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Native Labour from Nyasaland

NATIVE labour, more especially after the great expansion of the mining industry, was for long one of the more insistent problems of the southern half of the African continent. Many causes combined to restrict the supply of labour, and while in time every effort was made to ensure that conditions should be as favourable to the native labourer as circumstances allowed, the authorities were even more exercised as to the means whereby the numbers seeking employment could be maintained at a figure adequate to the requirements of agriculture, mining and industry generally. After the failure of imported Chinese labour to meet this need in the early years of the present century, it became necessary for the labour-recruiting agencies to go farther and farther afield, until natives were being brought from districts very far removed from the provinces in which they were to be employed.

In these early days, the needs of industry and the call for the development of the resources of the country claimed to be, and were regarded as paramount. It was urged that any and every means, such as an increased hut tax or encouragement of the habit of purchasing European necessities or luxuries, might legitimately be used to induce or compel the native to work over and above that required for his bare level of subsistence. In justification of such argument, it has to be admitted that as the native mind has become familiarised with the idea of wage-earning, the opportunity afforded by the recruiting agent has suggested the most ready, if not indeed the only, means of meeting the deficit in the individual, or rather family, budget caused by taxation, even when it has not opened a road to the acquisition of European luxuries, or wealth in the form of cattle.

The introduction and employment of native labour on a considerable scale in the mines imposed upon the authorities the obligation to look with care to the well-being of the employed. Not only has this obligation been recognised, but also on the whole it has been met to the full, especially in the oversight of the conditions of employment, and in regard to health, housing and general welfare in the labour compounds of the mines. Yet even so, it has been recognised, as a rule, that this system of native labour entails certain consequences and changes in the character of the individual, which are not entirely beneficial, and may indeed in certain conditions be regarded as incurring the risk of inflicting positive harm.

So much may be stated, as a necessary introduction, of the case to be made out for the needs of industry and development in relation to the supply of native labour, and the obligation thereby imposed to provide some measure of protection for the labourer as an individual. There is, however, another side to the picture, which events of recent years have brought to the front. Administrative difficulties due to the loosening of the bonds of tribal custom and collective responsibility in the repatriated labourer have directed attention to the effect of labour-recruiting on the area from which labour is drawn. Africa is no more immune from the effects of labour recruitment than the islands of the Pacific, which have furnished labour for the plantations. Experience has shown that in both areas the absence of virtually the whole of the able-bodied younger men for a more or less prolonged period affects adversely the increase and the morale of the tribe, while imperilling its social and economic stability.

An example of the disturbance caused by such a removal of a large part of the able-bodied

population, and the lengths to which it may go, is afforded by the Protectorate of Nyasaland. Here, as is shown by the recently published report of a Committee appointed by the Governor in 1935 to inquire into the conditions and effects of native migration for the purpose of seeking employment abroad, the situation is such as to constitute a serious menace to the future of population and country alike. The Committee, in fact, gives warning that unless the causes of migration are controlled and counteracted, the economic entity of the country will be imperilled, large tracts of land rendered unfit for cultivation, in the native community immorality and disease will be almost universal, and the native will hate administration by white people, which has been responsible for such results.

Could an indictment more grave be framed against an administration, which, so far from being oppressive, has on the whole been well-intentioned in its aims? That such a state of affairs should now be allowed to exist, or even that such possibilities could be envisaged for the future, argues a failure to appreciate native character and custom, which should be incredible in these days of intensive scientific study of the close-knit texture of African institutions. An outworn tradition has been allowed to survive too long. Nyasaland, since the early days of labour migration in South and Central Africa, has been known as a fertile source of man-power. For twenty-five years, that is up to 1935, labour recruiting has not been permitted within the borders of the Protectorate. This policy, no doubt, at the time of its inception was thought to be in the interests of the native. It was a mistake. Although the number of the inhabitants now outside the country is not known with certainty, it is estimated that they do not fall short of 120,000. As the labourers have sought employment independently, they have lost the advantage of the organisation and safeguards which apply to the labour-recruiting agencies. They have suffered untold hardships and privations in travel; the wages offered them have been low; and they have been victimised at the hands of unscrupulous employers and others; while no arrangements have been made to remit the money they came to earn to their families, or for their own safe return to their homes. In fact, it is found that 25–30 per cent of the emigrants never return. Either they die—as they are not subjected to medical examination for fitness, the rate of mortality is high—or they marry foreign women, or they never earn, or they spend, the money they needed, and are unable or ashamed to return home.

Such are the facts which the Committee established; and on them it comments that, although the state of affairs was known to be grave, as inquiry proceeded the Committee became more and more aware that "this uncontrolled and growing emigration brought misery and poverty to hundreds and thousands of families and that the waste of life, happiness, health and wealth was colossal".

In the month of June, 1935, the Governor announced that an exclusive three-year contract had been granted to a private company permitting the engagement of labour in the Northern Province for employment in Southern Rhodesia and the Union of South Africa. It is permissible to expect that this contract will serve as a safeguard against the worst of the evils affecting the migrant labourer to which attention has been directed. Up to the present, however, it has had little effect on native migration as a whole. In probing the causes which induce the native to migrate, the Committee, while allowing something to the love of adventure, places first economic necessity. The native needs cash wherewith to pay his hut or poll tax, and as he cannot earn it locally, he must seek employment abroad.

In making its recommendations as to how the situation which has arisen may best be remedied, the Committee, in view of its findings, turns first of all to the possibility of improving the economic position of the native population by openings which would serve as an alternative to emigration. It is recommended that agricultural surveys should be made of the large areas of the Protectorate which have not yet been surveyed; and it is suggested further that the native should be trained to adapt himself and his methods of cultivation to changing conditions. The only crop, however, which it is thought would meet native requirements of a ready cash return without involving too arduous labour, is cotton. On the other hand, it is the view of the Committee that certain changes in the incidence of taxation might press less hardly on the women, and reduce migration from certain undeveloped areas. In order to control the movement of labour, a system of registration such as that practised in Southern Rhodesia, Kenya and elsewhere is recommended, or alternatively a form of tax receipt which would prove identity.

Of the Committee's recommendations, by far the most obviously attractive is that which suggests the extension of the native's economic capacity by the cultivation of cotton, although clearly it is closely bound up with a number of questions, such as transport, markets, distribution and the like, which can only be discussed after a close and detailed study of both local and extra-territorial conditions.

The importance of the labour supply in Africa suggests that the problem with which the Nyasaland Administration is faced cannot be settled finally without consideration of its ramifications outside the boundaries of the Protectorate. To deal only with its internal aspects may raise more serious issues elsewhere. One method of bringing the wider question of the supply of labour into debate is perhaps indicated by the recommendation of the Committee that, in the interest of the control of recruiting, statutory agreements should be made with neighbouring territories. Such agreements would seem to imply a thorough ventilation of the whole position. Whatever may be the ultimate decision as to the action to be taken on the Committee's report, it is clear that a perilous situation has arisen out of Government action in imposing taxation. Almost any demands on the time and thought of the Administration in finding a way out could not be regarded as excessive.

In Search of Truth of Earth

The Land: Now and To-morrow
By Prof. R. G. Stapledon. Pp. xviii+336+12 plates. (London: Faber and Faber, Ltd., 1935.) 15*s*. net.

"Do you like playing with dirt? I do." (Small boy looking over rail into pit at navvy shovelling out earth.—*Punch*, April 8, 1936.)

OUT of the mouths of babes and sucklings cometh wisdom! Prof. Stapledon would have us all play with dirt. From no happier than this child's point of view can the enthralling vital message of his book be construed. He would have us all learn to know and love the land like innocent little children and be alive to its value. Strange to say, this is no matter of course. We know ourselves to be of the earth earthy; we are built of it, with sole aid of the sun, around a germinal nucleus in which lie hidden the potent templates of life; yet unfortunately we have little if any thought of our parentage. In an age nominally of great scientific progress, we are inconsiderately schooled to no useful purpose; we take no real care of ourselves, have not the slightest curiosity to know ourselves; we hand ourselves over to a control which is ignorant, mostly. As a people, we have probably gone back steadily in intelligence since the opening of our schools in 1870—because our teachers have not been taught in the right way.

"In a rapt ecstatic way", we worship the far-off heavens and are even spending two millions in making a new telescope; we jubilantly hoist the mystical electron aloft as our scientific lodestar. In real life, we rain high explosives and poison from the air upon defenceless peoples. Few give a thought for the soil: not ten per cent of our population is engaged in its service. There is nowhere a professor either of agriculture or of agricultural chemistry who is a practical farmer—with full feeling for the soil, let alone the growing plant. The seat of the academic research worker but revolves upon the laboratory stool—life in the open has neither attraction nor meaning for him. Man is not a living soul to-day. Nor will the leaf soon be allowed to show itself in vital green—under the highest scientific patronage, the poor hop is no longer allowed to grow unless plastered over with Bordeaux mixture: in fact, the vine everywhere is sicklied o'er with a by no means pale cast of vitriolic blue: the farce must soon cease or we ourselves shall be poisoned off by copper being everywhere. Natural growth is not studied: Nature is everywhere forcibly fed. The student is trained to think only in terms of statistical yields. At a college enjoying multiple county council support, trials are made year after year of the growth of barley upon laboriously randomised plots. The result is reported with great flourish of mathematical precision and calculation of probable errors in a most absurd way as the whole of such 'research' is in real error: nitrogen, we learn, in the end, is of benefit to the crop. Shade of Sir John Lawes—what say you to this?

It were time that we ceased from working at random in agriculture—that we had a clear conception what agriculture is to do for us as a nation. This, in fact, is Prof. Stapledon's main desire and purpose. As things are, we not only take no

considered notice of our land as a national possession but hide it away, more and more, with aid of tarmac, concrete, bricks and mortar. London, the greatest of our multitudinous cities, quietly allows the road engineer, the land speculator and the jerry builder to deprive it of all charm of setting; irreplaceable land of highest agricultural value is everywhere being filched from national service. Bumbledon being entirely without imagination, ignorance takes command in our councils.

The child in its innocence alone knows. Being recently sprung from the soil, he has a natural love for dirt, a desire to play with it and know it, appealing to him as it does in texture and mobility; he moulds it subconsciously, of necessity, being born to till it. Comes the day when he is sent to the prison house called school, where forthwith all knowledge of dirt is denied him by his teachers. Shut up in a featureless classroom, he is taught a worthless paper geography. His eyes are never trained to look around. The muddied oaf takes no notice of the mud with which he is bespattered; the football player knows nothing of clay more than that it is slippery. Geography should involve the study of the world at large but specially of its near details. It should begin with reasoned direct study of dirt and the land; it should not be treated as a matter of mere maps and irrelevant commercial twaddle.

In our schools the studied neglect of natural knowledge and of human needs and the failure to cultivate any faculty of contemplation are not compatible with modern life. Not until Shakespeare's incomparable lines

> "And this our life exempt from public haunt
> Finds tongues in trees, books in the living brooks,
> Sermons in stones and good in everything"

are written up in every classroom and made to have real meaning will schools be fit training grounds for youth. A geography must be taught and as principal subject that is of real meaning. The root study will necessarily be agriculture, a discipline now entirely disregarded: hence our general ignorance of life.

Nearly forty years ago, when Christ's Hospital School was translated from crowded London City, from next door to the General Post Office and a great hospital, into the country at West Horsham, Sussex, to occupy a site before used as a dairy farm, I secured for the use of the school a well situated piece of land upon which I pictured to myself the boys might play with dirt and learn some few primary lessons of agriculture. Plots were laid down on Rothamsted lines so that the conditions of plant fertility might be studied. The first headmaster, though himself a devoted gardener, was a cleric and classic, unable to get away from tradition. The school had been wholly classical, though well spiced with mathematics, in London.

A great opportunity was lost—only a few school dullards were set to work the land; no attempt was made to bring the lessons of the plots under general notice or in any way to make the purpose clear to the school. Virgil in the study was the only approach to the plant permitted to the boys. The bursar not only gave no help but did his best to discourage the work. Later headmasters, though neither clerics nor gardeners, have been classical and perforce of the pressure of university scholarships—not one is given in agriculture—and of examinations have continued to turn but a blind eye to our effort, so that the hoped-for school patronage of agriculture is still lacking. Meanwhile, the school has developed its own dairy farm, so that the boys may have a clean supply of good milk, unspoilt by pasteurisation; a competent farm manager and estate agent has taken the place of the bursar. Some few boys have had practice on the farm, even learning to milk cows. Still, boys will be boys and play the fool when they should work, and there is more or less open contempt of their ill-directed efforts, on the farm. It is a long lane that has no turning but I shall not see this reached, as I feel it must be sooner or later: reason must prevail. None the less, near forty years is a long time to abide the coming of a little practical thought.

Systematic scientific experimental studies were first begun in Christ's Hospital two or three years before it was established at Horsham. The work was carried on most successfully during about twenty years under free conditions: latterly, the School Certificate examinations have more and more interfered with the course and the general value of the laboratory training has been steadily lowered.

This has happened in schools generally. So long as we allow an unenlightened control from outside to operate in our schools, there can be no advance: no proper training in natural knowledge will be possible. Those engaged in the work are for the most part themselves too narrowly trained and without the least imagination. When the distribution of the whisky money was first begun, not a few men of genius were engaged in the work and a whole-hearted attempt was made to develop suitable methods of teaching: their successors are more familiar with red tape, particularly in large towns such as London: only a huge administrative machine has been constructed, serving every end but the purpose for which it is nominally called into existence—"putty, brass and paint, not the work of 'thinkin' ' man". If only all the official forms

are properly filled in, to be checked by a multitudinous bureaucracy, honour is satisfied. A great educational machine is created! Real machinery is put in charge of men who not only understand its working but are constantly raising its efficiency —not so the educational machine. There is no evidence to-day that its main function is supposed to be

"The makin's of a bloomin' soul".

It is difficult to say what England seems to-day: all the world is in such a muddle: blind are leading blind—most blundering of all being the universities. Research as a profession has been invented, by which attention has been withdrawn from true education. Those who fall short of learning how to pursue it, and are unprepared to take any risks, go into the schools, where they become passive resisters to the spread of intelligence—being without thought or philosophy. We cannot afford any longer to allow classical-literary authorities to mislead us into ignorance of everything we should know—to maintain the attitude that it is better to know of the past than to prepare to deal with the future. We cannot with safety allow clerical control of schools to be continued—get them to the land we must in some real way: our most vital need is to understand its value.

Prof. Stapledon maintains the thesis that, in any event, culture and land surface are interwoven and interact in countless directions difficult to unravel. To judge from the state of much of the land surface, our level of culture must be low, whatever the height. In place of culture, we have commercialism, pure and undiluted—keeping our land cultivation in general low. In large measure, King Coal has blotted out the land from our sight. Truly a nation of shopkeepers, we have subjected our farmers to a merciless competition, while protecting manufacturing industry; this at least has been the effect of free trade. Much land formerly under remunerative cultivation has been allowed to lapse to grass—without any proper care of the grass. Travelling about the country, the neglected state of our grasslands is deplorable to witness. In fact, the farmer has scarcely begun to think of grass in terms of fertility and quality—as a crop to be cultivated.

Prof. Stapledon is the apostle of grass; he has devoted his life to studying and improving it. He has proved himself an artist in grass of high and original genius. The picture he has painted, on barren Welsh hills, in grass, is fascinating beyond description: many blades have been made to grow where one grew before. The only fear is that he may brush the hills down in his ardour to develop fertility and paint them green. He is a statesman, too. One whose being is filled with a great desire to see our land properly used in the service of the nation—with absolute forethought and purpose. He would have it fully surveyed and a general policy developed, not only for agriculture, forestry and rural industries but also providing facilities in truly rural surroundings for the recreation and relaxation of the urban population. His call is to town as much as to the country. His book, in fact, is a discussion on land utilisation in general: a close national survey, no mere town planning, being advocated; it is to be studied by all who are interested in our islands from such a point of view. Hitherto, the use of land has been so little open to direction and control: it has been so entirely subject to individual ownership: that to draw up any close plan of collective action will be very difficult.

Still the writing upon the wall is clear. If only in self-protection, we shall be forced to make up our minds, without delay, to what extent we can provide ourselves with food—what we can best produce—without any regard of individual interests.

Fortunately, so great has been the advance in our knowledge of the philosophy of food, in recent years, that we can now sound a triumphant *leit motiv* to guide us on our way: we have gained a new conception of quality in food—that it involves the simultaneous interaction, in strictly balanced proportions, of a large number of unit qualities, both mineral and organic; no one of which can be omitted without harmful effect. The conviction is fast growing that most animal and plant disease is due more or less directly to malnutrition. The task now before us is to ascertain, down to the minutest details, what are the essential components of complete food and to set about producing these from the soil. Farming, at no distant date, must be the most scientific of all professions—the most highly honoured of industries. At present, we have almost everything to learn.

Prof. Stapledon's main interest lies in grass; that this will be our staple primary crop is beyond question. Still, he contemplates grass production in due rotation with other crops and, apart from the direct use to which it is put, would regard it as a means of accumulating fertility to be used at proper intervals in arable cultivation. Hitherto his work has lain in the direction of raising improved varieties, testing these mainly by the food value to sheep. More rapid, less expensive methods of testing have to be devised. The chemical issues have to be exhaustively explored.

It is clear that his plant breeding station has to be expanded into a complete organisation for the study of grass in every particular. Here is work for Mr. Lloyd George to take in hand—to develop a great Welsh institution with unfettered liberty to undertake the study of grass in every desirable

direction genius can suggest. Agricultural research has been deprived of practical value, over a long period, owing to the unfortunate policy developed by my old friend Sir Daniel Hall and the Development Commission in restricting the various subsidised stations to certain limited fields of action—Rothamsted, for example, to soil studies. I objected to this from the beginning. The result has been that we are without general knowledge of the plant, without knowledge of the animal, too, with only specialised feeling on isolated problems. If agricultural research is to be continued with public funds, it must be carried on under free conditions to a practical end. Over-lapping should be the soul of the machine, so as to give genius every opportunity to develop.

The call is for chemists—for men thoroughly trained as workers, wide in vision, with the imagination and biological feeling to woo the spirit of the land and of life as it emerges from it. The complaint is widespread that such men are not to be found. Unfortunately, the search for the chimera, not of truth, is more fashionable and attractive—far easier too. The president of the Chemical Society, at the recent ninety-fifth anniversary meeting, could only entertain his hearers with an account of modern speculation on the electronic linkages in carbon dioxide—this too at a meeting held in Bristol, where it was desirable to make clear to the public that chemistry is of all sciences the most important to the community, particularly as bearing on farming and food. The public doesn't know carbon dioxide even as the air in champagne and fizzy drinks—let alone that it is the initial fundamental raw material from which all farming starts, with the sun as ploughshare. Opportunity was there, indeed the need, to tell the wondrous story of the progress of the gas from its 3/10 thousandth state onward, which might well have been done in ultimate terms of the Clifton and Cheddar Carboniferous Gorges; cereal corn; Cheddar cheese; carrot, cabbage and cauliflower; ending in the cerebral cell and Ramon y Cajal. Instead, the Society was taken to sample chocolate! Sweetmeats, we know, are unwholesome, as they put us off our food and carry no general sustenance. Oxford hasn't enough innocence in it to play with dirt to-day. I once acclaimed it in NATURE as on the upgrade (June 16, 1904): I fear the fit is over; her chemists are now in chains, without sense of proportion.

HENRY E. ARMSTRONG.

Finance and Industry

(1) The Russian Financial System

By W. B. Reddaway. Pp. x+106. (London: Macmillan and Co., Ltd., 1935.) 5*s*. net.

(2) The Clash of Progress and Security

By Prof. Allan G. B. Fisher. Pp. xiii+234. (London: Macmillan and Co., Ltd., 1935.) 8*s*. 6*d*. net.

(1) AS might be expected, the Russian financial system is very different from that of other countries, since the U.S.S.R. is virtually a closed economy and there are none of the semi-automatic adjustments which come about in other countries, through gold movements or through foreign exchange variations. Moreover, through its control of industry, the State is able to use the monetary system as an instrument for obtaining results which can only be achieved, if at all, in other countries, through taxation. Foreign trade is a State monopoly, and the State Bank has the sole right to deal in foreign exchange. Some foreign exchange business, however, is carried out in illegal channels through the 'black bourse', and there a more favourable rate of exchange than the official rate can be obtained for foreign currency.

Mr. Reddaway outlines very clearly and succinctly the main features of the Soviet financial system, and he has collected much information, largely through interviews with officials of the Moscow State Bank. The book provides a valuable and comprehensive survey of a subject on which little has been written. The conditions described, however, relate to 1934, except for a note dealing with the derationing of bread early in 1935. Rationing has since been abolished for all foodstuffs, and the financial system is gradually being modified in the direction of greater flexibility.

Mr. Reddaway points out that the Soviet monetary system has been developed primarily with the view of facilitating planning and production. Its main functions, therefore, have been: (1) to furnish a unit of account; (2) to facilitate the distribution of the limited supplies of productive resources to the maximum advantage; and (3) to provide an efficient means of making payments between different enterprises and for adjusting their financial relationships generally.

The interests of the consumers have been secondary, and buyers were not given a free choice as to what they might purchase in the co-operative or factory shops, where goods are sold at lower

prices to the workers privileged to hold ration cards. From the State's point of view, it could always get rid of any surplus which might be depreciating the price in the commercial shops by including it in the ration cards. The position, however, was mitigated to some extent since rations were confined to necessities which in any event would probably be bought.

(2) In a capitalist society, if a surplus is produced, it would be necessary to transfer labour and capital to other industries and occupations, and until this was done unemployment and depression would occur in the industries affected. This is a main theme emphasised by Prof. Fisher in his "Clash of Progress and Security". He is concerned with the possibility of material progress being frustrated in a capitalist economy in an effort to gain individual security. Material progress, he emphasises, means change, and this often inflicts much inconvenience and even suffering on those directly affected. He holds that the paradox of poverty in a world of potential plenty is in part to be explained by our failure to appreciate the necessity for continual changes and transfers from older industries to new industries and into types of economic activity which a less wealthy economy has been unable to afford. Prompt and continuous diversion of labour and capital into relatively new types of production is an essential condition for maintaining a satisfactory rate of material progress, as well as for avoiding chronic relapse into depression.

As the author sees it, there has been in recent years an increasing reluctance among capitalists to undertake risks: "Instead of making the bold experiments which were characteristic of the capitalist of earlier generations, he tends much more to seek security for himself by the maintenance of the *status quo*".

Prof. Fisher's book is carefully argued and thought-provoking, and should be read by all interested in these problems. K. G. F.

Determination of Crystal Structure

Internationale Tabellen zur Bestimmung von Kristallstrukturen:
(International Tables for the Determination of Crystal Structures: Tables Internationales pour la Détermination des Structures des Cristaux). Band 1: Gruppentheoretische Tafeln: Tables on the Theory of Groups: Tables sur la théorie des groupes. Pp. xii+452. Band 2: Mathematische und physikalische Tafeln: Mathematical and Physical Tables: Tables mathématiques et physiques. Pp. viii+453–692. (Berlin: Gebrüder Borntraeger; London: G. Bell and Sons, Ltd.; Paris: Les Presses universitaires de France; New York: Chemical Catalog Co.; Amsterdam: N. N. Noordhollandsche Uitgevers Maatschappij, 1935.) 33 gold marks.

THE subject of X-ray analysis is difficult because it demands a knowledge of many widely different branches of science. The central problem, that of determining the relative positions of the atoms in the crystal, which in most cases includes the molecule, is obviously of supreme interest to chemistry. A new metrical chemistry is, in fact, rapidly being built up, based upon accurate measurements of interatomic distance and valency angle, which must in the future form an important connecting link between accumulated empirical data and theoretical developments. But although the subject matter is largely chemical, the investigator requires a specialised knowledge of other, and rather diverse, matters. The more abstract portions of crystallography and group theory are necessary in deriving the results, while on the practical side a knowledge of the physics of X-rays and diffraction experiments in general is desirable. It is also customary nowadays to make fairly extensive use of analysis by Fourier series in computing the more refined results, and considerable use of atomic theory is necessary in calculating the *f*-curves of different atoms.

The new international tables on crystal structure are particularly valuable because they bring together in conveniently tabulated form the essential results of these diverse sciences, thus saving much laborious reference to a scattered literature, with all portions of which no single worker can be familiar. The tables arose from the need of a standard reference work with a nomenclature to which all papers on the subject could be referred. But they achieve much more than this, because certain portions of the work have been specially prepared or computed for the present occasion, and these represent new and important contributions to scientific literature.

The first and much the larger volume contains the fundamentals of group theory and further data on the geometrical side of structural analysis. The new descriptive Hermann-Mauguin nomenclature is first explained in detail, and throughout the

work this system is used in juxtaposition with the older Schoenflies symbolism. Comparison tables of the different systems of nomenclature formerly in use are then given, and chapters on the crystal classes and translation groups and transformations follow. We then come to the main chapter dealing with the 230 space-groups, which occupies two-thirds of the volume. The description accorded to each space-group is much more complete than anything else which has appeared. The co-ordinates of the special and general point positions are given with the corresponding point symmetries and the lattice complex for each point position. The enumeration of the symmetry elements is completed by giving the screw axes and glide planes. A list of the sub-groups follows. All this information is then summarised by means of two diagrams for each space-group, one giving the general point positions and the other the distribution of symmetry elements. These pictures are greatly clarified as a result of this dual representation. The geometrical structure factor for the general plane (*hkl*) is next given, and it may be noted that this is the first time a complete set of structure factors for all the space groups has been published. They represent a valuable addition to the tools of research. The description of each space-group is completed by listing the characteristic missing spectra, or 'halving'. These lists of missing spectra are classified in the next chapter in the form of a new table by which the possible space-groups of any crystal can be determined in a systematic manner. Two further chapters on point symmetries and lattice complexes complete the first volume.

The second volume contains tables of mathematical and physical data which are of constant use in X-ray analysis: quadratic forms, trigonometrical and exponential functions, intensity formulæ, atomic scattering factors, absorption coefficients, wave-lengths, lattice constants, atomic radii, etc., and a long chapter on graphical methods of evaluating X-ray diagrams. The tables are admirably compact, and quite indispensable to anyone carrying out serious work on crystal structure.

In an international work of this magnitude which has been so skilfully planned and executed, there is little room for criticism, and we must congratulate the editors, Sir William Bragg, Prof. M. von Laue and Prof. C. Hermann, and the international group of authors on the successful completion of their immense task. The student will certainly find some difficulty with this work because portions are by no means easy to understand, although with continued use their contents may become more familiar. There is perhaps a tendency to over-elaboration in certain sections of the work. Most X-ray photographs can be analysed and the results interpreted from first principles; the use of space-group theory, for example, is important chiefly because it effects an economy of thought in presenting immediately all the mathematically possible arrangements of symmetry elements compatible with the X-ray data. But if the presentation of the theory is too elaborate the resulting economy of thought may be seriously diminished, and some workers might for a time prefer to go back to first principles rather than grapple with methods that are more complex on account of their greater generality. This criticism may apply to certain sections of the first volume, or alternatively it may be said that the reviewer does not fully understand them. The two statements are to some extent equivalent.

In minor points there are inevitably a few misprints, particularly in the second volume. We understand, however, that the publishers are preparing a leaflet of corrections. It should be noted that, contrary to the statement on p. 585, Table II, p. 588, is not based on the wave-lengths of the preceding Table I. J. M. ROBERTSON.

The Rise of Modern Physics

By Prof. Henry Crew. Second edition. Pp. xix + 434 + 16 plates. (London: Baillière, Tindall and Cox, 1935.) 18*s*.

THE original edition of this book, published in 1927, has been extended by about a hundred pages to deal with matters "that have only lately been reduced to order". Reference is given to the latest position of definitions of electrical units, research on the inertia of electricity, modern spectroscopy and the ether-drift problem. General corrections are made and up-to-date references to important original contributions to physics are embodied.

The author explains that the term 'modern' in the title of the book is used as opposed to 'ancient', and applies to the period since the time of Galileo. The essential object of the little volume is to present an informal connected introduction to physics, in the form of a history stated to represent the "irreducible minimum for one wishing to acquire a just perspective", with liberal references to and extracts from original sources. Actually, we are led up to modern physics, since sub-atomic research is introduced only very briefly; the older quantum theory goes as far as the Bohr atom, and the new quantum mechanics is held to be outside the scope of the book.

The whole forms a very readable and interesting discussion instead of the catalogue of facts of a conventional history. There are sixteen good portrait plates, sixteen simple line diagrams, and a few mathematical formulæ; when this is borne in mind, the price is, unfortunately, almost prohibitive to the general reader. N. M. B.

Official Guide to the Gardens and Aquarium of the Zoological Society of London

By Dr. Julian S. Huxley. New Series. Pp. 116. (London: Zoological Society, 1936.) 1*s*.

THE new guide to the gardens of the Zoological Society, by Dr. Julian S. Huxley, the secretary of the Society, forms a sharp and striking contrast with the stereotyped form which has done duty for so many generations of visitors. As a guide for those who wish to see the Gardens in one visit it has lost nothing in efficiency compared with its predecessors.

But at the end of their visit they will, almost certainly, carry this little booklet home with them, to read again at leisure, when they will discover how much there is to *learn*, as well as to see, during future visits. These pages, indeed, will open up an entirely new conception of the part the Gardens play as a source of information concerning the animals exhibited here, drawn from the ends of the earth; for compressed within a few pages they will find unsuspected interest concerning their geographical distribution, the marvellous way in which they have become moulded by their mode of life, and something of the meaning of the classification of animals.

W. P. P.

Man who could work Miracles

By H. G. Wells. A Film Story based on the Material contained in his short story "Man who could work Miracles". Pp. 96. (London: The Cresset Press, 1936.) 3*s*. 6*d*. net.

IN this film story Mr. H. G. Wells applies again the treatment used in "Things to Come" to material drawn from the fantastic vein of his earlier works. He describes how a draper's assistant in a small town suddenly becomes endowed with miraculous powers, how he uses his newly acquired gifts to further his own desires or those of friends, and how he loses his gift with dramatic suddenness just as he involves the world in disaster. Mr. Wells uses his new technique to expound his familiar theme of man's inability to use wisely the powers with which science has endowed him, and to bring into high relief the moral as well as the material obstacles which beset the transformation of the present situation of unemployment and impoverishment in the midst of overproduction and sabotage into an era of peace and plenitude for all.

A History of Gardening in Scotland

By E. H. M. Cox. Pp. xvi+229+20 plates. (London: Chatto and Windus, 1935.) 12*s*. 6*d*. net.

THE ten chapters of this book show that all aspects of the subject have been given due attention, ranging as they do from the earliest times to the accession of King James VI; the start of the country house; the age of the formal garden; the natural type of garden; the Victorian garden; botanic gardens; seedsmen, nurserymen and market gardens; college gardens; horticultural societies and flower shows and the gardener.

Early records are very few and uninteresting; they serve to show, however, that such cultivation as existed in the earliest times was almost exclusively fostered by the many monastic establishments. The unsettled state of the country and the lack of any security of land tenure in the earlier days did little or nothing to encourage either horticulture or agriculture in Scotland.

Not the least interesting portion of the book is the various lists of hardy fruit commonly grown, also lists of orders for vegetable seeds. We need only mention one dating back to 1689 which shows a surprising variety for that period.

There are several appendixes, a glossary and bibliography. There are also two good indexes, one devoted to the names of places—a valuable innovation.

More than twenty excellent illustrations add materially to the charm and interest of an attractively produced book. It should have a wide appeal to all interested in the history of gardening in Scotland, which, for many years, has been noted for the high cultivation of its gardens under often somewhat difficult climatic conditions, to say nothing of the fame of the Scottish gardener, which is world-wide.

Notes on Organic Chemistry

By Prof. F. Francis. Pp. viii+525. (London: Edward Arnold and Co., 1935.) 12*s*. 6*d*. net.

THIS book is on novel lines, and is likely to be of great use to honours and research students as well as to lecturers and workers in organic chemistry. The author sets out in short crisp paragraphs notes on a large variety of pertinent subjects. These include organic reactions, the hydrocarbons, their halogen derivatives, the reactions of unsaturated substances, oxidation and synthetic methods. The subject matter is printed on one side of the page only so that the worker can add his own notes. References are given to other sources of information, in particular to summary articles.

The book forms a mine of information gathered over many years by one who has high repute as a teacher and worker, and should prove a great saver of time to its possessors. Its price is remarkably reasonable.

Steel and its Heat Treatment

By D. K. Bullens. Third edition, rewritten and reset. Pp. xiii+580. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

THE only addition to this issue of "Steel and its Heat Treatment" is a chapter on nitriding, contributed by Dr. V. O. Homerberg. In the space of sixteen pages a brief outline is given of the nature and conduct of the nitriding process, of the steels suitable for nitriding, and of their properties after treatment. Otherwise the book remains the same, although eight years have passed since the preparation of the previous edition. There is still, therefore, no reference to the notched-bar impact tests to which British metallurgists rightly attach so much importance, to grain size control (although this originated in America), to the newer types of stainless steels, or to manganese-molybdenum steels.

Modern Developments in the Design of Aeroplanes*

Scientific Research and the Problems of the Future

PREVIOUS James Forrest lectures summing up the then situation in aeronautics were delivered by Dr. F. W. Lanchester in 1914 and Prof. R. V. Southwell in 1930. It is curious that the scientific development of the aeroplane has fallen into phases that appear to correspond with these dates. From 1914 until 1930, the aero-engine made the more marked progress, but since that date advances in aerodynamic efficiency of aircraft have been the outstanding achievement. General aerodynamic improvement has been compounded of a number of more or less independent steps : better shapes of wings and bodies ; smoother surfaces and the elimination of discontinuities in those surfaces ; reduction of excrescences ; closing over of openings such as cockpits ; retraction of undercarriages ; and improvements in means of engine cooling.

Comparing the De Havilland "Comet" and the Heinkel "He 70", the outstanding machines of 1935, with a good example of 1930 design, the drag coefficients for wing area and total 'wetted' area of the whole machine have been reduced to less than half their best value in 1930. The combination of this reduced resistance with higher powered modern engines has raised speeds from 170 miles per hour, quoted by Southwell in 1930, to more than 300 miles per hour to-day.

A great deal of this advance has been due to a more complete appreciation of the basic problem of aerodynamic effects, consequent upon the introduction of the compressed air wind tunnel. This has enabled phenomena to be studied over the whole range of Reynolds numbers, between that in an ordinary atmospheric tunnel, and that of full-scale flight. A typical case of this kind is that of the effect of surface roughness on drag, from which it has been established that, at speeds now reached, the surface roughness, due to the almost universal practice of covering aircraft wings with fabric, has an effect large enough to be intolerable.

This increase in top speed has brought its own problem, in that the minimum speed at which the machine will remain air-borne, that is, the landing speed, may not rise with it, because of safety requirements during landing and taking off. Handley Page slots, or trailing edge flaps, although their effect is basically different, both have the desired effect of delaying the 'stall' to safe speeds, and the appropriate use of either one, or a combination of both, appears to give such extra speed range as is necessary.

Another problem that has been attacked since its physical basis has become better understood is that of 'interference'. For example, the combination of a body and a wing, both separately of low drag, in such relative positions as practice demands for a low-wing monoplane, may give in total a high drag due to interference. It has been improved by filling in the regions of divergent flow with 'fillets'. The extra advantages due to having a short, easily retracted undercarriage, and the improved landing conditions due to the 'cushioning' of the air beneath a wing, close to the ground, more than compensate for the little remaining aerodynamic inferiority of this over other arrangements of wings and bodies.

Great advances have also been made in the problem of engine cooling, and the state of knowledge is now such that even further progress may be expected in the near future. The liquid-cooled engine may use retractable radiators, drawn progressively inside the body at higher speeds or when the temperature of the air falls, when the cooling is more effective. Alternatively, portions of the aeroplane's surface may be given a double skin between which a thin layer of liquid circulates, as developed for the machines in the Schneider Trophy race, which gives cooling for practically no drag. For air-cooled engines the "Townend Ring" and the "N.A.C.A." cowling can now be so designed that they not only give properly distributed and controlled cooling to the engine, thus increasing its efficiency, but also it is possible to visualise the exhausted cooling air being so directed that it adds to the propulsive force of the airscrew. Thus a cooling drag of a negative value will be possible, as compared with 6–10 per cent of the brake horse-power of the engine lost in measured cases of fairly recent machines.

Improvement of the airspeed of flying-boats and seaplanes is hampered by the necessity for good water performance. The best shape of floats and hulls for landing and taking off does not usually give low air drag. Further, either wing tip floats or stub wings are needed to give stability when afloat, and these are not so easy to retract as the corresponding undercarriage of a land machine. A certain part of this inevitable inferiority in performance is regained in that such a machine has

* Substance of the forty-second James Forrest Lecture delivered at the Institution of Civil Engineers on May 5, by E. F. Relf, superintendent of the Aerodynamics Department, National Physical Laboratory, Teddington.

larger surfaces from which to manœuvre, and consequently can have a higher minimum speed.

This increase of top speed, coupled with the extension of speed range, has brought many minor troubles that have called for special scientific investigations. The difference between minimum 'take-off' speed and normal 'cruising' speed is now so marked that a variable pitch propeller is necessary if maximum efficiency is demanded under all conditions. This has proved to be practicable in metal, but up to now is about three times the weight of a fixed pitch wooden airscrew. Servo-assisted controls are often necessary on both large and fast machines, and the correct relationship between aerodynamic balance, servo-action and manual operation of the various control surfaces, and their correlation with each other, is not easy to establish.

Considering the future, there are three main lines of progress: further reduction of drag, reduction of structure weight and improvement in engine performance. The margin between the present attained minimum drag and pure skin friction is small, and no great improvement in this is likely unless some revolutionary discovery points to a means of compelling the boundary layer flow to remain laminar over a much greater portion of a surface. Also as the speed of a body approaches the speed of sound in air the effect of compressibility causes a rapid rise in drag. The world's speed record is already six-tenths of the speed of sound. The problem of cooling will also be complicated by the natural rise in temperature of a body moving rapidly through air. Reduction of structure weight of a large order does not seem probable, unless research in atomic physics brings the production of synthetic materials with properties vastly superior to those in use at present. Improvements in engine performance will only be of a detailed order, unless something revolutionary in the manner of converting the latent energy in fuel into power is discovered.

Light and Temperature and the Reproduction of Plants*

By Prof. V. H. Blackman, F.R.S.

THE path of the plant physiologist who sets out to make accurate measurements of the effect of light and temperature on the growth and multiplication of the plant is beset with many hindrances. In the first place, the plant, the system which he investigates, is never completely reproducible. No two living things are exactly alike, and the variability of the biologist's material is an ever-present threat to the accuracy of his work. Something can be done to reduce the variability by selecting the progeny of a single individual, using clonal or pure-line plants. After the most careful selection, however, some variability inevitably remains; this must be evaluated by statistical methods.

Effect of Light

With the study of the influence of such an external condition as light, other difficulties arise. Sunlight, as we receive it, is inconstant in quantity and variable in quality. In exact studies of the action of light which are to last for more than the briefest period, one must inevitably resort to artificial sources of illumination, since they alone can be held constant for long periods. Unfortunately, electric light sources, though wanting nothing in steadiness, are very different from sunlight. No illumination engineer has yet achieved the 100 per cent efficiency of the 'cold' light of the glow-worm which includes no heat rays. Caution must therefore be exercised in applying to plants grown under natural conditions the physiological results obtained with artificial light sources.

Although in experimental work the constancy of the illuminant can be assured by the selection of artificial light, the uniformity of illumination of the whole plant surface is much more difficult of accomplishment. If the light source is removed so far from the plant that its upgrowth results in no marked difference of intensity between the upper and lower portions, then the illumination received is generally of too low intensity. When considering this difficulty some ten years ago, it was evident that the need was for a plant which had no upward growth but spread only horizontally. It was then realised that, in the ordinary duckweed (*Lemna minor*) of our ponds, Nature has provided such a plant. From that time onward, the physiological behaviour of this plant has been intensively studied in the laboratories of the Imperial College of Science.

By placing the plant under carefully controlled conditions, a regular, continuous growth can be

* Substance of the Friday Evening Discourse delivered at the Royal Institution on February 21.

ensured, and the effect of light and temperature upon it can be followed very simply. One has only to start a culture with a certain number of fronds, the frond being the unit of growth, and count every day the number of fronds present and so find how favourable or unfavourable are different temperatures and different light intensities for its multiplication.

The question arises as to the measure of the rate of multiplication to be employed. It is evident that as all fronds are multiplying, the more fronds there are at any given moment the more will be produced—in other words, the number produced in the culture during any given period is dependent upon the number existing in the culture at the beginning of that period. The multiplication of duckweed thus obeys the 'compound interest law', and can be expressed in a simple mathematical way. With money at compound interest the interest is added periodically, usually at annual periods. Nature, however, does not usually work spasmodically, so we find that as duckweed grows steadily in continuous light the new material which results is added continuously.

With the new material added continuously, the relation between the number of fronds at the beginning and end of any given period can be expressed by the equation $N_t = N_0 e^{rt}$ where N_t is the number given at the end of the period t, N_0 the initial number, r is the rate of compound interest and e the base of natural logarithms.

TABLE I

Day.	Frond numbers. Observed.	Calculated.
0	100	86
1	127	122
2	171	173
3	233	245
4	323	368
5	452	493
6	654	699
7	918	990
8	1406	1404
9	2150	2137
10	2800	2822
11	4140	4001
12	5760	5672
13	8250	8042

Table I from the work of Ashby and Oxley in the Imperial College laboratories shows the rates of multiplication observed and those to be expected if the rates are perfectly regular; the temperature was 24° C. and the illumination 500 foot-candles. The discrepancies between expectation and performance are only slight.

Using the formula applying to the increase in frond number or the relative multiplication rate we find in another experiment, one by H. L. White, that $N_t = N_0 e^{0.349t}$ where t is measured in days. The rate of interest was 34·9 per cent per day; this implies a speed of duplication of almost exactly two days, actually 1·99 days. Starting with a hundred, one would at this rate achieve a million in a little more than twenty-six days. For a flowering plant this rate is sufficiently remarkable; it is, however, nothing to that of bacteria, which may double their number every half-hour and so increase from a hundred to a million in about seven hours. If not the actual numbers but the logarithms of the frond numbers are plotted against time, then with a perfectly regular multiplication rate, all the points should fall on a straight line. In Fig. 1, from Ashby and Oxley's results, it is seen how closely the points correspond with a straight line. It is a curve such as one would expect in a purely physical or chemical experiment; it shows how by using the greatest care biological material may be made to yield data of very high accuracy.

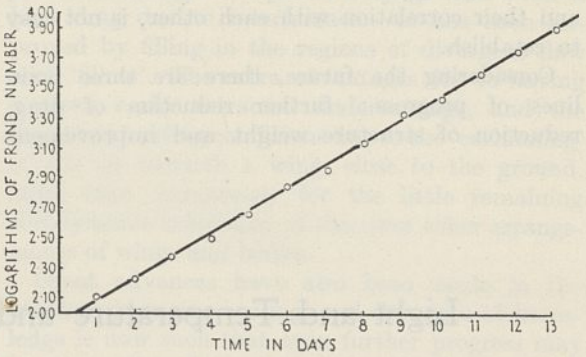

FIG. 1. Logarithms of frond number of *Lemna minor* plotted against time in days. The figures are taken from an experiment at 24° C. and 500 foot-candles. The straight line drawn through the points corresponds to the equation $y = 0{\cdot}152x + 1{\cdot}935$. (From Ashby and Oxley.)

One of the most surprising products of the work on duckweed is the discovery of the very low light intensity to which it is attuned. When one considers that the duckweed floating on the surface of the water is often exposed to direct sunlight with a brightness of many thousand foot-candles, it is unexpected to find that *above* 750 *foot-candles increase of intensity has no value.* At 1,400 foot-candles, far below direct sunlight, there is even an injurious effect.

A marked difficulty of research in plant physiology which is not met with in physical and chemical work is the change in the plant as we subject it to different conditions; the system we are studying is altered by the experimental conditions to which we expose it. With high light intensities we get thick fronds and with low light intensities thin ones, just as with sun and shade leaves in our gardens.

Another interesting phenomenon has come to light. As is well known, the green plant is dependent on light for the manufacture of its food materials, which are produced from water and the carbon dioxide of the air by the process of photosynthesis. Since multiplication of the plant requires a supply of new raw material, it might

be expected that the rate of multiplication would be dependent on the rate of photosynthesis. One finds, however, that there is no close relationship between the two. For example, they respond very differently to the effect of light intensity; rate of photosynthesis is still rising at a brightness of 1,600 foot-candles while the multiplication rate ceases to increase above 750 foot-candles. Light therefore affects the multiplication rate not only through food supply but also directly.

So regular is the growth of the plants under carefully controlled conditions that one can use the compound interest principle in the study of a *deleterious* factor. In some experiments, also by H. L. White, in which the plants were starved of potassium, an element essential for their growth, it was found that the growth-rate fell off at a constant rate as starvation set in. Thus with full nutrition the rate of compound interest was 33 per cent per day, while under potassium starvation this rate fell off at a rate of 15 per cent compound *decrement* per day.

PHOTO-PERIODISM

If we turn our attention to plants which reproduce themselves not by budding, as in duckweed—a process of vegetative reproduction—but by sexual reproduction, that is, by the function of flowers and fruits, we find again that light and temperature have profound effects.

Light is, of course, necessary for the unfolding of the flower buds, and often for their growth, but of recent years a much less obvious relationship has been established between light and the flowering of plants. It is, of course, well known that we have spring-flowering plants like *Viola*, *Anemone* and *Hepatica*, autumn-flowering forms like *Chrysanthemum*, *Nicotiana* and *Dahlia*, and numerous plants which flower in the summer. It used to be assumed that the time of flowering was determined by the temperature or by the relationship between temperature and intensity of light. The actual controlling factor was determined only in 1918 in the United States. A certain giant variety of tobacco, grown in Maryland, known as Maryland Mammoth, generally failed to flower or was cut down by frost before it had seeded. It could not therefore be multiplied by seed. In 1918 a potted plant of this variety happened to be brought into the greenhouse in the autumn. Protected thus from the frost, it flowered in November and later set seed. Experiments were then made with seedlings, and it was found that if seeds were sown in the autumn in the greenhouse they flowered very early, but if sown in the spring the plant grew vegetatively throughout the summer, only flowering in the autumn. Close investigation showed that the effect was due neither to temperature nor to light intensity, but the flowering was a response to the brevity of the autumn day. The plant is a *short-day* plant, that is, it will only flower if exposed to days of not more than 12 hours. Such plants when grown in temperate conditions flower only in the autumn or spring. To this class belong *Nicotiana*, *Cosmos*, *Poinsettia*, some species of *Ipomœa*, *Bougainvillea*, and the sub-tropical cereals such as maize, sorghum and other millets. With some varieties of soybean such as Biloxi the time to flower can be shortened from the 120 days required under normal conditions of summer illumination to 28 days when the period of daylight illumination is artificially shortened to 12 hours.

Sharply contrasted with these are the *long-day* plants which require for flowering a period of 14–15 hours, and thus bloom normally in the long summer days. To this group belong the spring varieties of the temperate cereals, runner beans, red clover, garden pea, lettuce, potato, the evening primrose, *Cassia*, *Sedum*, *Rudbeckia*, etc. Garner and Allard, who were the first to discover this response of flowering to length of day, have termed it *photo-periodism*.

Valid generalisations in biology are notoriously difficult of attainment, so that one is not surprised to find that there are many other plants which are so moderate in their demands that they may be described as indeterminate; they flower in both long and short days. To this class belong many widely distributed weeds, such as dandelion, chickweed and groundsel. In the tropics only short days are available, whereas in high latitudes short days are only available at times at which the temperature is liable to be too low for flowering. A plant to be useful both in the tropics and under outdoor conditions in high latitudes must be indeterminate in its light needs, that is, show no photo-periodic response. Plants like *Poinsettia* and *Bougainvillea*, which come from Central America, if they are to flower can tolerate no more than 12 hours of light. In our latitudes therefore they have no horticultural value except under warm greenhouse conditions, since they flower in the autumn and winter.

Viewed from the angle of the horticulturist, photo-periodism is of great interest, for it places in his hands a new power of control. By the use of artificial light for lengthening the period of illumination in spring and autumn, 'long-days' can be provided for flowering out of season. Similarly, by reducing the day to one of ten hours by the protection of the plants from light during a portion of the day, autumn blooming can be induced in summer. In the case of Maryland Mammoth tobacco, once the secret of its sterility had been penetrated the economic problem was easily

solved. Seed production is achieved in Florida where there are short days without the rigours of an autumn climate.

To the plant physiologist, on the other hand, photo-periodism presents a most baffling problem. When considering a reaction in the plant induced by light, he attempts at first to interpret it in terms of chemistry and therefore expects the 'product law' to hold. The effect should depend on the quantity of light energy received, and so should depend both on the time of exposure and the intensity of light. With the photo-periodic reaction we find no such relationship. It might be thought at first sight that the long-day plants require a greater light-supply for their flower formation than do the short-day ones. But this cannot be the explanation, for with long-day plants an exposure to a 10-hour day can be continued for a period which will give a total light supply much higher than is given by an exposure to a 14-hour day; yet flowering will result in the second case and not in the first. *Duration of illumination* rather than quantity of light is the important thing, and this is exceedingly difficult to interpret in terms of physiology. In the case of short-day plants there is some reason for believing that it is the corollary of the period of illumination, namely, the *period of darkness*, to which attention should be directed.

(*To be continued.*)

André Marie Ampère, 1775–1836

By Dr. D. McKie, University College, London

ANDRÉ MARIE AMPÈRE was born in Lyons on January 20, 1775, and died at Marseilles on June 7, 1836. His early childhood was spent in the country near his birthplace and his first studies were directed by his parents. A childish pastime of carrying out complicated arithmetical calculations with little pebbles was prophetic of his future devotion to mathematical studies, a devotion that was evidenced again when his father, a retired merchant, began to teach him Latin; for the young Ampère quickly showed his great preference for mathematics, whereupon his father wisely allowed natural inclination to take its own course, providing the necessary introductory works from his own small library. But when these had been mastered, more advanced reading was necessary; and it is recorded that, at twelve years of age, Ampère, accompanied by his father, went to ask in his piping boyish voice for the loan of the works of Euler and Bernoulli from the College Library at Lyons. He appears to have mastered these classics also; and he read widely in the literary, historical, scientific and philosophical authors of his country. In fact, like a recent Lord Chancellor of England, he turned to the current encyclopædia, in his case that of Diderot and d'Alembert, to equip himself with the accumulated knowledge of the ages; and a half-century later he was able to recite from memory whole passages from the famous "Encyclopédie" that expressed the genius of eighteenth century France.

Ampère's extraordinarily rapid intellectual development was, however, interrupted by the tragic death of his father, executed in 1793 as a victim of the Revolution. The shock of this event left Ampère bereft of all his faculties for a whole year, in which he is said to have done nothing but play childishly with heaps of sand and gaze vacantly at the sky, until by a fortunate chance he picked up Rousseau's "Lettres sur la botanique", the reading of which revived his interest and carried him back to his scientific studies. He now began to teach mathematics; and shortly afterwards, in 1801, he was appointed to the École centrale at Bourg. In 1803 he became professor of mathematics at the Lycée in Lyons. But in 1805 his increasing reputation carried him to an appointment at the École polytechnique in Paris, where he was appointed professor in 1809. He was elected to the Academy in 1814, and in 1824 he became professor of physics at the Collège de France.

In August 1799 Ampère contracted a happy but short-lived marriage with Mlle. Julie Carron, the daughter of a devout neighbouring family. The family were not over-blessed with this world's goods, but in their company Ampère appears to have found his spiritual ease, possibly through their reflection of his own natural piety, his religion throughout his life being something totally apart from his scientific interests and speculations. The only child of the marriage, a son, Jean Jacques, was born in 1800 and became a professor at the Collège de France and a member of the Academy. Mme. Ampère died after prolonged illness in 1803, some short time after Ampère had returned home from a separation enforced by his teaching duties elsewhere; and it is fortunate, having regard to the

severe consequences of the first, that Ampère was able to withstand this second tragedy of his early years as no more than a great and lasting grief.

Ampère's first scientific contribution, which dealt with the mathematical theory of games of chance, was published at Lyons in 1802. It attracted the attention of Delambre, and thereby led to Ampère's appointment at the Lycée. From then onwards Ampère published numerous memoirs on mathematics, physics and chemistry. But his classical work lay in the field of electro-magnetism, and it is for these researches that he is remembered as the father of electro-dynamics. His work here followed almost immediately on the announcement in July 1820 of the discovery by Oersted ("Experimenta circa Effectum Conflictus Electrici in Acum Magneticam", Copenhagen, 1820) that an electric current affected a magnetic needle, in brief, the discovery of electro-magnetism and the demonstration of the long-suspected connexion between electricity and magnetism. Many physicists turned their attention to this remarkable discovery, but it was Ampère who proved most successful; and in September of the same year he read before the Paris Academy of Sciences the first of a series of papers, setting out his own discoveries in electro-dynamics, including more notably the laws governing the deflection of the magnetic needle with regard to the current and the mutual attractions and repulsions of electric currents.

In 1822 Ampère presented to the Academy his mathematical analysis of these phenomena, confirming his studies in 1827 in his "Mémoire sur la théorie mathématique des phénomènes électro-dynamiques uniquement déduite de l'expérience", showing that an electric current is equivalent in its external effects to a magnetic shell, and propounding the theory that magnetism is the result of molecular electric currents. Of this work Arago wrote: "The vast field of physical science perhaps never presented so brilliant a discovery, conceived, verified and completed with such rapidity". And much later Clerk Maxwell said: "The whole, theory and experiment, seems as if it had leaped, full grown and full armed, from the brain of the 'Newton of electricity'. It is perfect in form, and unassailable in accuracy, and it is summed up in a formula from which all the phenomena may be deduced, and which must always remain the cardinal formula of electro-dynamics."

Among other interesting details of Ampère's scientific work, it might be noted that he devised astatic needles, formulated the well-known 'Ampère's Rule' for determining the deflection of a magnet by an electric current, suggested the electric telegraph as an application of Oersted's discovery, published an "Essai" (1834) on the philosophy and classification of the sciences, and expressed, unaware of their earlier publication, ideas similar to those expounded in Avogadro's hypothesis. Moreover, he was opposed to the caloric theory, regarding heat, as well as light, as the result of vibratory motion.

For his epitaph, Ampère chose the words *tandem felix* (happy at last). In France, the centenary of his death has been marked by the issue of a commemorative stamp and by an exhibition in his native city of Lyons. In the world of science he is remembered daily, the 'ampere', the practical unit of electric current, perpetuating his memory.

Obituary

Prof. A. C. Dixon, F.R.S.

PROF. ALFRED CARDEW DIXON, who died suddenly on May 4, at the age of seventy years, at his home in Northwood, Middlesex, was a mathematician of great ability and power, with a high reputation, founded, in the first place, on his brilliant Cambridge record, and steadily built up by a lifetime of research on a most unusual variety of mathematical topics.

As a student at Cambridge, Dixon's name, from all accounts, was one to conjure with; and he was perhaps best known to the public as the Senior Wrangler of 1886, who had the reputation of being unbeaten in any examination for which he had ever entered. He was a fellow of Trinity College, Cambridge, a fellow of the Royal Society; and on his retirement, after thirty years' service, from the chair of mathematics at the Queen's University, Belfast, he settled down in Northwood; he was elected president of the London Mathematical Society for the period 1931–33.

In private life, Dixon was as quietly simple and sincere as he was distinguished in public life; and this kindly simplicity and sincerity endeared him exceedingly to all who came much in personal contact with him. He was by persuasion a Methodist, and took a deep and lifelong interest in all the affairs of his church; and he was passionately fond of music and for many years an enthusiastic performer in the Philharmonic Orchestra, Belfast.

In his original work, Dixon contributed to many fields, and to every one something of strength and value. His earliest interests were partly geometrical; and his researches on plane cubics, the double-six

configuration, and the cubic surface have left a permanent mark on the subject. In algebra he contributed to the theory of canonical forms of ternary and quaternary quantics. In analysis he was an authority on elliptic functions, his book on this subject being an original and elegant introduction to the general theory; and he contributed also on various other topics, touching even on the calculus of variations. But the problem which gave direction and stimulus to his best work in later years was that of the rectangular plate, which led him far into pioneering work on integral equations. This problem, as to the deflection produced at any point of a thin rectangular plate, clamped round the edges, by a load concentrated at one point of the plate, was brought to his notice by the professor of engineering at Belfast; and in it Dixon found an elusive and tantalising quest, after his own heart, and one which led him further afield into researches, of no immediate interest, it is true, to the engineer, but of great interest indeed to the pure mathematician. It was this problem, the partial progress made, and the methods which might lead to a complete solution, which formed the subject of his presidential address to the London Mathematical Society in 1933.

In the field of mathematical problems and recreations, also, Dixon contributed to the famous fifteen school-girls problem and to the problem of colouring a map; and at the end of last century he was setting, in entrance scholarship papers in Galway, 'shadow' division sums of the type that attained such widespread popularity later as mathematical conundrums.

As a teacher, Dixon was particularly invaluable to his advanced students on account of the breadth of his knowledge, and because he had the unusual gift of having it all ready to hand all the time—he never seemed to get 'rusty' on any branch he had ever studied. On the other hand, he never gave one the impression of great erudition; he seemed indeed, on the contrary, to prefer to trust to his own amazing resourcefulness in attacking any problem rather than spend a long period in gaining a comprehensive knowledge of all the contributions of others to its solution. His lectures were models of conciseness and economy of effort; and the quiet and imperturbable way in which he delivered them caused him to be known among his students at one period as 'the leisurely professor'. Even the weakest of his students, however, though he might find Dixon's lectures very hard going, always instinctively recognised and respected his greatness as a scholar and a man.

Science has lost in Dixon an eminent mathematician, who has justly been described as one of the last, if not the very last, of the great 'all-rounders'; and his many pupils and former colleagues will greatly mourn the loss of a stimulating teacher and a loyal friend. J. G. S.

Mr. J. Whitehead, K.C.

THE death of Mr. James Whitehead, K.C., on April 3, has removed an outstanding figure among those whose work lay in the exposition of scientific matters. He had for many years occupied a predominating position in technical cases which came before the Law Courts, and was engaged in numerous actions where complicated scientific phenomena have had to be explained to tribunals little conversant with such matters. For this work he had peculiar and striking gifts. He was able to make difficult and unfamiliar scientific ideas not only intelligible but also even fascinating, and it was this faculty which contributed largely to his success at the Bar.

Mr. Whitehead was, however, in addition, by reason of his critical and logical mind, a skilled—though always a quiet and courteous—cross-examiner of scientific witnesses. As a man he was distinguished by his courage and kindliness and by his wide sympathies and interests. In spite of the exacting character of a heavy practice he was always willing to place his knowledge and experience at the service of the public, particularly in relation to education in science and in the law, notwithstanding the fact that for many years he had to carry on his work under the burden of indifferent health.

James Whitehead was the eldest son of J. R. Whitehead, of Padiham, Burnley. He entered the Royal College of Science with a scholarship in October 1896, and in June 1899 became an associate of the Royal College of Science in chemistry. After a period of a year as student demonstrator in the Chemistry Department of the College, he became science master at Berkhamsted School, which position he held until the year 1911. He was called to the Bar in 1910 and began active practice in 1911. He took silk in 1923 and was elected a bencher of Gray's Inn in 1924.

Outside his chosen profession, Mr. Whitehead's activities were numerous. He was one of the first nine fellows of the Imperial College of Science elected in 1932, was a member of the governing body of the College for some years, and was a representative of the legal profession on the senate of the University of London. He served as a member of the Board of Trade Committee on the amendment of the Patents and Designs Act under the chairmanship of Sir Charles Sargent, and took a prominent part in the proceedings of the International Association for the Protection of Industrial Property, and was chairman of the British group when the International Conference of that body was held in London. In December of last year he became chairman of a committee of investigation into the milk trade under the Agricultural Marketing Act in succession to the late Mr. Edward Shortt, K.C. This inquiry continued until February of this year, and he had barely completed the report on the inquiry when he was stricken with the illness which in a few days caused his death.

Mr. Whitehead leaves behind him to his many friends both in the legal profession and in the scientific world the memory of a man of rare character and intellectual ability, and of a kindly, generous nature, whose wide sympathies and eager enthusiasm for, and knowledge of, many diverse subjects rendered him a most interesting and delightful companion.

Sir Frederick Macmillan, C.V.O.

THE death of Sir Frederick Macmillan on June 1, at eighty-four years of age, ends a remarkable triumvirate in the history of the firm of Messrs. Macmillan and Co., Ltd., the publishers of NATURE ever since it was founded by them and Sir Norman Lockyer in November 1869. At that time the firm consisted of Mr. Alexander Macmillan, who died in 1896, and Mr. George Lillie Craik, who died ten years later. During their lifetime three other partners were admitted—Frederick Orridge Macmillan (1874), George Augustin Macmillan (1879) and Maurice Crawford Macmillan (1883).

By a most tragic set of circumstances, these three directors have all passed into silence within a period of three months. Mr. George Macmillan died on March 3, Mr. Maurice Macmillan on March 30, and on the day of his brother's funeral Sir Frederick slipped on the floor of his dressing-room and this accident led to his death on Monday last.

Sir Frederick Macmillan began his training as a publisher at Cambridge, and then went to New York where a branch house was opened in 1869. He was away for five years before returning to settle finally in the London office. In 1890 the New York branch was constituted on an independent basis as The Macmillan Co., and in 1896 the London firm became Messrs. Macmillan and Co., Ltd. Sir Frederick Macmillan succeeded Mr. G. L. Craik as chairman of directors in 1905, and occupied that position until his death.

It is recorded in Mr. C. L. Graves's "Life and Letters of Alexander Macmillan" that "Sir Norman Lockyer had an absolutely free hand in reviewing books published by the firm, and never hesitated to criticise them adversely if he thought they deserved such treatment". To scientific readers it may seem unnecessary to refer to such editorial freedom; for reviewers pay little attention to the names of publishers, and would resent any suggestion as to the character of notices required of books submitted to them. It is, however, only just to testify that throughout the experience of the present Editor of NATURE, extending over forty-three years, neither Sir Frederick Macmillan, nor any other of the directors, has ever intervened in the editorial conduct of the journal. Only men with high ideals and broad outlook could take such an attitude towards a publication issued by them; and we gladly pay tribute to it.

NATURE would never have survived its early years if the publishers had regarded it merely as a business enterprise; for it was carried on for thirty-two years at a financial loss, and not until 1902 did the returns show a small profit. Sir Frederick Macmillan, who was the head of the firm for so many years, maintained this enlightened policy with unwavering support; and grateful acknowledgment may therefore be made appropriately in these columns of the important part he played in rendering the journal independent of considerations—financial and otherwise—which have often prevented other scientific periodicals from reaching maturity.

Sir Frederick Macmillan followed with close attention the main developments of science recorded in these columns, and his personal friends included many workers in scientific fields of the past and present generations. He took an active part in a number of public and philanthropic organisations, among them being the Royal Literary Fund and the National Hospital for Diseases of the Nervous System, of which he was chairman of the Council of Management. He received the honour of knighthood from King Edward VII in 1909, when the jubilee building of this hospital was opened, and was created a C.V.O. in 1928. He will be sadly missed by a large circle of friends, and the memory of his fine figure and stimulating influence will long be cherished with affection by all who came into contact with him.

Mr. H. G. G. Payne

MR. HUMFREY PAYNE, director of the British School of Archæology at Athens, died on May 8 at the age of thirty-four years. Humfrey Gilbert Garth Payne was born in 1902, the son of Mr. E. J. Payne, fellow of University College, Oxford. He was educated at Westminster School and Christ Church, Oxford, holding an open scholarship of the latter foundation. He took first-class honours in both Classical Moderations and the Final School of Literæ Humaniores. After graduation, a research studentship of the University and a scholarship from his college enabled him to devote himself to Mediterranean archæology. For two years he was an assistant on the staff of the Ashmolean Museum, and then in 1929 became director of the British School of Archæology at Athens. This post he filled with the greatest competence. Although in the term of his directorship no such major excavation as had attracted widespread attention under some of his predecessors occupied the activities of the members, the work of the school gained a decision and directness of purpose which made for a high level of efficiency and scientific precision in archæological training and research.

Payne's personal achievement was greatest in the field of archaic art. His "Necrocorinthia" (1929) and his subsequent excavation of the important site of Perachora, opposite Corinth, placed him in the front rank of archæologists as a pioneer and authoritative interpreter of Corinthian art and culture in the archaic period. His premature death has broken a career which held out every promise of great achievement.

WE regret to announce the following deaths:

Prof. Francis Cavers, formerly professor of biology in University College, Southampton, author of well-known text-books on elementary botany, on May 26.

Sir Archibald Denny, Bart., a well-known shipbuilder and engineer, formerly president of the Institute of Marine Engineers and in 1918–27 chairman of the British Engineering Standards Association, on May 29, aged seventy-six years.

News and Views

The Right Hon. W. G. A. Ormsby-Gore

ARCHÆOLOGISTS, while congratulating Mr. Ormsby-Gore on his promotion in the ranks of His Majesty's Ministry, will feel that, in his appointment to succeed Mr. J. H. Thomas as Secretary of State for the Colonies, the Empire gains what archæology can ill afford to lose. No more suitable appointment to the Colonial Office could have been made; but as First Commissioner of Works Mr. Ormsby-Gore has been responsible for the protection of ancient monuments, and to that duty of his department has brought a knowledge of archæology and an enthusiasm for the surviving relics of the past in Britain that has been an inspiration to the members of his staff and an encouragement to all who are interested in the scientific investigation and the preservation of sites and structures of archæological or historic interest in Great Britain. Of the work—much of it of first-rate scientific importance—which has been carried out under the supervision and with the co-operation of the Office of Works during his tenure of office, it is unnecessary to speak here in detail; but by his personal activities, more especially in his efforts to secure the preservation of the unique character of Avebury and its surroundings, and in the initiation of the excellent series of guides to ancient monuments, of which he has already published two volumes, while a third is in an advanced stage of preparation, he has widely extended public interest in this class of evidence of the nation's cultural development. He leaves behind him a well-established tradition of official sympathy with, and co-operation in, the aims of archæological studies in Great Britain, which will not readily be allowed to die out.

MR. ORMSBY-GORE takes up his duties as Secretary of State for the Colonies at a moment when many problems, actual and potential, have to be faced. Not only has he the advantage of his experience in a previous administration, but also he brings to his task a personal knowledge of British Colonies and their problems such as has been possessed by no previous holder of the office. As Under-Secretary he travelled widely in all the more important of the Colonial possessions of the Empire and gained a first-hand knowledge of local conditions, more especially in Africa, which cannot fail to carry the weight of authority in the discussions of matters of momentous interest which are imminent. Mr. Ormsby-Gore's readiness in the past to appreciate the contribution of scientific studies in the solution of the practical problems of administrator, settler and native alike, affords an assurance that no resource will be overlooked in helping the Colonies in their efforts to recover from the effects of the economic crisis and the unrest to which it has given rise.

Ancient Monuments in Southern England

THE second of Mr. Ormsby-Gore's guides to the ancient monuments, covering the area south of the Thames, includes the most impressive, as well as some of the most important, relics of the prehistoric period ("Illustrated Regional Guides to Ancient Monuments under the Ownership or Guardianship of His Majesty's Office of Works: Vol. 2, Southern England." London: H.M. Stationery Office, 1936. Pp. 86. 1*s*. net). Avebury, Stonehenge and Maiden Castle alone would serve to make this a volume of outstanding interest in the series; and in the subsequent periods its material is little less of note in its numerous aspects: to the important Roman fortresses of Richborough and Porchester must be added from the medieval period the castles of Dover and Carisbrook and the special attractions of the beautiful castle of Restormel in Cornwall and romantic Tintagel, while as an example of artistic achievement in a later age, the Queen's House at Greenwich by Inigo Jones is unrivalled in its way. Mr. Ormsby-Gore, following in general line the plan of his earlier volume, has provided for the prehistoric period a sketch of the cultures of the neolithic, bronze and iron ages, as well as of the period of Roman occupation, in which the monuments are called upon to illustrate and support the relation. Here the results of much recent research and discovery are digested and presented with a lucidity which cannot fail to hold and interest the least instructed visitor. The medieval period is treated under the two headings of Anglo-Saxon and Norman, and in this and the later sections history appears only to serve as a background. Mr. Ormsby-Gore has a gift of scholarship without pedantry. His second volume deserves the success which his first has already earned.

Archæological Discoveries in India and the Far East

DISCOVERIES of great interest to archæologists and students of the religious cults of India have been made in recent excavations carried out by the Archæological Department of the Government of India at Raigir in the District of Patna, the ancient Rajagriha, in an area adjoining the Maniyar Math, a site investigated some thirty years ago by Sir John Marshall and the late Dr. Bloch. Their investigations brought to light a circular brick structure, which was dated by its stucco figures in bas-relief at about A.D. 500. The nature of this structure has been the subject of much speculation. According to a statement of Mr. J. F. Blakiston, director-general of archæology in India, reported in *The Times* of June 1, two earlier strata of buildings underlying the foundations of the circular structure have now been discovered, which carry the dating of the site back at least two or three centuries earlier. A large quantity of pottery and terra-cotta objects, which seems to

have been buried purposely, has been found in a brick enclosure to the east of the Math. Among this pottery one type has a series of spouts, in number from four to thirty-four and of various designs. Most of the vessels bear representations of snake-hoods. This fact is taken as a confirmation of the theory that the site was sacred to the worship of the Nagas or snake-goddesses. Pottery with multiple spouts is not known from other sites in India. The popular name of Maniyar Math, it is thought, may preserve a tradition of Mant Naga, the preserver and rain-giver of Rajagriha. If this indeed be so, it is suggested that these vessels with their multiple channels were the votive offerings of suppliants for rain, which were deposited in the compound of the shrine. Serpent worship at Raigir can be traced back to the third century B.C. and still persists as a popular cult. In the course of excavations carried out on behalf of the Raffles Museum, Singapore, on the Phinsoon Estate at Sungei Siput, Malacca, Prof. Van Stein Callenfels, the distinguished authority on the archæology of the Malayan archipelago, it is reported by Reuter, has discovered a number of human skeletons believed to date from about 2,500 B.C.

The Approach to the Absolute Zero

THE Science Museum, South Kensington, has recently performed a most useful public service in arranging, in connexion with the Very Low Temperatures Exhibition, for a series of demonstrations and lectures by eminent authorities on recent scientific and technical developments. The series was concluded on Wednesday, May 27, by Prof. F. Simon, late of Berlin and Breslau and now of the Clarendon Laboratory, Oxford. Of the problems which can be investigated by experiment in the new temperature region below 1° Absolute, one of the most interesting is the specific heat of paramagnetic salts. In experiments carried out in conjunction with Kürti, Rollin and Lainé with the huge electromagnet of the Paris Academy of Sciences, it has been proved that the paramagnetic salts used become ferromagnetic at very low temperatures, showing Curie points of about 0·01° Absolute (see p. 961). The small helium liquefier used in the experiments was transported from Oxford. At the Science Museum, Prof. Simon succeeded in demonstrating a temperature of 0·12° Absolute, a noteworthy achievement, of which Prof. Simon and his co-workers, Mr. G. L. Pickard and Mr. A. H. Cooke, who were responsible for erecting the apparatus in the Science Museum and for the fact that the demonstration went off without a hitch, may well be proud. The magnet used in the experiment was lent by the Imperial College of Science and Technology; the hydrogen and helium pumps by Messrs. W. Edwards and Co.; the Cambridge Instrument Co., Ltd., provided a galvanometer. The limiting temperature region for this method lies between 0·01° and 0·001° Absolute. Further reduction of temperature will depend on the use of nuclear paramagnetism, starting at about 0·01° Absolute. Even to this method there will be a temperature limit, and the distance from the absolute zero, although very small when measured in degrees, is in reality an infinity. Although this unique series of lectures has now come to an end, the Exhibition of Very Low Temperatures will continue until the end of June. The Exhibition has so far attracted more than 140,000 visitors, and interest in it has not in any way diminished during the three months in which it has been on view.

Maiden Voyage of the *Queen Mary*

BRITAIN'S newest and finest liner, the *Queen Mary*, left Southampton Docks on Wednesday, May 27, and entered New York Harbour about four and a half days later after successfully completing her maiden trans-Atlantic trip. Whatever may have been the results of this crossing from the point of view of marine navigation, a new standard was set up in radio communication by the most successful completion of a series of daily broadcasting programmes throughout the voyage. Never before has the whole world been able to follow so closely the daily happenings on board an ocean liner. The progress made in this application of the art of radio communication is illustrated by a note from a special correspondent of *The Times*, who recalled that he was one of the only two journalists on board the *Mauretania* on her maiden voyage to New York nearly thirty years ago: his instructions were to send not more than twelve words a day by wireless, and to post an article from New York. In contrast with this, the *Queen Mary* carried about 150 journalists, and some twenty broadcast commentators of various nationalities. During the voyage, more than sixteen hours actual broadcasting took place from the ship, while many hundreds of wireless messages of all kinds were sent to all parts of the world. To enable this work to be carried out, the normal wireless installation in the *Queen Mary* (which was referred to in NATURE of January 18 last) was supplemented by special equipment fitted by the British Broadcasting Corporation. More than twenty microphones were fitted in various parts of the ship so that the general life on board could be described direct from the scene of activity in the course of the daily broadcasting programme. Each evening, listeners to British stations were provided with an interesting commentary direct from the *Queen Mary*, while on one afternoon a special programme was arranged for schoolchildren.

THESE broadcasts were received in Great Britain via the ship-to-shore radio-telephone service of the Post Office; they were naturally relayed through the Empire system, and the high standard of performance attained is greatly to the credit of all those concerned with the arrangements. Similar programmes were arranged by the appropriate authorities for listeners in America, Denmark, France and Holland. The climax of this radio sound-picture was provided by the joint programme arranged by the B.B.C. and the National Broadcasting Company of America, as the *Queen Mary* proceeded up the

Hudson River to her pier in New York Harbour on the completion of her voyage on Monday, June 1. The thrilling scenes which accompanied the superb reception given by the hundreds of thousands of spectators were described by commentators at various vantage points, such as the quay front, a tug accompanying the giant liner, an aeroplane flying overhead and a special announcer located seventy stories up on the Radio City building. Since much of this programme had to be relayed over two or more radio links with the intermediate land-line connexions, the high average standard of the broadcasts illustrates the tremendous possibilities which result from the modern technique and organisation of this branch of communications engineering.

Anniversary of Marconi's First Patent

FORTY years ago on June 2, Marconi filed the application for his first patent for a wireless invention. That patent—No. 12039 of 1896—described the use of Marconi's sensitive tube receiver, or coherer, connected to an earth and elevated aerial and the tuning of the transmitting and receiving circuits with each other. Since that time nearly 800 patents have either been granted to Marconi and the Marconi companies, or are pending, for the inventions and developments in wireless telegraphy and telephony and broadcasting. The first British ship was equipped with Marconi apparatus in 1901. To-day, more than 3,000 British ships carry Marconi wireless installations, and thousands of people owe their lives to its use. Wireless messages were exchanged between England and Canada in 1902, and a public service was opened in 1907. For direct transmission by the long-wave system the estimated power to the aerial amounted to something like 1,000 kilowatts, the stations were to cost more than £1,000,000 each, the wave-lengths were to be of the order of 18 miles, and the aerials were to be carried on towers about 800 feet high. These figures now seem fantastic. As the result of a series of tests between the experimental station at Poldhu and Marconi's yacht *Elettra*, in 1923 and 1924, the short-wave beam system was evolved which enabled the Marconi Company to make an offer to the Post Office to establish communication with the Dominions using a fiftieth of the power, involving a twentieth of the cost, and providing a speed of working at least three times as great as that which was possible with the earlier long-wave system of communication. Experiments in telephony by wireless were first carried out by the Marconi Company in 1906, and it is claimed that there are now 180 Marconi broadcasting stations in use in 32 countries. It is estimated that the wireless industry employs 50,000 workpeople in Great Britain, and that the British radio industry alone has a turnover of £30,000,000 per annum.

Zoo: A New Periodical

THE Zoological Society of London has begun a venture which rounds off its benefactions to the nation. For well over a century its collections have amused and instructed the general public, it has spent vast sums upon the publication of scientific papers for the learned, and now in a popular monthly magazine it proposes to bring the interest of the zoo to those who cannot visit the enclosures, and generally to diffuse a knowledge of animals and their ways. Britain has lagged far behind the United States in the production of high-class popular magazines of science: we know nothing that can compare with *Natural History*, the journal of the American Museum of Natural History. But *Zoo*, in the quality of its text and in the interest and character of its illustrations, comes near to the American standard, and from the popular view it has gone one better, in leaving the stricter path of knowledge and introducing lighter stories of wild life. Many of the articles in the first number are by well-known scientific workers, and it is a pleasure to see that they possess the art of driving the pen so that the plain man can read.

Cultivation of Cherries and Soft Fruits

THE healthy and expanding state of the fruit-growing industry in Great Britain is evident from the Royal Horticultural Society's report on the conference on cherries and soft fruits held in July last. This follows a similar report of the conference on apples and pears held in 1934. The chairman, Sir Daniel Hall, expressed the opinion in his opening address that no other branch of agriculture has profited so much from the findings of research, and this close connexion between the industry and the various research institutions is fully borne out by the papers read at the conference. These are contributed equally by officers of the research stations and commercial fruit growers, and display a close co-ordination between the two points of view. The subjects dealt with embrace every aspect of the soft fruit industry, particular attention being devoted to cultural problems and the control of pests and diseases, whilst extensive data are presented concerning manurial treatment and the effects of certain mineral deficiencies. A symposium on strawberry cultivation indicates the widespread interest in this fruit and the anxiety of both growers and research workers to deal with the numerous pests which have depleted the crop in recent years. Much information is given regarding the characteristics of varieties of cherries, raspberries and loganberries, and the qualities of fruit required for canning and bottling are also discussed. Copies of the report, price 6*s*., may be had from the Royal Horticultural Society, Vincent Square, S.W.1.

Greenkeeping Research

EVERY question connected with turf production and maintenance comes under review at the St. Ives Research Station, Bingley, Yorks, and a perusal of the Report for 1935 published by the Board of Greenkeeping Research shows how rapidly both the experimental and advisory work have developed since the Station was founded in 1929. The bulk of the money required to finance the work is subscribed by British golf clubs through the national unions. Free postal

advice is supplied to subscribers on any green-keeping matter, and advisory visits are carried out at standard terms, the large number of requests for advice showing that the work of the Research Station is already widely appreciated. At the same time, it is inevitable that non-subscribing golf clubs are also reaping the benefits of the experience gained at the Station, and the Board urges all unions to consider whether the time has not come when every affiliated club should be required to make an annual minimum contribution to this work for the common good, at a fixed rate according to membership and size or number of their courses. A danger exists that if the present system of purely voluntary subscriptions is maintained, clubs which have supported the work liberally in the past may be unwilling to continue their subscriptions at the same rate, while other clubs obtain similar benefit for a smaller contribution or even contribute nothing at all.

Oxford University Junior Scientific Club

THE triennial conversazione and exhibition meeting of the Oxford University Junior Scientific Club was held in the University Museum, Oxford, on May 23. An introductory lecture was given by Sir Edward Poulton, formerly Hope professor of zoology and one of the founders of the Club fifty-three years ago. A lecture, illustrated by a number of X-ray films, was given during the evening on "Cineradiology" by Dr. J. Russell Reynolds. A large number of exhibits of scientific interest were demonstrated by undergraduate members of the Club, and much research apparatus was on view. The exhibition was planned to provide both a summary of the progress of fundamental scientific research and a conspectus of the applications of research to modern life. The latter purpose was furthered by the generous assistance of many industrial undertakings, and of the Public Relations Department of the Post Office.

Award of the Albert Medal to Lord Derby

THE Council of the Royal Society of Arts, with the approval of the president, H.R.H. The Duke of Connaught, has awarded the Albert Medal for 1936 to the Earl of Derby, "for the advancement of Commerce and Arts especially in Lancashire". The Albert Medal, instituted in 1863 as a memorial of H.R.H. the Prince Consort, who for eighteen years was president of the Royal Society of Arts, is awarded for "distinguished merit in promoting Arts, Manufactures and Commerce". The list of past recipients includes the names of many persons of the highest distinction, both in Great Britain and abroad; of the seventy-five awards which have been made, no less than forty-one have been to ordinary fellows and nine to foreign members of the Royal Society. Last year's Albert Medal was awarded to Sir Robert Hadfield.

Linnean Society of London

AT the anniversary meeting of the Linnean Society of London held on May 28, the president, Dr. W. T. Calman, delivered his presidential address entitled "The Origin of Insects". The Linnean Gold Medal was presented to Prof. J. Stanley Gardiner. In making the presentation, the president referred to Prof. Gardiner's researches on the biology of corals, and the origin and development of coral reefs and islands, and also to his services to zoological exploration by means of the many important expeditions which owed their existence to his organising ability, and their success to his enthusiasm and leadership. The following were elected officers for the year 1936–37: *President*, Dr. W. T. Calman; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. John Ramsbottom (botany) and Dr. Stanley Kemp (zoology). The new members of the Council were Captain Cyril Diver, Mr. M. A. C. Hinton, Prof. R. C. McLean, Mr. Charles Oldham and Dr. Fred Stoker. The president announced that he had appointed the following vice-presidents: Mr. Francis Druce, Dr. John Hutchinson, Dr. Margery Knight and Lieut.-Colonel R. B. Seymour Sewell.

International Congress of Genetics

THE Seventh International Congress of Genetics will be held in Moscow in the second half of August 1937. Preparations for the Congress have been begun by the Organisation Committee, under the presidency of A. I. Muralov, president of the Lenin Academy of Agricultural Sciences; other members of the Committee are N. I. Vavilov and V. L. Komarov (vice-presidents), S. G. Levit (general secretary), and N. P. Gorbunov, G. D. Karpechenko, B. A. Keller, N. K. Koltzoff, T. D. Lysenko, G. K. Meister, H. J. Muller, M. S. Navashin and A. S. Serebrovsky. All those working in the field of genetics are invited to present contributions. The titles and abstracts should reach the Organisation Committee before February 15, 1937. Detailed information concerning the programme, membership, exhibits, accommodation and transport are being prepared. Excursions to various parts of the U.S.S.R. will form part of the programme. Suggestions and applications for information should be sent to the General Secretary, Organisation Committee, Seventh International Congress of Genetics, B. Kaluzhskaya, 75, Moscow, U.S.S.R.

Working-Class Family Budgets

IT was announced in the House of Commons on May 28 that the following committee has been appointed to advise the Minister of Labour as to the methods to be adopted in the collection of information, by means of family budgets, showing the approximate average weekly expenditure of working-class families on the items which should be taken into account in the construction of index numbers, designed to measure the percentage changes, from month to month, in the cost of maintaining a present-day standard of living: Mr. F. W. Leggett, Ministry of Labour (chairman); Mr. J. N. Beckett, Ministry of Health; Mr. F. J. Blakemore, past president of the National Chamber of Trade; Prof. A. L. Bowley, professor of statistics, University of London; Mr. H. Crow, Scottish Office; Mrs. W. Y. Darling; Mrs.

C. S. Ganley, of the Management Committee of the London Co-operative Society; Mr. J. Hallsworth, representing the Trades Union Congress General Council; Dr. J. M. Hamill, Ministry of Health; Mr. C. T. Houghton, Ministry of Agriculture and Fisheries; Mr. W. A. B. Iliff, Ministry of Labour, Northern Ireland; Mr. D. Caradog Jones, lecturer in social statistics, University of Liverpool, and director of the Social Survey of Merseyside; Mr. Kenelm Kerr, representing the National Confederation of Employers' Organizations; Mr. E. C. Ramsbottom, director of statistics, Ministry of Labour. The secretary to the committee is Mr. J. G. Cannell, Ministry of Labour, Queen Anne's Chambers, Broadway, Westminster, S.W.1.

Announcements

THE National Physical Laboratory, Teddington, will be open (by invitation) for inspection of the work in progress, on Wednesday, July 1, at 3–6 p.m.

THE British Chemical Plant Exhibition 1936, which is being held at the Central Hall, Westminster, London, S.W.1, at the same time and in the same building as the international Chemical Engineering Congress of the World Power Conference on June 22–27, will be opened at 11 a.m. by the Right Hon. Ramsay Macdonald, in the Great Hall of the Central Hall on June 22. Invitations to the opening ceremony can be obtained on application to the Managing Committee, British Chemical Plant Exhibition, 166 Piccadilly, London, W.1.

PROF. HERMANN WEIGMANN has been elected an honorary member of the Vienna Society for Microbiology.

AN Institute for Racial Biology is to be erected at Copenhagen by grants from the Rockefeller Foundation and the Danish Government.

A GERMAN society for animal psychology has recently been founded in Berlin under the presidency of Prof. C. Kronacher, director of the Berlin Institute for Animal Breeding and the Genetics of Domestic Animals.

A SYMPOSIUM on "Excitation Phenomena" will be held in the Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor, New York, on June 23–25. Further information can be obtained from Dr. Eric Ponder, The Biological Laboratory, Cold Spring Harbor, Long Island, New York.

AN association of medical men and pharmacists who are men of letters has recently been founded in Paris under the presidency of Prof. H. Roger, formerly dean of the faculty of medicine, with Dr. Georges Duhamel, member of the Académie Française and editor of the *Mercure de France*, as vice-president. Further information can be obtained from the General Secretary, Prof. A. Sartory, 1a Place de l'Université, Strasbourg.

IT is announced that Sir J. J. Thomson, Master of Trinity College, Cambridge, is writing a book of reminiscences, which will be published early in the autumn by Messrs. Bell and Sons, Ltd.

ERRATUM. In NATURE of May 30, p. 900, paragraph headed "Cotton Industry in Northern Nigeria", for "English Cotton Growing Corporation" read "Empire Cotton Growing Corporation".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An established assistant engineer in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, White-Hall Gardens, London, S.W.1 (June 9).

Temporary mechanical draughtsmen in connexion with research in air survey in the War Office—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (June 10).

Two junior assistants (chemistry or physics) in the Chemical Defence Research Department (War Department)—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (June 10).

A woman lecturer in mathematics and English in the Normal College, Bangor—The Principal (June 13).

A lecturer in botany in Armstrong College, Newcastle-upon-Tyne—The Registrar (June 13).

A lecturer in experimental physiology in University College, Cardiff—The Registrar (June 15).

A senior assistant lecturer in agricultural chemistry in the Edinburgh and East of Scotland College of Agriculture—The Secretary, 18 George Square, Edinburgh (June 17).

A technical officer and assistants (Grades II and III) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (June 19).

A half-time demonstrator in geology in Bedford College for Women, Regent's Park, N.W.1—The Secretary (June 20).

A lecturer in engineering (chiefly telegraphs and telephones) in the Cape Technical College, Capetown—J. A. Ewing and Co., Ltd., 73–74 Chiswell Street, London, E.C.1 (June 20).

A curator of Museum and Art Galleries in Paisley—Young, Martin, Martin and Sawers, 4 St. Mirren Street, Paisley (June 23).

A professor of physics in Canterbury University College, Christchurch, New Zealand—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W.C.1.

An assistant engineer in the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote *M*/4163).

A head of the Mechanical Engineering Department in the Royal Technical College, Salford—The Director of Education, Education Office, Salford.

An assistant engineer in the Public Works Department of the Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4199).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 952.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Transmutation of Phosphorus, Sulphur, Chlorine and Potassium, and the Masses of Light Atoms

REFINED study of the artificial disintegration of light elements by α-particle bombardment has revealed the important fact that the nuclear energy changes have discrete values presumably corresponding to quantised nuclear energy levels. These energy values are among the most definitely measurable properties of light nuclei and as such should be of importance to nuclear theory, but owing to the lack of experimental material no satisfactory explanation of these levels has yet been made.

We have observed the transmutation of sulphur, chlorine and potassium, all three of which emit protons under bombardment by thorium C′ α-particles, and by measuring the ranges of the protons we have shown that each element emits three groups of protons corresponding to values of the nuclear energy change given in the accompanying table. The values are in millions of electron volts.

$^{32}_{16}$S	$^{35}_{17}$Cl or $^{37}_{17}$Cl	$^{39}_{19}$K
Type $4n$	Type $4n+3$ or $4n+5$	Type $4n+3$
−2·4	+0·1	−0·9
−2·8	−2·4	−2·3
−3·6	−4·0	−3·4

The values for sulphur agree with those given by Haxel[1]. The levels for $4n$-type nuclei appear to be more closely spaced than those for less simple types. The greater abundance of the $^{35}_{17}$Cl isotope renders it probable that this is the isotope responsible for the energy values found.

Masses of Light Atoms.

The most positive nuclear energy change in each transmutation is of considerable importance, since it measures the difference of mass on the two sides of the equation. Aston's recently announced values[2] enable use to be made of the α-particle disintegration of ^{19}F [3], ^{24}Mg [1], ^{27}Al [3,4], ^{28}Si [1], in all of which protons are emitted, to determine the masses of the nuclei ^{22}Ne, ^{24}Mg, ^{30}Si, ^{31}P. By observation of the protons emitted by ^{32}S and ^{35}Cl when bombarded by α-particles, we have been able to estimate the masses of ^{32}S and of ^{38}A, while the mass of ^{34}S has been determined from experiments with ^{31}P, which yielded results in agreement with Paton[6].

The second table gives the known isotopic masses for the elements neon to argon. In addition to the elements the masses of which have been determined by the above methods, we have given Aston's most recent values for the elements marked by asterisks, his 1927 value for ^{36}A and Bainbridge's values[5] for ^{35}Cl and ^{37}Cl.

Atom	Mass	Atom	Mass
$^{20}_{10}$Ne	19·9986*	$^{31}_{15}$P	30·9844
$^{22}_{10}$Ne	21·9985	$^{32}_{16}$S	31·9812
$^{24}_{12}$Mg	23·9938	$^{34}_{16}$S	33·9799
$^{27}_{13}$Al	26·9909*	$^{35}_{17}$Cl	34·9796
$^{28}_{14}$Si	27·9860*	$^{36}_{18}$A	35·976
$^{29}_{14}$Si	28·9864*	$^{37}_{17}$Cl	36·9777
$^{30}_{14}$Si	29·9845	$^{38}_{18}$A	37·9753
		$^{40}_{18}$A	39·9754*

In a recent communication in NATURE, Oliphant[7] has given values for the masses of light atoms up to fluorine. He plots the departure of the mass from a whole number against the number of particles in the nucleus, obtaining a curve with well-defined minima at each multiple of four. In Fig. 1 we show his curve together with the extension permitted by the values given here, which are indicated as circles. It will be seen that the minima continue to appear in a less well-marked way until ^{40}A is reached, where Aston's latest value indicates a heavier mass than would fit into a minimum. Since this nucleus contains a unit of four neutrons in place of an α-particle unit, we can conclude that the observed extra stability found for multiples of four is to be ascribed to the existence of α-particles in the nucleus and not merely to shells of four particles irrespective of charge.

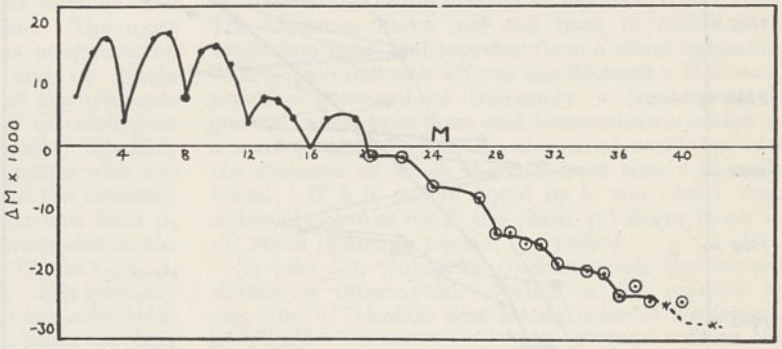

FIG. 1. Departure of mass from whole number plotted against nuclear mass number.

The fact that Aston's values for ^{27}Al, ^{28}Si and ^{36}A and Bainbridge's values for ^{35}Cl and ^{37}Cl are used to determine other masses which show the expected regularity tends to confirm the accuracy of their measurements.

The transmutation of potassium permits derivation of the mass difference between $^{39}_{19}$K and $^{42}_{20}$Ca. We have assumed that potassium has the mass given by the expected position (marked by the first cross in Fig. 1): the value for $^{42}_{20}$Ca then lies as shown by the second cross.

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Sloane Physics Laboratory, C. J. BRASEFIELD.
Yale University.
April 23.

[1] O. Haxel, *Phys. Z.*, **36**, 304 (1935).
[2] F. W. Aston, NATURE, **137**, 613 (1936).
[3] J. Chadwick and J. E. R. Constable, *Proc. Roy. Soc.*, A, **135**, 48 (1932).
[4] W. E. Duncanson and H. Miller, *Proc. Roy. Soc.*, A, **146**, 396 (1934).
[5] K. T. Bainbridge, *Phys. Rev.*, **43**, 378 (1933).
[6] R. F. Paton, *Z. Phys.*, **90**, 586 (1934).
[7] M. L. Oliphant, NATURE, **137**, 396 (1936).

Variation of Cosmic Ray Intensity with Height in the Atmosphere

THE well-known curves of cosmic ray intensity obtained by Kolhörster, Regener and others show no trace of discontinuity, for they are mean values for intervals of many hundreds or even thousands of metres.

G. A. Suckstorff[1] made measurements every 100–130 m. in a slowly ascending balloon, using a Kolhörster apparatus. He found a discontinuous curve, the discontinuities being especially great in higher regions of the troposphere between 7,000 m. and 9,700 m., the deviations amounting to $\pm$ 30 *I*. It has been suggested by Suckstorff that the irregularities may be accounted for by the existence of radioactive substances in the higher layers of the atmosphere.

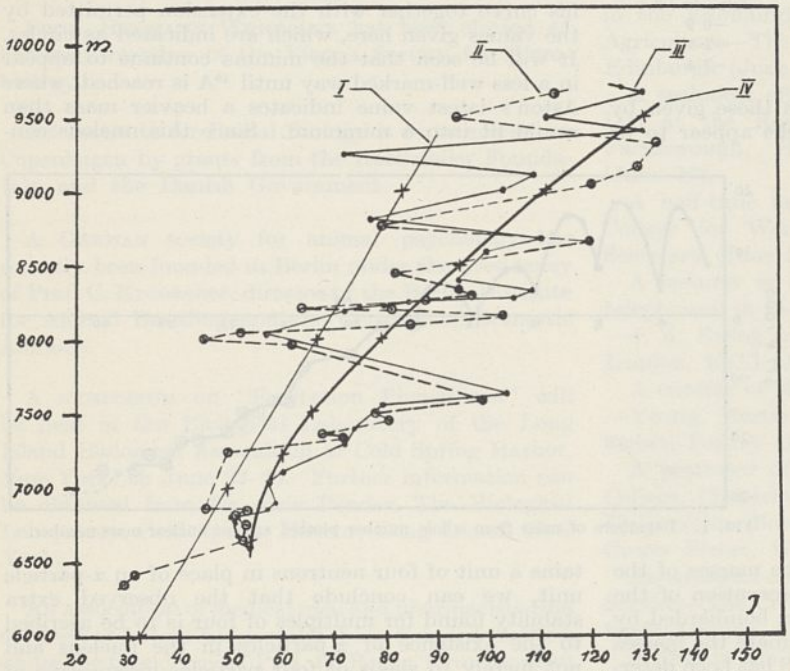

FIG. 1. Cosmic ray intensity. I: Kolhörster's measurements. II and III: curves obtained by Suckstorff. IV: curves obtained by Ziemecki and Narkiewicz-Jodko (only a few points are marked).

In order to examine the question more closely, we undertook similar observations. On March 29, an ascent was made in a free balloon (*Warszawa II*, 2,200 cu. m.) which reached the height of 10,800 m. During the slow ascent of the balloon between 6,600 m. and 10,000 m. measurements of ionisation were made. Our results give a smooth curve, the deviations from it in no case exceeding 5 per cent, and being in general less than 2 per cent (Fig. 1).

We used an ionisation chamber of approximately 1 litre capacity, filled with argon at a pressure of 15 atm., and connected with a Lindemann electrometer. The sensitivity of the electrometer was approximately 0·01 volt per division. Thus, individual measurements did not last more than 40 sec. The batteries were kept at constant temperature by means of a constant temperature jacket.

We think the discontinuities observed by G. A. Suckstorff were due to the irregularity of the movement of the electrometer thread, the Kolhörster apparatus not being sensitive enough for measurements of short duration.

We hope to be able to repeat our observations. Experimental details will be published in *Bulletin Acad. Polon.* We take this opportunity of expressing our thanks to the Department of Aeronautics of the Ministry of War, and especially to Capt. Z. Burzyński, who piloted the balloon.

ST. ZIEMECKI.
K. NARKIEWICZ-JODKO.
High School of Agriculture,
Warsaw. April 4.

[1] G. A. Suckstorff, *Phys. Z.*, **35**, 368 (1934).

The ^1X-level of the Hydrogen Molecule

As a result of the analysis of the near infra-red spectra of H_2, HD and D_2, some new facts have been discovered concerning the so-called ^1X-level of the hydrogen molecule which remove many of the uncertainties and difficulties in the interpretation of this level.

The analysis of the $^1X \rightarrow 2p^1\Sigma$ systems of HD and D_2 showed quite clearly that the vibrational quantum numbers of the ^1X-level given by Richardson[1] (but considered doubtful by him) must be raised by one.

The $0 \rightarrow 0$ bands of all three molecules were then discovered in the region near 11,200 A. The rest of the band system is distributed chiefly through the near infra-red. For H_2 my analysis agrees with that of Richardson for the principal lines, but there are several deviations. The $1 \rightarrow 0$ band for which Richardson gives only two lines is a strong, well-developed and fairly regular band.

The $V = 0$ level of ^1X is quite regular without any trace of perturbations or decoupling. The effective moments of inertia are 0·871, 1·156 and 1·725 $\times$ 10^{-40} for H_2, HD and D_2 respectively, and the effective internuclear distance is 1·019 $\times$ 10^{-8} cm. The $V = 1$ level shows a very faint perturbation, and the higher levels are strongly perturbed. The perturbations are of the same nature

as if they were caused by the interaction with a $^1\Sigma$-level.

The only two theoretical states with low enough energy and the right symmetry with which the empirical ^1X-level can be identified are $1s\sigma\ 2s\sigma\ ^1\Sigma_g$ and $(2p\sigma)^2\ ^1\Sigma_g$. I identified originally[2] the ^1X-level with $1s\sigma\ 2s\sigma^1\Sigma$, and this explanation has been adopted by Richardson[3], who has emphasised the difficulty due to the fact that for a $1s\sigma 2s\sigma\Sigma$ state we should expect neither perturbations nor decoupling. On account of these and other difficulties, Weizel[4] believes the ^1X state to be $(2p\sigma)^2\ ^1\Sigma$, but his arguments are largely invalidated by the new facts, which make the objections to the first explanation disappear.

The moment of inertia is considerably different from the value calculated previously from the higher vibrational states, and agrees very well with what should be expected for $1s\sigma 2s\sigma^1\Sigma$. As the $V = 0$ level is completely regular, the observed irregularities in the other vibrational levels cannot be due to the ordinary Λ-decoupling, but they must be true perturbations. Perturbations of just this kind can arise from interaction with the $(2p\sigma)^2\ ^1\Sigma$ level. On account of the Pauli exclusion principle, this level does not exist in the triplet system, which explains the fact that the $1s\sigma 2s\sigma^3\Sigma$ level shows no traces of perturbations. I have not yet succeeded in finding the $(2p\sigma)^2\ ^1\Sigma$ level empirically, but calculations are being made here to determine theoretically its properties.

G. H. DIEKE.

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Baltimore, Md.

[1] O. W. Richardson, "Molecular Hydrogen and its Spectrum".
[2] G. H. Dieke, *Z. Phys.*, **55**, 447 (1929).
[3] O. W. Richardson, NATURE, **135**, 99 (1935).
[4] W. Weizel, *Z. Phys.*, **65**, 456 (1930).

Raman Effect and Free Rotation

THE molecule of ethylene halide, $XH_2C–CH_2X$, has an axis C–C, around which the two CH_2X groups are capable of rotation, but not all the rotational states are equally probable. The most stable state corresponds to the *trans* configuration which has a centre of symmetry and no dipole moment. The mean dipole moment of the molecule increases with the decreasing number of molecules in the *trans* state[1]. We have made intensity measurements of the Raman lines together with the dipole moments[2] and have shown that the intensity ratio $I(\omega_1)/I(\omega_2)$ of the two strong Raman lines ω_1 and ω_2 decreases as the number of molecules in the *trans* state increases ($\omega_1 = 653, \omega_2 = 752$ for $C_2H_4Cl_2$ and $\omega_1 = 551, \omega_2 = 656$ for $C_2H_4Br_2$). The intensity measurement was also carried out for the solid state and at lower temperatures, and it was observed that the line ω_1 disappeared completely, while the line ω_2 remained very strong, that is, $I(\omega_1)/I(\omega_2) = 0$.

We have shown by the use of the appropriate values of the force constant that ω_1 corresponds to the antisymmetric and ω_2 to the symmetric vibrations in the *trans* state[3], consequently ω_1 is not permitted in the Raman effect, so long as the molecule is in the *trans* state. If, therefore, we consider that the characteristic frequency of the molecule is not appreciably different from state to state in the neighbourhood of the *trans* state, the intensity change observed above will at once be explicable from the selection rule. We must then consider that in the solid state and at lower temperatures almost all the molecules are in the *trans* state.

According to the assumption due to Kohlrausch[4], our observation should be explained as follows:—in the solid state these molecules are in the *trans* state, while in the liquid state or in solutions some are in the *cis* and others in the *trans* states.

The experiments are being continued. We have to thank Prof. M. Katayama for his kind advice.

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YONEZO MORINO.
SHICHIRO NOZIRI.

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Faculty of Science,
Imperial University,
Tokyo.
March 20.

[1] Mizushima and Higasi, *Proc. Imp. Acad. Japan*, **8**, 482 (1932).
[2] Mizushima, Morino and Higasi, *Phys. Z.*, **35**, 905 (1934). *Sci. Pap. I.P.C.R. Tokyo*, **26**, 1 (1934).
[3] Mizushima and Morino, *Phys. Z.*, **36**, 600 (1935). *Sci. Pap. I.P.C.R. Tokyo*, **26**, 1 (1934).
[4] Kohlrausch, *Z. phys. Chem.*, B, **18**, 61 (1932), ibid., **29**, 274 (1935).

Magnetron Oscillations

IN seeking to explain how electrical oscillations are maintained by a single anode magnetron, I have found a mathematical theory of which this is a short account. It is hoped that a fuller one will appear in the *Quarterly Journal of Mathematics*.

The theory is worked out for a filament of small radius a (taken as zero in part of the theory) and a co-axial cylindrical sheath of radius b (called the plate), each of length l much greater than b. The magnetic field is H and the emission I. I have shown, in a paper sent to the *Quarterly Journal*, that a saturated current I per cm. is turned back at a radius $15{,}400\ I^{1/2}/H^{3/2}$, from which it follows (what has no doubt been fully realised by experimenters) that the current in ordinary magnetron experiments is much below saturation. We can therefore ignore space charge, and we assume further that b is much smaller than the wave-length of the oscillations. Let $-e$ be the charge and m the mass of an electron, $\omega = He/mc$. The electrons move out and back in circles in a total time $2\pi/\omega$, and together form a cloud extending to a certain distance k from the filament. If a small periodic potential of frequency ν (containing in general a constant term and harmonics) is added to a former steady potential, the cloud oscillates, and the distance to which it extends at time t is easily found. If k is nearly equal to b, the cloud may either (1) always reach the plate, (2) never reach it, (3) reach it during part of the period.

In case (3), which we consider first, the inward stream is interrupted. What is the current at any time? Consider first a thin layer of electricity, of charge $-s$ per unit length, distant r from the filament at time t, and let $-f$ and p be the charges per unit length on filament and plate, V the scalar electromagnetic potential of the plate above the filament. Then the current from plate to filament is $l\ df/c\ dt$, where $f - p + s = 0$ and $V/c = 2f \log (r/a) + 2(f + s) \log (b/r)$. Thus the current is $i = KdV/dt + 2cKs\ d \log r/dt$, where K is the capacity of the cylinders. The second term may be called the convection current, though electrical influence plays a part too. It flows during the whole time that the layer is between the electrodes. In the magnetron, the charge leaving the filament between times t_0 and $t_0 + dt_0$ is $-cIdt_0$. If I is small, r can be taken

from the steady motion, and the element of convection current is $-(2c^2KI\,\partial \log r/l\,\partial t_0)dt_0$. Thus if the electrons between the plates, beginning with those which left first, extend at time t from r_1 to r_2, r_3 to r_4, and so on, the convection current is

$$(2c^2KI/l)(\log r_1 - \log r_2 + \log r_3 - \log r_4 + \ldots).$$

We have now a complete mathematical basis for solving any particular problem. I shall consider the simplest, in which all the electrons (somewhat unphysically) are emitted normally with the same finite velocity, so that those which return are caught on the filament. Then the convection current is independent of t in cases (1) and (2), and no oscillations can be maintained. If $\nu = \frac{1}{2}\omega$, and if the cloud of electrons grazes the plate once in every period, the mode of maintenance is fairly obvious. The boundary lags a quarter period behind the applied potential. A small gap in the return stream then moves back, and if the time of grazing is a small fraction of the period, though large compared with the time an electron is in the strong field near the filament, a convection current nearly equal to I flows for a time $2f\pi/\nu$ after a further quarter period has elapsed. The convection current is thus opposite to the potential at the time being.

Many problems can be proposed and solved. I have worked out the theory of a magnetron in a condenser circuit with $\nu = \frac{1}{2}\omega$, the high potential being connected through a large choke. If the resistance R of the circuit is so small that RI can be neglected, the oscillations are nearly sinoidal (having harmonics of a lower order than the fundamental) and the frequency is given approximately by Kelvin's formula $LKC\nu^2 = K + C$. The amplitude of oscillating potential on the plate is

$$2fILC/RK\,(K + C).$$

When a triode maintains slow oscillations, a certain minimum reaction is needed, and the amplitude cannot be determined by a linear theory. There is nothing like this with a magnetron, but the amplitude is determinate, proportional directly to I and inversely to R.

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April 8.

Combined Ascorbic Acid in Food-stuffs

THERE has lately been some discussion about the state in which ascorbic acid is present in natural food materials. Ahmad[1], and McHenry and Graham[2] observed that several fresh food-stuffs like cabbage, cauliflower, carrots, etc., give a higher ascorbic acid value on being cooked or boiled with water, as estimated by titration with the indophenol reagent. They conclude that at least part of the vitamin is present in the fresh food-stuffs in the combined state, from which the free vitamin is released on boiling with water. Van Eekelen[3], on the other hand, working with the potato, considers that the increase in the vitamin content on boiling is only apparent and not real, being due to the inactivation of ascorbic acid oxidase, which is normally present in these food-stuffs, by heat. We have carried out the following experiments in this connexion, which, we believe, demonstrate almost conclusively that the increase of the vitamin C value of certain food-stuffs on boiling cannot be accounted for on the oxidase theory, and that part of the vitamin in the natural food-stuffs is present in the combined state. All the estimations were carried out titrimetrically.

(1) Cabbage, when extracted with absolute alcohol in presence of anhydrous sodium sulphate, yields an extract, which, when heated for 4 minutes on a boiling water bath in an atmosphere of nitrogen, invariably gives an increased vitamin C value. Frequently the increase varies between 50 and 100 per cent. The alcoholic extract, on being heated at 36° for 10 minutes in an atmosphere of nitrogen, also shows a very considerable increase in vitamin C value, very often of the order of 50 per cent.

(2) Cabbage, on extraction with ether in the presence of anhydrous sodium sulphate, provides an extract, which, as such, gives practically no vitamin C value. On heating the air-dried ethereal extract in an aqueous medium on a boiling water bath for 4 minutes in an atmosphere of nitrogen, a considerable vitamin C value is obtained.

(3) Bel (*Aegle marmelos*), a common Indian fruit, gives alcoholic and ethereal extracts which behave similarly to those of cabbage, though the order of increase is not so great in this case.

(4) The increase in the vitamin C value of the aqueous extract of cabbage on boiling is shown also if the titration is carried out after mercuric acetate or formaldehyde treatment in order to remove interfering substances.

It is very unlikely that absolute alcohol and ether would extract the ascorbic acid oxidase from cabbage and 'bel', which might come out in an aqueous extract. Moreover, the oxidase, if extracted by alcohol, would scarcely be destroyed by 10 minutes' exposure to 36°, a treatment which produces a very considerable rise in the ascorbic acid value. Ether can apparently be made use of in separating the free ascorbic acid from the combined ascorbic acid in cabbage, the former being insoluble and the latter soluble in this solvent. It has been found that the aqueous extract of cabbage, on being made 0·2 per cent acid with hydrochloric acid and allowed to stand for an hour, also gives a considerably increased vitamin C value, which would indicate that gastric juice would split the combined ascorbic acid of food-stuffs fairly effectively. Ripe and unripe mangoes have not yielded an increased vitamin C value under the above treatments. It would seem, therefore, that not all food-stuffs contain the vitamin in the combined state.

B. C. GUHA.
J. C. PAL.

Indian Institute for Medical Research,
Calcutta.
April 27.

[1] Ahmad, NATURE, **136**, 797 (1935).
[2] McHenry and Graham, NATURE, **135**, 871 (1935).
[3] Van Eekelen, NATURE, **136**, 144 (1935).

Petroleum-soluble Fluorescent Constituents of Leaves

WHEN petroleum ether extracts of dried leaf material are passed through Tswett adsorption columns composed of magnesia and siliceous earth, the leaf pigments are adsorbed, and colourless solution percolates through the column[1]. The very first portions of the percolate contain colourless hydrocarbons recoverable in crystalline form. Other

colourless substances are slightly adsorbed on the magnesia, and may be recovered from subsequent portions of the percolate. The weakly adsorbed, colourless leaf constituents absorb ultra-violet light, in contrast to the non-adsorbed hydrocarbons which are transparent. Of particular interest, however, are two products which are strongly fluorescent in ultra-violet light. These substances form fluorescent bands or zones on the adsorption columns just below the α-carotene band. The light emitted by the fluorescent bands appears white to the eye, but, in the hand spectroscope, it ranges from the long green to the short red wave-lengths. Crystals, obtained after elution of the fluorescent bands with petroleum ether and ethanol, were strongly fluorescent, being comparable to anthracene and carbazole in this respect. Upon exposure to air the crystals slowly lost their fluorescent properties. Each fluorescent substance, dissolved in cyclohexane, exhibited strong absorption of ultra-violet light, particularly at shorter wave-lengths, but no maxima or minima were observed.

Saponification of leaf extracts before adsorption did not reduce the yield of the fluorescent constituents or alter their relative positions upon the adsorption columns. This and the occurrence of the fluorescent bands below the carotene bands on the adsorption columns indicate that the fluorescent substances do not contain ester, carboxyl or hydroxyl groups or their analogues.

By means of adsorption columns, one or both of the fluorescent substances have been isolated from the leaves of all the plants examined, from many other plant products and from etiolated maize and barley seedlings. Small quantities of other fluorescent substances (not yet isolated in crystalline form) give rise to fluorescent bands above the β-carotene band upon the adsorption column. These reactive materials, by their fluorescence and concomitant activation, may affect many physiological processes, such as photo-synthesis, pigment formation, cell elongation and light tropisms, and may account for some of the fluorescence of etiolated seedlings and of other pigment-free parts of plants.

The adsorbent magnesia, originally prepared for the separation of carotenes[1] (Micron Brand Magnesium Oxide No. 2641, manufactured by the California Chemical Company, Newark, California), is itself highly fluorescent and phosphorescent. These properties of the magnesia are not altered by different solvents or by adsorbed substances, such as alcohols, and may prevent the detection of weakly fluorescent substances which are adsorbed upon the Tswett columns. Siliceous earth, used as an aid to filtration in the magnesia columns (Hyflo Super Cel, F.A.501, manufactured by Johns-Manville), contained small quantities of organic substances which were removed by washing with petroleum ether and ethanol. Siliceous earth may therefore be a source of contamination when used as an aid to filtration or when introduced into reaction media.

I am indebted to Dr. W. G. Leighton for many determinations of absorption coefficients in the ultra-violet and to members of this Division for helpful suggestions.

HAROLD H. STRAIN.

Carnegie Institution of Washington,
Division of Plant Biology,
Stanford University, California.
April 6.

[1] H. H. Strain, *J. Biol. Chem.*, **105**, 523 (1934); ibid., **111**, 85 (1935).

The Earliest Published Figures (1613–1758) of the Oblong or Truncate-tailed Ocean Sunfish, *Ranzania truncata*

IN the course of my researches in the history of ichthyology, I have found the earliest published figure of the truncate-tailed ocean sunfish, *Ranzania*. This figure seems unknown to ichthyologists generally, and hence it should be reproduced where it will become widely known.

The ocean sunfishes, family Molidæ, or millstone-shaped fishes (Latin *mola* a mill), are so called because their short well-nigh tailless bodies give them a rather rotund form. The commonest sunfish is the round-tailed form, *Mola mola*. This fish, being found in the Mediterranean Sea, was known to the ancients, and was referred to by the classical writers (Aristotle, Aelian, Oppian, Pliny and others). It was first figured and described by Guillaume Rondelet in 1554. The pointed-tailed fish, *Masturus lanceolatus*, was discovered at Mauritius in 1835 by Elizé Liénard, and was described by him in 1840 and figured in 1841.

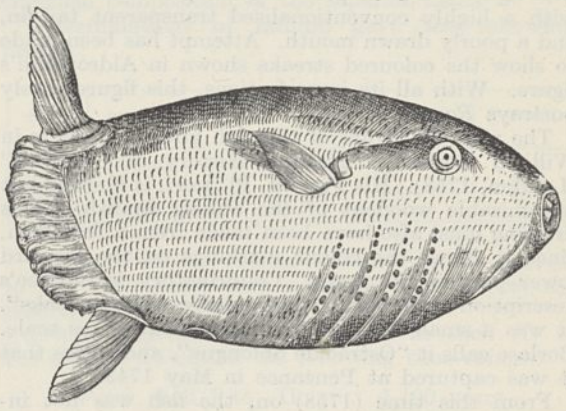

FIG. 1. The "Mola peregrina" of Aldrovandi, 1613. The earliest published figure of the oblong or truncate-tailed ocean sunfish.

The third form, *Ranzania truncata*, was first figured (but not described) by one of the earliest and in many ways the greatest of the Italian natural historians—Ulisse Aldrovandi. On page 413 of his great book, "De Piscibus Libri V" (Bononiae, 1613), is found the interesting woodcut reproduced herewith (Fig. 1), the first published representation of the fish in question. This Aldrovandi calls "Mola peregrina". This adjectival designation may mean—from foreign parts, exotic, wandering; or it may mean—merely unusual, out of the ordinary. In his text, Aldrovandi makes no reference to either figure or fish. However, we know that to Aldrovandi's museum in Bologna came curious animals from many foreign countries, and this fish might be classed as foreign but for two things. First it is found in the Mediterranean—not so plentifully, however, as *Mola*—and in the second place the figure seems to have been drawn from a fresh specimen.

The modern name of Aldrovandi's "Mola peregrina" is *Ranzania truncata*. The generic name was given in honour of Ranzani, another Italian writer on the Molidæ—about 226 years later; "truncata" of course means truncate, cut off, and this Aldrovandi's "Mola peregrina" surely was.

In the figure, the fish is shown to be oblong, the hinder end is truncate obliquely downward and forward. The position and form of mouth, eye, gill-

opening, and of the fins paired and unpaired—all are those of *Ranzania*. The three oblique stripes with spots are colours characteristic of the fresh animal, and lead to the conclusion that the drawing was made shortly after the capture of the fish.

Aldrovandi's figure was reproduced in a brass plate engraving by John Jonston in 1649[1] without any credit being given to Aldrovandi. From this time on, the figure seems—strangely enough—to have been lost sight of by modern ichthyologists. The only ones who, so far as I know, have referred to it are Steenstrup and Lütken in their great review paper on the Molidæ[2]; and they give it but a line and do not even reproduce Aldrovandi's figure, though they copy a number of early figures of *Mola*, including that of Aldrovandi, which is found on the page facing his "Mola peregrina".

The next figure of *Ranzania* following Jonston's is, so far as I know, one by Janus Plancus, dated 1746[3] and interestingly enough published in Aldrovandi's home city 130 years later. No source is given but presumably the fish came from the Adriatic. This figure is a brass plate engraving fairly well done, with a highly conventionalised transparent tail-fin, and a poorly drawn mouth. Attempt has been made to show the coloured streaks shown in Aldrovandi's figure. With all its imperfections, this figure surely portrays *Ranzania*.

The next old figure of this fish known to me is in William Borlase's "Natural History of Cornwall" (London, 1758). His Fig. vii, Pl. xxvi, is a crude but recognisable woodcut of the oblong sunfish. This drawing must also have been made from a fresh fish, since it shows the colour markings on the forward lower part of the body. Confirmatory is Borlase's description of the colour, particularly of the "streaks". It was a small fish—26·25 inches long by his scale. Borlase calls it "Ostracion oblongus", and states that it was captured at Penzance in May 1743.

From this time (1758) on, the fish was not infrequently captured (especially on the shores of western Europe), became fairly well known and was figured by many authors. However, to Aldrovandi in 1613 belongs the credit for the first published figure of the truncate-tailed ocean sunfish, *Ranzania truncata*.

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[1] "Historia de Piscibus, . . .", Francofurti, Fig. 1, pl. ix.
[2] Bidrag til Kunskab om Klump-eller Maanefiskene (Molidae). *K. Danske Vidensk. Selsk. Skrifter*, **6**, ix, 54 (1898).
[3] "De Mola pesci". *De Bonon. Sci. Art. Instit. Acad. Comment. Bononiae*, 2, pars ii, 297–303 (1746).

Orientation of *Chirocephalus* and *Daphnia*

Chirocephalus: The best explanation of the peculiar inverted swimming position of many Anostraca and Notostraca is that advanced by Lowndes[1] who, when directing attention to the respiratory function of the appendages, suggested that the attitude is concerned with respiration, for in this position the appendages can be brought into contact with the uppermost and best aerated layer of water.

Experiments were made to see what factors govern this attitude and how it is maintained. *Chirocephalus* swimming in a tank shows a moderately strong positive phototactic reaction when light is switched on; this, of course, is a shock reaction. When light falls from above, the normal inverted position is maintained; if, however, illumination is from below, the first reaction is to swim towards the light, the second to re-orientate so that the ventral groove is still directed towards the light. This falls into line with the work of McGinnis[2] on *Branchippus*, and Seifert[3] on *Lepidurus* and *Apus* (= *Triops*). The latter believes the compound eyes to play no part in this orientation, and that it is due to the median eye.

Chirocephalus, when illuminated from below, cannot maintain this attitude with the ventral groove directed downwards unless some part of the body, perhaps only the tips of the caudal rami, is touching the bottom, otherwise it automatically turns on its back with the ventral groove upwards.

Narcotised *Chirocephalus* when placed in water in any position rapidly attain the normal attitude and sink thus. It may, therefore, be assumed that orientation is normally maintained by the shape of the body and calls for no muscular exertion. It would seem unlikely that there are statocysts or other organs of orientation.

The experiments on light, however, show that there is some association between it and orientation. Cannon[4] has pointed out that *Chirocephalus* sometimes feeds dorsal side uppermost on the bottom. Lowndes[1] has referred to this and states significantly that he believes it to happen at night; for it is then that the creatures would be free from the stimulus of light, and it is very likely that in response to other stimuli they would descend to the bottom to feed.

The inverted position is taken on early in life. The nauplius, which swims almost entirely by means of the second antennæ, nearly always swims vertically in the water, but on those occasions on which it swims horizontally the ventral surface is directed upwards; this becomes more pronounced in the metanauplius. The completely horizontal attitude is adopted when the first group of thoracic appendages begins to assist in swimming. The gradual transference of the swimming function from the antennæ to the thoracic appendages is interesting, for the antennæ beat as they do in the nauplius while the thoracic appendages are beating in metachronial rhythm.

Daphnia: Orientation to gravity is of vital importance to planktonic creatures for another reason. During darkness, most planktonic animals maintain themselves at a fairly constant level in the water. Thus a creature sinking passively, does so in such an attitude that when it starts swimming it will automatically move upwards and so counteract the previous sinking; otherwise it might sink and swim out of the planktonic region altogether. In many Crustacea, statocysts are present to subserve this function, and in Brachyurous larvæ the spines are thought to be concerned with this function (see Foxon[5]).

Experiments were performed to see how this orientation is maintained in *Daphnia magna* and *D. pulex*. Narcotised *Daphnia* were found to sink dorsal side downwards unless the second antennæ were stretched out in front of the head in the position in which the effective stroke of the swimming movements is begun. In this attitude they sank with the head uppermost, and if they could have started swimming they would have moved upwards. *Daphnia* swimming freely without light stimulus will be seen alternately to sink in this attitude and to swim up.

It appears that in this case orientation to gravity is due to a combination of bodily shape and posture. That it is not due to the activities of other appendages can be shown by removing the second antennæ, when they are unable to retain the normal orientation.

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[1] Lowndes, *Proc. Zool. Soc. Lond.*, 1093 (1933).
[2] McGinnis, *J. Exp. Zool.*, **10**, 227 (1911).
[3] Seifert, *Z. vergleich. Physiol.*, **11**, 386 (1930).
[4] Cannon, *Phil. Trans.*, **222**, 267 (1933). *Proc. Roy. Soc.*, B, **117**, 455 (1935).
[5] Foxon, *J. Mar. Biol. Assoc.*, **19**, 829 (1934).

Occurrence of Pollen of *Carpinus* (Hornbeam) in Irish Peat

ALTHOUGH peat samples from Continental bogs frequently yield hornbeam pollen, there appear to be so far only two records of it from British peat bogs; that from the Blanchland peat of Northumberland investigated by Raistrick and Blackburn[1], and that from the Orkneys[2].

There is no published record from Ireland. It might therefore be of interest to workers who are or have been engaged on pollen analysis in Ireland to know that pollen grains, probably of hornbeam, have been found in Irish peat. Two specimens were obtained at a depth of 1·5 m. from highly humified *Sphagnum* peat in the Burrough Bog, Timahoe, Co. Kildare, in the course of preliminary investigations. They were provided with four pores and measured 30–32μ in diameter (Fig. 1).

FIG. 1. Photomicrograph of hornbeam pollen grain from Irish peat. Actual size, 31·2 μ. × about 850.

It is generally agreed that the hornbeam is not native in Ireland, and that in Britain it is native only in the south-east. So far as could be ascertained, the earliest record of the hornbeam in Ireland as an introduced tree is that found in Threlkeld's flora published in 1727, where he gives it the Irish name *Crann Sleauhain*.

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April 26.

[1] *Proc. Univ. Durham Phil. Soc.*, 8, Pt. 4.
[2] Erdtman, *J. Linn. Soc. Bot.*, **46**, 480 (1924).

Age of Ferro-Manganese Concretions

THE determinations of the radioactivity of a series of ferro-manganese concretions of the seas and lakes of the U.S.S.R.[1] (especially of the Kara Sea[2] and lakes of Karelia[3]) have brought out certain facts (the surface layer is more active than the central part, the want or insignificant contents of Th X–MsTh) which make possible the determination of the age of the concretions by the content of radium in its different layers.

The first specimen examined was one of the largest concretions from the Kara Sea (Station 74, expedition on the *Sedov* in 1934. Lat. 76° 2′ N.; long. 86° 13′ E., depth, 58 m.).

The concretion is of fairly regular, disk-like form with a pebble in the centre (size, 80–90 mm.; thickness, 11–12 mm.; weight, 117·74 gm.; size of pebble, 12–30 mm.; weight, 12·77 gm.). The concretion was divided into three shells, each of which consisted of a group of thin concentric layers.

The results of the chemical analysis (made by V. A. Yegorov) have shown the constancy of the chemical composition of the separate shells

Determinations of radium gave the following results:

Shell	Average width	Weight	Ra content (per cent × 10^{-10})	Per cent
I	8 mm.	31·15 gm.	19·3	100·0
II	10 ,,	47·15 ,,	12·1	62·7
III	14 ,,	26·31 ,,	3·1	16·1

Such a decrease of radium content from the outer (I) to the inner (III) shell must be regarded as the results of its disintegration.

Taking the contents of radium in shell (I) as the earliest we obtain the following time-values:

From shell I to II . . 1,100 years
,, ,, I to III . . 4,200 ,,

The age of the concretion examined would appear to be 5,300–5,500 years.

The results obtained show that in the development of the concretion there were periods (as for example between shells II and III) during which the growth of the concretion stopped or was greatly slowed down. Possibly, too, there are periods in which there was a partial destruction of surface layers.

The second specimen examined was a concretion from Lake Uksche, Karelia (size, 30–40 mm.; thickness, 18–20 mm.; weight, 10·10 gm.). The concretion was divided into two parts. Determinations of radium gave the following results:

	Average width	Weight	Ra content (per cent × 10^{-10})	Per cent
I (outer shell)	5 mm.	5·21 gm.	13·5	100·0
II (central part)	24 ,,	4·64 gm.	8·6	63·7

From the data obtained we obtain the following time-values from the outer shell to the central part, 1,030 years, and the age of the concretion about 2,000 years.

Investigations show that in several cases it is possible also to determine the rate of formation of

different kinds of deposits (for example, contemporary marine deposits, sediments of springs, etc.) according to the change in the content of radium or elements of the thorium group in separate layers of these deposits.

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[1] L. M. Kurbatov, NATURE, **136**, 871, Nov. 30, 1935.
[2] L. M. Kurbatov, "Radioactivity of Ferro-Manganese Formations of Kara Sea" (in preparation).
[3] L. M. Kurbatov, ibid.

Normal Erosion as a Factor in Soil Profile Development

AMONG the factors concerned in the development of soil profiles, erosion has, until recently, received comparatively little attention. I venture to direct attention to two possible examples of the influence of normal erosion, as distinct from catastrophic erosion, on the course of profile development.

(1) Studies in North Wales and elsewhere have shown the occurrence of soil profiles which may be described as 'truncated', that is, profiles in which the surface soil resembles the sub-surface or *B*-horizon material of developed podsol profiles in possessing a sesquioxidic type of clay fraction. I was formerly disposed to attribute their origin to removal of the siliceous *A*-horizon by erosion consequent on deforestation and cultivation[1]. Further consideration of the problem, however, suggests that it is not necessary to postulate catastrophic erosion to account for such profiles.

Whilst such erosion may have occurred in past centuries, and is known to occur in certain regions, for example, in the United States, at the present day, it seems possible that normal erosion could account for the observed facts. Such slow erosion will affect principally the immediate surface soil, which, under the humid conditions of western Britain, tends to be more siliceous in character than the underlying soil. The steady removal of material more siliceous than the body of the soil profile, operating over centuries, must result in a relative enrichment of the residual material in sesquioxides.

The actual profile will represent a balance between the podsolising process, resulting in the development of an *A*-horizon impoverished in sesquioxides, and the process whereby this relatively siliceous horizon is removed. Truncated soils of a sesquioxidic character are found most commonly in regions of strong relief. In Wales, they are characteristic of the foothills. They are less common at high altitudes, where, it may be presumed, podsolisation keeps pace with erosion.

The suggestion may be hazarded that a similar process has operated in the formation of the sesquioxidic soils of humid tropical regions.

(2) A second example of the possible effect of normal erosion may be seen in soil profiles developed in clay formations such as the Gault and the Keuper Marl. Almost invariably, the surface soil shows a more sandy texture than the subsoil. This has been ascribed to the presence of sandy wash of external origin or, alternatively, to mechanical eluviation within the profile. In the latter case, a horizon of maximum clay accumulation would be expected, whereas normally there is a steady increase in the clay content down the profile.

While either or both of the above two causes may produce the observed differences in texture between surface and subsoil, I would suggest that normal erosion, involving lateral removal of the finer fractions, is generally a sufficient explanation of the observed facts. Such removal might take place along the surface of the soil itself or along the surface of a water table. In either case, the result would be to produce a surface horizon relatively richer in the coarser fractions than the parent material. The effect would be more pronounced under arable or partially arable conditions than under a permanent closed cover of vegetation.

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University College of North Wales,
Bangor. May 12.

[1] G. W. Robinson, *J. Agric. Sci.*, **20**, 618 (1930).

Cohesion of Alkali Metals

IN two recent papers[1] I have developed a statistical method for calculating the cohesion of the alkali metals. The density of the metal electrons in the lattice has been supposed to be constant. As cohesion energies, the following have been taken into account: the electrostatic energy of the metal electrons with respect to the simply charged ions, the exchange energy of the metal electrons and the correlation energy of the metal electrons with antiparallel spins as calculated according to Prof. E. Wigner and Dr. F. Seitz[2]. As causing repulsive forces, the electrostatic energy, the zero-point energy of the metal electrons and the energy resulting from their penetration into the electron clouds of the ions have been taken into account. The repulsive forces between the ions are also taken into consideration.

The method applied to the calculation of the heat of evaporation of potassium, rubidium and cæsium gives the following results[3]:

		K	Rb	Cs
Heat of evaporation	Calc.	21 kcal./mol.	18 kcal./mol.	18 kcal./mol.
	Observed	26·5 kcal./mol.	25·0 kcal./mol.	24·0 kcal./mol.

Calculated values of the lattice energy and of the lattice constant are also in good agreement with experimental values. All these results were obtained without assuming empirical parameters.

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April 3.

[1] P. Gombás, *Z. Phys.*, **94**, 473 (1935); **95**, 687 (1935).
[2] E. Wigner and F. Seitz, *Phys. Rev.*, (2), **46**, 509 (1934). E. Wigner, *Phys. Rev.*, (2), **46**, 1002 (1934).
[3] A detailed paper will appear in the *Zeitschrift für Physik*.

Stresses in a Rotating Disk

THE stresses set up in a rotating disk appear first to have been considered by Maxwell[1], and the solution adopted by many engineering text-books[2] shows that an axial hole, however small, halves the strength of the disk. This result, which is repugnant to physical intuition, does not appear to have been tested experimentally. During the design of an ultra-centrifuge[3] to be used for separating isotopes, we had to investigate the effect of a small axial hole on the bursting speed of the rotor, and it is interesting to compare our results with the above theory.

With disks of 8 cm. diameter and 1 cm. thickness, made from 'magnuminium', a magnesium alloy of high specific tensile strength, the breaking speed of 1,500 rev./sec. was unchanged by a 1 mm. axial hole. With rotors shaped so as to have nearly uniform stresses throughout, the presence of a hole lowered the breaking speed about 10 per cent, or the strength 20 per cent. Unluckily for our purpose, a radial hole reduces the strength to less than half. In these experiments peripheral speeds as high as 700 metres per second were recorded.

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May 14.

[1] J. C. Maxwell, "Collected Papers".
[2] A. Stodola, "Dampf und Gasturbinen", Sixth Edit. Timoshenko and Lessels, "Applied Elasticity". J. Prescott, "Applied Elasticity".
[3] J. W. Beams and E. G. Pickels, *Rev. of Sci. Inst.* (U.S.A.), Oct. 1935.

Origin of Levirate in Assam

RECENT investigation *in situ* among the different tribes of Assam has led me to think that the hitherto accepted theories on the origin of levirate seem to be untenable in this area. This institution varies so widely from area to area, and the theories propounded so far being based on materials from different countries, that a separate explanation for Assam is needed.

Of the two types of levirate, the junior and the senior, the former is by far the more widely prevalent in Assam, though among some of the Old Kukis groups, for example, Aimols, Mantaks, Anals, etc., both types are still in vogue. But as the tribes are coming in contact with the people of superior culture who dislike this custom, it is losing its force. For example, the Wainems having long been influenced by the Meitheis, who have discarded this practice, do not look upon this type of union with favour. Amongst them the senior levirate is absolutely forbidden. The junior levirate also, though found in exceptional cases, is not looked upon with favour. The Chiru Kukis, who are coming in contact with the Meitheis, have already deviated from some of their social customs and also forbid senior levirate; though junior levirate is still to be found amongst them. The other branches of the Old Kukis, who are far away from civilisation and have very rarely come in contact with peoples of superior culture, do not embrace these tenets and they still practise both types of levirate.

The avoidance of senior levirate in this area has sometimes resulted from a dislike for polygyny amongst the people. The elder brother having generally married before the younger, he cannot take the younger brother's widow without having a plurality of wives. The younger brother who is not married, however, weds the deceased brother's wife. For this reason this type of union is more common. In this area, economic factors also play a very important role.

The high bride-price and service in the house of the future father-in-law for several years put a great hardship on the people, and they always try to get round this custom. In some tribes, we find that the rich men are trying to substitute payment for service. Poor men cannot have recourse to this alternative; but by accepting the hand of the deceased brother's widow, they can avoid this service, and so amongst them it is more common. Moreover, the property of the deceased brother comes into the possession of the man marrying the widow, who in a sense has been earned by payment and service. Thus the combination of both economic and social factors tends to the widespread prevalence of this institution in Assam.

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March 18.

Simple Relations between Vibrational Frequencies of Isotopic Molecules

THE following relations may be useful in discussions of the isotopic effect in Raman spectra. Let ν_i' and ν_i'' be corresponding frequencies of the isotopic molecules, m_a' and m_a'' the masses of the isotopic atoms and A_{ab} the constants of the vibrational potential energy; then

$$(2\pi)^2 \sum_i (\nu_i'^2 - \nu_i''^2) = \sum_a \left(\frac{1}{m_a'} - \frac{1}{m_a''}\right) A_{aa};$$

$$(2\pi)^4 \sum_i (\nu_i'^4 - \nu_i''^4) = \sum_{ab} \left(\frac{1}{m_a' m_b'} - \frac{1}{m_a'' m_b''}\right) A_{ab}.$$

Similar equations hold for the 6th, 8th and following powers of the frequencies. The equations may be applied to each symmetry class separately, if symmetry co-ordinates are suitably chosen.

Applications of these equations, especially with regard to the problem of benzene, will be discussed elsewhere.

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Karl Pearson

MR. G. UDNY YULE'S interesting obituary of Karl Pearson (NATURE, May 23, p. 856) does not offer "the meed of some melodious tear" to his efforts for the creation of a great University of London. "K. P." collected his ephemeral contributions on this question in a small book, "The New University of London" (Fisher Unwin, 1892). Appendix C (p. 130) deals exhaustively with the contributions of Sir Thistleton Dyer and Sir Ray Lankester to NATURE of May and June 1891; but "K. P." himself does not appear to have used this journal for his polemics. Unlike Huxley, he was as regards the colleges an 'absorptionist', his somewhat naïve idea being that absorption would prevent domination. For the vigour of its dialectic, this little book is a delight.

Although at variance on a question of fundamental policy, "K. P." acknowledged—and this is characteristic of the man—"that Huxley's leadership did at any rate a great deal to unite the London teachers and raise their ideal of a true university, while at the same time helping to repress the self-interests of many persons and institutions which had been before very much to the front" ("Life and Letters of Thomas Henry Huxley", vol. 2, p. 314).

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Points from Foregoing Letters

EXPERIMENTALLY determined values of the nuclear energy change for the transmutation of sulphur, chlorine and potassium are given by Dr. E. Pollard and C. J. Brasefield. These suggest that the energy levels are closer in nuclei of the type $4n$ than in more complex nuclei. The masses are derived for the majority of nuclei from neon to argon. Plotting departure of mass from whole number against nuclear mass number (Oliphant), these show indications of extra stability at each repetition of four units until ^{40}A is reached, which is exceptional, indicating that the stability is due to α-particles and not to units of four irrespective of charge.

Dr. St. Ziemecki and Dr. K. Narkiewicz-Jodko have taken measurements of cosmic ray intensity at individual points between 6,600 m. and 10,000 m. in a free balloon, and find that the results fall on a smooth curve, contrary to the results obtained by G. A. Suckstorff during similar observations.

New observations on the infra red spectra of molecular hydrogen of the light (H_2), heavy (D_2) and mixed (HD) type are reported by Prof. G. H. Dieke. The author calculates that the effective moments of inertia are 0·871, 1·156 and 1·725 × 10^{-40} for H_2, HD and D_2 respectively, and the effective internuclear distance is 1·019 × 10^{-8} cm. The observed spectrum lines are attributed to the so-called ^1X level of the hydrogen molecule, and the author discusses how far this empirically deduced 'level' can be identified with one or another of the theoretically deduced 'states' inferred from the current theory of the structure of the hydrogen molecule.

From the intensity of certain lines in the Raman spectrum of the light scattered by organic substances like ethylene dichloride, the molecules of which may have two different configurations known as *cis* and *trans*, S. Mizushima, Y. Morino and S. Noziri deduce that in the solid the molecules are in the *trans* state; in the liquid form or in solutions some are in the *cis* and others in the *trans* state.

A mathematical theory of the maintenance of electrical oscillations by a single anode magnetron is put forward by Dr. F. B. Pidduck. The stream of electrons must be interrupted, and oscillations can then be maintained by any emission, however small, provided the resistance of the circuit is small.

Prof. B. C. Guha and J. C. Pal find that extracts of cabbage and of bel (*Aegle marmelos*) obtained with absolute alcohol and ether give a considerably increased vitamin C value on being heated. This increase is ascribed to the splitting of bound ascorbic acid, and not merely to an apparent increase caused by the destruction of the appropriate oxidase by heat.

The isolation of two fluorescent substances from leaves, barley seedlings, etc., by means of adsorption on magnesia in a percolator (Tswett column) is described by Dr. H. H. Strain. The author considers that by their fluorescence these substances may affect many physiological processes, such as photosynthesis, pigment formation, cell elongation and sensitivity to light, and may account for the fluorescence of etiolated seedlings and of other pigment-free parts of plants.

A figure of the truncate-tailed ocean sunfish, *Ranzania truncata*, published by Ulisse Aldrovandi in 1613, is submitted by Dr. E. W. Gudger, as being the earliest known drawing of that species. Dr. Gudger gives a review of other early references and drawings of ocean sunfishes.

G. E. H. Foxon points out that orientation to gravity is of vital importance to both the fairy shrimp (*Chirocephalus*) and the water flea (*Daphnia*), although for quite different reasons. From experiments it is concluded that in *Chirocephalus* orientation is a direct result of bodily form, and that in *Daphnia* it is due to a combination of shape and posture; in neither case do special organs of orientation appear to be involved.

A photomicrograph of a pollen grain of hornbeam (*Carpinus*) found at a depth of 1·5 m. in highly humified peat in the Burrough Bog, Timahoe, Co. Kildare, Ireland, is submitted by C. J. La Touche. It is of interest in view of the general assumption that the hornbeam has been introduced only recently in Ireland.

From the variation in the radium content in successive layers of ferro-manganese concretions, the time of deposition is calculated by L. M. Kurbatov. For one specimen, from the Kara Sea, this comes out at 5,300–5,500 years, and for another specimen from Lake Uksche, Karelia, at about 2,000 years.

The ash-coloured soils of forest-land have a 'profile' or structure consisting of an upper leached ('podsolised') layer (A) and a lower coloured layer (B) enriched by iron oxides and humus. Prof. G. W. Robinson suggests that in the case of 'truncated' soils, where the upper siliceous (A) layer is lacking, this has not necessarily been removed by rapid ('catastrophic') erosion following upon deforestation and cultivation, but that it may have been brought about by normal erosion involving the lateral removal of the finer fractions of the soil constituents.

P. Gombás calculates the heat of evaporation of potassium, rubidium and cæsium metals from data referring to the energy of the metal electrons and the simply charged ions; he finds good agreement with the experimentally determined values.

Experimental results on the effect of the presence of a small hole on the strength of a rotating disk are described by H. C. Pollock and C. H. Collie. They find that, contrary to theoretical deductions, which state that an axial hole however small should halve the strength of the disk, a small axial hole reduces only slightly the breaking point; a radial hole was found to reduce the strength to less than half.

The practice of 'levirate' (according to which a widow must marry a brother of the deceased husband) by various tribes in Assam is discussed by J. K. Bose. He concludes that this custom originated in Assam by a combination of social and economic factors different from those to which it has been ascribed in other countries.

Two formulæ giving the relation between the vibrational frequencies that affect the Raman spectra and the masses of isotopic molecules (molecules of equal mass) are given by H. Tompa. These formulæ, the author indicates, may be useful in connexion with the problem of the structure of benzene.

Research Items

Cephalic Types among the Seminole Indians

IN the summer of 1932, Dr. Wilton Marion Krogman and others with him secured an anthropometric record of a number of full and mixed blooded Seminole Indians of Oklahoma. The Seminole is apt to be an extremely mixed type. Linguistically they are referred to the Muskogean stock, belonging specifically to the northern division, which embodies Upper Creek, Lower Creek and Seminole. In physical character, the Seminole incorporates diverse elements, Indian, Negro and white. From 1702 onwards the Creek gradually absorbed Floridan tribes, among whom were the Oconees, who formed the essential nucleus of the Seminoles. The Oklahoma Seminoles appear to have mixed more freely with both white and Negro than the Florida Seminoles have done. There also have been in the Oklahoma Seminoles occasional crosses with Comanches, Kiowa, Caddo, Pawnee, Shawnee and other neighbouring tribes. The data examined by Dr. Krogman (*Z. Rassenkunde*, 3, 2; 1936) are derived from the cephalic dimensions and indices of 109 full-blooded Seminoles and 41 Seminole-Creek mixed-bloods. The head is found to be of moderate length, full-blood, male, 191·9 mm.; mixed, male, 192·1 mm.; broad, full-blood, male, 132·7 mm.; mixed, male, 133·6 mm. The cephalic type of both the full-blood and the mixed groups tends to sub-brachycephaly and moderate hypsicephaly. The forehead is wide. On the basis of the frequency distribution of cephalic indices and the calculation of the coefficient of variation, it is concluded that the full-blooded Seminoles are relatively homogeneous. It is thought possible that the long- and high-headedness may have been introduced by whites, the most frequent intermarriage being with whites of Scottish descent.

Anahæmin B.D.H.

THE success of liver therapy in the treatment of pernicious anæmia has naturally led to many attempts to isolate the active principle. The basis of most subsequent work was the investigation of Cohn, Minot and their co-workers, who isolated a fraction from liver which was both active when given by mouth and could also be administered by injection. More recently, Dakin and West (*J. Biol. Chem.*, 109, 489; 1935) obtained a polypeptide from liver which they showed to be curative in pernicious anæmia when injected subcutaneously in quite small doses. The British Drug Houses, Ltd., London, N.1, has prepared this polypeptide, to which the name 'Anahæmin' has been given; its hæmatopoietic activity has been demonstrated, in clinical trials arranged by the Medical Research Council, by Ungley, Davidson and Wayne (*Lancet*, Feb. 15, p. 349): reference to this work was made in the Council's Report for 1934–35. Anahæmin yields on hydrolysis the amino-acids lysine, arginine, glycine, leucine, hydroxyprotine and aspartic acid, together with glucosamine. One injection of 2 c.c. of a solution containing 200 mgm. of anahæmin produced an immediate reticulocyte response, followed by a striking increase in the number of red blood corpuscles, which was maintained for a period of more than thirty days. Further, there was considerable subjective improvement, and in the cases which manifested signs of degeneration of the cord, there was noticed a distinct amelioration of the symptoms.

Parasites of *Munida*

THE species of *Munida* and their Rhizocephalian parasites in northern European waters form the subject of an exhaustive investigation by Brinkmann (Bergens Museum Skrifter No. 18, 1926). It is divided into three parts, the hosts, the parasites, and the hosts with their parasites; the last section is subdivided into two portions, (1) the general relationships between the two, and (2) the effects of the parasite upon the tissues of the host. Three species of *Munida* are recognised, namely, *M. bamffia*, a form rarely found below 100 m.; *M. sarsi* (the *M. rugosa* of Sars but not of Fabricius) generally found between 100 m. and 300 m.; and *M. tenuimana* which has 250–300 m. as its upper limit. Three species of parasites are also recognised, namely, *Lernœodiscus ingolfi* found on all species of *Munida* but principally on *M. sarsi*; *Triangularis munidæ* similarly found on all but mostly on *M. sarsi*, and *T. boshmai* found equally on two species but only once on *M. bamffia* in many thousands of specimens. The infection takes place at a moult of the host. In a number of double infections it was found that both parasites were of the same size, and so presumably infected the host at the same time. A smaller group, however, showed infections at different moults, and from this it is evident, despite what was previously thought, that infection does not ensure immunity against subsequent infections. The effects of parasitism on the host are fully discussed, and the author finds that Geoffrey Smith's theory does not explain the phenomena in *Munida*. The work is well illustrated.

A New Enteropneust

KAPELUS (*Ann. Nat. Mus.*, 8; 1936) gives a detailed account of a new enteropneust, *Saccoglossus inhacensis* which was collected by Mortensen and by van der Horst in Lourenço Marques. It presents two features of interest. First, the nervous tissue is very well developed and an epidermal nerve layer is present in proboscis, proboscis stalk, collar and a thinner layer in the body region. In the collar the central nervous system is hollow for part of its course, and its neural crests are still in direct connexion with the epidermis without being separated from it by the limiting membrane. This shows clearly its derivation from the ectoderm. The body region also has a dorsal and ventral cord, and the position of the former is marked externally. Secondly, for the genus, this species possesses a large number of gill slits, up to 82 pairs. The last six pairs are reduced to mere circular canals, without tongue bars, placing the alimentary canal in direct communication with the exterior.

Metabolism of Stored Fruit

THE inhibition of ripening in fruit and of germination in seeds and potatoes has recently been discussed by M. Copisarow (*J. Pom. and Hort. Sci.*, **14**, 1, 9; 1936). In experiments with potatoes he has obtained inhibition of sprouting and suppression of fungal decay by spraying with a 1 per cent solution of maleic acid in amyl acetate. Normal development occurred on discontinuing the treatment. Similar results were obtained when potatoes were treated with an amyl acetate emulsion of the ether extract residue from unripe apples, whilst the extract residue from mature apples gave slight sprouting and over-ripe apples more vigorous sprouting. Ripening of Newtown Pippin and Jonathan apples, pears and green bananas was also suppressed by the maleic acid treatment. In all cases, an aqueous solution of maleic acid was found to be unstable in its inhibiting effect compared with the amyl acetate solution. Attention is directed to the fact that the decline in naturally occurring inhibition is accompanied by evolution of the accelerator (ethylene), and it is suggested that maleic acid may probably be identical with the natural inhibitor, the 'blastokolin', which, according to Kockemann, has the properties of an unsaturated acid. On the basis of the chemical and physiological similarity between maleic acid and the naturally occurring inhibitor and the constitutional link between ethylene, maleic acid and the acid-fruit constituents, it seems not improbable that maleic acid acts as inhibitor and is degraded to ethylene with the onset of ripening. Certain practical applications to fruit storage are discussed, and it is suggested that paraffin oil wrappers containing maleic acid might be effectively used.

Ink Disease of *Iris reticulata*

THE outer bulb scales of *Iris reticulata* are sometimes attacked by a fungus which causes the appearance of inky black patches. *Mystrosporium adustum* is the organism concerned, and as its horticultural significance is not fully understood, Mr. D. E. Green has carried out several experiments upon the incidence and control of the malady (*J. Roy. Hort. Soc.*, **61**, Pt. 4, 167–175, April 1936). Artificially inoculated bulbs rotted very quickly, but naturally infected organs flowered, and showed relatively little effect of the disease, except a decrease in the number of bulbs over a period of years. Rotting was always more rapid in unsterilised, than in sterilised, soil, thus indicating that the actual destruction of tissues is brought about by secondary organisms. The experiments on control seem to show that it is improbable that any simple treatment can eradicate the disease, and the most that can be done at present is to reduce the spread of the fungus by annual lifting and removal of diseased bulbils.

West African Timbers

UNDER the auspices of the Department of Scientific and Industrial Research, two pamphlets have been issued by the Forest Products Research Laboratory, Princes Risborough (*For. Prod. Res. Records*, Nos. 6 and 7. London: H.M. Stationery Office, 1935), dealing with the properties of an African mahogany and mansonia respectively. Generally speaking, the investigations on the two timbers are discussed under distribution, description of tree and of the timber, seasoning and mechanical properties, durability, working qualities, uses and supplies. The home of both species is in the African forests. The African mahogany (*Khaya anthotheca*) occurs in mixed evergreen and deciduous forest, ranging from the Ivory Coast, through the Gold Coast, Nigeria, French Cameroons and Angola to Uganda in the east. The specimen of the tree submitted to tests at Princes Risborough came from Uganda. The supplies in the past have come mainly from the Ivory Coast. From the tests undertaken, it is considered at Princes Risborough that this mahogany is suitable for the purposes to which other African mahoganies are applied. It is said to be superior to *Khaya ivorensis* in strength, but only equal in stiffness, whilst under transverse loads the timber is slightly inferior to the Central American mahogany, *Swietenia macrophylla*. Valuable data on the African mahoganies have also been obtained by French investigators (Bois Coloniaux; Plaquette documentaire éditée sous les auspices du Comité National des Bois Coloniaux. Paris: Musée des Colonies, 1935). The Mansonia (*Mansonia altissima*), so far as present records go, occurs in the deciduous forests of west tropical Africa from the Ivory Coast through the Gold Coast, Dahomey to Nigeria. From the research work undertaken by one of the sylviculturists in Nigeria with this species, it would appear to be possibly more abundant than has hitherto been surmised; and it seems under suitable conditions to regenerate with comparative ease. The timber has a similarity to black walnut in appearance and strength properties. It is therefore considered that it should be fit for use for practically all purposes for which black walnut has previously been employed, including the manufacture of propellers for aircraft, an important and increasing economic demand.

Halleförs Dolerite Dyke, Sweden

AN important contribution to the petrology of basaltic intrusions is made by T. Krokström in a study of the great Halleförs dyke of Middle Sweden (*Bull. Geol. Inst. Upsala*, **26**, 115–263; 1936). The dyke is about 40 km. long, has an average width of 1 km., and trends east and west. The marginal type is mainly ophitic olivine-dolerite, associated with a coarser variety which locally shows a glassy development of its interstitial material. The central parts of the eastern half of the dyke display an apparently continuous variation from coarse, even-grained dolerite to markedly porphyritic types with a very fine-grained groundmass. The latter types, and even, in part, the dolerites, have locally been subjected to albitisation which is referred to late magmatic processes. A few small dykes of adamellitic affinities intersect the marginal dolerite and are interpreted as consanguineous with the rocks of the central suite. Certain granophyre veins, however, found near the margin, are thought to have been generated by transfusion of the gneissic country rocks. In the western part of the dyke a few exposures of helsinkitic rocks and epidotic breccia occur. These are interpreted as results of pneumatolytic action combined with a certain amount of mechanical deformation. The age of the dyke cannot be irrefutably established, but it is shown that there is no reasonable objection to the general opinion that it is post-Jotnian. Comparison is made with the Breven dyke. It is found that both dykes are consanguineous, but that the present section exposed through the Breven dyke is a deeper one as compared with that through the Halleförs dyke.

Destructive Earthquakes of 1935

IN the latest issue of the *Matériaux pour l'Étude des Calamités* (No. 36, 160–163; 1935), M. C. Bois gives a list of the destructive earthquakes that occurred during the latter half of the year 1935 (see NATURE, **136**, 639; 1935). The total number of such earthquakes is 24, making 40 for the whole year, in some of which, however, the damage caused was extremely slight. During the first half of the year, there were four earthquakes of the highest degree (III) of Milne's scale for destructive earthquakes, and during the latter half only one, namely, the Turkestan earthquake of October 8, during which 105 lives were lost. If the total number of earthquakes for the year is somewhat less than usual, their destructiveness, as measured by the loss of human lives (about 35,000), is above the average of about 28,000 given in NATURE of April 11, p. 605.

Surface Temperatures in Sliding Friction

F. P. BOWDEN and K. E. W. Ridler (*Proc. Roy. Soc.*, A, May 1) have made experiments in which two metals in sliding contact were used as the elements of a thermocouple, and estimates of the surface temperature were made. This temperature may be quite high (above 1,000° for constantan on mild steel), though the mass of the metal remains cool. A simple calculation of the rate of production of heat and its transfer by conduction shows that high local temperatures are to be expected, particularly as only a fraction of the surface is actually in contact. The temperature rises with the load and the speed of sliding but reaches a constant value corresponding to the melting point of one of the metals, when the latter is relatively fusible (for example, gallium, Wood's metal, lead). The experiments were repeated with the surfaces lubricated under 'boundary' conditions—that is, covered with an adsorbed film of lubricant. Here also high temperatures were observed, and it is suggested that the high temperature is an important factor in the breakdown of the boundary film. There is evidence from other work that the boundary film is continually broken down and regenerated during sliding.

New Methods in Mass Spectroscopy

A. J. DEMPSTER has recently described (*Proc. Amer. Phil. Soc.*, **75**, 8) a new mass-spectrograph with which he has obtained several new and important results (see NATURE, **135**, 542; **135**, 993; **136**, 65; **136**, 180). The source of positive ions is a vacuum spark energised by a Tesla circuit. This arrangement gives singly and multiply charged ions of all the electrode metals tried, including palladium, platinum, gold and uranium, which have proved recalcitrant in other arrangements. The arrangement for analysing the rays consists of an electrostatic field between curved plates, followed by a magnetic field, and it gives focusing of ions of constant m/e even if both their initial directions and initial velocities are spread over limited ranges. This double focusing property represents an advance on the arrangements of Aston and of Bainbridge.

Locating Underground Rock by Sound Waves

IN *Roads and Streets* of April, a simple method developed by the U.S. Bureau of Public Roads for locating the distance of rock beneath the ground surface is described, and is said to be giving excellent results. The method has been previously used extensively when prospecting for oil at considerable depths, but in these cases elaborate and costly apparatus has been used. The device now employed is a highly sensitive seismograph, and by its use the time and expense required for drilling to find out how deep the rock lies is saved. Accurate results are obtained by measuring the speed with which an impulse from the explosion of a buried blasting cap travels through the earth. The impulse travels through soil at a speed of 1,000–6,000 ft. per sec. but through rock it travels at a rate of 16,000–20,000 ft. per sec. When the cap is exploded, a record is made for the time measurement. Special detectors are placed on the ground at different distances from the explosion and pick up the impulse as it comes through the ground. The detectors are electrically connected with the time-recording device. When a detector is close to the explosion, one impulse coming through the soil is received. At greater distances an impulse coming through the soil is received and also another which has travelled through soil to rock, through rock and finally from the rock to the surface, arriving at the detector a fraction of a second later. At still greater distances the impulse moving through soil and rock arrives ahead of the impulse moving more slowly through the soil alone. From the data thus obtained, it is possible to calculate how far the impulse went downward through the soil before it encountered rock.

Lightning Discharges and Atmospherics

AN investigation has been made by H. Norinder, of the Institute of High-Tension Research, University of Uppsala, on the relation between lightning discharges and atmospherics in radio-receiving. The investigation lasted over two years, and a very large number of atmospherics was recorded. In a paper to the *Journal of the Franklin Institute* of May, he discusses in detail the observations and the results he has obtained. The author's method of studying atmospherics is to use horizontal aerials in connexion with resistances and cathode ray oscillographs. The atmospherics were observed in mobile field stations. By varying their position it could easily be found out whether any of the effects were produced by high-tension transmission lines. By connecting loud speakers to the aerial as well as the cathode ray oscillographs, a simultaneous record was obtained of the noise and the associated disturbances. A very clear distinction was obtained between the atmospherics of short duration ('clicks') and the atmospherics of long duration ('grinders'). The 'clicks', in the author's opinion, are due to local actions inside the thunderstorm clouds, such as short sparks which are not easy to detect by visual observations. They can be seen when an aeroplane traverses local showers of rain, snow or hail. The 'grinders' are quite distinct from the clicks both in their general aspect and the way they vary. Good reasons are given for believing that 'grinders' are caused by distant lightning discharges. It is shown that the field of an electric discharge will, after a short passage in the atmosphere, be transformed into superimposed components having different periodic variations. The sometimes apparently complicated forms of atmospherics are in most cases found to be a secondary effect caused by gradual deformation during transmission.

Growth of Knowledge of the Ionosphere

IT is now well known that all long-distance radio communication takes place by the propagation of electric waves through the upper regions of the atmosphere which are embraced by the modern term 'ionosphere'. Although a conducting upper atmosphere was postulated in 1902, direct experimental evidence of its existence was not obtained until 1924. Since the latter date, a vast and increasing amount of research has been devoted to the ionosphere as a branch of theoretical and applied physics. While the major portion of this work has been conducted in Great Britain and in the United States, the fascination of the subject has attracted a number of research workers in other countries. The results of this work are generally recorded in the various scientific publications of the world. These publications are so numerous and so widespread, however, that the industrious worker in the subject is faced with a strenuous task if he is to study them all. Those whose main interest lies in other fields find it increasingly difficult to maintain an up-to-date knowledge on the ionosphere, and particularly to keep a clear perspective view of the progress which has been achieved and of its bearing on other fields such as meteorology and geophysics.

It is here that Prof. S. K. Mitra has come to our rescue with his "Report on the Present State of our Knowledge of the Ionosphere", which was prepared for the opening of a symposium organised by the National Institute of Sciences of India in 1935, and is now reprinted from the *Proceedings* of that body. This report presents in a connected and concise form the main results of both theoretical and experimental investigations on the ionosphere during the past twelve years. The work has been treated from a fundamental point of view, and it is not concerned with the science or practice of radio communication except in so far as radio methods are nowadays employed as a tool for the exploration of the upper atmosphere.

The first large section of the paper gives in a clear and concise manner the theory of the propagation of electric waves through an ionised gaseous medium, introducing in sequence the effects of the earth's magnetic field and of energy dissipation by collisions. The results of the theoretical treatment are illustrated by typical dispersion curves showing the effects of these quantities upon the refractive index and absorbing powers of the medium and on the polarisation of the transmitted waves.

Next, an outline is given of the three main experimental methods which have been developed for the study of the properties of the ionosphere. The two of these most widely used involve the emission of a radio signal with special characteristics impressed upon it, and the study of the echo signal upon its return from the ionosphere to earth. A description is given of the methods by which information is obtained, from such records, on the equivalent height of the ionosphere, and the density and gradient of ionisation. Indeed modern research based on a study of such records of received signals is providing us with a detailed knowledge of the structure of the atmosphere at heights above about 80 km.; such knowledge is at present unobtainable in any other way. Throughout the paper, typical results of this research are presented in graphical form, and an appendix provides a bibliography, which has the merit of being obviously selected on a critical basis rather than of being entirely comprehensive.

Prof. Mitra appears to have succeeded admirably in compressing a large volume of matter into a small space, and in a subject which is progressing as rapidly as that under discussion, this has necessarily involved omitting reference to many investigations, which although helpful in the general progress of the work, are of lesser fundamental importance. The report should prove of great use to those studying or carrying out research in this most fascinating subject.

Bacteriological Grading of Milk in Great Britain

GRADING of milk was introduced in Great Britain in 1923. Producers who conformed to certain rules and attained certain standards for the milk they supplied were given the right to apply certain statutory names to their products. It was expected that both the public and the producers would benefit, the former by obtaining a more hygienic milk supply, the latter by an increased commercial return—hopes not altogether realised. After consideration and consultation respecting the working of the Order during the past seven years, the Minister of Health has decided to institute a new "Milk (Special Designations) Order, 1936"[1], which came into operation on June 1.

The new Order has two main objects—to transfer from the Minister to local authorities the duty of granting licences to producers of certain graded milks, and to improve and simplify the special designations of milk. The present designations are 'Certified', 'Grade A. (Tuberculin Tested)', 'Grade A' and 'Pasteurised'. It is considered that so many grades create confusion, and the designations of some do not give a clear indication of their nature. Accordingly it is proposed to reduce the number of grades to three—'Tuberculin Tested', 'Accredited' and 'Pasteurised'. 'Tuberculin Tested' is raw milk from tuberculin tested cows and will replace the existing designations 'Certified' and 'Grade A. (Tuberculin Tested)'; it may also be pasteurised. 'Accredited' milk will replace the present 'Grade A' milk, and like the latter will be raw milk from cows regularly inspected by a veterinary surgeon, but not tuberculin tested. 'Pasteurised' milk will, as at present, be milk which has been held at a temperature of 145°–150° F.

for 30 minutes. The new Order contains a number of other provisions and administrative requirements for carrying it out. As it will affect large numbers of people, Sir Kingsley Wood has also issued an explanatory Memorandum setting out in non-technical language the effect of the Order and the way in which it will work[2].

Bacteriological standards were prescribed for the various classes of graded milk under the Order of 1923, namely, 'Certified' and 'Grade A. (Pasteurised)' must not contain more than 30,000 bacteria per c.c. and must not contain coliform bacilli in 1/10 c.c., 'Grade A. (Tuberculin Tested)' and 'Grade A' must not contain more than 200,000 bacteria per c.c. nor coliform bacilli in 1/100 c.c., and 'Pasteurised' must not contain more than 100,000 organisms per c.c., and the conditions for sampling and testing were standardised by the Ministry of Health so far as possible, so that it was hoped that reasonably concordant results might be obtained by different analysts. It was found in practice, however, that reputable workers employing a similar technique obtained the most discordant results, and a critical inquiry into the validity of the methods available for the bacteriological grading of milk was carried out for the Medical Research Council by Prof. G. S. Wilson and his assistants[3]. It was found that the plate count test for numbers of bacteria breaks down on account of the irregularity of distribution and clumping of the organisms in the milk, so that, under the best conditions, on any count an allowance of ±90 per cent may have to be made. Much the same may be said of the coliform test, except for pasteurised milk, when it may be of some value, serving as an index of the efficiency of the processing if performed with the freshly pasteurised milk. The new Order, therefore, while prescribing plate count tests for raw 'Tuberculin Tested' and 'Accredited' milks until December 31, 1936, substitutes for them a methylene blue reduction test for these milks on and after January 1, 1937. In addition, a coliform test is prescribed for these milks. Plate counts are to be continued for 'Tuberculin Tested Milk (Pasteurised)' and for 'Pasteurised' milk, the method of carrying out these tests being the same as obtains at present (Memo. 139/Foods). The methylene blue reduction test was the subject of much experimental work by Prof. Wilson and his colleagues, and appeared to fulfil most of the requirements demanded of a test for routine grading of *raw* milk. It is a simple test, with a very small experimental error, can be carried out by relatively unskilled workers on a large number of samples, and requires little equipment. By means of it, milk can be classified into the three or four grades necessary on the basis of cleanliness, it affords a useful index of the keeping qualities and gives more information about the milk than does the plate count. Allusion is also made to the possible use of the phosphatase test of Kay and Graham for the detection of imperfect pasteurisation.

[1] Ministry of Health: Statutory Rules and Orders 1936. No. 356. 4*d*. net. Circular 1533. 2*d*. net. (London: H.M. Stationery Office, 1936.)

[2] Sale of Milk under Special Designations. Memo. 197/Foods. 3*d*. net.

[3] Medical Research Council. Special Report Series, No. 206: The Bacteriological Grading of Milk. By G. S. Wilson, assisted by R. S. Twigg, R. C. Wright, C. B. Hendry, M. P. Cowell and I. Maier. Pp. 392. (London: H.M. Stationery Office, 1935.) 7*s*. 6*d*. net.

Transitional Cultures in the Stone Age

A STUDY of the late palæolithic, mesolithic and early neolithic periods, of which the conclusions point to the necessity of a reclassification and further refinement in the definition of their characteristic industries, is based by M. Laurent Coulonges on his exploration of the prehistoric sites of Sauveterre-la-Lémance (Lot-et-Garonne). His report on his excavations and discussion of the evidence are published by the Institut de Paléontologie Humaine (*Archives*, Mém. 14).

Two sites were under investigation. They are situated on either side of the Paris-Agen railway in the valley of the Lémance, a tributary of the Lot, in the Canton of Fumel in the north-east of the department. One of the sites consists of two rock shelters on the south side of a detached island of the Cretaceous limestone, known as Le Martinet. They were first brought to light in 1868 when the railroad was under construction. M. Coulonges began excavation here in 1923. The second site, situated 300 metres away to the north, is a rock-shelter on the north side of the Roc Allan beside the Périgueux road.

Le Martinet. On this site ten different levels were clearly to be distinguished. Its importance lies in the fact that here, for the first time, was found on one and the same site a stratigraphic succession of Upper Palæolithic, Mesolithic and Neolithic. Of the various levels, the first was archæologically sterile, as was the third; the second level is Upper Palæolithic, the fourth, fifth and sixth, Mesolithic, the seventh, Neolithic, and the eighth, Iron Age and Gallo-Roman, with sub-soil and soil above.

In regard to cultures, that of Level 2 is Upper Magdalenian, but with certain resemblances to Azilian, more especially the Azilian of the Dordogne, and it is, therefore, here regarded as a proto-Azilian. In the Mesolithic three stages are differentiated. Level 4 contains a characteristic Azilian industry in demonstrable relations to palæolithic types; and sharply contrasting with them is a considerable number of microlithic implements in a great variety of types in pygmy form. For this industry the specific name of Sauveterrian is adopted. It is followed in Level 5 by what is obviously the industry of a new race, differing in its culture and habits from the Sauveterrian. There is, for example, for the first time in this station, the evidence of a hut site. This is Tardenois I, and unlike Sauveterrian which clearly represents a local development, it is an intrusive culture from outside. In this the most typical and characteristic implement is the trapezoidal barb-point (*pointe-barbelure*). The industry is free from extraneous influence, a fact perhaps most patently indicated by the striking absence of the characteristic small triangular forms of the Sauveterrian.

The cultural break between Levels 4 and 5 is also marked in the fauna, the presence of the beaver and *Helix nemoralis* in quantity in Level 4 pointing to a period of humidity.

Immediately above Tardenois I is Tardenois II in Level 6. Here appear the true trapeze, half-moons, the small implements with transverse cutting-edge and the first indications in technique of the approaching Neolithic, to which the next level belongs.

Tardenois III, the first neolithic phase, appears in Level 7, in which there are several hut-sites, clearly of the same age, with an abundance of implements. The technique is essentially the same as that of the two preceding Tardenois industries, but the cores and scrapers are larger and the large burins, planes and picks, and other forms characteristic of a neolithic industry appear. There are no polished implements. Pottery, absent in the lower levels, is abundant. The forms cannot be reconstructed, owing to the fragmentary condition of the finds; but the ornament is either impressed with the finger, in relief, or incised in horizontal lines and bands, or in the incised ornament, in oblique lines. It resembles pottery with impressed or incised ornament from Spain, France (Gard, Aude, Drôme, Lozère), Swiss lake dwellings and the beginnings of æneolithic and bronze in Belgium. Art is represented by an important human mask in calcareous stone, resembling the figures of the menhirs, and a phallic bisexual object. The culture appears to be advanced neolithic, bordering on the æneolithic.

Le Roc Allan. Here on the second site no less than nineteen levels have been distinguished, extending from Magdalenian to the modern surface. Except in the Azilian and the Sauveterrian the deposits are thin. Impressions of leaves from Tardenois levels have been identified and indicate a vegetation in mesolithic times comparable to that of to-day—*Hedera*, *Ruscus*, *Ilex*, *Populus*, *Ulmus*, *Quercus*, *Corylus*, *Acer*. The industries of the various levels follow those of Le Martinet sufficiently closely to call for no special comment here.

The results of these excavations, and especially the stratigraphy of mesolithic industries, constitute a contribution of the first importance to prehistoric science. As M. Coulonges points out, not only does it throw light on the development of the Tardenoisian industry and on its differentiation and chronology in relation to other cultures; but it also makes possible for the first time the characterisation of a new industry, often confused with the Tardenoisian, namely, the Sauveterrian. The Tardenoisian itself, which has often been regarded, in the absence of stratigraphic evidence, as merely a form or type, must now be regarded as a widely distributed and distinct culture, not entirely microlithic, but one in which the trapezoidal implement, if characteristic, is associated with forms which conform to the normal in size. From this must be distinguished the Sauveterrian, an industry with which triangular microliths are associated, and derived from the Upper Palæolithic.

In Tardenois I two types are distinguished, a coastal which appears at Mugem in Portugal and in the Morbihan, with widely spread affinities, of which the racial type is seen in the short dolichocephals of Mugem, and a continental, which appears at Le Martinet and in the Tardenois of Central Germany, of which the racial type is the skeleton of Cuzoul de Gramat.

Since the distinction to be drawn between Sauveterrian and Tardenoisian has been pointed out, its existence has been notified from a large number of stations generally distributed over France. The racial type is the man of Roc-du-Barbeau (Dordogne).

The classification which M. Coulonges now proposes is as follows.

Final Palæolithic: (1) Upper Magdalenian; (2) Proto-Azilian.

Mesolithic: (1) Azilian, subdivided into a Perigordian facies and a Pyrenean facies; (2) Sauveterrian, subdivided into Extended Aurignacian, Extended Magdalenian (rare), and Final Azilian; (3) Tardenois I, subdivided into coastal and continental; (4) Tardenois II.

Neolithic: Tardenois III and the civilisations of the polished axe.

Elements beyond Uranium

THE possibility of producing elements with atomic numbers greater than 92 was discussed in 1934 by Fermi and his colleagues, who found that nearly all the elements undergo some transformation when bombarded with neutrons, and it was claimed that, among the products derived from uranium in this process, two at least, with half-life periods of 13 minutes and 90–100 minutes, must lie in the unknown range beyond uranium.

In view of the fact that this claim was challenged by von Grosse and Agruss (NATURE, **134**, 773, November 17, 1934), who declared that the 13-minute radio-element must be an isotope of protactinium, it is interesting to read in the April issue of the *Berichte der deutschen chemischen Gesellschaft* that Profs. Otto Hahn and Luise Meitner and Herr F. Strassmann have found substantial support for Fermi's contention by devising a satisfactory chemical method of separating the products of bombardment of uranium from known elements and to some extent from one another. Thus the so-called 13-minute and 100-minute products are both precipitated by hydrogen sulphide from strong acid solutions containing either platinum or rhenium as carriers, whereas elements Nos. 90–92 all remain dissolved. Moreover, they do not share with protactinium (No. 91) the characteristic property of co-precipitation with zirconium phosphate. Thus it is concluded that they are *trans-uranic* elements. That they are not themselves isotopes follows from the fact that they can be separated by means of sodium hydroxide.

Further examination has shown that the half-life periods have been incorrectly estimated, and that the longer-lived product is a mixture of homologues of the platinum group (Nos. 94–96). These can all be separated from eka-rhenium (No. 93) by precipitation in acid solution by platinum foil. Altogether five or six trans-uranic radio-elements have been detected, namely, two isotopes of eka-rhenium, two of eka-osmium, one of eka-iridium and perhaps one of eka-platinum, the corresponding half-life periods being 16 minutes, 2·2 minutes, 12 hours, 59 minutes, 3 days and about 3 hours. The first and third of these are produced only by 'fast' neutrons,

the others more readily by neutrons which have been delayed by passage through thick layers of water, paraffin and other hydrides.

The mechanism of the transformations is discussed at some length. Bombardment of an atom by a neutron will produce an element of lower atomic number whenever an α-particle or a proton is eliminated, but this effect will be counteracted or even reversed when the unstable product emits sufficient β-radiation. On the other hand, an initial decrease in atomic number may be avoided, either by the expulsion of a second *neutron* along with the bombarding neutron, or by the mere absorption of the latter without nuclear disintegration. These effects are produced by 'fast' and 'slow' neutrons respectively, and in both cases the initial products become stabilised by the emission of β-rays, with consequent increase in atomic number.

A plate showing three photographic exposures by the Wilson method in a magnetic field is given as evidence of the β-radiation of trans-uranic elements.

Educational Topics and Events

BELFAST.—The Senate has decided to confer the honorary degree of D.Sc. on Prof. T. H. Milroy, emeritus professor of physiology, and Prof. W. B. Morton, emeritus professor of physics.

CAMBRIDGE.—It is proposed by the Buildings Syndicate that a site for a new School of Anatomy be assigned on the Downing Street site in the court surrounded by the Schools of Agriculture, Pathology and Biochemistry and the Molteno Institute.

D. R. Pye, of Trinity College, has been approved for the degree of Sc.D., and Miss M. J. Stephenson, of Newnham College, for the title of the degree of Sc.D.

Dr. E. A. Moelwyn-Hughes, of Corpus Christi College, has been admitted by incorporation to the degree of Ph.D.

Mr. F. T. Brookes, fellow of Emmanuel College and University reader in mycology, has been appointed to the professorship of botany vacant by the resignation of Prof. A. C. Seward.

The Cambridge Philosophical Society is holding an exhibition of historic scientific apparatus in the Old Schools on June 8–23. The exhibition will be opened by Lord Rutherford in the Regent House of the Old Schools on June 8 at 9 p.m.

LIVERPOOL.—The University is to confer the honorary degree of Doctor of Laws upon Mr. Harold Cohen in special recognition of his munificent gift of £100,000 for the erection of a new Library, and for his previous gifts to the endowment fund of the library, and to the Students' Union.

LONDON.—The University's great scheme for building on its Bloomsbury site to the north of the British Museum is in process of realisation. The 'senate-house block', comprising accommodation for the meetings of the Court, the Senate and its various committees, a conference room, small hall and the administrative offices, is, says the Principal's Report for 1935–36, nearing completion, and it is hoped that the first part of the move from the Imperial Institute building in South Kensington will be achieved during the coming long vacation. So, exactly a hundred years after its foundation by Royal Charter in 1836, the University will occupy a home of its own. From its foundation until 1900, the functions of the University were almost entirely restricted to those of examination, and examination statistics still figure prominently in its annual reports. In the past year, candidates numbered 44,274, as compared with 42,822 in 1934 and 16,906 in 1919. The number of students reading in colleges of, or affiliated to, the University was 13,364. External students registered as preparing for the University's external examinations exceeded 12,000, of whom 6,000 were preparing for various intermediate examinations and 4,000 for degree examinations. Among the numerous benefactions mentioned in the report, a significant item is Sir Montague Burton's gift of £500 a year for the partial endowment of the chair of international relations at the London School of Economics. Seeing that a large proportion of the students in attendance at the School are residents of countries outside the British Isles (37 per cent of the 911 full-time students in 1934–35 were from abroad) it is obviously desirable to maintain and, if possible, enhance the prestige of this chair.

THE Trustees of the Garton Foundation have awarded the Garton Foundation studentship in the social sciences for 1936 to Mr. Harold Barger of the University of London (University College). The studentship, founded in 1928 by the late Sir Richard Garton, is intended to assist students of exceptional capacity to devote themselves for a year or more to the study of social or economic problems of fundamental importance. It is open to British subjects, and is of the annual value of £400 and is offered every second year. Mr. Barger proposes to study the economic fluctuations in the United States since the Great War.

THE Committee of Award of the Commonwealth Fund fellowships has made the following appointments, among others, to fellowships tenable by British graduates in American universities for the two years beginning September 1936. Gordon Bowen (Liverpool and Glasgow), to the University of California, in geography; P. M. Butler (Cambridge), to Columbia University, in zoology; H. R. X. D'Aeth (Cambridge), to Harvard University, in botany; J. C. Dykes (Cambridge), to the California Institute of Technology, in engineering; R. G. Flood (Manchester), to the University of Chicago, in economics; Dr. G. C. Hampson (Oxford), to the California Institute of Technology, in chemistry; W. M. Honeyman (St. Andrews), to Columbia University, in medicine; J. C. Hornel (Edinburgh), to the University of California, in chemistry; Dr. M. S. Jones (Edinburgh), to the University of Pennsylvania, in medicine; Dr. W. B. Mann (Imperial College of Science and Technology, London), to the University of California, in physics; F. H. Merrill (Liverpool), to the Massachusetts Institute of Technology, in engineering; A. L. Percival (Cambridge), to the Massachusetts Institute of Technology, in engineering; Dr. Donald Purdie (Cambridge), to Stanford University, in chemistry; H. D. Springall (Oxford), to the California Institute of Technology, in chemistry; Dr. E. G. Taylor (University College, Swansea), to Brown University, in chemistry. The following have been appointed to fellowships tenable by candidates from the British Dominions: I. P.

Norval (South Africa and Oxford), to the Rockefeller Institute, Princeton, in botany; W. E. van Heyningen (Stellenbosch and Cambridge), to Harvard University, in biochemistry. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: C. R. Barnicoat (New Zealand), of the Department of Scientific and Industrial Research, Government of New Zealand, to the University of Minnesota, in dairy research; R. M. du Toit (Pretoria), of the Department of Agriculture, Government of South Africa, to the University of Minnesota, in veterinary science; R. G. Simmers (New Zealand), of the Department of Scientific and Industrial Research, Government of New Zealand, to the Massachusetts Institute of Technology, in meteorology; Dr. E. J. Underwood (Western Australia and Cambridge), of the Department of Agriculture, Government of Western Australia, to the University of Wisconsin, in agriculture.

Science News a Century Ago

The University of London

The Times of June 6, 1836, said, in the form of a quotation from the *Observer*: "As there seems to be some doubt respecting the progress of the arrangements for the constitution of the new Metropolitan University, we have much pleasure in announcing that the charter is already in a state of forwardness, and will probably be mature for promulgation in about a fortnight. In addition to Professor Airy, the Rev. Mr. Thirlwall and Mr. Senior, who, we were enabled to state some time since, would be members of the board of examiners, the public will be gratified to learn that the following distinguished persons are also to be among the number:—Mr. Lubbock, Vice-President of the Royal Society; Mr. Sheepshanks, of Trinity College, Cambridge; Dr. Arnold; and Dr. Dalton, the eminent chymist, of Manchester."

Lyell and Sir John Herschel

On June 7, 1836, Lyell wrote from 16 Hart Street, Bloomsbury, to Herschel, at the Cape, "A few days ago I sent to Captain Beaufort a long letter which I had written to you, in which I hoped to enclose some letters of introduction to persons at Rio, as you wished. I now enclose them, together with the abstract of Babbage's paper to which I alluded. . . . Yesterday I sat next Babbage at Miss Rogers' at dinner. . . . Mr. Rogers, the poet, was talking of your astronomy which he had read, as well as the introduction to 'Natural Philosophy', and with both of which he had been much delighted; and among other things, with the manner in which you had alluded to certain papers of Dr. Young's on light and colour, which Brougham has so contemptuously and unmercifully cut up in the 'Edinburgh Review'. . . . I think it was Sydney Smith who said of Brougham that he had made two great discoveries in the 'Edinburgh Review'—the first was that Byron was no poet, the second that Young was no philosopher."

Brain of the Negro

In a paper read before the Royal Society on June 9, 1836, Dr. Frederick Tiedemann, professor of anatomy and physiology in the University of Heidelberg and foreign member of the Royal Society, presented a paper on this subject, which he said was one of great importance in the natural history, anatomy and physiology of man, as well as interesting in a political and legislative aspect. His extensive researches had led him to the following conclusions: (1) The brain of a Negro is on the whole quite as large as that of the European and other human races. (2) The nerves of the Negro, relatively to the size of the brain, are not thicker than those of Europeans, as Soemmering and his followers had said. (3) The outward form of the spinal end, medulla oblongata, cerebellum and cerebrum of the Negro show no important differences from that of the European. (4) Nor does the inward structure, order of the cortical and medullary substance, nor the inward organisation of the interior of the Negro brain show any difference from that of the European. (5) The Negro brain does not resemble that of the orang-utan more than the European brain, except in the more symmetrical distribution of the gyri and sulci. In conclusion, Prof. Tiedemann maintained that neither anatomy nor physiology justified our placing the Negro beneath the European in a moral or intellectual point of view. (*Phil. Trans.*, 497; 1836.)

Humboldt and Terrestrial Magnetism

The foremost contributors to the knowledge of terrestrial magnetism in the early part of the nineteenth century were Hansteen, Gauss and Alexander von Humboldt. Born in 1769, Humboldt made his celebrated journey in Southern and Central America during 1799–1804, and from 1808 until 1826 resided mainly in Paris where he was the friend of Arago. Returning to Germany, in conjunction with Gauss, he organised the German Magnetic Union and vigorously impressed the importance of magnetic expeditions on both the Russian and British Governments. His letter on a systematic course of observations in various parts of the world was addressed to the Duke of Sussex, then president of the Royal Society. This was referred to Christie and Airy, who, on June 9, 1836, reported favourably upon it, strongly recommending the adoption of the scheme.

Societies and Academies

Edinburgh

Royal Society, May 4, 1936. Stefan Jellinek: The theory of electrical traces (address). The external or superficial effects upon objects struck by lightning have long been known. These effects (or 'traces') are shown to be separable into three distinct geometrical types—the straight line, the circular and the spiral. In addition to the thermal and chemical action, it has been demonstrated that there is also a mechanical action.

Paris

Academy of Sciences, April 27 (*C.R.*, 202, 1389–1468). Dimitri Riabouchinsky: The régime of velocities almost equal to the local velocity of sound. Jean André Ville: Indifferent frequencies. Léon Pomey: The determination and the harmonic

properties of multiple points of a unicursal involution of any order. NICOLAS ABRAMESCO : The study of the form of a curve or a surface in the neighbourhood of one of its points. ALFRED ROSENBLATT : The conformal representation of plane domains. KAROL BORSUK : Groups of classes of continued transformations. FRÉDÉRIC ROGER : The distribution of certain limit directions and its application to the theory of functions with complex variable. CHARLES PLATRIER : The calculation of the energy of acceleration of a solid. FERNAND AIMOND : The energy of acceleration of a solid having a fixed point. PAUL DUMANOIS : A motor with heavy fuel, with constant pulverisation and with limited maximum pressure. ALBERT ARNULF : The ultra-violet spectrum of the night sky. Analysis of the results obtained with four negatives, one taken at the Jungfraujoch, the others at Villennes-sur-Seine. The lines measured range from 3556 A. to 3030 A. : below 3030 A., no lines could be proved with certainty. RENÉ DUGAS : The reality of quantic mechanics. JACQUES WINTER : The diffusion of Dirac waves. MAX GELOSO and MLLE. CHARLOTTE ROUILLARD : Experimental researches on the electrolysis of manganous salts. The oxide deposited varies in composition with the experimental conditions, but always contains less oxygen than the peroxide, MnO_2. NICOLAS KÜRTI, PAUL LAINÉ, BERNARD VINCENT ROLLIN and FRANZ SIMON : The installation, at the Bellevue electromagnet laboratory, of an apparatus for the liquefaction of helium and for obtaining temperatures below 1° K. by the magnetic method. Description and photograph of the apparatus. It has been found that at these low temperatures some paramagnetic salts become ferromagnetic. ROBERT GUILLIEN : The band *A* in liquid oxygen. ETIENNE VASSY : The influence of temperature on the absorption spectrum of ozone. The absorption spectrum of ozone was proved to be independent of the pressure. Measurements of the absorption coefficient were then made at 20° C. and − 80° C. Applying this to the results previously obtained for atmospheric ozone, it is concluded that 85 per cent of atmospheric ozone is at a low temperature. NY TSI-ZÉ and WENG WEN-PO : The absorption spectrum of rubidium. PIERRE MONTAGNE : The evolution of reactions in systems in chemical equilibrium submitted to adiabatic expansion. GEORGES COSTEANU : The Raman effect of liquid ammonia and of solutions of nitrates in liquid ammonia. ANDRÉ BOULLÉ : The calcium metaphosphates. Proof of the existence of two crystalline varieties of calcium metaphosphate. PIERRE THOMAS and MLLE. C. KALMAN : The catalytic oxidation by copper salts in the presence of manganese salts. A. BOUCHONNET : The nitration of cellulose by nitric acid as vapour. Nitrocelluloses containing between 10·0 per cent and 13·7 per cent of nitrogen can be prepared by acting upon cellulose with the vapour of nitric acid under reduced pressure. PAUL CORDIER : The condensation of phenylpyruvic acid with acetophenone. RAYMOND QUELET and MLLE. YVETTE GERMAIN : The synthetic preparation of 3-nitro-4-methoxy-benzyl alcohol and of its ether oxides. RAYMOND PAUL : The hydrol character of furylphenylcarbinol. GUSTAVE VAVON and LOUIS BOURGEOIS : The reactivity and structure of the primary aromatic amines. JACQUES BOURCART : The evolution of the coast of the Iberian peninsula from the peninsula of Peniche (Portugal) to Cape Finisterre (Spanish Galicia). ROGER HEIM : The three Agarics with latex of the Madagascan flora. CONSTANTIN T. POPESCO : Researches on meandriform decortications. PIERRE CHOUARD : Some effects of light on growth, flowering, root formation and budding in various plants. RENÉ SOUÈGES : The embryogeny of the Droseraceæ. The development of the embryo in *Drosera rotundifolia*. LOUIS C. MAILLARD and JEAN ETTORI : The proportion of titanium in the bodies of mammals. Titanium was found in various organs from man, dog, horse and sheep. There appears to be no concentration in any special organ. GEORGES BLANC and MARCEL BALTAZARD : The longevity of the virus of murin typhus in the flea, *Xenopsylla cheopis*. Experiments showing that the rat flea may remain infected and capable of carrying infection during the whole of its life. PAUL F. ARMAND-DELILLE : The resistance conferred on the ape by the inoculation of an *S* strain of human tubercle bacillus isolated by hæmoculture. G. RAMON and E. LEMÉTAYER : The value and duration of the immunity conferred by tetanus anatoxin in the vaccination of the horse against tetanus. More than 50,000 horses have been submitted to the anatoxin treatment, which has given good results. The immunity lasts several years. ANDREW WATSON SELLARDS and JEAN LAIGRET : A new demonstration of the efficacy of vaccination for yellow fever.

AMSTERDAM

Royal Academy (*Proc.*, **39**, No. 3 ; 1936). A. J. KLUYVER and J. C. HOOGERHEIDE : Some remarks on the reduction intensity of living cells. M. W. WOERDEMAN : 'Embryonic induction' by chemical substances. W. H. KEESOM and K. W. TACONIS : Structure of solid chlorine. Chlorine has a tetragonal molecular lattice, $a = 8{\cdot}56$ A., $c = 6{\cdot}12$ A., space group $D^1{}_4h$. L. S. ORNSTEIN, H. BRINKMAN and T. HAMADA : The mechanism in the positive column of a discharge. Interpretation of Hamada's measurements of the temperatures in the positive column. L. S. ORNSTEIN, D. T. J. TER HORST and G. H. FREDERIK : Change of the dipole moment of transformer oil through alteration during use. The oxidation during use can be followed by determining the dipole moment. J. de GIER and P. ZEEMAN : An eighth isotope of molybdenum. Discovery of an eighth isotope at 102. F. K. T. VAN ITERSON : Cavitation and surface tension (2). A discussion of the effect of impurities (oil, etc.) in water on the occurrence of cavitation. J. G. VAN DER CORPUT : Distribution functions (6). J. G. VAN DER CORPUT : Some Vinogradoff methods. E. COHEN and A. K. W. A. VAN LIESHOUT : Influence of mechanical deformation on the velocity of transformation of polymorphic metals (2). Influence of metallic admixtures. E. COHEN and H. L. BREDÉE : Negative coefficient of expansion of silver iodide. The results of Jones and Jelen are seriously in error due to their using physically impure material. E. COHEN and W. A. T. COHEN DE MEESTER : Studies on corrosion. E. ROSENBOHM and F. M. JAEGER : Localisation of the transition points of allotropic metals under various conditions by means of the Saladin–Le Chatelier method. E. ROSENBOHM and F. M. JAEGER : Measurement of the electrical resistance of metals as a function of the temperature by means of a twin galvanometer with photographic recording. Results for nickel between 320° and 430° C. F. M. JAEGER and J. A. VAN DIJK : Preparation and properties of some orthodiaminocyclohexanes. C. S. MEYER :

Some integral representations in the theory of Bessel and Whittaker functions. J. D. GERRITSEN and W. G. v. d. KLOOT: Differences in the flower-forming capacity of *Narcissus Pseudonarcissus* and *Hyacinthus orientalis*. M. G. RUTTEN: An interseptal canal system in the foraminiferal species *Discocyclina papyracea*, Boubée. L. BOOMGAART and J. VROMAN: Smaller Foraminifera from the marl zone between Sonde and Modjokerto (Java). C. D. VERRIJP and E. F. DRION: The frequency distribution of growth in homogeneous material (2). G. P. FRETS: Hereditary variability in the F_3 seed generation after cross-fertilisation of bean races.

BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 32, No. 3, 1936). L. GODEAUX: (1) Algebraic surfaces possessing a simple linear system, the curves of which contain an involution. (2) Some involutions belonging to the generalised Humbert surface. J. E. VERSCHAFFELT: The course of the lines of constant affinity in phase transformations of a simple substance. Generalised thermodynamic treatment with special reference to supraconductivity and liquid helium. TH. DE DONDER: The 'discontinuity brackets' of Hadamard and van Mieghem. C. LURQUIN: The algebra of eventual variables (2). L. DERWIDUÉ: A congruence of twisted cubics. G. SOKOLOFF: Collision in the problem of three bodies which attract each other proportionally to their masses and to a function of the distance. E. DELPORTE: Discovery of a peculiar star at the Belgian Royal Observatory. The body, asteroid or comet, was moving in an orbit of high eccentricity and was rapidly decreasing in magnitude. W. H. BENEDICTUS: New application of the Maxwell – De Donder asymmetric electromagnetic tensor. H. VOGELS: Photolysis of nitrates (spectrophotometric determinations of potassium nitrite, catalytic action of manganous salts). Development of a method for estimating potassium nitrite from its absorption in the neighbourhood of 3650 A. E. ZUNZ: The action of derivatives of aminomethylbenzodioxane, of phenoxydiethylamines and of naphthoxydiethylamines on aqueous diuresis in the dog.

Moscow

Academy of Sciences, *C.R.*, 1, No. 3, 1936. E. VORONOVSKAJA: A minimum problem in the theory of moments and the evaluation of polynomials. N. MOISSEJEV: On some anepicyclic regions in the asteroidal problem of three bodies. E. K. SAVOJSKIJ and B. M. KOSYREV: Changes in the absorption of weak electrical high-frequency fields by certain fluids, in connexion with the strength of these fields. K. S. TOPCHIJEV: *N*-methyl-pyridine-thiuram-disulphide. A. E. FERSMAN: Polar isomorphism. S. G. ZEITLIN: The borax content of oilfield waters. J. CHARIT, S. A. NEUFACH and K. N. MOROZOVA: Flavins and metabolism (3). Action of lactoflavin and methanol extract from the liver on blood glycolysis. A. J. ATABEKOVA: On some anomalies in atypical karyokinesis. A. G. ROMANKOVA: Parasitism of the mould *Penicillium rugulosum*, Thom., on *Aspergillus niger*. M. I. KNIAGINICHEV: Difference in the variation of the protein content in wheat and barley grains within one ear. A. J. TARANETZ: A short review of the genera related to *Stichaeus* from the Bering, Okhotsk and Japanese Seas.

Forthcoming Events

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

Monday, June 8

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION, at 5.30.—Prof. Ernest Barker: "Education for Citizenship".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—C. P. Skrine: "The Quetta Earthquake".

Tuesday, June 9

RESEARCH DEFENCE SOCIETY, at 3—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Annual General Meeting.

Sir Malcolm Watson: "Manson, Ross and Reed: Pioneers in Research in Tropical Medicine" (Tenth Stephen Paget Memorial Lecture).

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. S. P. Bedson, F.R.S.: "A Study of Psittacosis Virus and what can be learned from it concerning the Nature of Filterable Viruses".

Wednesday, June 10

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. A. Kopff: "Star Catalogues, especially those of Fundamental Character" (George Darwin Lecture).

GEOLOGICAL SOCIETY OF LONDON, at 6.—Dr. F. J. North: "De la Beche and his Activities, as revealed by his Diaries and Correspondence".

Official Publications Received

Great Britain and Ireland

Official Guide to the Gardens and Aquarium of the Zoological Society of London. By Dr. Julian S. Huxley. (New Series.) Pp. 116. (London: Zoological Society of London.) 1*s.* [85

World Power Conference. Annual Report, 1935. Pp. 13+iv. (London: World Power Conference.) [115

The John Innes Horticultural Institution, 1910–1935. Pp. 58. (London: John Innes Horticultural Institution.) [115

Experimental Researches and Reports published by Department of Glass Technology, The University, Sheffield. Vol. 18, 1935. Pp. iv+330. (Sheffield: The University.) 7*s.* 6*d.* [115

Education (Scotland). Report for the Year 1935 by the Director of the Royal Scottish Museum, Edinburgh. Pp. 13. (Edinburgh: Royal Scottish Museum.) [125

The Handbook of the National Institute of Poultry Husbandry, Newport, Shropshire. (Bulletin No. 11.) Pp. 52. (Newport: National Institute of Poultry Husbandry.) [125

Technical Publications of the International Tin Research and Development Council. Series A, No. 35: Research on Thin Layers of Tin and other Metals, 2: The Corrosion of Metals by Technical Insulating Oils. By P. J. Haringhuizen and D. A. Was. Pp. 16. (London: International Tin Research and Development Council.) Free. [135

Seale-Hayne Agricultural College: Department of Plant Pathology. Twelfth Annual Report for the Year ending September 30th, 1935. (Pamphlet No. 46.) Pp. 32. (Newton Abbot: Seale-Hayne Agricultural College.) [135

Other Countries

Journal of the Indian Institute of Science. Vol. 18A, Part 18: Studies in the Proteins of Indian Foodstuffs. vii. Globulins of the Aconite Bean (*P. aconitifolius* Jacq.), and viii. On the Heat Coagulation of Globulins from *Vigna catiang*, Walp., and *P. aconitifolius* Jacq. By Miss K. Bhagvat. Pp. 137–151. 1.2 rupees. Vol. 19A, Part 1: The Sandal Seed, its Oil and Proteins. By Motnahalli Sreenivasaya and Nuggehalli Narayana. Pp. 8. 12 annas. Vol. 19A, Part 2: Studies in the Proteins of Indian Foodstuffs. ix. Digestibility of the Globulins from Cowpea (*Vigna catiang*, Walp.) and Aconite Bean (*P. aconitifolius*, Jacq.). By Miss K. Bhagvat and M. Sreenivasaya. Pp. 9–18. 14 annas. Vol. 19A, Part 3: Studies on Starches from Indigenous Grains and Tubers. Part ii. Jowar Starch, and Part iii. Ragi Starch. By H. P. Das Gupta. Pp. 19–29. 1 rupee. Vol. 19A, Part 4: Studies on Starches from Indigenous Grains and Tubers. Part iv. Cassava Starch; Part v. Starches from Different Varieties of Rice, and Part vi. Use of Tintometer in the Study of the Degradation Products of Starch. By H. P. Das Gupta. Pp. 31–43. 1.2 rupees. Vol. 19A, Part 5: Determination of Carbonate, Organic Carbon and Total Nitrogen in the Same Sample. By T. R. Bhaskaran, C. R. Harihara Iyer, R. Rajagopalan and V. Subrahmanyan. Pp. 45–52. 12 annas. (Bangalore: Indian Institute of Science.) [125

Annals of the Observatory of Lund. No. 5: Altitude Tables for Mariners and Aviators. By Erik Tillman. Pp. 45. (Lund: Observatory.) [155