to connect these points by conductors with a water pipe. According to the *Wireless World* for March 23, the Metropolitan Water Board has been investigating to find out whether the leakage currents flowing into their mains are producing appreciable corrosion in the mains or are eating them away at the places where the currents leave them to enter the earth. In the early days of tramway electric traction, where the current when it left the motors was supposed to get back to the generators by the tram rails, it was found that a large proportion of the current left the rails and came back by the earth, the water and gas pipes, and other conductors. In several cases damage was done to the pipes. To obviate this trouble, the Board of Trade insisted that the voltage drop between any two points on the rails should not exceed seven volts, and this has proved satisfactory. If it is found that the leakage currents are damaging the water or gas pipes, we have no doubt that some remedy will soon be invented, as electrical engineers have been making an intensive study of the problem of 'earthing' for several years. It would be very difficult to prove that the damage, if any, is being done by the mains-driven radio sets, as the currents in the earth are well known to be mainly due to cosmical and atmospheric action and to the leakage or 'vagabond' currents from electric supply stations.

Large Alternators

It is gratifying to find from the *Metropolitan Vickers Gazette* for January that, despite depression in many industrial centres, rapid progress was made during last year in engineering development. Two turbo-alternators have been supplied to the power station at Clarence Dock, Liverpool, each of which has a power of 71,500 kilovolt-amperes, runs at 1500 revolutions per minute, and generates at 7250 volts. One of the two large 80,000 kilovolt-ampere machines for the new Battersea Power Station of the London Power Company is now practically completed. This is the largest 1500 r.p.m. machine yet built in Great Britain. The company has also built a 40,000 kva. alternator for the Victoria Falls Power Company, two of 31,250 kva. capacity for Japan, and several for Australia, Mexico, and Calcutta; all of these large machines run at the almost incredible speed of fifty revolutions per second. Three novel and interesting motor-alternator sets have been supplied for operating the Sperry gyroscope equipments on the Italian liner *Conte di Savoia*. The replacement of human effort by automatic electric control is proceeding very rapidly. The steam pressure in the boilers is maintained at the desired value by automatic regulation of the fans and grates. Substations are sometimes left entirely unattended; the starting, synchronising, and stopping of 14,000 kva. alternators being entirely automatic. The first section of the power station the company is building for Montevideo is now operating. It is interesting to note that the whole of the work from the commencement of the excavation of the site to the starting up of the plant was carried through in sixteen months. This performance is excellent considering the distance the bulk of material had to be shipped.

Science Talks by Gramophone

Science teaching in schools in the United States is to be enlivened by the employment of gramophones for bringing to the class-rooms the voices of the most eminent men of science. The records are being produced by Science Service, of Washington, D.C. The "Durium" record used consists of a thin layer of a synthetic resin so strong that the sound grooves can be placed very close together, nearly doubling the time of playing. We have received a set of the first seven records, and listened to them with pleasure. The recording has been excellently done, and each speaker gives the kind of talk that would be expected from him were he invited by a teacher to address a class for five minutes. The speakers in this first set are: Prof. Robert A. Millikan, director of the Norman Bridge Physics Laboratory, California Institute, Pasadena, on "The Rise of Physics"; Prof. John C. Merriam, president of the Carnegie Institution, Washington, on "The Record of the Rocks"; Prof. Edwin G. Conklin, professor of zoology in Princeton University, on "The Mystery of Life"; Prof. Karl T. Compton, president of the Massachusetts Institute of Technology, on "Science and Engineering"; Prof. L. H. Baekeland, pioneer in industrial chemistry, on "Chemistry and Civilization"; Prof. William H. Welch, professor of the history of medicine in Johns Hopkins University, on "The Tubercle Bacillus"; and Dr. William M. Mann, director of the National Zoological Park of the Smithsonian Institution, Washington, on "Our Animal Friends". With each record is supplied a card,

bearing on one side a photograph of the speaker and on the other side bibliographical details of his scientific work, together with the complete text of the talk. The set is being offered at an inclusive charge of three dollars, and, at such a low price, may be recommended not only to teachers and students, but also to anyone interested in science in general.

Co-ordination of Scientific Terminology

AMONG the scientific questions which the International Institute of Intellectual Co-operation has been asked to examine is the co-ordination of scientific terminology. Various international organisations, including the Commission of Electro-technics and certain scientific unions, have undertaken, each in its respective sphere, the compilation of scientific or technical vocabularies. The different branches of science, however, constantly employ, and very often with a different meaning, terms which are common to all of them. It therefore appeared indispensable that the co-ordination of these terms should be undertaken. For this purpose, a Committee recently met at the International Institute of Intellectual Co-operation. It was composed of Prof. Cabrera (Madrid, chairman); Prof. Cotton (Paris), representing the International Union of Physics; Prof. Willstätter (Munich), Prof. Lowry (Cambridge), delegates of the International Union of Chemistry; Prof. Selys-Longchamps and Dr. Ledoux (Brussels), representing the International Union of Biological Sciences; and Prof. Lombardi (Rome), delegate of the International Union of Electro-technics. The Committee invited the International Institute of Intellectual Co-operation to undertake the work of co-ordination in conjunction with the international organisations concerned.

Fourteenth International Physiological Congress

THE Fourteenth International Physiological Congress will be held in Rome on Aug. 28–Sept. 3, as arranged; no change has taken place in the date fixed for it. The president of the Congress is Prof. Bottazzi of Naples, and the International Committee consists of Profs. Pavlov (Russia), Johansson (Sweden), Howell (United States), Frank (Germany), Lapicque (France), and A. V. Hill (Great Britain). The inaugural ceremony will be held in the Giulio Cesare Hall of the Campidoglio. The inaugural lecture will be given by Prof. A. V. Hill, and receptions will be given by the Governor of Rome and the Royal Academy of Italy. Foreign participants in the Congress will enjoy a reduction of fifty per cent for tickets taken, under certain conditions, on the Italian railways. In the near future, those who have already returned their applications for membership will receive further information, and a programme of the inaugural ceremony and other functions.

Announcements

IT is announced in *Science* of March 18 that Sir James Jeans has been made an honorary member of the Washington Academy of Sciences, in recognition of his contributions to the dynamical theory of gases, to cosmogony, and to astrophysics.

THE William H. Nichols Medal for 1932 of the New York Section of the American Chemical Society was presented on March 1 to Prof. J. B. Conant, chairman of the division of chemistry in Harvard University, in recognition of his work in organic chemistry, particularly in the chemistry of chlorophyll.

AT the annual general meeting of the Physical Society, held on March 18, the following officers were elected: *President*, Prof. A. O. Rankine; *Secretaries*, Dr. Ezer Griffiths (Business), Dr. Allan Ferguson (Papers); *Foreign Secretary*, Prof. O. W. Richardson; *Treasurer*, Mr. R. S. Whipple; *Librarian*, Dr. J. H. Brinkworth.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A male assistant in the Department of Printed Books of the National Library of Wales—The Librarian, National Library of Wales, Aberystwyth (April 12). A registrar of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (April 15). A director of education for the City of Sheffield—The Director of Education, Leopold Street, Sheffield (April 16). A Dickinson research travelling scholar in medicine; a Dickinson research surgery scholar; and a Dickinson research scholar in medicine, each at the Manchester Royal Infirmary—The Secretary to the Trustees, Royal Infirmary, Manchester (April 16). A head of the Commerce Department of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (April 18). A full-time lecturer with degree, and a knowledge of general engineering or mining, at the County Technical Institute, Worksop—The Principal, County Technical Institute, Worksop (April 21). A junior scientific officer in an Admiralty establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (April 23). Probationary assistant naval constructors—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (April 30). An assistant in the Department of Forestry of the University College of North Wales—The Registrar, University College of North Wales, Bangor (May 9). A professor of physiology at the London Hospital Medical College—The Academic Registrar, University of London, South Kensington, S.W.7 (May 14). A head of the Mechanical and Electrical Engineering Department of the Harris Institute, Preston—The Principal, Harris Institute, Preston (June 1). An assistant lecturer in civil engineering, building construction and sanitary science at the Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11. An assistant master for elementary engineering and metalwork at the Sawston Village College—The Education Secretary, County Hall, Cambridge. A temporary junior assistant with first or second class honours in physics, or equivalent, at the Experimental Station, Porton, near Salisbury—The Chief Superintendent, Chemical Defence Research Department, War Office, 14 Grosvenor Gardens, S.W.1.

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.*]

Palæacariformes, a New Sub-order of the Acari

THE discovery of the two genera of Acari for which it has been necessary to create this new sub-order affords us ample evidence of the truth of the contention that our knowledge of the teeming world of micro-arthropods is as yet very insufficient. A thorough exploration of the fauna of the tropics by the use of the modern method of automatic collecting, devised by the late Prof. Antonio Berlese of Florence, will undoubtedly yield a rich crop of many new and strange forms which will substantially alter our conceptions regarding these creatures.

One of the genera for which the new sub-order had to be erected, *Archeonothrus*, was discovered by me in 1905 in Natal, and a brief preliminary description of it was published in 1906,[1] the name implying that it was considered related to the Oribatid genus, *Nothrus*, although more primitive. The re-examination of this form last autumn, following on an investigation of the mouth-parts of the Oribatids,[2] revealed, however, at once such a large number of differing features that it soon became evident that the genus could not possibly be referred to any of the existing sub-orders of Acari. At the same time I was convinced that *Archeonothrus* must be considered the most primitive of recent Acari, presenting as it does the very aspect of a living fossil the nearest relative of which must be sought for amongst the fossil Acari from the Devonian epoch.

This discovery was eclipsed by the later surprising discovery of yet another genus of the new sub-order, this time in the soil in a spruce forest in southern Sweden, a genus which I have called *Palcæacarus*.

In their general appearance both forms resemble very much the nymphæ of Oribatids, this very deceptive resemblance being due to the soft cuticle, the presence of pseudostigmatic organs, although of a more primitive type, and the long hairs on the hysterosoma.

The body is divided into two parts, the propodosoma and the hysterosoma, between which there is a distinct neck-shaped constriction. The propodosoma is covered by a shield which has five pairs of hairs besides the pseudostigmatic organs. Such a large number of propodosomatic hairs is very unusual in the recent Acari, but occurs also in the Devonian *Protacarus* described by Stanley Hirst from the Old Red Sandstone, a feature which lends support to the view held by some acaridologists that the propodosoma consists of six segments besides the acron.

The isolated position as well as the primitive organisation of the Palæacariformes is most clearly realised when one examines their maxillæ. In these there is no trace of the so-called hypostome which is such a conspicuous feature in the Oribatids; but, on the other hand, there are two pairs of appendages, the lateral ones of which are evidently homologous with the so-called maxillary lobes of the Oribatids and the Mesostigmata, while the median appendages are conspicuous through the presence of three pairs of hairs. In the Oribatids the maxillary lobes are enormously developed and meet in the middle, thus completely concealing the median appendages, the presence of which had previously been completely overlooked, but which I was able to discover by dissecting these organs, once the presence of them in the Palæacariformes had rendered it likely that they occurred also in the Oribatids. As regards the presence of two pairs of maxillary appendages, the Palæacariformes agree with the most primitive Trombidiformes, for example, *Speleorchestes*.

The new sub-order is undoubtedly related to the most primitive Oribatids. Thus the shape of the chela of the mandible, as well as the easily recognisable content of the hind part of the alimentary canal, is a sufficient proof that they are phytophagous, feeding probably on decaying leaves or possibly on mosses and lichens. But from the Oribatids they differ profoundly in the absence of hypostome and epimera and still more by the respiratory organs, which consist of a pair of minute stigmata on the base of the mandibles exteriorly and short tracheæ.

It is on the whole evident that the Palæacariformes show affinity to the more primitive forms of both the Oribatid and the Trombidiformes. The genus *Protacarus* mentioned above was placed by Hirst amongst the Eupodidæ, which are, however, in my opinion too specialised to be taken into account. As a matter of fact, *Protacarus* agrees in many respects in a striking way with the Palæacariformes, especially *Palcæacarus*, as, for example, in the number of hairs on the propodosoma, the presence of pseudostigmatic organs, and, although Hirst could not discern clearly the shape of the chela of the mandible, he describes it as dark-coloured, which is precisely the colour of the chela of the phytophagous Oribatids and of *Palcæacarus*.

It is admittedly premature to draw any far-reaching conclusions regarding the phylogeny of the Acari from the facts established by the discovery of *Protacarus* and the Palæacariformes; and the very discovery of the latter, however unexpected, must make it seem quite within the bounds of possibility that other forms may yet be discovered, representing new types which will remodel our present conceptions regarding the relationship of the different sub-orders with one another and concerning the origin of the Acari.

Nevertheless, the dim outline of the ancestor of at least the Oribatids, the Tyroglyphids, and the Trombidiformes seems to begin to materalise in the shape of a creature not unlike *Protacarus* and the Palæacariformes, whereas the connexion between these groups and the Mesostigmata and the Holothyrioidea seems very obscure.

IVAR TRÄGÅRDH
(Chief Entomologist).
Royal Swedish Forest Experiment Station,
Feb. 11.

[1] *Zool. Anz.*, Bd. 30, No. 26, pp. 870-871.
[2] Concerning the Mouth-parts of the Oribatids. *Entom. Tidskrift*, pp. 209-217; 1931.

Function of the Adrenal Medulla

ADRENALINE, as it is generally known to-day, seems to be different from the substance primarily produced by the adrenal gland. Adrenaline appears to be a decomposition product of the natural substance, the decomposition taking place post-mortem in the gland and during subsequent chemical manipulations. If the glands (ox) are collected and the extraction carried out in the usual way, adrenaline is obtained. If, however, the chances for post-mortem enzymic reactions are minimised by rapid excision and cooling of the glands after death, a substance is obtained by careful extraction the physiological action of which is distinctly different from that of the ordinary adrenaline. We propose to call this new substance ' novadrenaline '.

As is known, small doses of common adrenaline, of about 0·001 mgm., given intravenously to the decerebrated or anæsthetised cat, usually produce a fall of blood pressure. Only larger doses cause a definite

rise. Novadrenaline does not show this depressor action of small doses. Even doses fifty times smaller give still a definite pressor effect.

If larger doses are given (0·05 mgm. with cut vagi), novadrenaline always produces a higher rise of blood pressure than the corresponding amount of adrenaline, as determined by colorimetric comparison. A striking difference between the actions of the two substances is seen also in the duration of their pressor effects. While with common adrenaline (0·05-0·1 mgm.) the blood pressure, after reaching its maximum, quickly returns to the original level, the rise of blood pressure produced by an equal dose of novadrenaline subsides only very slowly, often with a wide plateau lasting for several minutes, reaching the original level in 8-10 minutes, the return being three to four times slower than with adrenaline. As shown by I. Huszák in this laboratory, the action of novadrenaline on the Trendelenburg frog preparation is much stronger than that of adrenaline.

The difference between the action of adrenaline and that of our extracts cannot be due to the modifying influence of some accompanying substance, since on further purification the action of novadrenaline remains unchanged.

Our extracts were made with ½ per cent trichloracetic acid, 2 c.c. being used for every gram of the minced medulla. The suspension was quickly heated to 80° C. and rapidly cooled again. The neutralised extract could be concentrated *in vacuo* to a syrup, and fractionated with methyl alcohol and acetone. From the acetone, novadrenaline was precipitated as a ferrous complex, the formation of which is highly specific for the *ortho* dihydroxy grouping. The active substance was liberated in watery solution from this complex by hydrogen sulphide, and still showed an unchanged activity. If once extracted and kept cool, novadrenaline is reasonably stable.

As to the chemical nature of novadrenaline, no more than a mere suggestion can be given at present. The evidence available suggests that novadrenaline is a low molecular weight ester of adrenaline, the esterifying radicle being attached to the alcoholic hydroxyl of the side-chain. This suggestion is based on the following observations. The general chemical properties of adrenaline and novadrenaline are very similar. The specific activity of novadrenaline can be destroyed by treatment with hydrochloric acid. As shown by the iron colour reaction, the *ortho* dihydroxy grouping is free in novadrenaline, as in adrenaline. Since the entire physiological activity of novadrenaline is destroyed by formaldehyde, the imino group seems also to be free.

As to the physiological importance of novadrenaline, it seems to be not unlikely that this substance presents, with respect to adrenaline, a relation analogous to that of acetylcholine to choline, with an activity related, however, in this instance, to the true sympathetic nervous system.

We hope that our findings may contribute not only to knowledge of the action of sympathetic nerves, but also to the understanding of pathological conditions, such as hypertonia and asthma.

We were led to the finding of novadrenaline by the study of oxidation processes, but were greatly helped in our work by a personal communication from Sir H. H. Dale, relating to a casual observation of the more persistent pressor action of extracts from the adrenal gland, in comparison with that of chemically isolated adrenaline. Our work has been supported by the Ella Sachs Plotz Foundation.

J. L. SVIRBELY.
A. SZENT-GYÖRGYI.
Institute of Medical Chemistry,
University of Szeged, Hungary.

Gill-Morrell and Barkhausen-Kurz Oscillations

IN NATURE of Feb. 6, Mr. R. Cockburn has described results which appear to show the presence of two types of electronic oscillations in a triode with positive grid voltage.

I should like to express disagreement with this result, for the following reasons :

(1) Mr. Cockburn's results shown in his Fig. 2 have been obtained by the simultaneous variation of two quantities, circuit length and filament emission, and present a misleading picture of the relation between circuit tuning and wave-length.

The apparent overlapping of the so-called Gill-Morrell and Barkhausen-Kurz oscillations is due to the dependence of the space charge oscillation frequency on emission current. Fig. 10 of Hollmann's paper [1] quoted by Mr. Cockburn shows the true nature of this effect.

(2) The variations of wave-length and amplitude with circuit tuning have been satisfactorily explained as ' coupled circuit ' effects.[2] The hypothesis of two different types of oscillation is therefore unnecessary.

(3) There appears to be no valid experimental evidence for the existence in gas-free tubes of oscillations independent of the inter-electrode impedances (' B-K ' oscillations), and existing theories [3] show that such oscillations are impossible.

(4) The simultaneous existence of two types of oscillation (apart from harmonics) has, so far as I am aware, never been demonstrated. I have shown elsewhere [4] that apparent experimental evidence [1] of this is untrustworthy.

Regarding the effect of varying the emission current, theory and experiment [2] have shown that the oscillation amplitude is a maximum in the region of the transition from space charge to emission saturation of the grid current characteristic. The presence of more than one optimum value of emission current usually indicates the presence of ' harmonic ' space charge oscillations,[5] that is, oscillations of frequency nearly, but not necessarily exactly, an integral number of times that given by the Barkhausen-Kurz equation. ' Overtones ' is possibly a better name than ' harmonics ' for these oscillations.

It is probable that such oscillations occurred in the cases mentioned by Mr. Cockburn. The fact that the wave-length was shorter at the lower emission value (which is the opposite of the normal result where only fundamental oscillations are concerned) favours this hypothesis.

E. C. S. MEGAW.
Research Laboratories of the
General Electric Company, Ltd.,
Wembley, Feb. 11.

[1] Hollmann, *Ann. Phys.*, **86**, 129 ; 1928.
[2] Tank and Schiltknecht, *Helvetica Phys. Acta.*, **1**, 110 ; 1928.
[3] See, for example, Möller, *Jahrb. drahtl. Tel.*, **34**, 201 ; 1929.
[4] Paper to appear shortly, probably in *Jour. I.E.E.*
[5] Potapenko, *Z. tech. Phys.*, **10**, 542 ; 1929.

IN my original letter (NATURE, Feb. 6), only the actual fact of the existence of two types of oscillations was mentioned, with perhaps insufficient explanation. In view of Mr. Megaw's letter, however, I feel that more details should be given.

Mr. Megaw explains the results as due to the variation of space charge oscillation frequency with emission current, suggesting, presumably, that a maximum in the amplitude of the oscillations would be obtained quite normally when this frequency corresponds to that of the external circuit. Perhaps it was not made sufficiently clear that the ranges of emission current for the two types of oscillations are quite distinct.

For example, with $V_g = 40$ v., $V_a = 0$ v., the space

charge saturation current is in the neighbourhood of 20 ma. The optimum emission for the maintenance of the 130 cm. Barkhausen-Kurz wave is fairly constant at 16 ma. for variations of the tuning circuit, except at points *A* (Fig. 2, previous letter), where it drops to 14 ma., corresponding to the drop in wave-length noticeable at these points. In the Barkhausen-Kurz zone, therefore, the oscillations are a maximum in the neighbourhood of space charge saturation of the grid current characteristic, in agreement with the results of Tank and Schiltknecht mentioned by Mr. Megaw. The secondary optimum emission value maintaining approximately the same wave-length is 8 ma. The emission range for optimum maintenance

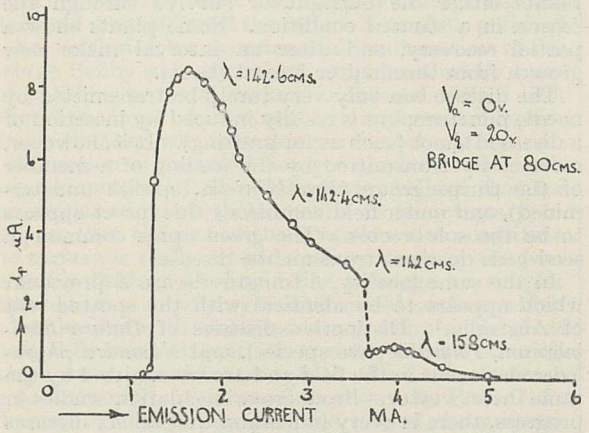

FIG. 1.—Variation of plate current (and wave-length) with emission current.

of the Gill-Morrell oscillations is continuous from 1 ma. to 11 ma., the wave-lengths extending from 90 cm. to 170 cm. The emission for optimum maintenance of a wave-length of 130 cm. in this zone is 3 ma.

With the tuning bridge fixed in such a position as to offer a wave-length suitable for maintenance in the Gill-Morrell zone and variation of emission current, usually a sudden change in plate current, together with a change in wave-length, is noticed as the oscillations change from one type to the other. A clear example is shown in Fig. 1.

It is not at present possible to offer a full explanation of the existence of the two zones. However, it has been shown [1] that electron oscillations can occur in the grid-anode space when it is space charge saturated, and in the valve used the dimensions were such as to permit this state to exist. If, then, oscillations can occur in the anode-cathode space as well, there would appear to be sufficient justification for postulating the existence of two types of oscillations. Fundamentally, no doubt, they are due to the same basic cause, and if in his forthcoming paper Mr. Megaw co-ordinates the various conflicting experimental results, a distinct advance will have been made.

R. COCKBURN.

Municipal College,
West Ham, E.15,
Feb. 15.

[1] Gill, (*a*) A Space Charge Effect, *Phil. Mag.*, Ser. 6, **49**, 993; 1925: (*b*) Electrical Oscillations of Very Short Wave-length, *Phil. Mag.*, Ser. 7, **12**, 843; 1931.

Light as a Factor in Sexual Periodicity

REFERRING to the recent papers and communications of Dr. J. R. Baker and Mr. R. M. Ranson and Prof. T. H. Bissonette, read before the Royal Society, Feb. 4, Dr. Marshall [1] suggests that the conclusion concerning light as a factor governing sexual periodicity involves a principle of wide application.

In view of this remark, it may be of some general interest to biologists to know that so far as the flowering plants are concerned this holds true.

Since a brief account of the earlier work on these lines was published in 1924,[2] further investigations have been carried out, and more than one hundred varieties and species have now been tested in Great Britain; whilst in America, Russia, and elsewhere similar work has been done. The results have appeared in various botanical periodicals.

Briefly, it appears that the period of light exercises a profound influence upon the habit of growth, and determines whether many plants flower or remain in the vegetative condition. Under an unfavourable period of light, the formation of sexual organs may be suppressed for very long periods during which vegetative growth continues (Garner and Allard). The flowering plant is so organised morphologically that the response can be strictly localised to one part (Knott). The distribution of the sexual organs in the plant may also be controlled in another manner, as, for example, in hemp, where 'sex reversal' may occur; or in cucumber, where the sex ratio may be modified as a result of the influence of the period of light (Schaffner).

All observers record that the utilisation of the food products, whether in storage or in rapid growth, reflects the operation of this factor, which may also govern the rate of tuber formation (Maximov).

I am unaware that much information has as yet been collected from studies made with cryptogams. However, in the Hepaticæ (Liverworts) the formation of sexual organs and their supporting tissues is at least partially controlled by this factor (Wann).

Possibly the well-known periodicity of the plankton (diatoms, peridineans, and crustaceans) would also provide an interesting series of observations when studied under varying conditions of light and constant temperature, salinity, etc.

M. A. H. TINCKER.

Royal Horticultural Society,
Wisley, March 5.

[1] NATURE, **129**, 344; March 5, 1932.
[2] M. A. H. Tincker, NATURE, **114**, 350; Sept. 6, 1924.

WITH reference to the letter of Dr. F. H. A. Marshall on the above subject,[1] I should like to direct attention to the relation of sexual maturity in marine invertebrates to the phases of the moon, a relation which was stated to exist many years ago and seemed at first scientifically incredible and imaginary, but which has been more recently verified by exact research carried out by several competent marine zoologists. The most famous case is that of the Palolo worm, *Eunice viridis*, the sexually mature posterior parts of which swarm at the surface of the sea off the islands of Samoa and Fiji in the mornings of the seventh, eighth, and ninth days after the full moon of November. The most recent paper on the subject is that by Silvio Ranzi of the Zoological Station of Naples.[2] In many other species of Polychæta the sexual maturity and discharge of mature ova and sperms has been shown to synchronise with particular days of the lunar cycle, but in some localities certain species show no evidence of such a relation.

Ranzi's own researches were made on *Platynereis dumerilii*, in which he found that mature individuals occur at Naples from March to November, but that the greatest number of spawning individuals occurred on the third day after the full moon. Sexual maturity is thus not confined to one lunar month of the year in all cases as in the Palolo, but the sexual cycle is affected by the lunar cycle.

Ranzi concludes that the sexual cycle of marine annelids is influenced by a lunar factor, which cannot be the tide, because it occurs in the Mediterranean, where the tides are negligible, nor the light, because sunlight has no such effect. He suggests, therefore, that the influence of the moon is due to some action of unknown nature, not perceptible to our senses, but producing an effect on the sexual cycle of organisms. The facts would suggest that the effect is due to some peculiarity of moonlight which is absent from sunlight, and here is a question which bio-physicists might investigate. Moonlight is, I believe, polarised, but I do not know that any attempt has been made to test the effect of polarised light on the sexual cycle of living organisms.

J. T. CUNNINGHAM.
35 Wavendon Avenue, W.4,
March 14.

[1] NATURE, **129**, 344, March 5, 1932.
[2] *Pubblicazioni della Staz. Zool. di Napoli*, vol. 11, Fascicolo 2, 1931.

Stomatal Movement and Hydrogen Ion Concentration

IN order to test the effect of the hydrogen ion concentration of the cell-sap on stomatal movement, experiments were made with the stomata of *Tulipa*, *Scilla*, *Iris*, and *Tradescantia*. It was found that the hydrogen ion concentration of the cell-sap of the guard-cells was approximately 4·5, while the epidermal cells were slightly less acid. The stripped epidermis was placed in buffer mixtures of known hydrogen ion concentration and left for two, six, twelve, and twenty-four hours respectively. The mixture used was the B.D.H. 'Universal Buffer Mixture'. For each time interval, one set was kept in the light and another in the dark for comparison. It was found that, in the case of *Tulipa*, the stomata were closed between *p*H 1 and *p*H 5, and at *p*H 6, 7, and 9 they were open, the maximum being at *p*H 7. In the dark the stomata were open at *p*H 5, 6, 7, and 9, the maximum being at *p*H 5. In the case of *Scilla*, the closure continued up to *p*H 6 in light, to *p*H 5 in the dark, with a maximum at *p*H 7.

In order to avoid the possibly toxic effects of the buffer mixture, the experiments were repeated with solutions of carbon dioxide, of *p*H values 4·4, 4·6, 4·8, and 5·0. In all these, the stomata of *Tulipa* were open, the greatest opening being at 4·4 in light and 5·0 in dark. *Scilla* showed closure at *p*H 4·4 and 5·0 in light and dark, opening at 4·6 and 4·8. *Iris* stomata were open throughout the whole range in light, and closed at 4·8 and 5·0 in dark, with a maximum opening at 4·4. *Tradescantia* showed a maximum opening at 4·4 in light, and closed at 4·4 in dark, with greatest opening at 5·0.

It is evident from this that the stomata of these forms are susceptible to changes in the *p*H value of the sap produced by carbon dioxide, and that the guard-cells respond by movement to these artificially produced changes. The experiments of which this is a preliminary account are still in progress, and it is intended to extend the observations to dicotyledons as well as to monocotyledons.

E. PHILIP SMITH.
M. S. JOLLY.
University College, Dundee,
March 3.

A Virus Disease of Tobacco in South Africa

AN obscure and destructive disease of tobacco has occurred for many years in the Stockenstrom district of the eastern Cape Province. It is becoming yearly more serious, and frequently causes total loss of both seed-beds and early plantings. Recent investigation has shown that it is a virus disease which, although bearing some resemblance to the 'ring-spot' described by Smith [1] and Wingard,[2] has important distinctive characters of its own.

A constant symptom of the disease is the sudden stoppage of apical growth and the stunting of leaves in process of formation. Leaf-spotting develops along various lines, but is usually of a 'ring-spot' or hieroglyphic type, often definitely related to the veins in a fern-leaf pattern. The youngest leaves show marked distortion and blistering, frequently accompanied by brilliant mottling. General chlorosis is usual in varieties of the Burley type, and is followed by discoloration of the stem in cortex and pith and by root decay associated with secondary organisms. Affected plants either die outright or survive through the season in a stunted condition. Some plants show a partial recovery, and after an interval make new growth from terminal or lateral shoots.

The disease can only very rarely be transmitted by needle puncture, but is readily induced by insertion of a diseased shoot (such as for grafting). It is, however, most easily transmitted by the feeding of a member of the thrips group (*Frankliniella*, species undetermined), and under field conditions this insect appears to be the sole vector. The green aphis common in seed-beds does not transmit the disease.

In the same locality, a tomato disease is prevalent which appears to be identical with the spotted wilt of Australia.[3] Distinctive diseases of *Datura Stramonium*, *Physalis* (two species), and *Nicandra physalodes* also occur in the field and are transmitted by the same insect vector. From cross-inoculation studies in progress, there is every indication that all six diseases are caused by one and the same virus.

E. S. MOORE.
Department of Agriculture,
Tobacco Laboratory,
Balfour (Cape), South Africa,
Feb. 1.

[1] Smith, *Ann. Appl. Biol.*, **16**, 382; 1929.
[2] Wingard, *J. Agri. Res.*, **37**, 127; 1928.
[3] Samuel, Bald, and Pittman, *Bull.* 44, Coun. Sci. Ind. Res. Australia, 1930. See also NATURE, **128**, 494; 1931.

Oviposition of *Telenomus nigrocoxalis* Aschm. (Chalcididæ)

Telenomus nigrocoxalis, a hymenopterous egg-parasite of the Coconut butterfly in British Guiana (*Brassolis sophoræ* L.), was observed under magnification on an egg-mass of the host. After a careful inspection and tapping of the eggs with her antennæ, the female decides upon a particular egg and penetrates the shell dorso-laterally with a few strokes of the ovipositor, which is inserted into a minute puncture. The female remains in this position for about four minutes. Now and then a male stops to tap the female on the head and thorax with his antennæ.

One female, probably an old one, was unable to extricate her ovipositor and, after about ten minutes in this awkward position, collapsed and lay apparently dead between the eggs. Presently a male happened upon her, and immediately showed the greatest concern for the unfortunate female. His agitated movements in attempting to revive the female and distracted behaviour were quite touching. A speck of water, accidentally left with my brush on an adjacent egg before this incident occurred, was now noticed apparently for the first time. By means of one of his antennæ the male applied some of this water to the prostrate female.

This movement was repeated many times, but without great success, for there was no sign of life yet and the ovipositor was still held by the egg. Another male appeared on the scene and immediately took in

the situation. Perhaps he has had a similar task before. He seized the female by the ovipositor and with the help of the other male dragged it out, and walked off quite unconcerned. The female brushed herself and made off in another direction, followed by a grateful male tapping her affectionately with his antennæ. F. A. SQUIRE.

Dept. of Agriculture, Georgetown,
British Guiana, Feb. 17.

Polish on Metals

MR. R. C. FRENCH has reported on electron diffraction experiments on polished metal surfaces (copper, silver).[1] The fact that the diffraction rings become more and more diffuse if the surface is carefully polished is, he concludes, an experimental confirmation of Sir George Beilby's theory, which supposes that by careful polishing a metal surface is covered with a thin amorphous layer of the metal as a supercooled liquid. Mr. H. Raether, who is working in this laboratory with a diffraction apparatus,[2] has got similar results with polished metals. I do not, however, believe that for the explanation of these results it is necessary to suppose that the size of the crystals which constitute the surface is really altered so very much by the process of polishing. I should like to suggest a simpler explanation. A polycrystalline metal surface which is bombarded with electrons at a grazing angle gives sharp diffraction rings if the surface consists of small lumps which are thin enough to allow the electrons to pass through; this was first shown by Prof. G. P. Thomson.[3] The *lumps* play the rôle of the grating, and if by polishing the metal they are levelled, the resolving power of the gratings is gradually diminished (corresponding to the diminished breadth of the gratings).

The sharpness of the diffraction rings proves nothing, therefore, about the real size of the crystals, but gives definite information of the degree of levelling of the surface. Finally, if at the highest degree of polishing the lumps have wholly disappeared, the diffraction would be a specular reflection on the plane surface of the polycrystalline target. In this case refraction would occur and cause a considerable shift of the interference maxima—which would also be broadened—and probably the vanishing of (111) and (002); however, this seems not to be realised in the present experiments, and requires further investigation. F. KIRCHNER.

Institute for Theoretical Physics,
Munich, Feb. 5.

[1] NATURE, **129**, 169, Jan. 30, 1932.
[2] F. Kirchner, *Ann. Phys.*, **11**, 741; 1931.
[3] G. P. Thomson, *Proc. Roy. Soc.*, A, **128**, 650; 1930.

IN connexion with Mr. French's work on polished metal surfaces [1] and Prof. Kirchner's very interesting suggestion above that diffuse diffraction rings may be due to extreme flatness of the surface rather than to an amorphous state, we should like to mention some results which we have recently obtained.

Surfaces of platinum spluttered on glass have been examined by electron diffraction; they show various patterns, of which one is that given by platinum in its ordinary state. If the platinum is spluttered in oxygen at a voltage not exceeding about 1150 and a pressure of not less than 0·014 mm., the surface is active in promoting the combination of hydrogen and oxygen by catalytic action. Such surfaces show at first diffuse rings very similar to those found by French for polished metals, but after the surface has been used as a catalyst until its activity is lost, these diffuse rings change to the sharp rings characteristic of normal platinum. This change is also produced by heating *in vacuo*.

It is unlikely that these diffuse rings are due to an extremely flat platinum surface, which one would not expect to be catalytically active, and we find that the change from diffuse to sharp rings is accompanied by an improvement in the specular reflection, suggesting that the surface gets smoother rather than rougher. It seems more likely that the diffuse rings are due to some substance in a state of very fine subdivision, with perhaps inclusions of gas molecules.

C. A. MURISON.
N. STUART.
G. P. THOMSON.

Imperial College of Science,
S.W.7, March 22.

[1] NATURE, **129**, 169, Jan. 30, 1932.

Non-polar Auroral Light from the Night Sky in the Tropics

IN a previous communication from one of us,[1] it was stated that the brightness of the auroral green line in the northern and southern night skies at Poona (lat. 18° 31′ N.) does not show the midnight maximum observed by Lord Rayleigh and by McLennan and his collaborators in temperate latitudes. Further estimates of intensity obtained by exposing Mimosa extreme orthochromatic plates through suitable green and orange filters, and with an aperture of about 45° towards the zenith, shows definitely that, in general, the brightness of the overhead sky gradually decreases from sunset to a minimum at about midnight, and increases after midnight.

To test whether the result was due to admixture with zodiacal light (it is questionable whether we should consider it as separate from night sky light), simultaneous photographs were taken on a few occasions of the spectrum of the sky with the spectrograph pointed approximately towards the pole star. These confirm that even in the north sky there is a distinct minimum of brightness within an hour of midnight. It may be mentioned that the nights were all perfectly clear. Occasional casual variations, such as have been noted by various observers in Europe and America, also occur.

If the excitation of the green line is directly or indirectly due to ultra-violet light from the sun, one would *a priori* expect a minimum brightness of the sky some time after midnight depending on the height of the effective layer of atomic oxygen. The maximum brightness observed in temperate latitudes at about this hour is in need of adequate explanation.

K. R. RAMANATHAN.
J. V. KARANDIKAR.

Meteorological Office,
Ganeshkind Road, Poona 5,
Jan. 14.

[1] [NATURE, **129**, 280, Feb. 20, 1932.]

Anomalous Diamagnetism of Bismuth

BISMUTH when electrically or mechanically colloidalised shows a fall in its diamagnetic susceptibility value.[1] Doubts were raised by Prof. Bhatnagar as to whether this fall in value could not be due to oxidation.[2] It was shown by me [3] that though a large part of this value was certainly due to oxidation, still there was a decrease in value which could be explained only by attributing it to reduced particle size, as in the case of graphite.

The problem has now been attacked in a different manner. Colloidal bismuth, mechanically prepared and purified by treatment with tartaric acid and alcohol, was investigated in the following way: A small quantity was sealed *in vacuo* in a small glass bulb. The deflexion was noted in a Curie balance

having for comparison a standard benzene bulb. The powder was then melted, and recrystallised by heating the bulb in an electric heater to about 270° C. and very slowly cooling it. After noting the deflexion due to the bulb with the resolidified bismuth, that of the container alone was determined by breaking it open and dissolving out the metal with nitric acid. Experiments with similar bulbs and bismuth regulus showed no change of deflexion after heat treatment. But when bismuth powder was melted and recrystallised, the diamagnetic susceptibility rose nearly to the regulus value. Many samples of colloidal bismuth gave similar results.

These observations indicate that the fall in the susceptibility value with reduction of particle size in the case of bismuth is a genuine effect. Full details of this investigation will be published elsewhere.

S. RAMACHANDRA RAO.

Annamalai University,
Annamalainagar, Jan. 28.

[1] *Ind. J. Phys.* **5**, 559; 1930.
[2] *Ind. Chem. Soc.*, **7**, 975; 1930.
[3] *Ind. J. Phys.*, **6**, 241; 1931.

Photochemical Decomposition of Phosphine

IT is rather surprising to find that, although the photochemistry of ammonia has attracted considerable attention since Warburg's[1] work, no corresponding experiments have been carried out with the equally simple molecule of phosphine. Such experiments have now been in progress in this laboratory for some time.

The absorption spectrum of phosphine consists of a region of continuous absorption beginning at about 220 $\mu\mu$ and continuing to 185 $\mu\mu$, the limit of the spectrograph used. Preceding this continuous band there are three diffuse bands in the region 220-230 $\mu\mu$. No fine structure is exhibited by these bands. The spectrum, like that of ammonia, would appear to be of the predissociation type.

Light from zinc or aluminium sparks readily decomposes the phosphine into hydrogen and phosphorus, which is deposited as the red variety on the walls of the insolation tube. The experiments on the direct photochemical decomposition have not yet been completed. The mercury photosensitised reaction has, however, been investigated in some detail. The rate of decomposition is about ten times that of ammonia under the same conditions. It is dependent on the diameter of the reaction tube; for, as the diameter is decreased—that is, the surface volume ratio increased—there is a decrease in the rate of decomposition. For example, in tubes of 2 cm., 1 cm., and 0·5 cm. diameter, the rates are in the ratio 2·5 : 1·5 : 1. This would indicate that recombination of the products of dissociation occurs at the walls of the reaction tube. Argon has no effect on the velocity. On the other hand, oxygen increases the rate of decomposition as much as five times ($p_{PH_3} = 0{\cdot}05$ mm.; $p_{O_2} = 0{\cdot}05$ mm)., while the subsequent addition of argon (0·1 mm.) still further increases this rate. These observations are most plausibly explained if it is assumed that oxygen attacks the products of dissociation, thus preventing their recombination. The resulting oxide molecules then initiate a stable chain reaction between the undecomposed phosphine and the oxygen.[2]

These results partly explain an interesting observation of Hinshelwood and Clusius,[3] who found that on illuminating a $PH_3 - O_2$ mixture below the lower critical explosion pressure, the pressure to which the mixture had to be compressed in order to obtain explosion was lower than that of the unilluminated gases. A mercury lamp with a chlorine-bromine filter transmitting 250-280 $\mu\mu$ was used in these experiments. The effect was shown to have its origin in the phosphine molecule, but in view of the fact that phosphine itself does not absorb in the region 250-280 $\mu\mu$, it would seem that the incidental presence of mercury vapour resulted in the phosphine being decomposed by excited mercury atoms into hydrogen atoms and probably PH or PH_2 radicals, which produce the Hinshelwood-Clusius effect. Hinshelwood and Clusius concluded that the active material was present in the gas phase, but on repeating their experiment by exposing the mixture in one tube and determining the explosion pressure immediately after in another similar tube, the effect was not observed. That is, the effect is most probably a wall phenomenon, the illumination of the mixture producing a molecule or radical which is afterwards adsorbed on the walls; the latter are thereby enabled to reflect the chains more efficiently, thus decreasing the explosion pressure. It has also been found that pretreatment of the walls with atomic hydrogen results in a decreased explosion pressure.

H. W. MELVILLE.

Chemistry Department,
The University, Edinburgh, Feb. 25.

[1] *Sitzungsber. Preuss. Akad.*, p. 746; 1911.
[2] Cf. Dalton and Hinshelwood, *Proc. Roy. Soc.*, A, **125**, 294; 1929.
[3] *Proc. Roy. Soc.*, A, **129**, 589; 1930.

Structure of the Third Positive Group of CO Bands

THE third positive group of CO bands has been studied often before, but no satisfactory analysis of the bands seems to have resulted from it. Therefore we have photographed the bands in the second and third order of a 21-ft. concave grating with 20,000 lines per inch. So far, we have studied the bands 0⟶0 to 0⟶4 with heads at 2833, 2977, 3134, 3305, and 3493 A. The bands are due to a $^3\Sigma \longrightarrow {}^3\Pi$ transition. The triplet separation of the $^3\Sigma$ state is unnoticeable for $J<20$. Under these conditions we must expect 15 branches if the resultant spin is not yet completely coupled to the rotational axis (transition from case *a* to case *b*). We found 13 of these branches and traces of the remaining two, which are too faint to be observed among the strong main branches. The five heads which are characteristic for the bands under low dispersion are the heads of the O_3, O_2, P_3, P_2, and P_1 branches (in the simplified notation of case *b*). The initial level shows very strong perturbations from about $K = 16$ on, and slight irregularities also for very small K values. This fact makes an analysis of the higher lines of the bands much more difficult, and we have not yet completed this part entirely. The moment of inertia for the final state is $16{\cdot}5 \times 10^{-40}$, and for the initial state approximately $14{\cdot}3 \times 10^{-40}$. The character of the λ-doubling and the number of missing lines near the origin identifies the final electronic state as a regular $^3\Pi$ state.

Our results are not in agreement with the analysis of Asundi,[1] who classified these bands as $^5\Sigma \longrightarrow {}^5\Pi$ transitions. The fact, however, that the observed structure agrees perfectly with the theoretical expectation that practically all lines in the region investigated can be arranged into those branches, that all combination relations are fulfilled within the limits of experimental errors, and that the perturbations of equivalent lines are identical in the sixty branches in which they occur, seems to us a strong argument in favour of the correctness of our analysis.

Complete details will be found elsewhere.

G. H. DIEKE.
J. W. MAUCHLY.

The Johns Hopkins University, Jan. 21.

[1] *Proc. Roy. Soc.*, A, **125**, 277; 1929.

Research Items

Pigmentation of Sussex School Children.—Dr. W. R. Dunstan contributes to the *Medical Officer* (March 19, 1932) a survey of 18,349 children attending the elementary schools of East Sussex, comprising both rural and urban communities. He has found, as did Prof. H. J. Fleure in his survey of the population of Wales, that there is a decided tendency to the differentiation of local types. In this community, usually regarded as one of pure Saxon descent, red hair occurred in 4·9 per cent of the children examined; round Heathfield there was 8 per cent of red-haired children, while in Rye there was only 3 per cent. Flaxen hair had a general incidence of 7·7 per cent; along the northern area examined by Dr. Dunstan it rose to 10 per cent; in Uckfield it fell to 4 per cent. Black hair occurred in 6·7 per cent of the 18,000 children surveyed; in the schools of Newhaven it had an incidence of 16·7 per cent, in Uckfield 12 per cent, in Rye only 2 per cent. In most points observed, urban children had the same degree of colouring as the children of the neighbouring rural district. There were exceptions, however. Rather unexpectedly, there was a decided preponderance of flaxen-haired boys in the town schools, and also of black-haired boys and girls, as compared with the corresponding rural children. The maps which Dr. Dunstan has prepared to show the distribution of hair and eye colouring reveal distinctive areas and zones. If a population is stationary as regards residence, a differentiation into local types is to be expected. Whether the increased industrialisation of the home counties will lead to the break-up of these 'local pockets' remains to be seen. Dr. Dunstan's survey has demonstrated that they still persist in East Sussex.

The Drum in South America.—In South America the drum plays a very small part, and, indeed, it has been doubted whether it existed on the Amazon and in the Guianas in pre-Columbian days and may not have been entirely of European introduction. In the southern area it takes the form of a hollow membrane-covered vessel, which, curiously enough, is filled with water when it is in use. This form also occurs in the extreme east of North America. In ancient Peru, judging from the Chimu pottery figures, the drum was more prominent, though no examples have as yet been recovered from the ancient graves. Nordenskiöld holds the opinion that the true Indian drum had a membrane on one side only. A Chiriguan specimen, now in the Göteborg Museum, is made from a hollow log, one end of which is open, while a circle of wood, covered with skin, fits closely to the other. It is evidently of Peruvian derivation. Harcourt, on the other hand, holds that the Peruvian drums had parchment on both sides. All doubt is set at rest by three specimens, hitherto undescribed, which are illustrated in the *Journal de la Société des Américanistes*, N.S., t. 23, fasc. 1, by Dr. Karl G. Izikowitz, who examines the whole question in some detail. One drum, now in the Hamburg Museum, comes from Quillagua, Northern Chile. It is probably made of a hollow log of wood (diameter 26 cm.). It cannot be examined, as it is entirely covered with skin. The second, in the Munich Museum, is also completely covered with skin, but owing to its condition the method of construction can be seen. It is made of slats of wood fastened by threads to two rods, one above the other, bent to form an oval (long axis 29 cm.). These might from their size have been the originals of the Chimu drums. The third specimen, now in the Göteborg Museum, is from Southern Peru, probably Ica. It is a terra-cotta vase with skin over the expanding mouth. It is analogous to the water drums of the Chaco, and probably, like them, was filled with water when played.

Life History of *Paralepis*.—No. 10, vol. 2 (Biology) of the Report on the Danish Oceanographical Expeditions 1908–1910 to the Mediterranean and adjacent seas, under the superintendence of Dr. Johs. Schmidt, contains two memoirs, *A.* 13: "The Sudidæ (Paralepis)", by Vilh. Ege, and *A.* 14: "Carangidæ", by W. Schnakenbeck. The pelagic fish genus *Paralepis* inhabits the North Atlantic and the Mediterranean. The specimens collected embrace upwards of 13,000 specimens, mostly post-larvæ at different stages, with a certain number of very young forms. The author has elucidated the life-histories of all the species investigated which, except for very few larval and post-larval stages, were previously unknown, and represent ten species, three of which are new. The characters used for distinguishing the species are the number of vertebræ and fin rays, length of head, dentition, position of the fins, and the length of the pectorals. These characters can be recognised in most of the older post-larvæ. To link them up with the younger larvæ, the position and number of the chromatophores, which are very characteristic of the species, are used. The first part is an introduction; the second is systematic, and excellent figures are given of a series of young of each species and also of the jaws; the third part deals with the biology of the post-larvæ, their horizontal and vertical distribution at different times and in different places, with relation to temperature and the probable time of spawning. The specimen from Polkerris in Cornwall, described by Day (1880–84) as *Paralepis coregonoides*, has been examined and pronounced to be *Paralepis coregonoides borealis* Reinhardt, which the author regards as distinct from *Paralepis coregonoides coregonoides*, with a more northerly distribution. He is also of the opinion that the post-larva from the Bay of Biscay, recorded by Holt and Byrne (1906), is probably this northern species.

The Structure and Division of Chromosomes.—With advances in genetic theory, the detailed structure of chromosomes and the manner of their division have become matters of increasing importance. In a critical study of mitosis in the root tips of diploid and tetraploid forms of *Narcissus*, Dr. S. Hedayetullah (*J. Roy. Micro. Soc.*, vol. 51, p. 347) has made observations which throw light on previous views and give a consistent picture of the chromosome as a structure which is double throughout the mitotic cycle, splitting in each metaphase into halves, which will separate in the following metaphase. The chromosome is thus double both in anaphase and prophase and in the interkinesis stage between. Cytologists have frequently regarded the chromonema and chromomere hypotheses as mutually exclusive, but here it is shown that by the fusion of the chromomeres in early prophase a continuous chromonema is formed, which then splits longitudinally in metaphase. The two threads in the matrix of the chromosome begin to twist around each other in anaphase, and so form in telophase appearances which have been mistakenly interpreted as due to a process of alveolisation. In telophase the chromonemata untwine and become chromomeric, and the resting nucleus is essentially composed of strings of chromomeres running parallel in pairs, not forming a network in the true sense. The cleavage

of the chromonema in metaphase is regarded as bringing about the longitudinal division of the gene thread in each mitosis. The fact that the chromosome is at all times essentially a double structure composed of two threads will need to be taken into account in future interpretations of the phenomena of meiosis.

Ore Deposits of Nevada.—An important structural and economic study of the mining district of Goodsprings, Nevada, has been made by D. F. Hewett (*Prof. Paper*, 162, U.S. Geol. Sur., 1931). Stratified rocks range from Upper Cambrian to Recent. In early Tertiary times folding occurred, followed by thrusting and injection of sills and dykes of granite-porphyry. Normal faults accompanied by ore deposition are succeeded by still later faults which are older than a series of middle Tertiary volcanic rocks of the andesite-rhyolite suite. The ores include gold, deposited in granite-porphyry and adjacent carbonate rocks; oxidised copper minerals with accessory cobalt, nickel and silver, some of which occur near the granite-porphyry masses; and lead and zinc sulphides and oxidised ores mostly remote from outcropping bodies of intrusive rock. The copper deposits lie in Devonian or older beds, while those of lead and zinc are concentrated in dolomitised limestones of Lower Carboniferous age. Apart from the regional zoning of the ores and the distribution of alteration there is nothing to prove a genetic relation between the intrusive rocks and the lead and zinc deposits. Such indirect evidence, however, points here, as elsewhere, to a deeply buried mass of igneous material as the source from which the ore-solutions ascended.

Earthquake Frequency in Northern Europe.—In *Sveriges Geologiska Undersökning, Årsbok* (1930), No. 1, K. E. Sahlström publishes a new seismological map of Scandinavia and Finland, showing by different intensities of blue colouring the total number of earthquakes recorded in that region during the period 1600–1925. It is an extension of a map lately published by H. Renquist (*Z. Geophysik*, vol. 4, p. 7) for Finland, and is made on the same novel plan. The regions in which seismicity in recent centuries has been strongest are along the west coast of Norway, between Stavanger and Molde and in another narrow belt farther north; the country around Oslo and eastwards towards Lake Venern; and the region round the Bothnian Gulf. An interesting brief discussion of the cause of the marked seismic activity of certain limited regions and the seismic quiet of others is given.

Magnetic Anomalies in France.—In the *Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau Central de Magnétisme Terrestre* (t. 9, Paris, 1931, pp. 210), eighteen papers on geophysics are included, together with the annual summaries of magnetic data from the two French magnetic observatories of Val Joyeux (for which hourly data are printed) and Nantes. Probably the paper of most novelty and interest is that on the anomalies of the earth's magnetic field over France, that is, the departures from the smooth distribution of isomagnetic lines most nearly fitting the observed field. This paper is illustrated by four charts showing, in colour, the anomalies in declination, inclination, horizontal force, and vertical force. In some of their main features these four charts show notable differences. The most striking anomaly is that in the 'Paris basin', extending in a narrow belt half-way across France, from the coast of the English Channel in a south-south-easterly direction. On the east of its centre line the declination is in excess, and on the west in defect, by amounts surpassing half a degree in some places; the vertical force is in excess over the same region, and on both sides of the centre line; while the horizontal force shows no particular abnormality. The anomaly is not explicable in terms of the magnetic properties of the known geological strata in the region, and points to unknown influences deeper down.

Monochromatic Atomic Waves.—Two ways for obtaining beams of atomic rays which have only a small range of velocities or de Broglie wave-lengths are described by I. Estermann, R. Frisch, and O. Stern in the *Zeitschrift für Physik* for Dec. 10. In one, a monochromatic beam of helium atoms is sorted out from a heterogeneous beam with a Maxwellian distribution by forming its wave-spectrum by diffraction at a crystal of lithium fluoride, and working only with diffracted beams coming off from the crystal within small angular ranges. In the other method, the Maxwellian beam is passed through a form of mechanical filter which consists of two parallel toothed wheels rotating on a common axis. This method, which has already been used by K. T. Compton and others, has given particularly good results with Prof. Stern's fine technique for this type of work, and has the great merit that the mechanical speed of the particles can be calculated from the speed of rotation and the geometry of the system. In this way, it has been found possible to verify rather closely that the distribution of velocities in the original beam conforms to Maxwell's theory, and to show that de Broglie's formula is correct to within two per cent for helium atoms, the diffraction being again performed at a lithium fluoride crystal.

Some Properties of Cerium Ions.—We have received from Prof. D. M. Bose and S. Datta, University College of Science, Calcutta, a preliminary account of some new theoretical and experimental work bearing on the binding forces between atoms in crystals, exemplified particularly by the properties of the cerium ion Ce^{+++}. Recent interest in this dates from the discovery made by de Haas and Becquerel, in 1929, that the magnetic rotation of the plane of polarisation by tysonite, which contains this ion, follows a modified Langevin formula which requires the effect to be due to a single electron bound in the ion in the simplest possible way, although Hund's theory shows that the state of the ion is decidedly more complex. Evidently some part of the elementary magnetic moment has become immobile in the crystal. The explanation offered for this is based on Stoner's theory of the magnetic properties of the ions of the first transition group of the periodic table, and is essentially that in this case the orbits of the electrons involved are held rigidly by the fields of near-by atoms, whilst the spin moments of the electrons are unaffected and can orientate in the applied magnetic field. Prof. Bose had already produced a closely similar immobilisation in ions of cobalt, nickel, and iron by changing these into complex forms, and it is now found that this also involves a shift of the absorption bands of their spectra towards the ultra-violet. This is attributed to the necessity for overcoming the orbital coupling forces within the complex when the electron jump associated with the absorption takes place, and it is shown that an extension of these ideas will account for the changes in the absorption spectra of both cerium and gadolinium ions which have been observed by Freed on cooling certain substances which contain them. Further evidence for the nature of the coupling forces which immobilise part of the ion is contained in a second letter received from Prof. Bose and Mr. Datta, in

which they outline a possible correlation between some new bands which they have observed in the ultra-violet absorption spectrum of the ion Ce^{+++} in solution and some of the lines in the ultra-violet emission spectrum of the same ion which were measured and classified by Badami last year. An explanation is offered, based upon the nature of the terms involved, of why the difference between their and Badami's wave-lengths is sometimes positive and sometimes negative.

Sensitive Flames.—Whilst the behaviour of the sensitive flame is still imperfectly understood, a number of interesting experiments on the subject have been described by G. B. Brown (*Phil. Mag.*, Jan. 1932). The best jet diameters lie between 0·5 mm. and 5 mm., and the flame is always most sensitive to sound when it is on the point of 'flaring'. The position and construction of the tube supplying gas to the jet affects the sensitivity only in so far as it can alter the way in which the gas streams out of the orifice. The sound frequencies producing maximum or minimum disturbance are definite constants for any particular gas, no matter what kind of jet is used. The range of frequency to which gaseous streams are sensitive varies with the gas used and with the size and nature of the jet. With air the range is quite low (80-900), with unlit gas somewhat higher, and with ignited coal gas or hydrogen the range extends with different jets from 500 to more than 18,000 vib. per sec. For a regular circular orifice the velocity for sensitiveness is high for a high-frequency range and low for a low-frequency range. It appears that sound does not, as has been generally assumed, precipitate the state of turbulence into which the gas stream is about to fall, but it causes regular undulations to proceed from the jet up the column, the upper part of the column breaking into turbulence. The wave-length of these undulations depends, as would be expected, on the velocity of the column and the frequency of the sound. The most sensitive flames have marked directional properties.

Discs and Conical Diaphragms in Sound Reproduction.—The use of conical diaphragms in the design of modern loud-speakers has stimulated interest in their behaviour from the physical point of view. In a recent paper by Dr. N. W. McLachlan (*Proc. Phys. Soc.*, Jan. 1932), the results of experimental methods have been developed which lead to the determination of the effective mass of vibrating discs and conical diaphragms. It is shown that the 'effective' mass of a circular aluminium disc vibrating in air is variable. In the centre-stationary mode the effective mass attains a positive maximum before the zero value and a negative maximum after it. From the shape of the curves for a disc, it is possible to interpret those obtained for conical diaphragms. In the latter case the curves depend on the angle of the apex of the cone. When the apex angle is 160° the disc characteristics are still apparent. As the angle is reduced the properties peculiar to a conical diaphragm assert themselves. When the angle is nearly zero, the characteristics of a cylinder become apparent. The expression 'nodal circle' is sometimes used in connexion with conical diaphragms, but the actual lines of minimum amplitude traced by the lycopodium powder were quite irregular and occasionally discontinuous. The shape of the diaphragm during vibration is determined partly by (*a*) transmission loss, (*b*) acoustic load, and (*c*) reactive load due to accession to inertia. When impedance measurements are made in air and *in vacuo*, it is seen that (*b*) and (*c*) are absent in the second case.

Astronomical Topics

Application of Sound Films to Timing Solar Eclipses.—The Annual Report of Mount Wilson Observatory for the year 1930–31 refers to an ingenious method of obtaining the exact time and duration of totality in the very brief total eclipse of April 28, 1930. The Mount Wilson party was stationed at Honey Lake, California, which is at lat. 40° 8′ 20″ N., long. 120° 15′ 30″ W., altitude 4000 feet. Moving pictures with sound records were taken by the Fox Movietone News. The observers gave audible time signals about the time of totality, which were recorded in conjunction with the film showing the progress of the eclipse. The time of mid-totality was thus recorded as $19^h\ 5^m\ 51{\cdot}4^s$ U.T., which was $1{\cdot}7^s$ earlier than the prediction; the duration of totality was recorded as $1{\cdot}2^s$, which was $0{\cdot}2^s$ less than the prediction. It is worth while noting that totality could frequently be timed in this manner, even if the weather is cloudy. At Colwyn Bay in 1927 the sky was densely overcast, but the passage of the moon's shadow on the clouds at the beginning and end of totality was plainly visible. As the seconds of Greenwich time were audible, distributed by wireless from Daventry, such a record would have enabled the times to be deduced at least to the nearest second.

Another Search for Intra-Mercurial Planets.—Searches made in former eclipses have made the existence of intra-Mercurial planets very improbable. But the plates taken by Prof. Freundlich's expedition to north Sumatra in 1929 were so rich in stars that Herr von Kluber, of Potsdam Observatory, thought it worth while to make an exhaustive search for such bodies: the plates were compared with the control ones taken six months later with the same instrument. The search established that there was no planetary body as bright as magnitude 9·5 in the regions of the plates that were more than 40′ from the sun's limb. The brightness of the corona obscured faint stars nearer the sun, but even in this region a body of magnitude 7 could have been detected. The search was worth making, and strengthens the conclusion that there is no body of appreciable size inside the orbit of Mercury.

A Tenth Trojan Planet.—The object detected by Herr Reinmuth on Dec. 31 was at first thought to be a comet, but the suspicion of nebulosity round it was not confirmed, and a new orbit of it is given by Dr. Kahrstedt in *Rech. Inst. Circ.* 547, based on observations on Dec. 31, Jan. 12, Feb. 6:

Epoch 1932 Jan. 17·0 U.T.

M	305·0058°	
ω	87·0034	1932·0
Ω	47·0466	
i	32·9207	
ϕ	2·1893	
n	294·549″	
$\log a$	0·720566	

There are now five known Trojans on each side of Jupiter; Achilles, Hector, Nestor, Agamemnon, Odysseus have longitude about 60° greater than Jupiter's; Patroclus, Priamus, Aeneas, Anchises, 1931 YA have longitude 60° less. If the names of Hector and Patroclus were interchanged, we should have Greeks on one side and Trojans on the other.

Medical Research in Great Britain

FEW people can do more than glance through the majority of the scientific periodicals, reserving their attention solely for papers which deal with the subjects in which they are particularly interested. For those who wish to keep abreast of the times in medical science, perusal of the Report of the Medical Research Council * is a convenient means of obtaining a review of recent work carried out in Great Britain. For those who desire fuller information on any subject, the lists of papers published by investigators working under the auspices of the Council will afford a starting-point.

As in previous years, the facilities of the Council have been increased by additions to its funds from various public bodies and private benefactors, by gifts of material from manufacturing firms, and by the fact that more than half of the work sponsored by the Council is carried out by investigators in university laboratories, where the general facilities of the laboratory are at their disposal. Particular investigations have been aided by the Empire Marketing Board, the Dental Board of the United Kingdom, the British Empire Cancer Campaign, the Distemper Research Council of the *Field*, and the Foot-and-Mouth Disease Research Committee. The material supplied by different firms has permitted extensive investigation into the control of dental decay, puerperal fever, and other infections by dietetic means, as well as facilitating the search for pure vitamin D, to mention only two examples.

The two senior members of the Council, Prof. T. R. Elliott and Prof. J. B. Leathes, retired at the close of the year under review, their places being taken by Lord Dawson of Penn and Prof. E. Mellanby. It is also noted in the Report that a Committee of the Privy Council for Agricultural Research and an Agricultural Research Council have now been appointed. With their formation the full triad of research organisations under the Privy Council is now completed. They deal together with the three main departments of man's activities with material things: the Agricultural Research Council with the production and protection of plant and animal life needed for human use, the Department of Scientific and Industrial Research with the materials and methods used in all forms of manufacturing industry, and the Medical Research Council with the proper development and use of the human body in all conditions, as well as with its protection from disease and accident and its repair.

The Medical Research Council awarded eight travelling Rockefeller medical fellowships and two Dorothy Temple Cross research fellowships in tuberculosis for the academic year 1931–32. During the past year the publication of a "System of Bacteriology" in nine volumes was completed and financial aid has been brought to *Nutrition Abstracts and Reviews*, in which the Imperial Agricultural Bureaux Council and the Reid Library of the Rowett Institute, Aberdeen, are also interested.

This year's Report reprints in an appendix the Council's memorandum on patent law in relation to medical research, which was submitted for consideration by the Departmental Committee on the Patents and Designs Acts and Practice of the Patent Office, 1929–31, since the Council does not believe that the questions at issue in the case of medical patents can long await renewed attempt towards their solution. The objections to the operation of the Patent Law in the field of biology and medicine are three in number. First, the discovery of new facts in the medical field may lead, obviously and at once, without any intervening steps of ingenious invention, to valuable practical uses; discovery and invention cannot be clearly distinguished as in the inorganic field. Secondly, biological discoveries in their first phases are necessarily in the form of vague knowledge, and patents are likely to be drawn in wide terms that really go beyond the knowledge of the moment; for example, the Steenbock patent, controlling the commercial production of vitamin D by a natural process, covered the production of a substance of undetermined composition from an unknown constituent of certain complex materials by an action not then understood: it is now claimed to cover the production of calciferol or pure vitamin D from pure ergosterol, knowledge which is of more recent date and of independent origin. In the third place, medical discoverers in Great Britain rarely take out patents, so that the law works capriciously in favour of the few who break the tradition, or of the foreigner. The Council recommends that medical discoveries should not be patentable.

The National Institute for Medical Research carried out much work in connexion with biological standards, especially in preparation for the meeting of the Permanent Commission on Biological Standards (Health Organisation of the League of Nations) held in London at the end of June, which dealt with sera and bacterial products and the vitamins. Standards for gas gangrene antitoxin, diphtheria toxin for the Schick test, and for vitamins A, B_1, C, and D were adopted at this conference. Gas gangrene antitoxin has now been scheduled under the Therapeutic Substances Act. The National Institute is also preparing the standards for vitamins A and D, carotene and an oily solution of irradiated ergosterol respectively, and is acting as the distributing centre for these as well as for the standard for vitamin B_1, a dried adsorption product, on fuller's earth, of the active constituent of rice polishings, supplied by Prof. Jansen. The Institute already holds the international standards for insulin, digitalis, strophanthin, and certain organic arsenical preparations. In addition, it prepares and maintains for Great Britain all the standard preparations required for substances scheduled under the Therapeutic Substances Act.

During the year the Council formed the Therapeutic Trials Committee, under the supervision and authority of which clinical trials of new substances may be organised. Conditions have been made with the Association of British Chemical Manufacturers under which new substances will be accepted for clinical study. It is also expected that other committees of the Council, such as the Chemotherapy and Sex Hormones Committees, will bring forward new synthetic compounds or biological products for early clinical appraisement under controlled conditions.

Brief reference must be made to some of the researches carried out by members of the staff of the National Institute and by other investigators on the Council's staff or provided with grants-in-aid. W. J. Elford has prepared a series of graded collodion membranes of which the pores have a uniform and measurable size and yet are sufficiently strong for bacteriological work. By means of these filters it has been possible to determine the size of the particles of a number of different viruses. Thus the diameter of the vaccinia virus ranges from 0·125 μ to 0·175 μ, that of infectious ectromelia of mice from 0·1 μ to 0·15 μ, that of a bacteriophage from 0·02 μ to 0·08 μ, whilst that of foot-and-mouth disease is of the minute size of 0·008-0·012 μ. The size of the virus particles of

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1930–1931. (Cmd. 4008.) Pp. 153. (London: H.M. Stationery Office, 1932.) 2*s*. 6*d*. net.

infectious ectromelia agrees with that found by J. E. Barnard by the methods of ultra-microscopy.

The vaccine-virus method for the immunisation of dogs against distemper is now firmly established and its value has been amply demonstrated. It will be possible to bring the research work to an end in the near future. The difficulties in the commercial production of this preparation have now been overcome. Inquiry of masters of foxhounds has shown that the incidence of infection among immunised animals is only 1·4 per cent and the mortality 0·3 per cent, whereas without inoculation the incidence among young foxhounds is nearly a hundred per cent and the mortality is frequently 50 per cent and may be 75 per cent. G. W. Dunkin and P. P. Laidlaw have also succeeded in preparing a hyper-immune serum which can be used in the incubation period of the disease or in its treatment, as well as in the production of immunity by injection simultaneously with the virus.

W. E. Gye and W. J. Purdy have continued their work on the viruses of avian tumours and have published their results in "The Cause of Cancer" (1931). In the sera obtained after injecting tumour filtrates containing the active agents into other animals, two kinds of antibodies were detected, one directed against a factor in the infective agent which is specific to the cells of the host, and the others adapted to an extrinsic factor of this agent. The viruses from most of the fowl tumours are serologically identical, but Fujinami's fowl tumour, which is also transmissible to the duck, yields a virus which is immunologically distinct from the others.

M. Greenwood, W. W. C. Topley, and J. Wilson have continued their studies in experimental epidemiology. From a study of the virus disease, infectious ectromelia, in mice, it is concluded that herd immunisation in bacterial and virus infections may be fundamentally different: in mouse typhoid, an immunised group will withstand a period of acute exposure to risk better than untreated animals, but, provided the exposure is continued, the general effect on the herd will be relatively trivial. In the case of a virus disease, it is probable that if admission to an infected herd were restricted to immunised animals, the herd mortality might be completely arrested. Experience with human diseases, in which the immunity produced is antitoxic rather than antibacterial, suggests that such infections behave as virus rather than bacterial infections.

In conclusion, it may be mentioned that reference is made in the Report to the work of Bourdillon and his colleagues on the preparation of pure vitamin D, as well as to the work carried out on the relation between diet and dental disease, and diet and infantile anæmia; summaries of many of these researches have already appeared in our columns. Work has also been continued, under the direction of E. Mellanby, on the relation of diet to certain types of nervous disease, as well as to goitre and puerperal infection.

Science and Economic Values

IN a paper before the London Section of the Society of Chemical Industry on Feb. 1, Mr. H. A. F. Lindsay, India Trade Commissioner, dealing with "Modern Trade Tendencies and where they are leading", referred to the pronounced tendency to shorten stocks and to place the main responsibility on the primary producer. The shorter stocks carried in the chain between producer and consumer and the closer contact between producer and consumer are responsible in large measure for the violent fluctuations of price which are so prominent a feature of the markets to-day. A return to the practice of stock-holding by intermediates is not probable, and accordingly the contribution which science renders in speeding up and rendering more accurate and general the trade information available for the world's markets is an important factor in stability, if only as assisting the spread of the practice of long-term contracts.

Trade cannot be established on a really satisfactory basis until the prices of raw materials and manufactured goods are brought close together, and towards this scientific methods are assisting by gradually increasing the output of the primary producer—whether in quantity or quality or both—and thus increasing the profits of agriculture; by bringing down the price and improving the quality of manufactures; and by slowly reducing the costs of distribution and transport. A new order of retail selling in which retail prices are fixed by the manufacturer, allowing a sufficient margin for retail and other distribution costs, has the merit of being scientific, but low wholesale prices cannot induce increased demand unless the public secures the benefit of a fall in the wholesale prices of any given commodity.

Mr. Lindsay further suggested that our economic relations, whether national or international, are losing much of their instinctive value and acquiring new and more conscious values. New principles which are checking the operation of the old 'laws' of supply and demand may prove to be better suited for the changed conditions of modern life, and the extent to which humanitarian factors now affect the level of wages may only be an example of the passing of instinctive into conscious control, in which the humanitarian and the economic aspects are finally reconciled.

So far as scientific discoveries tend to cheapen production and eliminate waste, by stimulating demand they simultaneously tend to encourage the factors the strength of which increases with every swing of the pendulum away from equilibrium. So far as synthetic products are concerned, science appears to be co-operating most closely with economics, and it is only in its quicker response to the transition from an ideal of competition to an ideal of co-operation that science can be said to have outstripped economics. The new ideal of efficiency attained by mankind working consciously, constructively, and in co-operation towards a common goal does not eliminate competition but subordinates it to constructive forces, among which science is pre-eminent, and which are more qualified to exert deliberate and conscious control.

Mechanism of the Combustion of Methane

THIRTY years have elapsed since Profs. W. A. Bone and R. V. Wheeler first studied the combustion of methane and were led to the view that oxidation takes place through successive stages of hydroxylation of the hydrocarbon. In view of suggestions made in recent years that the initial products of combustion might be peroxides rather than hydroxides, the investigation has been resumed and some important results are embodied in two recent papers.[1] In the first of these, Prof. Bone and Mr. R. E. Allum describe the course of the reaction at atmospheric pressure; while in the second, Dr. D. M. Newitt

and Mr. A. E. Haffner discuss the effect of pressures, varying from 48 to 150 atmospheres, upon the same reaction.

The low-pressure experiments were carried out in silica vessels, which could be heated in an electric furnace to about 450° C. and suddenly chilled by immersion in ice water, so that the process could be arrested and the products analysed; while the high-pressure experiments were conducted in chambers of special steel, which could be made to communicate with an expansion chamber at any moment. Precautions were taken to dissipate the heat of reactions sufficiently to counteract any rise of temperature, by diluting the original gas mixtures with excess either of the hydrocarbon or of indifferent gases. Varying proportions of the reacting gases were used, and the effect of adding water vapour and other gases to the carefully purified and well-dried mixtures was also studied. The results are in complete agreement with the original view that oxidation proceeds by the process of hydroxylation.

In the first place, in these experiments, as in former investigations, it has been shown that the most reactive of all the mixtures is that expressed by the formula $2CH_4 + O_2$, which corresponds with the formation of methanol. Secondly, although there is a considerable deficiency of oxygen in this mixture for complete combustion of the hydrocarbon, neither free carbon nor free hydrogen was ever liberated, nor was any trace of a peroxide detected at any stage of the reaction. The most conclusive evidence, however, lies in the actual isolation and identification of the primary product, methanol, which under high pressure is formed in considerable amount. It was to be expected from stoichiometric relationships that increased pressure would favour the formation of the alcohol at the expense of the aldehyde, and the authors are to be congratulated on being able to show that this expectation has at last been realised.

It appears from these results that the effect of increasing the pressure is to increase not only the amounts of methanol and formaldehyde which survive, but also the ratio of alcohol to aldehyde. Moreover, for each pressure there is a definite temperature (not the lowest effective temperature) at which the yield of alcohol reaches a maximum. The alcohol was characterised by means of its *p*-nitrobenzoyl derivative, and the complete absence of peroxides was inferred from the failure of the titanic sulphate reaction, which is sensitive to two parts per million.

The oxidation is mainly a surface effect, characterised by a marked period of induction, which may be obliterated by the addition of certain vapours. The authors do not discuss the cause of this period of induction, but they state that the end of it synchronises with a certain small accumulation of formaldehyde, which persists throughout the reaction period.

[1] *Proc. Roy. Soc.*, A, **134**, 578, 591. See also NATURE, **127**, 481; **128**, 188.

University and Educational Intelligence

APPLICATIONS are invited for grants from the Thomas Smythe Hughes Medical Research Fund of the University of London. They should reach the Academic Registrar, University of London, South Kensington, S.W.7, not later than May 16.

THE latest date for the receipt of applications for grants from the Dixon Fund for the assistance of scientific investigations is May 14. The applications, accompanied by the names and addresses of two references, should be sent to the Academic Registrar, University of London, South Kensington, S.W.7.

OPTOMETRY, defined in the New York State law as "the employment of any means other than the use of drugs, for the measurement of the powers of vision and the adaptation of lenses for the aid thereof", offers opportunities of a career for which a four years university course is held to be a suitable preparation. A bulletin received from Columbia University, New York, describes in detail a curriculum analogous to other professional courses designed to occupy a student's entire time during four years, of which the first two include such fundamental subjects as English, German, contemporary civilisation, mathematics, physics, chemistry, physiology, etc., and the last two are devoted almost exclusively to professional studies bearing directly on the theory and practice of optometry. That these courses are held by qualified judges to be in fact a suitable preparation for practical work seems to be proved by the fact that during the past ten or twelve years optical societies, instrument makers, and others specially interested in the development of optical engineering or in training optometrists have contributed gifts of apparatus valued at 25-30 thousand dollars.

Calendar of Geographical Exploration

April 10, 1627.—South Coast of Australia

The *Gulden Zeepard*, commanded by Francis Thijszoon, with Pieter Nuyts on board, arrived in Batavia, Java, after having in a single voyage discovered the whole south coast of Australia so far east as long. 133°. The Pieter Nuyts Archipelago indicates the eastern limit which they reached, and the land north of the Great Australian Bight was long known as Pieter Nuyts Land.

April 15, 1928.—An Arctic Flight

Starting from Point Barrow, Alaska, Capt. G. H. Wilkins and Lieut. Eielson flew across the Arctic Ocean, reaching Spitsbergen in 20½ hours and covering 2200 miles. Wilkins was knighted on his return.

April 16, 1245.—A Papal Envoy to the Grand Khan

John de Plano Carpini, a Franciscan, set out on a mission from the Pope to the Grand Khan of the Mongols. He travelled via Cracow and Kiev, went down the Dnieper, crossed the Don near its mouth, and reached the Volga about a hundred miles north of the modern Astrakhan. He then went across the Aral-Caspian depression to the Syr Daria, went past Lake Ala Kul, and arrived at the camp of the Mongols near Karakoram on July 22, 1246. He left a very accurate and detailed description of his journey, giving accounts of the climate and vegetation of the steppe and of the customs of the nomads. He described the drainage of South Russia, giving the Slavonic names of the rivers.

April 16, 1906.—Mountain Ascents by the Duke of the Abruzzi

Luigi Amadeo, Duke of the Abruzzi, left Naples for Mombasa on an expedition to Mt. Ruwenzori. He was the first to reach its twin summits, which he named Margherita and Alexandra. His party made a detailed survey of the Ruwenzori Range. In 1897 he had been the first to ascend Mt. St. Elias in Alaska, and in 1899 he organised a polar expedition, which reached lat. 86° 3′ N., at that time a record. In 1909 he explored the Central Karakoram in the Himalayas, and achieved a record for height by climbing peak *K*2.

Societies and Academies

LONDON

Physical Society, Feb. 5.—**R. M. Davies**: The rapid determination of the moisture-content of seeds. Two new methods are described, the first involving the use of a thermionic oscillator, the second a direct-current galvanometer and a battery. The first method is best suited for use with large-grained seed, whilst the second can be used with all types of seed. —**M. C. Johnson**: Surface heating by neutralised positive rays before and after return to normal state. This is shown by investigating the disturbance of a bridge balance between two filaments accurately aligned across the beam at different distances along its path. Excess heating occurs in that filament which receives the larger proportion of atoms in excited states. The variation of this excess heating with the potential driving the discharge is quantitatively in agreement with the variation of concentration of excited atoms at the different distances along the beam: this latter is calculated from Wien's experiments on the exponential decay of excited states along the path of neutralised positive rays.—**E. V. Appleton** and **F. W. Chapman**: The collisional friction experienced by vibrating electrons in ionised air. The variation of the radio-frequency conductivity of ionised air with pressure has been studied experimentally at frequencies of the order of 10^9~. From the measurements of the critical pressure at which such conductivity is a maximum, the magnitude of the collisional frictional forces experienced by vibrating electrons has been estimated.

Geological Society, Feb. 10.—**S. James Shand**: The reaction between granitic magma and limestone at Palabora, Transvaal (lecture). The Palabora granite is intrusive among ancient schists which include bodies of crystalline limestone. The hill Lulu Kop is a mass of metamorphosed dolomitic limestone isolated in the granite. Between granite and limestone there is a belt of flat ground, within which all the rocks exposed are rich in diopside and apatite; they vary from shonkinite to pyroxenite and massive apatite. Between these rocks and the granite there is a narrow belt of diopside-arfvedsonite-syenite. The evidence indicates extensive reaction between granitic magma and limestone, producing syenite and shonkinite, and it is suggested that the pyroxenite was formed by the sinking of diopside crystals from the contaminated magma.—**S. James Shand**: The lavas of Mauritius. The lavas of Mauritius are mainly basalts, some rich in olivine and others almost or quite free from it. No felspathoids have been detected, but some of the rocks are of the 'pacificite' type, having nepheline in the norm. Soda-trachyte was found at two localities, and must be regarded as a differentiate of the basaltic magma.

DUBLIN

Royal Dublin Society, Feb. 23.—**W. S. E. Hickson** and **K. C. Bailey**: The inhibition of chemical reactions (5). The inhibition of the absorption of ethylene by sulphuric acid. The surface tension of solutions of pyridine in sulphuric acid. The absorption of ethylene by sulphuric acid is inhibited by pyridine and other substances. The amount of inhibitor required is relatively large. The inhibitors investigated raise the surface tension of sulphuric acid and are therefore present in low concentration at the liquid-gas interface, at or near which the main reaction takes place.—**James B. Butler** and **Annie Humphries**: On the growth in artificial media of *Catenaria anguillulæ*, a chytridiacean fungus, parasitic on the ova of *Fasciola hepatica*. Various combinations of agar, extract of fluke ova, and egg albumen gave positive results. The fungus grew out from the infected ova, and formed an extensive thallus, containing in one instance upwards of sixty zoosporangia. Germination of the zoospores in the artificial media was observed. The zoospores developed profuse growths of hyphæ, which advanced to the formation of zoosporangia. The zoosporangia in their turn produced zoospores and dehiscence tubes.—**James B. Butler**.—On a method of determining the depth of penetration of wood-boring beetles in structural timber. A modified form of laryngoscope was shown which could conveniently be used for exploring the surface of a half-inch hole bored in the beam to be tested.

EDINBURGH

Royal Society of Edinburgh, Feb. 1.—**Frederick Walker**: Differentiation in the sills of Northern Trotternish, Skye. The sills intrusive into the Jurassic strata of Northern Trotternish represent the continuation north of the great group of basic sills described by Dr. Harker. They were, however, injected under a much thicker cover than the more southerly examples, and therefore show the effects of differentiation to a far greater extent. Picrite-dolerite sills are very common, and teschenites are also to be found. Gravitational settling of olivine *in situ* may be demonstrated in more than one sill, but the mode of differentiation in other cases is less certain.—**Geo. A. Cumming**: A study of the San Andreas rift and adjacent features near Redlands, California. The fault zone is composed of numerous interlacing faults tending roughly to parallel the master fault. The fault planes are in general nearly vertical. Horizontal shearing appears to be the dominant movement, but in this area there is also evidence of great vertical movements. A major branch fault, the Mission Creek fault, is characterised by the presence of a narrow ribbon of steeply dipping Tertiary sediments, traceable for miles, faulted between immensely older gneisses.—**G. W. Tyrrell**: Contributions to the stratigraphy of the Stor Fjord region of Spitsbergen. Numerous sections in the gently inclined Mesozoic rocks were described. Fossil determinations show that the western coast of the Stor Fjord is composed mainly of Jurassic and Cretaceous rocks, while Barents and Edge Islands on the east are built of Triassic strata.—**G. W. Tyrrell** and **K. S. Sandford**: Tectonics and petrology of the dolerites of Spitsbergen. A great dolerite sill-swarm of Lower Cretaceous age is distributed over 50,000 square miles of the Spitsbergen archipelago. The petrography of the rocks, with two new analyses, is described, and their relations to the structural lines and tectonic history of Spitsbergen are elucidated.

PARIS

Academy of Sciences, Feb. 22.—**A. Lacroix**: The intrusive and vein-containing rocks of the granitic and sedimentary region of the north of Tibesti.—**J. Costantin**: Climatic degenerescence of the potato. —**Armand de Gramont**: The factors of reflection and transmission of some metals deposited by cathode sputtering. The results differ with the gas present: deposits formed in argon are generally the best. Good mirrors can be deposited with tin, and this metal has the advantage that the films are less alterable in air than those of silver.—**Henri Lagatu**, **Louis Maume**, and **Mlle. Lucienne Cros**: Study of the variations in the amounts of nitrogen in very localised points of the leaf of the vine.—Theobald Smith was elected *Correspondant* for the Section of Rural Economy, and Jules Schokalsky *Correspondant* for the Section of Geography and Navigation.—**Miron**

Nicolesco: The problem of Riquier.—S. Sanielevici: Singular integral equations.—Mariani: Relativity and quanta.—Edouard Callandreau: A property of circular cylinders submitted to torsion.—Ch. Féry and N. Stoyko: The isochronism of a pendulum maintained by an impulse acting after the vertical.—Al. Proca: A new characteristic of Dirac's electron.—Louis de Broglie: Remarks on the first integrals of wave mechanics.—L. Bouchet: The influence of radioactive bodies on the Volta effect.—R. Forrer: The law of discontinuous distribution of the Curie points.—B. Demetrovic: The pseudo-reflection of the X-rays.—Ion I. Agarbiceanu: The absorption spectrum of iodine.—E. Darmois and Yeu-Ki-Heng: The influence of thorium salts on the rotatory power of tartaric acid and the tartrates. Thorium forms complex compounds with tartrates. The large rotations observed are due to the formation of true chemical compounds.—J. Cabannes and A. Rousset: Molecular symmetry and diffusion spectra.—Mme. Irène Curie and F. Joliot: The effect of absorption of γ-rays of very high frequency by projection of light nuclei.—Morice Letort: Five new oxido-reduction indicators.—E. Cornec and H. Krombach: The equilibria between water, potassium chloride, and sodium chloride from $-23°$ C. to $+190°$ C.—Mlle. O. Hun: Boiling point study of the molecular equilibria of pyrocatechol in solutions of calcium chloride and barium chloride.—E. Vellinger: The rotatory power of some aminoacids as a function of the acidity (pH).—Lucien Andrieux: The preparation of the mixed borides of thorium and cerium.—L. Bert and E. Andor: A new method of preparation of the β-chlorallyl bromide and iodide.—Er. Toporescu: Studies on the inversion of sugar.—Mme. Ramart-Lucas: The parallelism between colour and reactivity of a chromophore group.—P. Fleury and J. Courtois: The general character of the precipitation of sugars and the polyols by the hydroxides of the heavy metals in alkaline media.—Mlle. M. Th. François: The acidity of castor oil. The free fatty acids contained in castor oil are strongly retained by the neutral glycerides, and separation by physical methods appears to be impossible.—Paul Gaubert: Spherolites of helenine.—J. P. Arend: The genesis of ooliths.—Raymond Furon: New observations on the Cretaceous rocks of the Gabon coast.—Mlle. Lucienne George: Observations on *Sorbus confusa* (= *S. aria* + *torminalis*).—J. Trochain: The biology of two Commelinaceæ, *Commelina Forskalœi* and *C. benghalensis*.—E. Bachrach and G. Morin: A new (conditional) acquired reflex.—Pierre Girard and Mme. L. Guastalla: The electrophoresis of biological media.—F. Vlès and A. de Coulon: An intervention of electrostatic conditions in the appearance of certain spontaneous cancers.

Feb. 29.—The president announced the death on Feb. 28 of M. G. Bigourdan, of the Section of Astronomy, president of the Academy in 1924.—A. Lacroix: The composition of the orthose lavas of the Tibesti volcanoes.—Paul Pascal and Mme. Réchid: The hexametaphosphates. A description of the preparation and properties of a new sodium hexametaphosphate, $Na_6(PO_3)_6$, 10 H_2O. This salt is regarded as a definite individual, and resembles the monometaphosphate in that it can be heated to any temperature without undergoing modification.—Pierre de Vanssay was elected *Correspondant* for the Section of Geography and Navigation.—Claude Chevalley: The structure of the theory of the body of classes.—D. Belorizky: The nature of the impacts in the problem of three bodies with three degrees of freedom.—Thadée Banachiewicz: The determination of the orbit from two heliocentric points.—L. Goldstein: The multiple excitation of complex atoms by impacts with electrons.—A. Guillet: An electrodynamical arrangement for the measurement of small mutual inductances. Application to the examination of micrometers.—R. Forrer: Verifications of the law of discontinuous distribution of the Curie points.—R. Ricard: The first spark spectrum of mercury.—Paul Soleillet: The mean duration of life of the cadmium atom in the excited states $^3P_1$ and $^1P_1$.—E. Cornec and H. Krombach: A physical method for the determination of potassium chloride in sylvinites. The method is based on the fall of temperature resulting from the addition of potassium chloride to a saturated solution of sodium chloride. Comparisons between results obtained by this method and the usual perchlorate method are given.—Louis Chassevent: Anhydrite and its formation. An explanation of the apparent contradiction between the results of van 't Hoff and those of Jolibois and Lefebvre.—V. Auger and Mme. Poulenc-Ferrand: Cupric carbonate. Normal copper carbonate ($CuCO_3$) has not yet been prepared, and it appears improbable that it can be prepared by a wet method.—J. Marçais: The Cretaceous and the Nummulitic in the eastern Rif.—Antonin Lanquine: The *accidents* of the western edge of the Jurassic *Barres* between Belgentier and Néoules (Var.).—P. Fallot: The extension towards the south-east of the marginal overlapping of the limestone chain of the Spanish Rif.—Mlle. M. Goldsmith: The proportion of the sexes in *Galleria melonella*. While under normal conditions of temperature and diet the two sexes occur in practically equal numbers, if the food is insufficient, males predominate (17 per cent females).—P. Durand and J. Laigret: Pustular fever (fièvre boutonneuse) and 'Marseilles fever'. Crossed immunity. A first attack of fièvre boutonneuse of Tunisian origin confers complete immunity against another Tunisian virus. Similarly, a first attack due to a virus of Marseilles origin confers immunity against a Tunisian virus.

Rome

Royal National Academy of the Lincei, Nov. 1.—S. Pincherle: A special linear operator (3).—Luisa Pelosi: Maximum and minimum chords normal to a hypersurface. By somewhat complicated calculation Bonnet determined (in 1843) the normal to a given ellipse (or parabola) for which the chord within the curve is a minimum, and found that such chord is tangential to the evolute of the ellipse at the point where it meets the ellipse. It is now shown that this result is capable of generalisation, and that if a chord normal to a hypersurface is such that the segment of it contained in the hypersurface is a maximum or a minimum (without being binormal to the surface), this segment is equal to one of the principal radii of curvature of the hypersurface.—B. Hostinsky: Integration of linear functional transformations (2).—A. Quarleri: Theory of the 'wake' in perfect liquids: case of the round cylinder.—G. Lampariello: Waves of discontinuity in the more general elastic media. The existence in the most general elastic medium of three possible waves is established, the direction of propagation of each of them being determinable by constructing the corresponding bicharacteristics.—A. Corbellini and L. Barbaro: Abnormal decomposition of the tetrazo-derivative of 2 : 2′-diamino-1 : 1′-dinaphthyl. The acidic compound formed as a result of this decomposition is, most probably, [4 : 5-(naphtho-1′ : 2′)-pyrazolyl (3)]-orthocinnamic acid.—G. Mezzadroli and E. Vareton: Contribution to the study of the photosynthesis of glucides in ultra-violet light from aqueous solutions of activated carbon dioxide. The formation of formaldehyde, glycollic aldehyde,

and reducing sugars on exposure of carbon dioxide solution to the action of ultra-violet rays is greatly enhanced by the presence in the solution of colloidal calcium or magnesium carbonate.—G. Zanoni: Certain correlation phenomena in plants. Experiments with *Solanum pseudocapsicum* and *Jasminum lucidum* show that the action of light on leaves exposed to it modifies the transparent green colour according to a kind of cyclic curve during the twenty-four hours of the day. With this local action, there corresponds a diffusion of the reaction, by which the leaves of the branches kept in the dark exhibit, more or less rapidly, the colour changes of the leaves subject to direct illumination.—L. Bucciante: Survival of embryonic tissues of the hen kept in Ringer's solution at low temperatures. The permanence of embryonic tissues of the hen in Ringer's solution at 5°-10° C. permits of the protracted survival of the elements of the tissues, but varies markedly in degree for different tissues. This phenomenon is probably accompanied by progressive subtraction of trophic substances, which diffuse from the cells into the liquid. Indeed, the addition of embryo juice is an almost indispensable condition for the cultivation of tissues in Ringer's solution; in a culture medium of plasma alone, the tissues either fail to grow or grow only to a very slight extent.—Aldo Spirito: Experiments on grafting with the edible frog (3).—O. Marcucci: Grafting experiments with amphibia.—Giulio Cotronei and Celso Guareschi: Zoological constitution and grafting (8). Experiments with Anura and Urodeles.—A. Galamini: Course of fasting and re-nutrition in ovariotomised albino rats (1). The phenomena observed with these rats during fasting and during subsequent feeding are substantially the same as with the normal rats.—A. Galamini and E. Serianni: Modifications of glucohemia and hydremia resulting from the administration of glucose and water.—Giuseppe Levi: Obituary notice of Albert Brachet.

VIENNA

Academy of Sciences, Dec. 3.—N. Fröschl, A. Maier, and A. Heuberger: The catalytic reduction of chlorides of dibasic acids.—N. Fröschl and J. Harlass: The preparation of naphthalene-dicarboxylic acid.—N. Fröschl and A. Heuberger: The acetalisation of polyvalent alcohols with mono- and di-ketones.—N. Fröschl and J. Harlass: Attempts at the synthetic preparation of agaricinic acid.—J. Zellner: The chemistry of lichens. (1) *Peltigera canina*.—J. Zellner: The chemistry of halophytes. (3) *Sueda salsa*.—C. G. Danoff and J. Zellner: Contributions to comparative plant chemistry. Chemistry of barks. Various substances in the barks of mountain ash and edible chestnut.—F. Feigl and P. Krumholz: The action of alkali alcoholates on iron pentacarbonyl. Salts of iron, barium and mercury can be obtained corresponding to a hydrogen iron carbonyl.—L. Schmid and L. Haschek: Cryoscopic determination of the molecular weights of sugars and of inulin in liquid ammonia.—K. Graff: Photometric observations of the Milky Way and of the zodiacal light in Majorca.—T. Pintner: The little-known and unknown as regards tapeworms.—E. Tschermak: Artificial illumination as a stimulus in hot-houses. For plant-breeders and scientific genetics it is becoming worth while to use cheap electric current in conjunction with gaseous carbon dioxide, especially in the winter months. In this way two generations can be raised indoors and a third in the open during one year, also artificial cross-fertilisations succeed indoors in winter.—Y. Lebzelter: The anthropology of the No-gau bushmen on the lower Omuramba Epukiro in South-West Africa. Measurements are given. The No-gau are allied to the Kung.

Forthcoming Events

FRIDAY, April 8

Royal Society of Arts (Indian Meeting), at 4.30.—Sir Richard Burn: Recent Developments in Land Revenue and Rent Policy in the United Provinces.

Society of Chemical Industry (Chemical Engineering Group) (at Royal Victoria Hotel, Sheffield), at 6.—T. G. Elliot and Dr. W. Cullen: Special Alloy Steels as applied to Chemical Engineering.

Institute of Fuel (East Midlands Section) (Annual General Meeting) (at University College, Nottingham), at 7.—V. B. Harley-Mason: Conditioning of Boiler Feed Water.

Society of Dyers and Colourists (Scottish Section) (Annual General Meeting) (at George Hotel, Glasgow), at 7.15.—J. Muir: Some Notes on *p*H Control by Colorimetric Methods (with demonstrations).

Oil and Colour Chemists' Association (Manchester Section) (at College of Technology, Manchester).—Annual Meeting.

April 8 to 11

Congress of German Pharmacological Society (at Wiesbaden).

MONDAY, April 11

Royal Society of Medicine (United Services Section) (Annual General Meeting), at 4.30.—Surg.-Commdr. W. H. Edgar: Scarlet Fever: an Effort in Preventive Medicine.

April 11 to 14

Congress of German Society for Internal Medicine (at Wiesbaden).

TUESDAY, April 12

Institution of Electrical Engineers (Scottish Centre) (Annual General Meeting) (at 39 Elmbank Crescent, Glasgow), at 7.30.—W. B. Hird and J. B. Mavor: Electrically Driven Underground Conveyors in Coal Mines, and their Economic Advantages.

Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent, Glasgow), at 7.30.—Annual General Meeting.

WEDNESDAY, April 13

Institute of Fuel (London Section) (Annual General Meeting) (at Chemical Society), at 6.—Dr. E. S. Grumell: Evaluation of Coal from the Users' Standpoint.

Royal Society of Arts, at 8.—J. R. I. Brooke: Rural Industries: their Organisation and Development (Lecture).

THURSDAY, April 14

Institute of Metals (London Local Section) (Annual General Meeting) (at 83 Pall Mall), at 7.30.—Discussion on Welding, Brazing, and Soldering.

FRIDAY, April 15

Society for Experimental Biology (in Department of Zoology, University Museums, Oxford), at 10.30 A.M., 2.30, and 5.30.

Royal Anthropological Institute (Sociological Research Committee), at 2.—J. H. Driberg: Economic Stages of Development in Africa.

Society of Dyers and Colourists (Manchester Section) (at 36 George Street, Manchester), at 7.—Annual Meeting.

SATURDAY, April 16

Society for Experimental Biology (in Department of Zoology, University Museums, Oxford), at 10 A.M. and 2.30.

Official Publications Received

BRITISH

Union of South Africa: Department of Mines and Industries: Geological Survey. The Geology of the Country south of Piet Retief; an Explanation of Sheet No. 68 (Piet Retief). By Dr. W. A. Humphrey and Dr. L. J. Krige. Pp. 72. (Pretoria: Government Printing Office.) 5s., including Map.

Memoirs of the Geological Survey of India. Vol. 57: Coal in India. 1: The Natural History of Indian Coal. By Dr. Cyril S. Fox. Pp. viii+283+xvii+17 plates. (Calcutta: Government of India Central Publication Branch.) 9.4 rupees: 15*s.* 6*d.*

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