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The International Mind

THE League of Nations has recently published a small book* giving in brief outline some idea of the gigantic task involved in co-ordinating into one grand homogeneous whole all the numerous and varied activities in the international world of culture—science, art, letters, music, education. In any one of these realms of intellectual work, considerable progress has already been made towards collaboration among the nations ; in any one of them it is indeed a lofty and shining light towards which the workers in each country look with earnest hope and expectation as a splendid ideal, the ideal of closer union, understanding and sympathy with their fellow workers in other lands. Some tentative excursions have already been made towards union in even larger and more comprehensive groups, not limited to science only, or to art only, but overleaping the bounds of any one of these, wide as they are, and seeking to form one grand solar system, as it were, of all the worlds of culture. A thorough survey of what has already been accomplished would be a tremendous task, and the question that immediately presents itself is whether any such universal co-ordination is either practicable or worth while ; whether, that is to say, there is not an optimum limit even to the blessedness of that blessed thing co-operation ; and whether any larger body than those already existent would not be altogether unmanageable and unwieldy and ineffectual.

The main purpose of the League of Nations in its furtherance—or attempts thereat—of international intellectual co-operation is to strengthen the bonds of peace among the nations, to create an atmosphere favourable to the pacific solution of international questions.

The present little book is written around that great saying of Paul Valery : "A League of Nations implies a league of minds", and one of the main highways to peace is that of "Moral Disarmament". It is assumed that this type of disarmament is best achieved by closer co-operation of intellectual workers in every sphere. If by this is meant a strengthening of existing forms of collaboration, in each of the numerous realms of science, art, letters, etc., without any grandiloquent attempt to embrace them all in one huge omnibus organisation, then such co-operation will be entirely practicable and of great value. It

* League of Nations. International Intellectual Co-operation, 1932. Pp. 148+8 plates. (Paris : International Institute of Intellectual Co-operation ; London : George Allen and Unwin, Ltd., 1933.) 2*s*. 6*d*. net.

appears, however, that the League wishes to add to all the existing forms of international fellowship yet another of extremely wide and complex character. It is a very difficult matter to get a clear and comprehensive idea of this new organisation, or to form a considered judgment of its practical utility or moral value. As an effort in the cause of world peace it necessarily merits close and sympathetic examination.

Prof. Gilbert Murray, president of the International Committee on Intellectual Co-operation, says, in a letter printed in the book before us, that such co-operation is the normal method of world government and human progress, and has a two-fold purpose: first the advancement of knowledge and the maintenance of intellectual standards, and secondly the increase of mutual understanding and goodwill between nations.

"Both these objects, as we understand them, require regular practice of international co-operation in the fields of science, art, letters. For example, if we try to organise co-operation between museums or libraries in different nations, our object is both to make each institution more practically useful and also to encourage students and researchers in each country to look confidently to their colleagues in other countries for friendly aid."

The organisation set up by the League consists of (*a*) an International Committee on Intellectual Co-operation which acts as the advisory organ of the Council and Assembly; (*b*) three permanent institutions: an Intellectual Co-operation Section in the League Secretariat, an International Institute of Intellectual Co-operation in Paris, and an International Educational Cinematographic Institute in Rome; (*c*) thirty-nine national committees serving as a link between the International Committee on one hand and intellectual life in the various countries on the other; and (*d*) a large number of committees of experts.

Nothing would be easier than to scoff at this further bewildering outbreak of the committee plague, to remind the League that each of the activities aimed at by the different parts of this new organisation is already being better done by existing bodies, or to demand proof of real useful practical achievement in the one thing which before all others is said to be the principal aim of the new corpus, namely, the strengthening of world peace. But let us defer such facile criticism until we have attempted a better understanding of the new organisation and its work.

A great part of its work is rightly concerned with education, including the revision of school books in a broad and impartial spirit free from excessive national bias, interchange of visits by students of different countries, adult education, workers' leisure and much else. In the field of political and economic studies the new body seems less happy. As a result of two conferences, one at Copenhagen and another at Milan, although the subject of debate was supposed to be specific, a pamphlet has been issued on "The State and Economic Life" than which it would be difficult to find a more discursive and general topic. Other parts of the programme deal with international collaboration in connexion with libraries and museums, preservation of ancient monuments, the "exact and natural sciences", music and broadcasting, and so on. The new body works, as we have seen, through a vast number of committees of every conceivable type—national and international, executive and advisory, liaison and special, holds many conferences, and issues a goodly sheaf of pamphlets and periodicals. Among its periodicals are its monthly bulletin, its information bulletin, the *Mouseion* (a quarterly on museography) and some others. It also issues "Collections", including conversations like the one on Goethe (200 pages) and another on the future of Western civilisation; "Exchanges of Letters", "Volumes" and "Cahiers".

Doubtless all this and the other work which the International Committee on Intellectual Co-operation proposes to take up has some relation with moral disarmament and the creation of an atmosphere favourable to the pacific solution of international problems; some of it doubtless has a very direct bearing thereon, but much appears to be remote and indirect. As already pointed out, the most direct and valuable contribution to moral disarmament is the educational part of the programme. Education is undoubtedly the League's most powerful weapon, and one can note with the utmost satisfaction and indeed enthusiasm that this is given by far the most space in the present pamphlet. Practical results of real value are here being achieved. One could almost find it in one's heart to beg the League to concentrate practically all its energies on this particular manifestation of international fellowship, and to leave some of the other parts of its programme where its efforts appear to be attended with less happy results, and frequently lead only to interminable debate and profuse documentation of a rather dull and dreary sort.

In fact, the International Committee on Intellectual Co-operation, although it embraces letters within its scope, has not yet succeeded in finding a writer sufficiently gifted to infuse some fire and enthusiasm or soul-stirring eloquence into either its written or spoken word. Even a good journalist or publicity man should have ample opportunity here for some real dynamic propaganda. But the League has always had a poor press; and even though this Committee has been in existence for some years and claims to include within its capacious terms of reference every form of intellectual or cultural activity, it has hitherto entirely overlooked the Press. Perhaps it has supposed that the journalist is outside the pale of culture. However, it appears that this strange omission is shortly to be rectified. We may then hope that both in debate and in documentation there will be better quality, more life and verve and energy, with perhaps some reduction in quantity.

Education and the Press, these are surely two of the mightiest forces for good or evil in the modern world, and if the League would bend all its powers and organisation to strengthen these as factors in the lasting peace of the world, would this not be better than dissipating its energies over too wide a field—a field already effectually covered in many of its most important sections? The League might indeed make a thorough study of the work already being done by existing organisations and serve as a central clearing house of information on this very important matter; for a systematic study of this sort has not yet, to our knowledge, been made, and the results would be of great value and interest. But it should surely curb with a strong hand any undue indulgence in the committee habit, interminable indefinite debate, and verbose documentation. Under the growing burden of this latter the intellectual worker in every land already groans; and both his means and his time in these difficult days are very limited. In most cases he already has as much opportunity as he needs or can make use of for co-operation with fellow workers in other countries. He is afflicted at times, moreover, with an uneasy feeling that, so far as the gospel of moral disarmament is being urged on the cultured classes, it is merely a case of preaching to the converted; for the mighty forces which unleash the dogs of war, the black clouds which swiftly gather on the political horizon, the sudden storms of passion and hatred: Whence and what are they? How far can they be governed by international intellectual co-operation? Yet we must reach forward to this also, with faith and hope amid much gloomy uncertainty. This, too, can be made a potent factor in world peace, especially in the realms of education and the Press, and indeed in every realm of intellectual activity. The League of Nations should certainly occupy itself with the two specifically mentioned; but whether it should embrace all the others seems a little doubtful. W. G. L. C.

Max Planck's Mechanics

(1) *General Mechanics.* Pp. ix+272. 12*s.* net. (2) *The Mechanics of Deformable Bodies.* Pp. vii+234. 10*s.* 6*d.* net. (Being Vols. 1 and 2 of "Introduction to Theoretical Physics".) By Prof. Max Planck. Translated by Prof. Henry L. Brose. (London: Macmillan and Co., Ltd., 1932, 1933.)

MECHANICS has always been regarded as the corner stone of natural philosophy and it is fitting that an introduction to theoretical physics should begin with a study of the laws of motion of material bodies. These two volumes form such a commencement and prepare the way for the three other volumes on electricity and magnetism, light and heat which have already been reviewed in these columns (NATURE, **130**, 943; 1932).

When an independent discoverer and a recognised authority of the calibre of Prof. Max Planck takes in hand the task of writing textbooks, it behoves all teachers of the subject to pay attention to his methods and procedure. He points out that "the difficulties with which the student has to contend when he first enters the realm of theoretical physics are more often concerned not with the mathematical form, but with the physical content of the ideas which are presented to him." Accordingly the method adopted is that of presenting the structure of mechanics not as something already given, but as something which has been evolved step by step. This is essentially the point of view of Ernst Mach, who wrote in his "Science of Mechanics": "The gist and kernel of mechanical ideas has in almost every case grown up in the investigation of very simple and special cases of mechanical processes; and the analysis of the history of the discussions concerning these cases must ever remain the method at once the most

effective and the most natural for laying this gist and kernel bare."

In general, Planck's treatment follows the same lines as were actually pursued when the science was being evolved, for the author holds that "the history of an exact science does not deviate markedly from its structure as developed logically".

In following out this fundamental principle, emphasis is placed on the physical ideas rather than on the mathematical formulæ. "For the compactness of a formula often makes the relationship which it expresses appear simpler than it is in reality; this is because the real difficulty has been transferred to the definitions." Poincaré once said that mathematics is the art of giving the same name to different things, but before this process can be effective as a scientific tool it is necessary to study carefully the points of resemblance and also the points of difference involved in the things considered. What definitions are we to adopt in the study of mechanics? To such a question Planck replies: "As a first introduction to a branch of knowledge, it is essential, in my opinion, that the ultimate definitions should not be placed at the beginning as ready products, but that their usefulness and necessity must impress themselves only in the course of presentation in discussing definite problems."

In illustration, we may consider Planck's treatment of the fundamental concepts of force and mass and the laws of motion. The difficulty here met with is partly heuristic but largely philosophical, for it is related to the attempt to build up an external or objective world in correspondence with the subjective world of sense impressions. This problem has been discussed by Planck himself in recent works, as, for example, in his Guthrie lecture on "Causality" delivered before the Physical Society on June 13, 1932. Here he distinguished between the world of the senses and the world picture of physics which contains nothing but symbols. It is only in this world picture that events are strictly determined causally. The law of causality is itself a heuristic principle.

In § 7 of his "General Mechanics" Planck says: "the main object of mechanics is to find the motion which results from a prescribed cause", and then proceeds to enunciate the principle of inertia, known as Newton's First Law of Motion, in the form: "A material point which is deprived of all causes of motion moves uniformly and rectilinearly." He tells us that we must not regard the principle of inertia as obvious or as a mere definition. But this statement surely implies that the student is already familiar with the idea of a "cause of motion".

It is not until § 8 that the word 'force' is introduced. If we produce a change of motion by means of our muscles we experience a feeling of exertion "which is incapable of being defined more precisely as a sensation, but whose intensity is certainly related causally to the amount of acceleration produced. We shall, therefore, use the sensation of our muscular sense as a measure for the cause of the acceleration, and so call the cause of the acceleration the 'force' which we exert".

To the reviewer it seems most natural and convenient, at least in teaching, frankly to accept the concept of 'force' as derived from our sensations, and to use it as Newton seems to have done as one of the primary 'indefinables'. Experiment then teaches us that a more intense muscular sensation corresponds to a greater acceleration, and a more precise definition may be introduced. Planck sets the force proportional in magnitude and sign to the acceleration that is produced in a given body. "This method of defining a fundamental physical concept by first referring it back to a specific sense-impression and then supplementing and refining this first primitive definition by means of a second definition is the one usually adopted in physics and is probably the only possible one."

Planck's definition of force based on acceleration is still further generalised later in the volume after a discussion of Hamilton's principle.

> "But see! Tait writes in lucid symbols clear
> One small equation;
> And Force becomes of Energy a mere
> Space-Variation."

Unfortunately Tait, followed by Clerk Maxwell in his famous poem, fails to give any satisfactory definition of 'energy'.

In § 9 Planck introduces the concept of mass. Experiment teaches us that it requires a greater effort to accelerate or retard an iron sphere in a definite way than a wooden sphere of the same size. Hence we say that the iron sphere 'has more inertia' than the wooden sphere. The constant of proportionality in the relationship between force and acceleration we call the *inertial mass* of the body.

Attempts have been made by Mach and others to define mass without introducing the concept of

force by employing the Third Law of Motion, but it is difficult to see how such definitions can remain valid when the range of experiment is extended to velocities approaching the velocity of light. Einstein's theory of relativity has disclosed an intimate relationship between mass and energy and it may now be said that the great conservation laws of physics, as regards matter, momentum and energy, are no longer three but are fused into a single law—that of the conservation of energy.

Mechanics is defined as the study of the laws of motion of material bodies, and as the simplest material body is one the spatial dimensions of which are vanishingly small compared with all the dimensions that play a part in its motion, Part 1 of the "General Mechanics" is concerned with the mechanics of a material point. Since any actual body may be regarded, subject to the limitations imposed by quantum theory, as composed of material points, Part 2 of this volume deals with the mechanics of a system of material points. Here it is assumed that the bodies discussed are rigid, but strictly speaking all bodies are deformable, that is, they are susceptible of a change of form either as a whole or in some of their parts. Accordingly a separate volume is devoted to the "Mechanics of Deformable Bodies", the fundamental assumption made being that the space occupied by a body is continuously filled with matter.

These two volumes form an excellent introduction to more detailed textbooks and advanced treatises, and may be warmly recommended to students of applied mathematics or theoretical physics.

H. S. ALLEN.

Life and Love in the Universe

The Living Universe. By Sir Francis Younghusband. Pp. x+252. (London : John Murray, 1933.) 10*s*. 6*d*. net.

SIR FRANCIS YOUNGHUSBAND has offered us a worthy memorial of his seventieth birthday. His book is not a contribution to science, nor can it be said to contain anything novel either of a philosophic or a religious kind. Yet it is new and strongly inspiring, because it is something beyond all these, and, by drawing on ideas of all these fields and enforcing them with remarkable fervour and personal sincerity, it transfuses an ideal of unity, hope and love.

Sir Francis begins with a statement of the orderliness of the universe, inferring from it the presence of universal mind, and then presents an admirable sketch of evolutionary biology (based mainly on Wells and Huxley's "Science of Life"). From this he goes on to deduce the supremacy of creative love, manifested in the production of new creatures from the union of diverse but converging elements at each level of existence. The highest human type naturally dominates his scheme and he finds in the purest mysticism the goal of human thought, and the best guarantee for the upspringing of similar manifestations of life both in the future of the earth and—his boldest and most original flight—throughout the universe as a whole. He sketches what such more perfect beings would be like in the imaginary planet of Altair. Why should we not conceive among the unnumbered starry nebulæ which are swimming into our ken, an unlimited supply of possible places where life on various levels and in various forms may be developed ? Life-germs, diffused throughout the universe, have been imagined by many thinkers. The 'maybes' in this part of the book naturally occur rather frequently, but the 'maybes', actually delineated, follow in the main lines of their growth the conditions observed by life on earth. Growth, sensitiveness to outside stimulus, power of choice and movement and power of reproduction, these are the universal characteristics. On these we may base the conception of a rhythmic universe. "The living universe is an ever-living universe—lovely, loving, lovable. Of it and by it, we are made. And of it we remain, ever helping to make it. We partake in making the universe to be as the universe has made us. And as the universe has loved us, so do we love it."

These are the concluding words of the book and express its spirit. It is needless to dwell on their extreme generality or the ease with which the critical mind may perforate the case with questions and contradictions and difficult cases. It is a more congenial and, in the end, a more useful task, to point out how much of solid truth there is in it, and how by absorbing the ideal elements which Sir Francis Younghusband puts into prominence, we may, at least in our sublunary sphere, do something to promote the spirit which he would have us believe pervades the whole. There is clearly great need among us of the sympathy, fine feelings, ardent aspirations and confident hopes which inspire his work. To dwell on these is to increase them. The book needs no other justification, though there is

another on the purely intellectual side. It is a highly stimulating thing and often leads to real discoveries, to look for analogies in the complex manifold which our nature and the world present to the mind, so long only as the critical faculties are awake to control the resultant theories. Sir Francis is in the line of the Pythagoreans. If he can find in the universe more perfect beings beckoning us on by their example, if he can persuade mankind that the universe, as one, is labouring to maintain and multiply to infinity the things that we recognise as best on earth, he will give fresh force both to mind and spirit. As a storehouse of such thoughts, we believe that the book has been built to good purpose and that many will come back to it in future. F. S. MARVIN.

Conifers and Sempervivums

(1) *Conifers in Cultivation: the Report of the Conifer Conference held by the Royal Horticultural Society, Nov. 10–12, 1931.* Edited by F. J. Chittenden. Pp. ii+634+84 plates. (London: Royal Horticultural Society, 1932.) 21*s*.

(2) *An Account of the Sempervivum Group.* By Dr. R. Lloyd Praeger. Pp. ii+265. (London: Royal Horticultural Society, 1932.) To Fellows, 15*s*.; to non-Fellows, 21*s*.

THE two volumes under notice are official publications of the Royal Horticultural Society. The first is the report of the Conifer Conference held by the Society in 1931, and its 634 pages are filled with information on conifers. Forty years had passed since the previous Conifer Conference was held, and during that time many new species had been introduced; therefore the Conference had a peculiar interest to all who are concerned with trees. Every effort was made to ensure the success of the undertaking, and visitors were unanimous in their opinion that no such collection of plants and cut specimens had ever before been brought together.

As the Council of the Society was particularly anxious to try to establish uniformity for the names used for various species, a list of the kinds usually grown out of doors in the British Isles was compiled, in which the names now looked upon as correct according to the international rules on nomenclature were given, with many of the more important synonyms. This list appears in the early pages of the book and is followed by the fifteen papers read at the Conference, some of which are well illustrated. An account of the plants and cut specimens follows, then about 300 pages are devoted to statistical returns of conifers growing in 240 gardens and pineta in Great Britain and Ireland. The book will be found to be valuable alike from arboricultural and historical points of view.

The second book is a monograph of sempervivums by Dr. R. Lloyd Praeger, and it is very well done. The sempervivums present many botanical difficulties, for they hybridise so freely that it is very difficult to raise a species true to name from seed taken from cultivated plants or from wild plants where two or more species are growing in close association. Fortunately, all the species can be increased by offsets, therefore seed need not be relied upon.

Botanists working upon this group of plants are faced with another difficulty, for owing to the succulent nature of stems and leaves, they are difficult to dry and it is almost impossible to make a conclusive study of the species from dried plants. Therefore Dr. Praeger went to a great deal of trouble in collecting living plants in their native haunts from which to make his descriptions.

The work is divided into two parts, general and systematic. In the first part the author discusses systematy, history, hardy and tender kinds, variability, hybrids, parasites, epiphytes, teratology, the place of sempervivums in the garden, cultivation and economic uses; and in part two, which extends from p. 34 to p. 256, the various species are dealt with systematically under sectional headings. The descriptions are accompanied by excellent botanical drawings, and the book is concluded by a good index.

A Square Meal

Food, Health, Vitamins. By Prof. R. H. A. Plimmer and Violet G. Plimmer. Fifth edition. Pp. xii+143. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 3*s*. 6*d*.

NEARLY forty years ago, widespread interest was aroused by the discoveries of new and unsuspected gases in the air around us; to-day the man in the street and even more the woman at home is interested in vitamins—those surprising and apparently essential constituents of our foods. Ten years ago their very existence was disputed by the 'die-hards' of the calorie school of nutrition:

during the last few months three of them have been isolated in a pure state and day by day new facts come to light about them. A new science has dawned, that of proper feeding: it is one immediately available for everyone, it wants but little more than common sense for its application. We now know that much of what we eat is of little value to us by itself except as a source of heat; that for perfect health our daily food should include certain ingredients which are easy and inexpensive to procure; that even the humblest can have a balanced diet, and indeed that often the rich are the worst nurtured. The new learning must be spread abroad, spread by honest writers with accurate knowledge of the facts and not by cranks, or still worse in the form of advertisement of would-be proprietary articles claimed to be rich in vitamins.

Pioneers in this field have been Prof. and Mrs. Plimmer, whose little book, launched in 1925 when just enough was known with certainty to make it safe to apply the new doctrines in every household, has now reached its fifth edition. Their writing is based on a coloured chart termed 'a square meal', on which are indicated the foods supplying the vitamins A and D, B or B_1, C, B_2 or G, whilst outside the coloured areas are listed the foods of a similar nature which do not supply the vitamins. All that it is needful to know is contained in this chart, which indeed should be hung up over every housekeeper's desk, but the book contains a great store of practical lore besides.

Civilised man has no instinct for choosing the right kind of food amongst the abundance of products, most of them artificial, which are offered to him to-day. Even the farm animals are fed on sophisticated materials of low nutritive value in relation to vitamin content.

However, the new knowledge is spreading fast, and man and beast alike will be fed more rationally in future, until perhaps newer information sets us going on other lines. In the meantime, we have scientific confirmation of our convictions that flavour is an indication of quality and that small green vegetables are superior to large pale growths, deep-yoked eggs preferable to pale yellow ones, and above all that the value of butter can be judged by the depth of its colour though, before this is practicable, all form of artificial colouring of it must be prohibited. Surely this is a piece of legislation which is urgent.

As the result of the frequent revision, the Plimmers' book rises superior to any possible friendly criticism. The insertion of dates after references to individual workers enables the student to seek out the original work in the biochemical literature: it would be obviously out of place to insert references in a book of universal appeal of this type.

Our literary contemporaries from time to time remind us of the services rendered to man by 'Mrs. Beeton', and there must be many who have gained in girth as the result of the labours of her disciples, often to the subsequent advantage of 'Harley Street'. Under the Plimmer regime, 'Harley Street' will be no more, actuaries will have to revise their mortality tables and the growers of fresh food will become prosperous unless the chemist, as is indeed likely, first learns to synthesise the vitamins.

It is remarkable that with a considerable knowledge of their structure available, there is all the more uncertainty as to how vitamins act in the process of metabolism. Even if they take part in the oxidation-reduction cycle of changes, it is difficult to understand why they should be essential. So, as always, one discovery only brings more problems in its train.

Such a book should be read by everyone; it concerns each of us and may save us suffering. Its teachings hold the elixir of life which the alchemists so diligently sought of yore. E. F. A.

Short Reviews

Principles of Radio Communication. By Prof. John H. Morecroft, assisted by A. Pinto and Prof. W. A. Curry. Third edition, thoroughly revised. Pp. xviii+1084. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 46*s*. 6*d*. net.

"THE big Morecroft" is so familiar to every serious worker on radio communications that little more than 'welcome' need be said of this third edition. The first chapter remains the least satisfactory in the book, since the most difficult of all the tasks of authorship is to be at once elementary and accurate; the later chapters gain from the compact accuracy of technical 'shorthand'. The work of bringing into perspective the substantial advances registered in the five years between editions has, on the whole, been skilfully and successfully done. It must, however, be suggested that the accounts of fading, direction-finding, and indeed of all the phenomena of ionospheric 'reflection'

would have been better done had the author relied less exclusively on the *Proceedings of the Institute of Radio Engineers*—excellent as they are—as a source book, and come to British publications which were available before June 1932, the date of the preface to this edition. The structure and properties of the ionosphere are, quite certainly, more satisfactorily discussed in the British than in the American papers.

The extent of national unbalance in references may be judged from the following figures: citations from *Proc. I.R.E.* 157, from other American periodicals (excluding the publications of the Bureau of Standards) 100; from British periodicals 16, German 5, French 1. "America 257 not out, the rest 24" is a score which may mislead the author's young disciples in their most impressionable years. By way of contrast there may be quoted as a random sample the corresponding figures from a recent British book, nominally restricted to British work:—British 26, American 9, German 7, International 1.

The proof-reader has somewhat scamped his work, but the general make-up of the book is good, and this third edition can be cordially commended as a good general review of the very wide subject matter indicated in its title.

Animal Industry in the British Empire: a Brief Review of the Significance, Methods, Problems and Potentialities of the Live-Stock and Dairying Industries of the British Commonwealth. By A. N. Duckham. Pp. xvii+239. (London: Oxford University Press, 1932.) 15*s.* net.

In this book the author surveys the animal industry of the British Empire which, as he shows, is responsible for about two-thirds of its farming output. The range of efficiency is wide, varying from native management under which, in spite of large numbers of animals, the marketed products are only a few skins and hides, to intensive milk production as practised in Great Britain, where the annual gross output may be up to £50 per cow. Great Britain stands first in value of output of animal products, this being estimated, in units of a million pounds, at 200 in 1928 out of a total Empire production of about 650; of the individual products milk comes easily first, its value being about 200, while cattle for beef are valued at 100, wool about the same, and poultry, pigs and sheep each are valued at 50. This gives the perspective on which the survey is based. The author then proceeds to study the separate countries, giving a general account of the live-stock conditions in each, discussing also the physical and the economic factors concerned. Finally he discusses the question whether the Empire could or could not be made self-supporting for various items.

The book brings together much useful information not easily available elsewhere and presents it in a readable form. Lists are given in an appendix of sources of further information. Altogether the book can be commended to the student.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 30: *Barium.* Pp. xvi+390. (Berlin: Verlag Chemie G.m.b.H., 1932.) 64 gold marks.

The literature on barium compounds has been reviewed up to April 1932, and compounds which it forms with any of the 29 elements preceding it in the system are described with the usual wealth of detail. Considerable space has naturally been allotted to barium sulphate. Thus the various results of solubility determinations of this salt are tabulated and discussed. Whilst the values obtained at ordinary temperatures are moderately concordant, those near the boiling-point of water show wide discrepancies. In particular, gravimetric results appear to be very much higher than those calculated from conductivities, and natural barytes is said to give results about 15 per cent higher than the artificial salt. The physical properties of the element have been fully dealt with. These include atomic structure, mechanical properties, tables of wave-lengths of spectral lines and electrical conductivity, etc.

Experimental Atomic Physics. By Prof. G. P. Harnwell and Dr. J. J. Livingood. (International Series in Physics.) Pp. xiii+472. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1933.) 30*s.* net.

This introduction to atomic physics is based upon a course given at Princeton University, the purpose of the course having been to present the subject from a predominantly experimental point of view. Amongst the material included may be found radiation, atomicity of matter and electricity, thermionic and photoelectric effects, line spectra, atomic energy states, X-rays and radioactivity. Sufficient theoretical discussion is given to render the development systematic, but stress is laid on the experimental side and many experiments are described that are suitable for performance by students. Such experiments are by no means easy to arrange and this part of the book should make it of service to teachers who are planning a laboratory course on modern physics.

Mirrors, Prisms and Lenses: a Text-Book of Geometrical Optics. By Prof. James P. C. Southall. Third edition. Pp. xxiv+806. (New York: The Macmillan Co., 1933.) 22*s.* 6*d.* net.

This useful book on geometrical optics has been enlarged and improved by the addition of two new chapters. One of these deals with the microscope considered as being more or less typical of optical instruments, and the other treats of various subjects pertaining rather to physical and physiological optics yet having a bearing on the plan of the book as a whole. As in the earlier text, the historical notes are well done and add greatly to the interest of the volume.

The Expanding Universe

THE suggestion made by de Sitter in 1917, based on the general theory of relativity, that distant celestial objects would appear to be moving away from us, and the subsequent experimental discovery that the extra-galactic nebulæ have radial velocities which are a simple linear function of their distances—these have been followed by consequences sufficiently exciting, even to a generation which has witnessed an almost complete revolution in our physical notions. The discussion arranged in Section A of the British Association at the Leicester meeting, focusing as it did a number of these later developments, roused very general interest.

Sir Arthur Eddington, who opened the discussion with a rapid review of the problem, pointed out that the observational evidence, not strong enough in itself to warrant far-reaching conclusions, is backed by relativity theory which, although it does not predict the rate, demands an expanding or contracting universe.

An application of the uncertainty principle helps to show that the theoretical rate of expansion is equal to that observed. If e is a unit vector in random direction, the uncertainty of position of a particle in space-time of radius R is Re. The mean of N particles used as a reference frame will have an uncertainty of position $(R/\sqrt{N})e$, with a corresponding momentum uncertainty of $h/2\pi.\sqrt{N}/R.e$. Taking into account the energy corresponding to this momentum vector, we find that, if a particle is referred to the reference frame provided by a random distribution of the other N particles of the universe, the proper mass of the reference frame is $m_0 = (h\sqrt{N})/2\pi cR$. This makes m_0 intermediate between the masses of the proton and the electron, if we assume the value of $\sqrt{N}/R$ given by the recession of the spiral nebulæ. In an ordinary representation proper mass is attributed to the particle instead of to the reference frame, and in a one-dimensional problem the mass m would be directly transferred to the particle. Taking account of the dimensions of the problem, the apparent mass m of a particle (proton or electron) is given by

$$10m^2 - 136mm_0 + m_0^2 = 0.$$

Prof. E. A. Milne pointed out that the observed motions of the extra-galactic nebulæ are totally different from the motions of the planets in a solar system, from double-star orbits or from star-streaming. The nebulæ are simply separating one from the other—a motion typical of particles in free flight, or possessing velocities sufficiently large to escape from the gravitational attraction of the rest. Such a system must necessarily expand and the fastest particles will, at any given epoch, be the farthest. Moreover, the velocity-distance relation is one of simple proportionality. It is suggested, therefore, that the system of the nebulæ is that of a system of particles in free flight, subject to negligible gravitational influences. The expansion is an inevitable kinematic phenomenon, and is *the most natural thing in the world*.

In discussing the general kinematics of a particle system, those systems only are selected in which all points are fully equivalent. Flat space is chosen, the choice of space being open, and it can be shown that the Lorentz formulæ are applicable; it then appears that only one system of flow is possible, a flow which reproduces the observed expansion. Moreover, the observable volume of the system is finite and the density must slowly increase outwards from any observer.

Dr. G. C. McVittie remarked that Lemaître's original theory assumed that a fair approximation to the facts might be obtained by treating the matter in the universe as if it were diffused in the form of a cosmic cloud. But in actual fact there are regions of condensation—spiral nebulæ or stars—separated by comparatively empty regions. What is the effect on the theory of an attempt to take account of this discontinuous distribution? The problem turns out to be intractable—we cannot solve even the problem of two particles. But a system in which we have one particle and the remainder of the universe a cosmic cloud may be handled, although the solution is not unique.

The Einstein universe—one in which the cosmic cloud had everywhere constant density and a very small pressure, space being spherical and closed—is unstable. The theory of Lemaître gave no indication of the direction of motion of such a universe from its equilibrium position, and the theory of condensations was first developed in order to find out whether the condensation of the cosmic cloud into particles would initiate an expansion. Unfortunately the disturbance of the equilibrium is a second order effect and the problem is mathematically so complicated that no satisfactory method of solution has yet been evolved. The theory of condensations is much more helpful in the consideration of the question of cosmic time.

Dr. W. H. McCrea dealt with the relation of Milne's theory to the general relativity theory of the expanding universe. De Sitter, on general relativity grounds, had predicted a systematic recession of distant nebulæ, for which observational support accumulated. Lemaître, Friedmann and others, using general relativity theory, arrived at the concept of an expanding universe, and an explanation of Hubble's empirical law for the variation of recession-velocity with distance. Milne then suggested an explanation of the recession which might stir someone to the remark that, had it been propounded earlier, it might have saved us all the trouble of trying to fathom general relativity. But general relativity is really the best mathematical method for dealing with Milne's phenomenon. Consider the simplest

solution of Milne's problem. He chooses his space-time first and then seeks that gravitational law which will reproduce the actual state of affairs. General relativity, on the other hand, puts the gravitational law first and then seeks a form of space-time which will reproduce the actual system. The general relativity theory of the expanding universe admits a whole class of curved spaces. Choose the right one with λ equal to zero, neglect the gravitational interaction of the particles and we obtain Milne's universe as just considered. We then proceed to discuss the effect on Milne's theory of an allowance for the detailed gravitational attraction of the particles.

M. l'Abbé Lemaître remarked that the theory of the expanding universe demands a modest age for the universe—a period a thousand times less than that dependent on the usual theory of the evolution of the stars. Can the expanding universe theory substitute for this slow evolution a more rapid process? It *is* possible to envisage a process in which the universe in general starting with a small radius expands with a diminishing velocity, until the equilibrium radius is reached, when it will expand with an accelerated velocity. Interior regions of a somewhat greater density might fail to attain equilibrium and contract, while the universe at large continues to expand. Hence the rapid formation of nebulæ. A difficulty arises, inasmuch as for a condensation of the thousand millions suns required for a normal nebula the equilibrium radius is about 80,000 light years, instead of the 1,000 light years radius of a typically elliptical nebula. Consideration of the energy turned into heat by the rapid concentration of diffuse matter into stars minimises this difficulty, and we may picture stars and nebulæ as being born together in an astronomical instant, a sudden evolution of the universe taking the place of a slow evolution of the stars.

Prof. de Sitter's masterly survey of the problem almost defies analysis. He discussed three of the theories proposed for the explanation of the linear velocity-distance formula found for the recession of the spiral nebulæ. He remarked of Milne's theory that the frequency law of the velocities V of the spirals is rather artificial. But the principal objection to the theory is that it ignores the fact that on the relativity theory of gravitation, it is impossible for the velocities V to remain constant.

'Solution B' of the general field equations of the relativity theory shows that the locus of a spiral is a hyperbola described with a variable velocity, the radial component of which, at large distances from the origin, is given by $V/c = \pm hr$. A special hypothesis, that the spirals are all on the receding branches of their hyperbolas, is required to give the velocities a positive sign. But the theory had to be abandoned because it requires an 'empty universe', that is, a universe containing a density of matter so low as to be indistinguishable from zero.

The solutions on which the third theory is based are due to Friedmann and to Lemaître. In Lemaître's theory the formula $V/c = hr$ is rigorous, and it provides the required adjustment between the observed coefficient h and the observed density.

The shortness of the time that has elapsed since the 'beginning of the universe'—that is, since the time of minimum mutual distances of the galaxies, as compared with the accepted ages of the stars, has been expressed by the statement that 'the stars must be older than the universe'. This sounds paradoxical, but there is really no paradox. The ages of the giant Redwood trees in California are of the order of 2,000 years but California, as a State, is less than a century old. We do not for this reason revise our estimate of the ages of the trees, but we conclude that trees could live in California before California was born. Similarly stars could exist in the universe before it attained its present configuration.

One of the most important of the services which the British Association renders to the public is that of organising discussions which may assist in elucidating the more difficult scientific problems of the day. The expanding universe discussion was, perhaps, rather on the technical side, but it was memorable alike for the subject and for the personalities engaged therein, and it will rank high on the list of those great discussions with which the name of the Association is linked. A. F.

Recent Developments in Television*

By ARCHIBALD CHURCH, D.S.O., M.C.

ALL development of the art of television is recent. It is less than ten years since John Baird first obtained televised images of simple stationary objects such as a Maltese cross. He first demonstrated 'real' television, the instantaneous reception of optical images of moving subjects, images of which had been transmitted by means of a variable electric current, on January 27, 1926. Most of the scientific workers and publicists present at that demonstration, while impressed by the achievement, were frankly sceptical of television ever achieving any position as a medium of entertainment or of its being put to other commercial uses. The received images were recognisable, but blurred and flickering, and to many scientific workers, a proof of the impossibility of advance in television by a mechanical system of transmission and reception. Other scientific observers, though less antipathetic to the mechanical system, were unconvinced that television broadcasting would ever be practicable owing to the wide range of frequencies which

* Paper read before Section A (Mathematical and Physical Sciences) of the British Association at Leicester on September 13.

would have to be made available if images with detail comparing with that obtainable on a cinema screen were to be received. This was the more vital criticism of television, as it applied not only to the mechanical means by which Baird obtained his first results but also to any other means, for example, the utilisation of cathode rays, which might afterwards be enlisted in the service of television.

Only minor modifications had been made of the original apparatus used when Baird gave his first demonstration to members of the British Association at Leeds in 1927. In 1926 the subject to be televised was bathed in light from a battery of powerful electric lamps. Between the photoelectric cells and the illuminated subject was a scanning device, a disc in which thirty holes were punched at regular intervals on a spiral and making five revolutions per second. The subject was thus scanned by a rotating optical element strip by strip, each strip being presented in sequence to a light sensitive element, the photoelectric cells. The varying strength of electric current transmitted by the photoelectric cells modified the light in a neon lamp at the receiving end, and this varying single light source was scanned in turn by a 'Nipkow' disc synchronised with the disc at the transmitting end. The reconstituted image, two inches square, was seen by looking at the neon lamp through the scanning disc. Synchronism was obtained by the use of synchronous motors.

For the Leeds demonstration 'noctovision' was used, the person televised being shielded from the direct glare of the lamps by a sheet of ebonite. In the meantime, however, Baird had made a further notable advance by his invention of the light spot method of scanning. To quote the text of his patent: "The scene or object to be transmitted is traversed by a spot of light, a light sensitive cell being so placed that light reflected back from the spot of light traversing the object falls on the cell." It is, in effect, an inversion of the flood-lighting method, and possesses the advantage that greatly increased signal strengths are obtained with considerable diminution in the intensity of the illumination to which the subject of transmission is exposed.

Abroad, the method was almost immediately applied by the Bell Telephone Company in the United States in carrying out a television transmission over a circuit between New York and Washington. The same year, 1927, Belin and Holweck achieved a measure of success in transmitting outlines and shadowgraphs using a cathode ray oscillograph (Fig. 1). The success of Baird had given an impetus to research in television in several countries as the patent records of England, the United States, Germany and France will testify.

On February 9, 1928, Baird achieved an ambition to be the first to televise across the Atlantic. The signals were picked up in the presence of Reuter's representative by an amateur operator at Hartsdale, a few miles from New York, the experimental receiver showing an image about three inches square on a ground glass screen. This Baird followed almost immediately by a transmission from London to the s.s. *Berengaria* in mid-ocean. According to the chief staff engineer of the vessel, the "image varied from time to time in clarity, but movements could be clearly seen, and the image, when clear, was unmistakable". In these transmissions the wave-length used was 45 metres. The following year, using light spot transmission and cathode glow lamp with disc reconstruction, Baird demonstrated in engineering form at the British Association meeting in Cape Town, and the British Broadcasting Corporation agreed to provide facilities for a series of experimental television broadcasts by the Baird system on the London B.B.C. transmitter. At this time, the transmission of wording for instantaneous news broadcasts, telegram transmission in character, languages and other purposes was further developed by Baird and transmissions of this kind were featured in the experimental broadcasts.

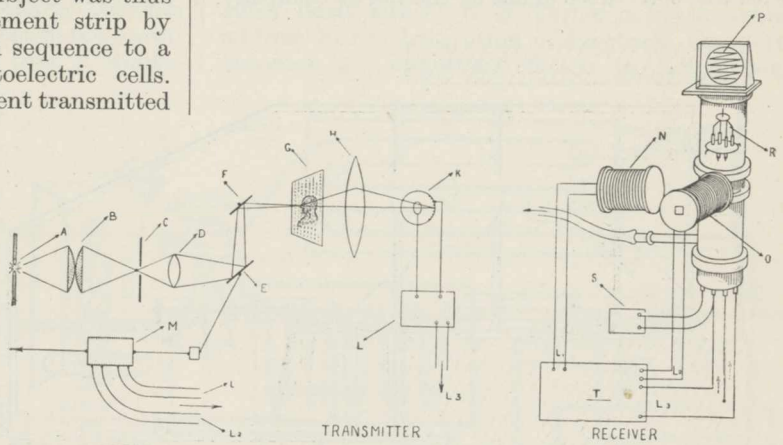

FIG. 1. Schematic diagram of Belin and Holweck's television apparatus.

In July 1930, the Baird Company gave its first public demonstration in a theatre, living artists and cinema films being transmitted from its studios in Long Acre, London, W.C.2, and reproduced on a multi-cellular lamp screen on the stage of the London Coliseum. The same year the youthful Baron von Ardenne in Germany commenced his researches on television, utilising the technique acquired in his development of cathode ray oscillograph tubes for the transmission and reception of television images, and within a year earned the distinction of being the first to demonstrate publicly cathode ray reception comparable with that produced by mechanical means. At first, von Ardenne received images transmitted by mechanical means, but later, by

using a variable velocity constant intensity cathode stream instead of one of varying intensity and constant velocity, he was able to employ his cathode ray tubes for transmission and reception.

Meanwhile, researches into the possibilities of cathode ray television were engaging the attention of a large number of scientific workers in the laboratories of the Radio Corporation of America and its associated enterprises, independently by the Philco and other American companies, and by the Fernseh A. G. of Berlin, in which the Baird Company are equal partners with Bosch, Zeiss-Ikon, and Loewe. The last-named holds important von Ardenne patent rights. In the Fernseh A. G. laboratories, research in cathode ray television was directed towards the development and utilisation of 'hard' tubes, that is, tubes at pressures below 10^{-5} mm., as contrasted with the 'soft' tubes in use by the Loewe Company,

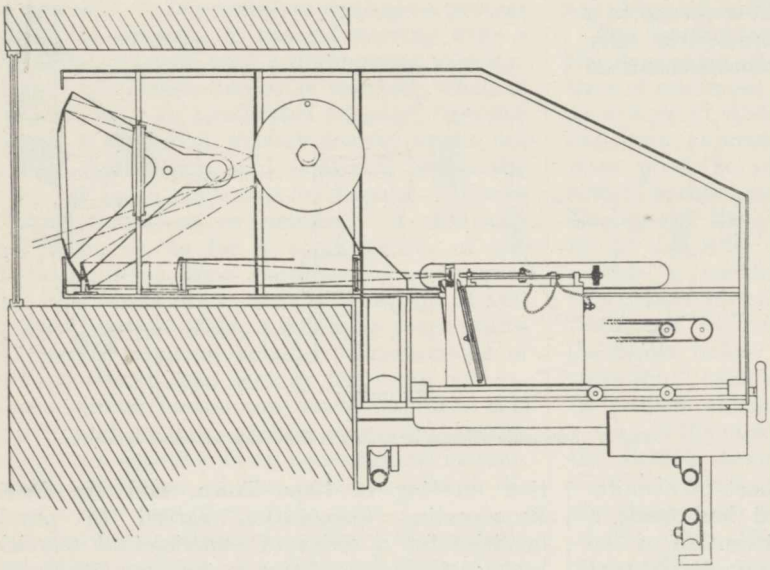

FIG. 2. A sectional scale drawing of the television transmitter as installed at Studio B.B., at Broadcasting House, London.

the advantage claimed for the hard tube being its long life, an important consideration.

Proponents of mechanical methods, however, were by no means discouraged by the results obtained by the use of cathode ray tubes. The Baird Company, by using a mirror-drum instead of a Nipkow disc at the transmitting end, and at the receiving end using either a directly-modulated arc or a multiple Kerr cell in conjunction with a mirror-drum, was able to project fairly bright images on a screen about 6 ft. × 2 ft. in size, and demonstrated its results at the British Association centenary meeting in London, in the exhibition devoted to Mechanical Aids to Learning. This demonstration followed one in January 1931 in the Baird Laboratories at Long Acre of three-zone television, three 30-line mirror-drums being used to obtain an extended image. Later in the same month the Gramophone Company gave a similar performance in London at the Exhibition of the Physical and Optical Society, at which cinema films were transmitted by the multi-channel process and reproduced by means of a Kerr cell and mirror drum apparatus on a translucent screen. In the same year the Derby was televised by the Baird process.

In 1932 five major events in the progress of television took place. Fernseh A. G., the company organised to develop the Baird processes in Germany, built and installed a complete transmission equipment for the Ente Italiano per le Audizione Radiofoniche in Rome ; the Derby was televised and projected at the time of its occurrence upon the screen of a London cinema by the Baird Company ; the British Broadcasting Corporation installed television transmission equipment designed by Baird Television Ltd., for regular transmissions from its London studio (Fig. 2) ; and the Baird Company designed and marketed a much improved home television receiver, the Nipkow disc and neon tube of the old type being replaced by a mirror-drum and Kerr cell combination for projecting the received image on a translucent screen : and Dr. Alexanderson, of the American General Electric Company, successfully transmitted and received television images over a light-beam, with apparatus and by methods similar to those demonstrated by the Marconi Company at Leicester at the recent meeting of the British Association.

This year has been one of feverish activity on the part of all companies interested in the commercial exploitation of television, and of numerous independent research workers in various countries. Many interesting and ingenious modifications have been made in the cathode ray oscillographs. The Fernseh A. G. has made tubes with fluorescent ends with diameters up to 2 feet. Von Ardenne has devised a method of projecting the cathode ray beam from a plate within the tube on to an external screen. Von Mihaly has developed a mechanical system by which the modulated light of the receiver is swept by a small rotating mirror at the axis of a stationary drum across a number of mirrors fixed on its inside surface, for which he claims superiority over the revolving mirror-drum. The Fernseh A. G. laboratories have constructed beautifully accurate mirror-screws with 90 and 120 reflecting surfaces of stainless steel. Dr. Vladimir Zworykin, the American research engineer, has made sensational claims for what he terms his iconoscope, which has been described as consisting of two devices—a photo-electric mosaic on which a scene is focused by a lens system, and a cathode ray gun which fires

at this mosaic screen a stream of electron projectiles. The signal plate on which the scene to be televised is focused may be about 4 in. × 5 in. in size and on this surface are millions of small photo-cells, each consisting of a minute silver globule sensitised by cæsium. These globules are deposited on an insulating plate, such as a thin sheet of mica, the back of which is made conductive by a metal coating. Within the same glass bulb as the mosaic screen is the electron gun, which throws a beam of electrons at the screen and is made to sweep across the screen horizontally and vertically by deflecting coils as in an ordinary cathode ray tube. Whenever an electron hits a photocell, it neutralises part of the charge on the associated condenser. This discharge current is picked up, amplified and transmitted to the receiving cathode ray beam which is moving across a fluorescent screen in synchronism with the scanning beam. The varying discharge currents modulate this receiving beam and hence the screen at the receiver. It is reported that a similar device has been invented by Dr. Francis Henroteau, chief of the Dominion Observatory, Ottawa, who calls his invention the 'super-eye'. If the claims can be backed up by practical demonstrations, a new and important advance will be made in television.

Again and again in the last two years, it has been urged that finer resolution than that obtainable with the 30-line standard, 2·4 : 1 ratio, picture is necessary before television will become popular. This may or may not be so, but the true nature of the present position should now be realised. In the first place, it is easily demonstrable (and it has in fact already been put forward) that, with a 10 kc./sec. band-width, the intelligence-time transmission characteristic of a channel (at a reasonable picture-speed such as 12·5 per second to minimise flicker) is most economically filled at about this number of lines and ratio.

At the moment, pictures incomparably better than those possible with 30 lines, using mechanical reconstituting devices, are obtainable with cathode ray receiving apparatus which has become available this year. Such pictures were first demonstrated publicly in Great Britain by the Baird Company at this year's meeting at Leicester of the British Association and by Loewe, Fernseh A. G. and others at the Berlin Radio Exhibition, comprise 120–240 scanning strips, and require side band widths of from 150 kc./sec. to 1,000 kc./sec. for their proper transmission. In view of the Geneva convention, under which absolutely no provision was made for the proper expansion and development of television in the broadcast band of wave-lengths, an entirely new radio technique will have to be developed. Local areas, served by ultra short wave radio transmitters, seem an ideal solution. In practice, however, many difficulties arise, not the least of which is the shielding effect in populous areas of buildings, steel structures, trees, rises in ground contour, etc. Research in this direction is progressing; in fact, experimental short-wave transmissions of high quality pictures (that is, of 120-line definition or more) have already commenced in the London area, the Crystal Palace towers being utilised for this purpose. But it may be a year or two before an established service throughout the country is achieved. In the meantime, further problems arise in connexion with distortion in amplifiers against which the weapons provided by Oliver Heaviside, to whose classic researches on the underlying electrical principles of distortion in communication engineering too little credit is given, are powerless. In extending the band-pass of an amplifier, the 'temperature effect' dealt with by L. B. Turner in his inaugural address to the Institution of Electrical Engineers becomes an important factor in determining the interference level of a system; all the more so because an increase in the number of scanning strips in a picture involves the diminution, usually according to some power-function, of light available to affect the light sensitive cells. Further carefully directed research in this direction has become imperative for the transmission of actual scenes, as opposed to film broadcasts. For the projection of television pictures to large audiences in cinema theatres and elsewhere, Fernseh A. G. has recently demonstrated an 'intermediate-film' method (Fig. 3). In this the televised image is received on a cinema film which is then developed and passed through an ordinary cinema projector, the time interval between the reception and projection being about 6 seconds if an ordinary reel of film is used, about 20 seconds if an endless loop of film is used, the 'base' being first emulsified and dried, then exposed to the receiving scanning device, developed, projected and de-emulsified. This method shows great promise but much further work remains to be done on it.

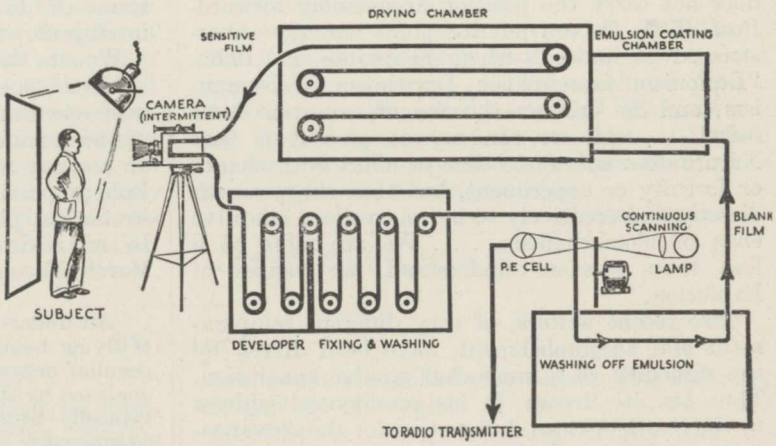

FIG. 3. Simplified diagram of the apparatus employed by Fernseh A. G. for the transmission of television by the intermediate film method.

The Origin of Species

THE problem of the origin of species seems to be as far from solution as ever, but one tendency, even if it be only a negative trend, runs through the most recent discussions of the question. It is the denial of the possibility that fortuitous minimal variations, even under the pruning of natural selection, could ever bring about those fine adjustments between organisms and their environment which is the most outstanding characteristic of living things. Positively the idea is that the accuracy and delicacy of the adaptations of living things betoken a relationship with outside Nature, inorganic and organic, more direct and spontaneous than chance could explain. Should the idea be correct, many of the old theories must undergo modification or fall into abeyance. Even the widely accepted modification that mutations, arising fortuitously in the germplasm, have been weeded out by natural selection, does not carry the position appreciably forward. Prof. H. F. Osborn put the point strongly—overstressed it indeed—when he wrote in 1926: "Buffonism, Lamarckism, Darwinism, Weismannism, and de Vriesian theories of causation have failed. . . . All we can say at present is that Nature does not waste time or effort with chance or fortuity or experiment, but that she proceeds directly and creatively to her marvellous adaptive ends of biomechanism. . . . We are more at a loss than ever to understand the causes of Evolution."

Two recent writers, of very different temperament and accomplishment, have been driven by the difficulty to a somewhat similar conclusion. Thus Dr. R. Broom, in his presidential address to the South African Association for the Advancement of Science, at Barberton, on July 3, 1933, cites remarkable cases of adaptation, the mimicry of butterflies, the fertilisation of the *Yucca* by the moth *Pronuba*, the egg-breaking projections in the gullet of the snake *Dasypeltis*. He considers that all important evolution, except the appearance of man, ended in the Eocene period, and that all forms of plants and animals are now so specialised that they can scarcely evolve further. It might be pointed out that the great periods of organic evolution seem to be associated with great movements of displacement in the earth's crust, and that these are responded to, not by the finished specialists at the tips of evolutionary branches, but by less specialised forms nearer the point of the origin of their group. Nevertheless, the facts appeal to Dr. Broom as suggesting that evolution has not been haphazard but has been controlled by some intelligence; he is forced to the conclusion that there must be behind evolution spiritual agencies of various degrees of intelligence, and that the chief end of it all has been the production of man.

Dr. Ronald Campbell Macfie, graduate in arts and medicine of the University of Aberdeen, poet and philosopher, examines the claims of the old theories of evolution in his recently published posthumous work "The Theology of Evolution". Rejecting all mechanical explanations, he is compelled to postulate behind the changes of evolution, if indeed he will admit that evolution really occurred, a directive mind or "mento-volition". Further, he holds that mento-volition, though inherent in living matter, is not completed therein, but may occasionally assume the direction of evolution from without. "Behind life, behind mutation, behind evolution or transformism, is a Causal Intelligence and it is this Intelligence that intelligently selects and couples biophilic correspondences of organisms and environment, and that, wisely rearranging the germplasm, *may* have produced genetic mutations that may perhaps be competent to effect a transformation of one or two primal cells into all the forms of life." "Matter is will; living matter is intelligent will."

We cite these as recent examples of the extreme vitalistic position to which a systematist and a poet-scientist have been compelled by their study of the manifestations of life. On the other hand, an analogy with modern physics suggests to Prof. Bohr a possible explanation of a problem which so far no physico-chemical analysis has solved. In an address delivered a year ago (NATURE, March 25 and April 1, 1933) Prof. Bohr said:

> "An understanding of the essential characteristics of living beings must be sought, no doubt, in their peculiar organisation, in which features that may be analysed by the usual mechanics are interwoven with typically atomistic traits in a manner having no counterpart in organic matter. . . . On one hand, the wonderful features which are constantly revealed in physiological investigations and differ so strikingly from what is known of inorganic matter, have led many biologists to doubt that a real understanding of the nature of life is possible on a purely physical basis. On the other hand, this view, often known as vitalism, scarcely finds its proper expression in the old supposition that a peculiar vital force, quite unknown to physics, governs all organic life. . . . In every experiment on living organisms, there must remain an uncertainty as regards the physical conditions to which they are subjected, and the idea suggests itself that the minimal freedom we must allow the organism in this respect is just large enough to permit it, so to say, to hide its ultimate secrets from us. On this view, the existence of life must be considered as an elementary fact that cannot be explained, but must be taken as a starting point in biology, in a similar way as the quantum of action, which appears as an irrational element from the point of view of classical mechanical physics, taken together with the existence of the elementary particles, forms the foundation of atomic physics."

While efforts such as these are being made to find a formula which will meet the peculiar demands of organisms and the minimum that

different types of mind are prepared to allow in order to bridge a gulf in scientific analysis, other efforts are being made to define with greater precision the actual steps of evolution. Notable amongst these are the recent contributions of Henry Fairfield Osborn to the problem of the origin of species. Like Prof. Bohr, he admits the distinctiveness of life, and uniting the biotic and the physico-chemical notions, he terms organic as distinguished from inorganic processes, "biomechanical". The products of biomechanical processes are "biomechanisms" and the origin of new adaptive biomechanisms is termed "aristogenesis".

Aristogenesis, according to Osborn, differs from the theoretical concepts of life activity, such as entelechy, vitalism, emergence, holism, and the rest, in that it is descriptive, relating to an observed order of Nature, a concrete process or processes. It is not an explanation or hypothesis or theory, for the principles of its operation are known, though no explanation or hypothesis is offered as to why it works or what its causes are. Osborn himself described a series of principles of its operation in an address at the centenary meeting of the British Association in 1931—"The Nine Principles of Evolution Revealed by Palæontology"[1]. One, the directive mutation discovered by Waagen in the shells of molluscs, where inconspicuous mutations proceed to develop into conspicuous organs, has been amplified by Osborn's work upon the teeth of several mammalian series.

As a result of these inductive investigations, aristogenesis is now defined[2] as "the gradual, secular, continuous, direct, reactive, adaptive origin of new biomechanisms. It is a creative process from the geneplasm [or germplasm] of entirely new germinal characters. . . . Aristogenesis is a secular genetic and adaptive reaction rather than an immediate adaptive reaction to new habit or environment as in Lamarck's theory." So regarded, aristogenesis expresses itself into two ways: as "aristogenes", governed or predetermined by germinal potentialities in certain lines of descent, so that in closely related stocks parallel aristogenes arise no matter how far the stocks may be separated geographically; and as "allometrons", changes of proportion or intensity which are not governed or predetermined by germinal potentiality in certain lines of descent, but arise independently within species or races.

Allometrons, of which the changes of proportion of parts in human races may be taken as an illustration, are relatively rapid in development or temporal, whereas aristogenes are slow in development or secular.

The essence of Osborn's view of evolution is that it gives expression to the tendency to look upon adaptations not as the result of chance variations experimentally selected, but as definitive steps in an orderly direct series, and these can scarcely be regarded as other than steps to an end in a teleological sense.

JAMES RITCHIE.

[1] *American Naturalist*, 1932, p. 52.
[2] *Proc. U.S. Nat. Acad. Sci.*, **19**, 699, July 1933.

Obituary

DR. HERBERT LAPWORTH

DR. HERBERT LAPWORTH died on September 18 at his home in Sutton, Surrey, at the age of fifty-eight years. He was the younger son of Prof. Charles Lapworth, F.R.S., and was educated at King Edward VI School, Birmingham, and at the University of Birmingham. Afterwards he was articled to the late James Mansergh, and during his pupilage he was for some time engaged on the Elan Valley water supply scheme for Birmingham, and later as an assistant resident engineer on the same undertaking. It was during this period that he carried out the field work placed on record in an admirable paper entitled "The Silurian Sequence of Rhayader" published by the Geological Society of London, which threw much light upon a geologically difficult district.

Dr. Lapworth's lectures of the session 1907–8 to the students of the Institution of Civil Engineers on "The Principles of Engineering Geology" were inspired by knowledge and distinguished by their lucidity. He was also, for several years about 1910, lecturer on engineering geology in the Universities of London and Liverpool.

Prior to his coming to London in 1910, Dr. Lapworth was engaged as resident engineer on various large works of public water supply. He soon became recognised as an outstanding authority on geology as applied in civil engineering and especially in waterworks engineering, and his opinion and evidence were in constant demand. In addition to the geological side of his activities, he also reported upon, designed and supervised the construction of many works of water supply, including those for Macclesfield, Hastings, Scarborough, Swindon and Bilston. In 1930 he delivered the Symons Memorial Lecture to the Royal Meteorological Society, his subject being "Meteorology and Water Supply".

Dr. Lapworth was the author of several technical papers, and these were invariably models in style and most informative and useful in their matter. He was a doctor of science, a member of the Institution of Civil Engineers, a past president of the Institution of Water Engineers, a member of the Association of Consulting Engineers and a past secretary of the Geological Society. He also served upon many technical committees, and his work in this sphere was notable for its sound judgment and broadness of view.

He was a man of such charming character and wide sympathy that he endeared himself to all with whom he came into contact, and his loss will be sincerely regretted by a large circle of friends.

H. J. F. G.

News and Views

Salaries of Scientific Workers in Government Employment

THE restoration of the economy cuts in salaries made by county councils and other public bodies in Great Britain within the last six months raises the important question as to when the Government proposes to follow suit. These cuts have inflicted considerable hardship on a large body of scientific workers in Government employment, and they were always avowedly temporary in their incidence. The ten per cent reductions have now been operative for two years, and in very many cases they were imposed on basic salaries that were in no way adequate considering the scientific attainments of the victims. Admittedly they were a breach of contract, and there is considerable force in the contention that the Government is in honour bound to follow the example of municipal bodies, and to restore these cuts at the earliest possible moment. The country's financial position is very different now from what it was in October 1931. The national finances have been stabilised. Successive conversion schemes have reduced the burden of debt charges. The estimated revenue from the new tariffs for the current year is £24,500,000. Moreover, during the current year the revenue has received a windfall of more than £8,000,000 from death duties on the estate of the late Sir John Ellerman alone.

TRADE is improving, and the adverse balance of trade is smaller than it has been for some considerable time. Employment is improving, whilst unemployment is decreasing. New industries are being launched, such as coal hydrogenation, which will be productive of increased employment and revenue. These new industries are frequently the outcome of scientific research; and it is not too much for scientific workers to expect that the conditions under which they have laboured during the past two years shall, at least, be restored to the level of 1931. Point is added to this expectation when it is borne in mind that the Government from time to time creates fresh appointments of a non-scientific character which carry no such burdens as salary cuts. A whole batch of appointments has recently been created under the Milk Marketing Board, none of which appears to have salary cuts imposed—notably a general manager has been appointed to this Board at a commencing salary of £5,000 rising to £7,000; that is to say, this general manager's salary is not subject to the cut which is imposed on the Prime Minister's, and will eventually be higher than the Prime Minister's basic salary. Then recently a fresh appointment was made at the Post Office, and there was no mention of the salary being subject to an economy cut. It is obvious that the time is ripe for reviewing the whole situation.

Dr. Herbert E. Ives

DR. HERBERT E. IVES, who is to deliver the Thomas Young Oration before the Physical Society on October 6 at 5.45 p.m., at the Royal Institution, is well-known to British physicists interested in optical subjects for his outstanding work on the theory and practice of modern photometry and colorimetry. For a period extending approximately from 1914 until 1925, Dr. Ives, with various collaborators, directed his attention to the various outstanding problems of light measurement, and in a succession of important papers introduced science where chaotic empiricism had previously prevailed. To him we owe the first systematic study of the problems of heterochromatic photometry, and his classical work on the theory of the flicker photometer is still the basis of present-day practice in the use of this instrument. He also laid the foundations on which any successful method of physical photometry must be built. While Ives cannot be said to have discovered the foundations of scientific colorimetry, which lay unnoticed in the work of earlier pioneers, he unearthed them and revealed their essential simplicity; and his work on this subject was the basis from which all modern developments in the United States, Great Britain and many other countries have followed. In more recent years, in the laboratories of the Bell Telephone Company of New York, Ives has been engaged on photoelectric problems, and has been personally responsible for many of the striking developments which have taken place in telephotography, television, stereoscopic cinematography and allied subjects.

Marking of European Storks

ARRANGEMENTS that have been made to broadcast the progress of flights of storks marked with numbered rings at the ornithological stations at Rossitten and Essen in Germany, recall the history and results of bird-ringing in Europe, which commenced with the stork and have, perhaps, revealed most regarding the migrations of the white stork, *Ciconia alba*. In 1710 a large bird, described as a heron or a stork, probably the latter, was captured in Germany and on its legs were several metal rings, one of which bore an inscription stating the bird had been caught in Turkey several years before. This is believed to be the first attempt at marking migrating birds with rings. A hundred years later Brugmann captured a few storks in Holland and placed rings on their legs, but failed to trace them. In 1899, Mortensen, in Denmark, succeeded in marking and recovering a number of birds, and after that the practice of ringing became very extensive. Two years later, Prof. Thienemann founded the Rossitten Ornithological Station on the Baltic shores, where bird marking has since been carried out on an extensive scale. 110,000–120,000 storks have been marked since 1917 in Denmark and one from Jutland is believed to be between thirty and forty years of age (Skovgaarde). At the same time, however, the stork population has been reported to be decreasing in Holland and elsewhere. 2,000 storks are estimated to inhabit Denmark, but France's nesting colonies have vanished and nests are rare in Italy and Russia, and the

colonies in Alsace are vanishing. It has been stated (Bowen) that a pair built on the roof of St. Giles Cathedral, Edinburgh, in 1466, but did not return.

Migration of Storks

STORKS nesting east of the River Elbe have been found to use the Asia Minor route when migrating, and those nesting west of the Elbe are stated to take the route through Spain. The winter quarters of European storks is Natal and near the Cape of Good Hope, South Africa, and Danish storks have been described using the route through Germany, Czechoslovakia and Hungary, to cross the Bosphorus to Asia Minor, but evidence of ringed birds reaching the Nile across the Mediterranean or through Palestine seems lacking, though prior to ringing, Shaw has described the annual migration from Egypt over Mount Carmel as occupying three hours. The Danish storks leave in late August and arrive at their winter quarters, 7,500 miles away, in about two months, though the return migration is quicker. Of 125 young storks bred at Rossitten, on the Asia Minor route, and released at Essen, on the France and Spain route, on September 12, to see whether the migration route is hereditary, reports indicated many following a south-eastern route, though two have been shot on the Loire, in France.

International Society of Leather Trades Chemists

THE bi-annual meeting of the International Society of Leather Trades Chemists was held at the Colonial Institute, Amsterdam, on September 18–21 in conjunction with the I.V.L.I.C., the president, Mr. F. C. Thompson, being in the chair. The president elect for 1934–35 is M. C. R. Loos (France), and the 1935 Conference is to be held at Brussels at the invitation of the Belgian Section. During the proceedings, Prof. E. Stiasny (Darmstadt) was unanimously elected an honorary member of the Society, in recognition of his international scientific services. In his presidential address, Mr. F. C. Thompson dealt with the subject of *p*H determination, at the conclusion of which the Society nominated a special commission to consider this subject, particularly from the point of view of the leather and allied industries. The technical and scientific agenda comprised some thirty-eight contributions, the opening paper being by Prof. H. R. Kruyt (University of Utrecht) on "The Colloid Chemistry of Collagen and Gelatin". In the light of de Jong's theory of complex coacervations, collagen was regarded as a complex coacervate, this theory being discussed also from the points of view of the histologist and embryologist. At a special session with the International Tanners' Council, a film was shown on the Warble fly, followed by a lecture by Prof. M. Bergmann (Dresden) on "Hide and Skin Preservation". Among other papers presented were "The Structure of Collagen Fibres" by Dr. A. Kuntzel, "Characteristics of Vegetable Tanning", Dr. F. Stather, "Some Problems of Two Bath Chrome Tanning", Prof. E. Stiasny, C. Riess and A. Papayannis, "Estimation of Acid in Chrome Leather", C. Riess and A. Papayannis, "X-ray Spectrograph of Albumin with Relation to Collagen and Gelatin" and "Studies on Mutarotation of Gelatin" by Prof. J. R. Katz. "Histology of the Corium and Grain of Hide", by Dr. G. C. Heringa, "On the Theory of Leather Dyeing" by Prof. E. Elod. A number of other papers related to leather technology.

Quality of Sound Reproduction

THE inaugural meeting of the 1933–34 session of the British Radio Institution was held at King's College, London, on September 22, when Dr. L. E. C. Hughes gave a lantern lecture entitled "Reproduction of Sound via Radio". Dr. Hughes introduced his topic from the system point of view, indicating that many mistakes have been made in the past in concentrating too closely on particular details of broadcasting, forgetting that other sound reproducing systems have overlapped and provided information which could be turned to use in the system under discussion. It is most desirable that the general conditions required for good reproduction of sound should be applied uniformly not only to sound-systems as a whole but also to the component parts. In this way, all departures from the ideal criteria for reproduction can be assessed. Of greatest importance are the response curves of microphones and loud-speaking receivers, not only the response relating to the actual power output as compared with the input power, but also the distribution curves indicating the response of the units in different directions. Dr. Hughes outlined the methods of sound measurement which are in use for determining these response curves. At the moment, the basic calibrations by the Rayleigh disc and the thermophone are relied upon. The great difficulty is to ascertain what tolerances from the ideal criterion can be permitted. At present there is no standard loud-speaking receiver, whereas for head-phone reception of reproduced sound, the moving-coil receiver has long been a standard and is accepted internationally. The hope was expressed that a standard for radiated sound reproduction would be soon realised and a large amount of guess-work in estimating the quality of reproduction eliminated.

Astrophysical Observations in the Southern Hemisphere

MR. A. G. C. CRUST, Meteorological Office, Wellington, New Zealand, has written directing attention to the advantages offered by certain sites in that country for the establishment of a large astrophysical observatory. Since statistical observations of the distribution of the various astrophysical objects over the sky are necessarily incomplete without observations of the southern skies, it is vitally important for the progress of astrophysics that a really large reflector should be established somewhere in the southern hemisphere. The only reason for the delay is, of course, the expense of erecting and maintaining an observatory with a large telescope, which would be considerable. So far, no private person or public institution has come forward with an offer to finance such an enterprise; instead, an extremely insular

spirit has been exhibited in some quarters, and there seems to have been a reluctance to place the best interests of observational science above local considerations. New Zealand offers the advantage of a relatively high southern latitude, but it seems improbable that the astronomical observing conditions can surpass those of the Orange Free State and Transvaal, which have received extremely favourable reports from experienced observers who have worked there. Nevertheless, the claims of New Zealand should not be allowed to pass by without some examination. Mr. Crust points out that in Central Otago there is a treeless area at an elevation reaching 3,000 ft. where the rainfall is less than 15 inches a year, while the number of clear nights may be so high as 276 a year.

Psychological Aspects of Unemployment

Character and Personality, 1, No. 2, contains an article on an "Unemployed Village" by Paul Lazarsfeld. It is a summary of an investigation into the psychological aspects of unemployment carried out in Austria. The village selected was one of 1,500 inhabitants who were originally employed by a large textile factory which had been closed down for three years. The investigators took particular care in collecting their material, and proceeded by establishing personal contact through the organisation of sewing, gymnastic and ambulance classes. In addition, there were reports and observations of communal officials, co-operative shops and police denunciations. The conclusion they formed was, that concurrent with the extraordinarily low economic standard of the population, there had been a narrowing of psychological wants which had enabled the greater proportion of the people to carry on in a state of resignation. This was characterised by a general state of apathy which covered even politics—once their chief interest. No one concerned himself with the news of the day, or troubled to debate at meetings. The books borrowed from the library decreased by fifty per cent. Time had ceased to have significance or economic value. In Austria, unemployment benefit decreases according to duration of unemployment. This is of interest in connexion with the classification of people into three classes: Unbroken, Resigned, Broken, which ranking corresponded to the average monthly income of the group. The health of the children graded in three classes was also found to correlate with the percentage still at work in the family from which they came. These facts of immense sociological as well as psychological importance deserve wide publicity.

The Hoover Dam

CONSTRUCTION work on the Hoover Dam on the Colorado River is progressing satisfactorily. This dam will be the largest in the world and will hold up more water than any other artificial reservoir. A description of it is given in *Engineering* of September 1. The Colorado River forms, for some distance, the boundary between the States of Arizona and Nevada and farther down it separates the former from California. The Boulder Canyon project is a Federal Government undertaking and as the Colorado watershed extends into Utah, Wyoming, Colorado and Mexico, seven States are affected. The water impounded in the dam will be used both for the production of power at the site and for irrigation purposes for lands at a lower level. The Imperial Valley in Southern California suffers from water shortage, from floods and from the silt they bring down. The great reservoir will enable the flow to be controlled and the avoidance of floods will prevent silt being carried down in troublesome quantities. It is estimated that silt is being deposited at present at the rate of 22 million cubic yards annually, the cost of clearing the canals amounting to more than a million dollars. The reservoir will cover an area of 145,000 acres and will have a capacity of 30,500,000 acre-feet. The scheme includes the construction of a new canal 80 miles long to the Imperial Valley. Unlike the present canal, none of it will be in Mexican territory. The hydro-electric power developed will be 620,000 horse power. The City of Los Angeles and the Southern California Edison Co. jointly will operate the power plant and distribute the energy in definite proportions to the city and various States and companies.

A Giant Electric Clock

ELECTRIC clocks have proved a great boon to many householders in the neighbourhood of electric mains. Their time-keeping qualities are far superior to those of ordinary clocks and as they need no compensating devices and require absolutely no attention, they are much more economical. They are beginning to be used widely for advertising purposes. In Paris a giant public clock has been erected on the Eiffel Tower. It is about half-way up the tower and has two dials each 20 metres in diameter. Although it shows the time in the usual way, it is not fitted with movable hands. Radial rows of electric lamps are provided and these are switched on one after the other and thus indicate the time. The markings of the dials at the five minute intervals are composed of illuminated circles made of green and red lamps. It is thus quite easy to distinguish the position of the main 'numerals'. At the quarter hour intervals the minute hand position is marked by sixty radial rows of red lamps which start at the centre and run to the edge of the dial. The hours and half-hour intervals are indicated in a similar way by 24 rows of blue-white lamps. In addition to the indication of the time given by the 'hands', a powerful light shines for two seconds at each quarter of an hour. The initiative for the erection of this novel clock is due to M. André Citroën. It also serves as a conspicuous advertisement; big vertical 'Citroën' inscriptions appear on the sides of the tower not occupied by the dials. They light up each time the minute hand of the clock reaches a five minute mark.

Fresh Fruit Supplies in Great Britain for 1932

FRESH fruit from the various parts of the British Empire formed a larger proportion of the total imports into Great Britain than ever before, according to the report issued by the Empire Marketing Board

on "Fruit Supplies in 1932" (H.M. Stationery Office, 1*s*. net). Nearly 10,600,000 cwt. came from Empire sources, a record total, whilst new high levels were reached in a variety of individual fruits, among them being apples, bananas, oranges, peaches and plums. Certain others—principally those imported from foreign countries—as cherries, gooseberries, raw currants and strawberries, showed greatly decreased imports, the lowest, in fact, since the War. Home fruit showed a slight increase in production, especially dessert and cooking apples, but cider apples reached a new low level. Strawberries, of which the output was heaviest in 1931, were plentiful, although there was a general decline in soft fruits. The total amount of fruit, grown at home or brought from outside, was sufficient for approximately 1½ lb. per head per week. Bananas, peaches and pineapples have grown in favour, but for the first time since the War there was a slight falling off in the imports of grape-fruit, although the principal sources of supply of the latter, namely South Africa, the British West Indies and Palestine, have each shown a remarkable expansion in the production of this fruit. A companion volume dealing with "Canned and Dried Fruit Supplies in 1932" is also available at the same price.

Potato Varieties

THE National Institute of Agricultural Botany, Cambridge, has issued a revised edition (2*s*. net) of its booklet, "Varieties of Potatoes, with Their Synonyms, Immune from and Susceptible to Wart Disease". The first complete list of potato varieties and their synonyms was published in 1925 and since that date a mass of new and named seedlings has been examined, of which some varieties were short-lived and others were quickly recognised as synonyms and distributed on their original name only. In compiling the present edition, drastic revision of the lists has been made so as to ensure that the varieties included are those which, besides having been submitted to a two-year wart disease test, are definitely on the market at the present time. The complete list of those varieties and synonyms which have been omitted is, however, available on application to the Secretary, Potato Testing Station, Ormskirk. The field trials upon which these lists are based have been carried out at Ormskirk and Corstorphine, and since 1925 an inter-departmental check scheme has been in operation which has increased the co-ordination between these two stations. No modification of the term synonymity has been found necessary in the new edition and where difficulties relating to the interpretation of the term have arisen, satisfactory solutions seem to have been found.

Seismological Records

WE have received the eighteenth annual volume (for 1930) of the seismological records of the Observatory of De Bilt in Holland. The observatory is provided with a pair of horizontal seismographs and a vertical seismograph of the Galitzin type, a Wiechert astatic horizontal seismograph, and a pair of Bosch horizontal pendulums. During the year 1930, 444 earthquakes were recorded at the station, in the great majority of which the position of the origin is known or estimated. In a paper recently published by the Seismological Society of America (*Bulletin*, vol. 22, pp. 263–269; 1932), Mr. J. A. Fleming describes the new seismological station at the Huancayo magnetic observatory in Peru, situated about 120 miles east of Lima in lat. 12° 2·7′ S., long. 75° 20·4′ W., at a height of 11,000 ft. above the sea. The station is equipped with a pair of Wenner horizontal component seismometers and a Benioff vertical component seismometer. Regular observations with the three instruments were begun on August 22, 1932.

Dutch Elm Disease

A MAIL Report of Science Service, Washington, D.C., dated August 22, states that there are no species or varieties of elm immune to the Dutch elm disease. Mr. R. K. Beattie, of the U.S. Department of Agriculture, has searched Japan, China and other eastern countries for possible immune species, but without success. Several horticultural forms apparently possess resistance to the disease, but there is no real certainty. The Chinese elm is a carrier for the fungus, producing brown wood without the characteristic leaf-fall, but is nevertheless a serious menace to other species. A rather alarming outbreak of the disease has occurred in a restricted area of New Jersey, U.S.A., and attempts are being made to keep it from spreading.

Mount Everest Flight

ATTENTION may be directed to a large number of fine photographs of Mount Everest and the surrounding country which illustrate an article in the *National Geographic Magazine* for August by Lieut.-Col. L. V. S. Blacker, who organised the Houston Mount Everest expedition of the spring of this year. Many of the photographs which appeared in the *Times* have been reproduced and give a vivid picture of the topography of the area. A pictorial map shows the route of the expedition and there are several pictures, as well as detailed descriptions, of the machines and of the apparatus used.

Fishes of the Philippine Seas

MR. HENRY W. FOWLER has recently published Part 5 of his systematic studies of the fishes collected by the United States Bureau of Fisheries research steamer *Albatross* (United States National Museum. Bulletin 100; vol. 12. "Contributions to the Biology of the Philippine Archipelago and adjacent Regions". Smithsonian Institution, Washington, D.C. 1933. n.p.). It includes the main percoid series and, like Part 4, it embraces a large number of valued food fishes. Most of the species dealt with were taken in the Philippine seas and adjacent waters, though some fishes from other localities in the Netherlands Indies, China, Formosa, and Oceania visited by the *Albatross* are also included. This publication, like the other parts of the series, is a very valuable work of reference.

September Flowering of the Horse-Chestnut

MR. F. B. HUTCHINSON of 36, St. Aubyns, Hove, Sussex, writes that early in September in Luxemburg, he noticed that two horse-chestnut trees (*Æsculus Hippocastanum*) in the Place Guillaume were in full flower. The square contained about twenty-four trees, all bearing abundant fruit except the two in flower in the extreme north-east corner; these had only flowers and new green leaves. On the normal trees the leaves were turning brown at the edge and some had already fallen. On the two flowering trees, all the leaves produced in the spring had turned completely brown and most of them had dropped off, while the buds which usually remain dormant during the winter had opened to produce fresh green leaves and apical inflorescences, leaving the bud scales scattered on the ground beneath. It is, perhaps, significant that the winter bud of *Æsculus* normally contains the next year's shoot and inflorescence in a very advanced stage of development. The flowers are normally produced in May.

Bee Flowers

MR. H. S. BOOTHMAN of Nightingale Nursery, Furze Platt, Maidenhead, has issued a list of bee flowers which will be very welcome to all bee-keepers who desire to establish beautiful gardens to assist their apiaries. A wide variety of annuals, biennials and perennials, in addition to bulbs, shrubs and heathers, is included, and special attention is given to plants flowering in late autumn, winter and early spring. The bees are not, of course, working very hard at these times, but it is claimed that the proximity of bee flowers to the hive will provide them with nectar when they fly out on sunny days, and thus economise the stored honey. Such plants as the Christmas rose (*Helleborus niger*), the 'golden wings' variety of *Solidago*, *Galanthus Elwesi*, the winter aconite (*Eranthis hyemalis*), *Erica carnea* and *E. darleyensis* are suitable for this purpose. Mr. Boothman can supply the seeds and plants mentioned in the list.

The Sky in October

OCTOBER will be a favourable month for seeing most of the planets. Mercury will be visible as an evening star; it reaches its greatest eastern elongation on October 28, when it will set an hour and a half after the sun. Without a telescope one can only conveniently see Mercury on these occasions of eastern elongation; choose a site with a good view of the western horizon and keep a sharp look-out just after sunset. Venus will also be visible in the evening sky. At the end of October this planet will set three hours after the sun. It will be a brilliant object (the stellar magnitude will be $-3{\cdot}8$). On October 14 there will be a conjunction of Venus and Mars. Actual conjunction takes place at 11 hours, that is, in broad daylight, but the close positions of the two planets just after sunset on the following evening should form an interesting sight, especially if Mercury is seen as well. Jupiter will only just have passed its conjunction with the sun, and so will be invisible, but Saturn will again be visible in the southern sky throughout the night. Finally, Uranus will be in opposition on October 19.

Announcements

MR. J. P. BUSHE-FOX, inspector of ancient monuments for England, has been appointed chief inspector of ancient monuments in succession to Sir Charles Peers, who has retired on attaining the age limit.

PROF. A. EINSTEIN will address a meeting to be held at the Royal Albert Hall, London, on October 3, under the auspices of the Society of Friends, the International Student Service, the Refugee Professionals Committee, and the Academic Assistance Council. Lord Rutherford will preside, and Sir Austen Chamberlain and others will also speak. The object of the meeting is to raise funds for refugees from Germany. Tickets can be obtained from the Refugee Assistance Fund, 54 St. Stephen's House, Westminster, S.W.1.

A SYMPOSIUM on "Bread and Milk" has been arranged by the Food Group of the Society of Chemical Industry, to be held in the hall of the British Medical Association, Tavistock Place, London, W.C.1, on November 23–24. The symposium will be divided into three sessions under the respective presidencies of Prof. W. W. Jameson, Sir John Russell and Prof. H. E. Armstrong. It will be international in character and several prominent foreign men of science have been invited to contribute to the proceedings.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A teacher of domestic subjects at the Yorkshire Training College of Housecraft, Vernon Road, Leeds—The Director of Education, Education Offices, Calverley Street, Leeds (Oct. 2). An engineering assistant in the Water Department of the County Borough of Wolverhampton—The Town Clerk, Town Hall, Wolverhampton (Oct. 5). A civil engineering assistant in the Water Department of the City of Lincoln—The Water Engineer and Manager, Water Engineer's Office, 4, Lindum Road, Lincoln (Oct. 6). A principal of the Dudden Hill Technical Institute, Denzil Road, Willesden, London, N.W.10—H.M. Walton (H.), Secretary, 10, Great George Street, Westminster, London, S.W.1 (Oct. 7). An explosives chemist at the Royal Gunpowder Factory, Waltham Abbey—Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Oct. 13). An assistant lecturer in mechanical engineering in the College of Technology, with the title and status of assistant lecturer in the University of Manchester—The Registrar, College of Technology, Manchester (Oct. 16). A lecturer in physiology in the University of Bristol—Winifred Shapland, Secretary and Registrar (Oct. 20). Evening lecturers in strength of materials, mathematics, electrical technology, thermodynamics, theory of machines and machine design at the Acton Technical College—H. M. Walton (H.), Secretary, 10, Great George Street, Westminster, London, S.W.1.

Letters to the Editor

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A Magnetic Material of High Coercive Force

IN making magnetic measurements on mineral powders, we found that certain iron ores, heated in reducing gases at about 600° C. for a short time and then passed over a high-intensity magnetic separator, could not be demagnetised in the customary manner. Complete demagnetisation was successful only under the following conditions: (1) high initial demagnetising fields; (2) slow reversals of the decreasing demagnetising field; and (3) packing the powder to prevent motion of the individual grains.

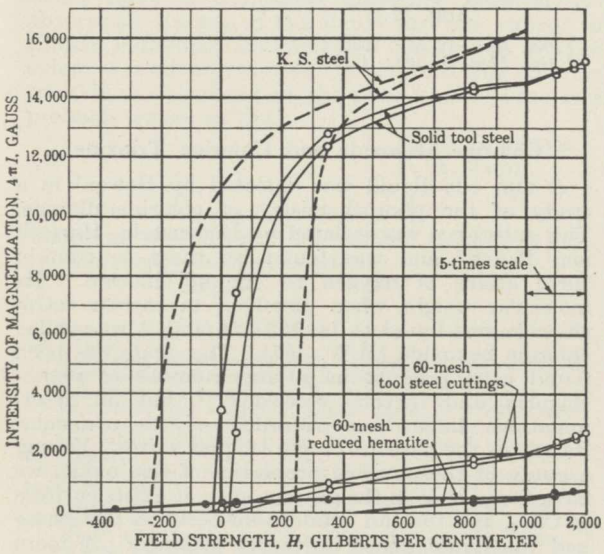

FIG. 1. Comparison of magnetic properties of 'reduced hæmatite' and *K.S.* steel.

Qualitative estimates of the coercive forces involved were so exceptionally high that a quantitative determination seemed desirable. For this purpose, we have devised a modified isthmus method for obtaining hysteresis loops with $H_{max.}$ up to 4,700 gilberts per centimetre. The coercive force of a number of samples of 60-mesh reduced hæmatite powders as determined by this method varies from 200 to 425.

Successive field strengths H (gauss or gilberts/cm.).	Intensity of magnetisation ($4\pi I$ gauss).		
	Rod No. 12 (solid)[1].	Rod No. 12 (60-mesh hack-saw cuttings)[2].	Reduced hæmatite[3].
2000	15200	2732	784
1800	15144	2608	748
1500	15022	2405	704
825	14342	1777	595
350	12807	1084	482
50	7340	364	367
0	3413	168	340
−50	−2676	−17	313
−350	−12239	−839	119
−825	−14417	−1636	−306
−1500	−15020	−2351	−647
−1800	−15139	−2587	−731
−2000	−15200	−2732	−784

[1] A rod 0·80 cm. diameter cut from No. 12 tool steel, after quenching from 530°–560° C. (7·72 gm. per c.c.).
[2] From No. 12 (solid) by collecting the cuttings obtained on sawing the rod into pieces (2·64 gm. per c.c.).
[3] 60 mesh (2·04 gm. per c.c.).

The sample that shows the highest coercive force—$H_c = 425$—was prepared by heating 60-mesh Minnewas martite from the Mesabi range in a reducing atmosphere for half an hour at 550° C.; after treatment, the sample contained approximately 27 per cent FeO. The hysteretic data for this sample, as well as for a tool steel in the shape of solid rod and of 60-mesh hack-saw cuttings measured in the same apparatus, are given in the accompanying table. The half-loops of the hysteresis curves for these three sets of data are shown plotted in Fig. 1, compared on the same scale with the half-loop for *K.S.* magnet steel as given in the "International Critical Tables", vol. 6, p. 389, Fig. 20.

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C. W. DAVIS.

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Aug. 22.

Application of Magneto-Striction Effect to the Observation of Work-Hardening of Steel Wires

A STEEL wire was suspended in a solenoid which was excited by direct current. Embracing the wire at the central part of the solenoid was a search coil of 4,000 turns in circuit with a ballistic galvanometer of long period of swing. When a load was applied to the wire a throw of the galvanometer was obtained and the magnitude of the change of flux linkages corresponding to this throw was found to be related to the magnetising force of the solenoid by a curve such as that shown in Fig. 1. It will be seen that this curve passes through a maximum value and also that there are two values of the magnetising force for which the change of flux linkages is zero. For each value of the applied load, a curve such as that shown in Fig. 1 was obtained.

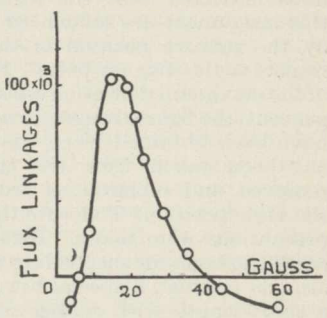

FIG. 1.

Tests were carried out on a group of steel wires each 0·116 in. in diameter as used for wire ropes, supplied by a well-known manufacturer of such ropes. Of these wires two were work-hardened by winding over a pulley 3½ in. in diameter and straightening out again—this process being repeated twelve times in the case of each of the two wires. The remaining wires were left in the normal condition as used in the manufacture of a new rope.

In Fig. 2 are shown representative results of the ballistic tests on one of the work-hardened wires and on one of the normal wires. In this graph the maximum values of the changes of flux linkages as obtained from curves such as those shown in Fig. 1

have been plotted against the stress on the wire due to the applied load. It will be seen that, whilst the normal wire gave a straight line relationship, the work-hardened sample gave a curve of which the slope decreases rapidly with increasing stress. The

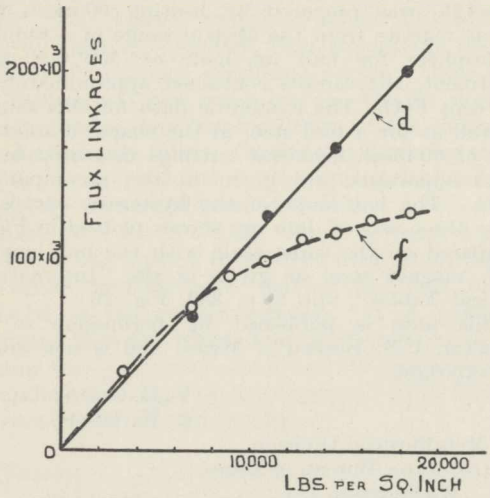

FIG. 2. Sample *d*, normal; sample *f*, work-hardened.

relationship between the slopes of these curves and the corresponding values of Young's modulus is now under investigation.

T. F. WALL.

Department of Electrical Engineering,
The University, Sheffield.
Aug. 28.

Accuracy of the Curie-Chéneveau Magnetic Balance

ATTEMPTS have been made recently in these laboratories to measure the diamagnetic susceptibilities of inorganic salts by means of the Curie-Chéneveau magnetic balance. The results obtained have indicated that the measurements made with this instrument are influenced to a very great extent by the relative position of the specimen tube with respect to the magnet poles. For example, variations in the maximum deflection amounting to as much as 20 per cent, the figures ranging from 9·40 cm. to 7·41 cm., have been obtained when the empty specimen tube has been taken from the apparatus, the stopper removed and replaced as accurately as possible in the same position. To locate this tube exactly, special precautions were taken. Instead of using a cork to carry the hook for suspending the tube on the balance arm, as is usual, a special brass stopper covered over a short length with rubber tubing was made. This fitted the tube tightly and could always be returned to the same position by means of marks on the tube and stopper. The top of the tube was ground square to its length and a collar on the stopper fitted down on to this. With the tube empty, or containing water or salt, the maximum variation in the deflections on repeating the procedure outlined above amounted to approximately 2 cm. On repeating observations without removing the tube, merely taking successive readings, the variation in the maximum deflections rarely amounted to so much as half a millimetre.

These results are interesting in view of certain remarks made by Gray and Dakers[1]. In this paper it is remarked (p. 89) ". . . a deflection for water was obtained in most cases before each measurement of the deflection for the substance under examination. This was necessary because unaccountable changes in the deflection for water were obtained from time to time."

It would seem possible that these unaccountable changes might be due to small variations in the location of the tube with respect to the magnet. The experimental details are very meagre, however, and no indication of the percentage variation found by Gray and Dakers is given.

In conclusion, the value for the molecular diamagnetic susceptibility found by these experimenters for rubidium bromide, namely $56{\cdot}69 \times 10^{-6}$, is very different from the value $65{\cdot}5 \times 10^{-6}$ found by Ikenmeyer[2].

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Aug. 31.

[1] *Phil. Mag.*, **11**, 81; 1931.
[2] *Ann. Phys.*, **1**, 169; 1929.

Chlorine Hexoxide and Chlorine Trioxide

A RED oily liquid was detected by Bowen[1] in a study of the photochemistry of chlorine dioxide. This substance was isolated by Bodenstein, Harteck and Padelt[2] and was found by them to contain three atoms of oxygen to one of chlorine. Its molecular weight when dissolved in carbon tetrachloride was found to be 153–156 and it was called chlorine hexoxide (M.W. 167). The oxide has been found as a product in a large number of photochemical and thermal reactions[3-12], but no determinations have been recorded of its molecular weight in the gaseous or pure liquid states. During a study of the physical properties of this oxide, we have found that in the gaseous state it exists entirely as ClO_3, and that an equilibrium between this phase and the liquid phase is readily attained. A more complete report of this work will appear shortly elsewhere.

"Chlorine hexoxide", produced by the thermal reaction between ozone and chlorine dioxide at 0° C.[13], was analysed by passing the vapour through a red hot quartz tube and determining the oxygen by volume and the chlorine by means of potassium iodide solution. The oxygen-chlorine ratio of three to one, found by other workers, was completely confirmed.

The molecular weight in the gas phase was determined by means of an apparatus consisting of a quartz bulb of 20 c.c. capacity, attached to a quartz spiral manometer, into which the vapour could be admitted rapidly from a reservoir of pure liquid. The pressure was read to 1/50 mm. and the reservoir sealed off. The bulb was then heated to red heat for some minutes and then allowed to cool to room temperature. As the vapour is known to be completely decomposed at this temperature, the final pressure gives the total pressure of the chlorine and oxygen in the original amount of oxide. The results of two determinations for each of two preparations are given in the accompanying table. The ratios are subject to a small correction, about 1 per cent increase, on account of the dead space in the gauge and connecting tubes. From the table it is seen that the amount of Cl_2O_6 present in the gas phase was very small.

We suggest the name 'chlorine trioxide' be given

to ClO_3 and not to the anhydride of chlorous acid, Cl_2O_3. For the latter, which has not been isolated, we suggest the name 'chlorous oxide'.

	Initial Pressure (mm.) (Chlorine Oxide) *a*	Final Pressure (mm.) (Chlorine + Oxygen) *b*	Ratio *b/a*
1*a*	2·81	5·42	1·93
1*b*	3·52	6·93	1·97
2*a*	1·37	2·70	1·98
2*b*	2·98	5·74	1·98

There is little evidence to indicate the molecular weight of the pure liquid. Measurements of its vapour pressure lead to an abnormally low value for the latent heat of vaporisation for such a non-volatile substance. This may be due to an exothermic dissociation taking place on evaporation. Furthermore, there is a marked difference between the absorption spectra of the liquid and the vapour in similar molecular thicknesses. Until more definite evidence is advanced, it can be assumed that chlorine trioxide is associated in the pure liquid phase and probably exists as Cl_2O_6.

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Aug. 23.

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[2] Bodenstein, Harteck und Padelt, *Z. anorg. Chem.*, **147**, 233; 1925.
[3] Hinshelwood und Hughes, *J.C.S.*, **125**, 1841; 1924.
[4] Bodenstein und Schumacher, *Z. physik. Chem.*, B **5**, 209; 1929.
[5] Schumacher und Stieger, *Z. physik. Chem.*, B **7**, 363; 1930.
[6] Beaver und Stieger, *Z. physik. Chem.*, B **12**, 93; 1931.
[7] Finkelnburg, Schumacher und Stieger, *Z. physik. Chem.*, B **15**, 127; 1931.
[8] Finkelnburg und Schumacher, *Z. physik. Chem.*, Bodensteinfestband, 704; 1931.
[9] Allmand and Spinks, *J.C.S.*, 1652; 1931; and 599; 1932.
[10] Spinks, *J.A.C.S.*, **54**, 1689; 1932.
[11] Heidt, Kistiakowsky and Forbes, *J.A.C.S.*, **55**, 223; 1933.
[12] Norrish and Neville, NATURE, **131**, 544, April 15, 1933.
[13] Schumacher und Stieger, *Z. anorg. Chem.*, **184–185**, 272; 1929.

Bound Water of Gelatin Gels

A FEW years ago, one of us (T.M.[1,2]) showed that by freezing, water could be withdrawn from a gelatin gel, the concentration of the remaining gel at equilibrium with any temperature increasing with falling temperature down to a temperature of $-20°$, below which no further water could be drawn out of the gel. At this temperature, the concentration of the gelatin in the gel is 66 per cent. The water in this gel was described as the combined (or bound) water and the experiments showed, therefore, that 1 gm. of gelatin combines with or binds about 0·5 gm. of water with forces greater than those of the formation of ice crystals at $-20°$.

A more direct measure of the force binding water to gelatin has now been obtained. With the use of an ultra-filter made of stout canvas impregnated with collodion, water can be squeezed out of gelatin gels in a press. A range of pressures from 0 to 2,250 lb. per square inch was used in the experiments and it was found that the concentration of the gel in equilibrium at the different pressures increased with increasing pressure up to a pressure of about 2,000 lb. At this pressure the concentration of gelatin in the gel is 60 per cent, a figure fairly close to that obtained at $-20°$ in the freezing experiments.

The experiments, therefore, confirm the view put forward previously that the water in gelatin gels exists in at least two states, firmly 'bound' or 'combined' water (which can also be called water of hydration) and loosely bound or 'free' water and, moreover, supports the quantitative relation previously obtained that 1 gm. of gelatin binds or combines with approximately 0·5 gm. of water.

The experiments referred to were carried out both at room temperature (18°–22°) and at 0°; the same pressure-concentration curve was obtained at both temperatures. Further work on the influence of temperature, hydrogen ion concentration, salt content, etc., on the bound water is in hand; the method is also being extended to higher pressures.

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[1] Moran, *Proc. Roy. Soc.*, A, **112**, 30; 1926.
[2] Moran, *Proc. Roy. Soc.*, A, **135**, 411; 1932.

Interaction between Soot Films and Oil

THE gas bubbles evolved on impacting the drop[1] are not likely to originate in the carbon film, which is so thin that even gas inter-layering implies adsorption, which Mr. Carding's experiment[2] with ammonia seems to show non-existent.

The production of the 'effect' suggests the plasticity and permeability of the film. In the time-fraction required for the drop to fall 3 cm., the inferior column of air of cross section equalling the drop diameter is likely to be compressed due to a slight time lag required for the drop pressure to become laterally equalised and nullified. The lower layers of the compressed air column will be driven between the particles of the carbon film (probably more readily than between lateral air molecules) to await expulsion as bubbles by the impacting drop; and/or, air may be trapped on impact between drop and film, then, passing under the film, burst through causing the clear spaces observed. Furthermore, the drop itself may carry an adsorbed gas layer, or due to its movement, even a shallow atmosphere, or owing to its fall its outer layer may become a colloidal dispersion of minute air bubbles in oil. In any of these cases such gas would probably be evolved as bubbles on impact.

The likelihood that the gas is, therefore, introduced as a foreign body due solely to the drop being impacted—since it is not present when the drop is posed—invalidates the impact method as presenting *not* an interaction between soot films and oil, but an interaction between soot films, *gas* and oil. The gas introduced is, on this basis, an agent of the impact in destroying the delicate central ring system produced when the interaction between soot film and oil alone is promoted.

Moreover, since the resulting respective figures are almost mutually exclusive they have not, in principle, separate simultaneous existence. Either result, therefore, is due to a manipulation variation in the cause of the other. A constructive interaction

occurs when the oil drop is carefully posed; a destructive or disruptive interaction when the drop is impacted. There cannot, therefore, be said to be two 'effects', though the effects differ. Rather two modifications of the same 'effect'.

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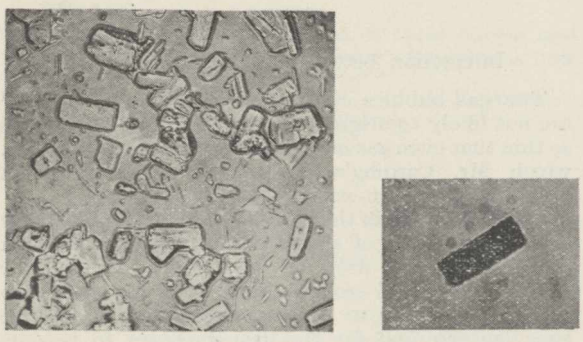
Aug. 31.

[1] NATURE, 131, 691, May 13, 1933.
[2] NATURE, 132, 317, Aug. 26, 1933.

Crystalline Chlorocruorin

CHLOROCRUORIN is a respiratory pigment, closely allied to hæmoglobin, which occurs only in the blood of certain polychæte worms[1,2]. We have now crystallised chlorocruorin, measured the absorption spectrum of the pure substance, and analysed it.

Blood of *Spirographis* from Tamaris was used. Abundant crystallisation occurs at 0° in blood to which ammonium sulphate has been added. The crystals, which belong to the rhombic system, are shown in Fig. 1. Most are pale yellowish green (Fig. 1, *a*), but some are dark brownish green (Fig. 1, *b*) with strong red dichroism.



(*a*) (*b*)

FIG. 1.

The absorption spectrum of an oxychlorocruorin solution made from the crystals resembles that previously described for *Spirographis* blood[1], with differences in the relative intensities of the ultra-violet bands. The third band in the visible at 515 mμ, which is absent in oxyhæmoglobin, is shown not to be due to an impurity.

For analysis several recrystallisations were made and then a solution in water prepared from the crystals was dialysed until all sulphate had disappeared. The chlorocruorin was then precipitated by acetone and dried. The analyses were carried out by Dr. R. J. W. Reynolds, using Pregl methods. The percentage composition of chlorocruorin, compared with that of hæmoglobin, is shown in the accompanying table:

	C	H	N	S	Fe
Chlorocruorin	49·2	7 3	15·4	2 6	1·2
Hæmoglobin	54 4	7 3	16·7	0·6	0·5

The striking differences between the two substances are the higher sulphur and iron contents of chlorocruorin.

There is evidence that the protein of chlorocruorin is different from globin[3,4]. Since globin is exceptionally poor in sulphur it is not surprising, then, that chlorocruorin is richer than hæmoglobin in this element.

It has been shown that the iron content of the hæmin of chlorocruorin and that of the hæmin of hæmoglobin are both 8·6 per cent[5]. The high iron content of chlorocruorin compared with hæmoglobin must mean, therefore, that, in the former, hæmatin forms a relatively greater part of the molecule.

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Aug. 5.

[1] H. Munro Fox, *Proc. Roy. Soc.*, B, 99, 199; 1926.
[2] *ibid.*, *Proc. Roy. Soc.*, B, 111, 356; 1932: 112, 479; 1933.
[3] Jean Roche, *C. R. Soc. Biol.*, 110, 48; 1932.
[4] O. Warburg und E. Negelein, *Bioch. Z.*, 244, 9; 1932.
[5] O. Warburg, E. Negelein und E. Haas, *Bioch. Z.*, 227, 171; 1930.

Control of Insects by Trapping Adults

IT is becoming generally recognised that it is seldom possible to reduce the numbers of insects by trapping or destroying adults. Most insects have such a high birth-rate that the numbers killed are replaced by other individuals; in other words, the insect community is very elastic, and will nearly always increase up to the limits set by food supply, climate or enemies.

It is, however, quite possible that control of tsetse flies (*Glossina*) may be achieved by killing adults, for these insects have a very low birth-rate. But whether or not the trap mentioned in NATURE of September 2, p. 361, can do this is not yet known; it seems that those who have worked with it have not made series of counts in trapped and untrapped areas. Only in this way can it be proved that traps are reducing the population of 'fly', for these insects are known to be subject to great increases and decreases in numbers apart from any which man may be able to cause.

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Flight of the Black Eagle, *Ictinætus malayensis perniger*, Hodg.

THIS fine bird is not uncommon in the hills of Ceylon, where I have seen it fairly frequently. Its habit is to sail close over the tops of the trees of jungle-clad hill-sides, wheeling into ravines and hollows with consummate ease, while it searches for its prey. I have never seen it perched, and the feature of its flight that has particularly struck me is the slowness with which it can sail without any wing-flapping, even when it finds itself in a deep pocket among the trees where it would seem inevitable that it must either crash or extricate itself by flapping flight. It seems to be able to avoid stalling even at what appears little more than walking pace, and certainly at very low speeds.

It occurs to me that this low stalling speed may be correlated with the great extent to which its long primaries are separated while in flight. The accompanying photograph (Fig. 1) is of a drawing which I

made of a freshly-killed specimen in February of this year, and shows this feature well. It should be noted that the drawing is of the nature of a 'map' and shows the upper surface on the left side and the under surface on the right.

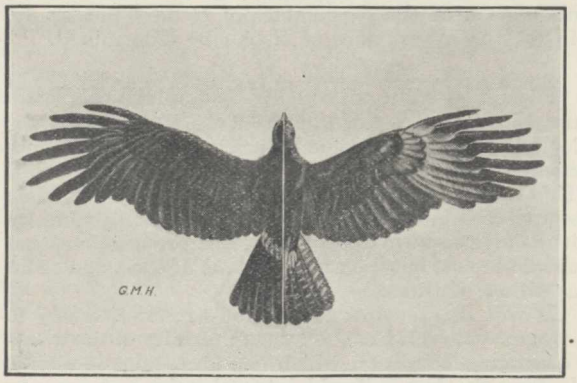

FIG. 1. Black eagle, *Ictinœtus malayensis perniger*. Left side, dorsal; right side, ventral.

It seems possible that an aeroplane with wings built on this plan would possess a lower stalling speed than those of orthodox shape, and I commend the suggestion to the attention of aircraft designers.

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Wildfire of Tobacco on *Nicandra physaloides*

THE wildfire disease of tobacco, caused by *Bacterium tabacum*, was first described in the United States in 1916; since then it has been reported from many parts of the world and has been the subject of extensive and detailed scientific investigations in many countries. The host range of the organism is a point of considerable importance and it has been found that many species of plants can be artificially infected with *B. tabacum*, with the production of definite pathological leaf symptoms. Yet, so far as I am aware, there are only three records (cowpea[1], tomato[2], and cucumber[3]) of the natural infection of plants other than tobacco. It is therefore of interest that I have found *Nicandra physaloides*, Gaertn. to be abundantly infected with wildfire in tobacco fields at Balfour in the East Cape Province, South Africa. This annual solanaceous weed is not indigenous but is widespread throughout arable lands. The infection was first observed in the late summer of 1932 among plants growing between the tobacco rows in a damp corner of the field; the following season, wildfire was very prevalent in tobacco and practically all the *Nicandra* plants throughout the same field showed wildfire spotting.

The leafspots on *Nicandra* are rounded in shape and measure 1·5–10 mm. in diameter, with an average of 6–7 mm. In colour they are dull brown with a definite dark edge and usually with several raised concentric rings; they lack the well-marked 'halo' which is characteristic of wildfire lesions on tobacco. The leafspots yielded a pure culture of bacteria which in general appearance and behaviour resembled parallel cultures of *B. tabacum* from tobacco. It was not possible to make a detailed examination of cultural characters, but parallel needle-prick inoculations were made with cultures of both organisms, on to experimental plants of tobacco and *Nicandra*; on the former the symptoms were identical and included a well-developed halo; on the latter in both cases a dull brown glassy lesion was formed. The *Nicandra* organism was recovered in pure culture by isolation from both the tobacco and *Nicandra* lesions, and when re-inoculated into both hosts, the characteristic symptoms again appeared.

Re-isolation from *Nicandra* completed the proof of the pathogenicity of the organism, whilst its similarity in culture and symptoms leaves no doubt as to its identity with *B. tabacum*.

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Aug. 29.

[1] Tisdale, W. B., Rep. Florida Agric. Expt. Sta., 1924.
[2] Chapman, G. H., and Anderson, P. J., Bull. 203, Mass. Agric. Expt. Sta., 1921.
[3] Johnson, J., *Phytopath* **14**, 4; 1924.

Remanence in Single Crystals of Iron

QUITE recently, Kaya[1] has published a very interesting series of measurements on the remanence in very oblong single crystals of iron. He finds that the remanence in the direction of the axis of the crystal wire is:

$$I_r = \frac{I_\infty}{l + m + n} \qquad (1)$$

where l, m and n are the cosines of the angles between the three crystallographic axes (which are the directions of easy magnetisation) and the axis of the crystal wire (which is also the direction of the external fields) and I_∞ indicates the saturation intensity.

Kaya imagines this result to be in disagreement with the present theoretical conceptions, according to which the remanence ought to have the value:

$$I_r = I_\infty \, l \qquad (2)$$

where l is the largest of the three cosines.

If, however, one takes into account the fact that a component of the magnetisation perpendicular to the axis of the wire I_p will be accompanied by a demagnetising field $(-2\pi I_p)$, and by a contribution

$$F_d = 2\pi I_p^2, \qquad (3)$$

to the free energy*, Kaya's result can easily be explained. F_d will provide an enormous contribution to the total free energy as soon as I_p differs appreciably from zero. Therefore I_p has to be practically zero in all weak fields.

In a very weak external field, the magnetisations in the spontaneously magnetised elementary regions will thus be distributed in such a way over the three directions of easy magnetisation, that (as has been indicated also by Kaya):

$$I_x = \frac{I_\infty \, l}{l + m + n}, \quad I_y = \frac{I_\infty \, m}{l + m + n}, \quad I_z = \frac{I_\infty \, n}{l + m + n} \qquad (4)$$

and so

$$I = \sqrt{I_x^2 + I_y^2 + I_z^2} = \frac{I_\infty}{l + m + n}. \qquad (5)$$

So we find, in agreement with the theoretical conceptions, that the experimental remanence is identical with the magnetisation to be expected theoretically for very weak external fields.

In stronger fields, magnetisation in the elementary regions will be deflected from the original directions

in accordance with the picture given by Weiss, Heisenberg and others. In still stronger fields a small component I_p, will also occur, which will vanish again at saturation. Kaya's result for his crystal 8, for which the calculations are rather simple, are, on the whole interval of field strengths, in satisfactory agreement with Gans's constants of anisotropy[2], if a term (3) is introduced into the expression of the free energy. Abrupt changes in the slope of the magnetisation curve, as reported also by Kaya, can, of course, scarcely be explained on the present theoretical basis.

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Sept. 5.

* In accordance with the general use, we employ the term 'free energy', though the term 'thermodynamic potential' for the same function would be more appropriate.

[1] S. Kaya, *Z. Phys.*, **84**, 705; 1933.
[2] R Gans, *Phys. Z.*, **33**, 924; 1932. E. Czerlinsky, *Ann. Phys.*, **13**, 80; 1932.

The Neutron in Quantum Mechanics

IT can be shown with the help of Dirac's relativity equation that the neutron can be properly placed in the scheme of the wave-mechanical theory. Dirac's Hamiltonian for a hydrogen-like atom in polar co-ordinates is

$$H/c = -e/c.A_0 - \varepsilon p_r - i\varepsilon\rho_3 jh'/r - \rho_3 mc$$

in which ε and ρ_3 are to be taken as the matrices

$$\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

respectively, leading to the equations

$$\left(\frac{1}{a_1} + \frac{\alpha}{r}\right)f - \left(\frac{\delta}{\delta r} - \frac{1}{a} + \frac{j}{r}\right)g = 0$$

$$\left(-\frac{1}{a_2} + \frac{\alpha}{r}\right)g + \left(\frac{\delta}{\delta r} - \frac{1}{a} - \frac{j}{r}\right)f = 0$$

where the wave-functions are $\psi_1 = e^{-r/a}f$, $\psi_2 = e^{-r/a}g$, $a_1 = \dfrac{h'}{mc + H'/c}$, $a_2 = \dfrac{h'}{mc - H'/c}$, $h' = h/2\pi$, $a = (a_1 a_2)^{1/2}$ and $\alpha = e^2/h'c$ is small[1].

f and g must be finite series, if a is real, or $H' < mc^2$. The radius of the smallest orbit will be the smallest value of r that makes $(\psi_1\bar{\psi}_1 + \psi_2\bar{\psi}_2)$ a maximum, since Dirac's wave-function is r times the Schrödinger function χ.[2]

The Schrödinger function χ is supposed to be uniform and finite everywhere, but as its physical significance is bound up with the probability $\chi\bar{\chi}dV$ of the electron being found in the elementary volume dV, it may be permissible to relax the conditions a little. A priori, there does not seem to be any reasonable ground for disallowing some form of singularity at the origin where there is a centre of force. We may tentatively suppose that χ must be such that $\int\chi\bar{\chi}dV$ should exist and be finite for any region finite or infinite. In the present case, a constant value for f and g would indicate that the electron falls into the centre. Leaving this case out, we assume the solutions

$$f = c_0 r^{1/2}, \quad g = c_0' r^{1/2},$$

which satisfy the wave equations above if $\alpha^2 = j^2 - \frac{1}{4}$. α being small ($7{\cdot}3 \times 10^{-3}$), j may be taken as $\pm\frac{1}{2}$ approximately. For the closest approach to the centre, we take $j = -\frac{1}{2}$ and the two solutions of the wave equations are

$$\psi_1 = -e^{-r/a}\, r^{1/2}, \quad \psi_2 = ke^{-r/a}\, r^{1/2} \text{ where } k = (a_2/a_1)^{1/2}.$$

On normalising, the smallest distance will be given by the value of r which makes $re^{-2r/a}$ a maximum, that is, $r = \frac{1}{2}a$.

Since the series for f and g have been taken as a single term, the quantum number n is zero and the case is really an exceptional one to which Dirac's calculation of the eigenvalues of H does not apply. In fact no eigenvalues of H can be determined.

Since $a = \dfrac{h'}{(m^2c^2 - H'^2/c^2)^{1/2}}$, taking H'/c as being not nearly equal to mc, we get $r = 1{\cdot}9 \times 10^{-11}$ cm. as the lowest permissible value, which is about 280 times smaller than the radius of the smallest Bohr orbit. This value of r gives a consistent value for H'/c when substituted in the expression for the Hamiltonian, as it makes the term h'/r of the same order as mc, and the difference between H'/c and mc of the same order as either of them.

It will also be clear that Dirac's restriction of j to integral values is based on the uniformity of the wave-function, a condition which has been relaxed above. It appears that half odd integral values of j are, in fact, permissible.[3]

In conclusion, even if the value of r does not agree with the value for the radius of the neutron (10^{-12} cm.) suggested at present, it may be of interest as the lower limit of the distance permissible under the Coulomb force.

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Aug. 18.

[1] "Principles of Quantum Mechanics", § 78, p. 253.
[2] *ibid.*, § 45, p. 143.
[3] See, for example, Born and Jordan, "Elementare Quanten Mechanik", § 27, p. 142.

$K\alpha_1\alpha_2$ Doublet of Phosphorus

SOME time ago I published the results of an investigation on the effect of chemical constitution on the $K\alpha_1\alpha_2$ doublet of the elements sulphur[1] and chlorine[2]. With sugar as analysing crystal I have now made an introductory, analogous investigation on the $K\alpha_1\alpha_2$ doublet of phosphorus. The emitting substances were violet phosphorus, sodium hypophosphite and sodium phosphate.

The experimental arrangements were the same as those for my investigation of chlorine. The phosphorus lines, excited by X-rays, were measured relative to the $K\beta_1$ line of calcium, excited by electron impact. The phosphorus lines were photographed in the third order, the reference line in the sixth one.

Measurement of the results shows a difference of the wave-length amounting to 0·8 X.U. between the doublet of the hypophosphite and that of the phosphate. Relative to the doublet of the free element I have found the following displacements towards shorter wave-lengths :

for the hypophosphite doublet	1·7 X.U.
for the phosphate doublet	2·5 X.U.

A displacement towards shorter wave-lengths of the doublet of a phosphate was earlier found by Bäcklin[3], who excited the doublet by electron impact.

A closer investigation on the doublet is in preparation.

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Lund. Aug. 26.

[1] *Z. Phys.*, 77, 778; 1932.
[2] *Z. Phys.*, 82, 85; 1933.
[3] *Z. Phys.*, **33**, 547; 1925.

Research Items

Agricultural Settlement in Early Britain. Dr. Cyril Fox has recognised 'areas of primary settlement' in prehistoric Britain on the porous soils derived from chalk, sand and gravel, and 'areas of secondary settlement' on the heavy clays. In *Antiquity* for September, Messrs. S. W. Wooldridge and D. L. Linton argue in amplification of Dr. Fox's contention for a distinction of the soils of south-eastern England into two classes, 'permeable' and 'impermeable', to cover the undoubted fact that there exists an 'intermediate' type of soil, not recognised by Dr. Fox, which gives rise to highly distinctive and clearly bounded regions figuring among the more important settlement areas of the country from the Bronze Age onwards and clearly recognisable in the present-day cultural landscape. They correspond to the *loess* and *limon* soils recognised by the Continental archæologists and geographers. It was these loam regions which figured most prominently as the nuclei of settlement and penetration during the earlier stages of peopling the country. Thus in the Bronze Age there are the settlements of the loam regions of Guildford and Godalming, the Southend loam plateau, and the Norwich region, a conspicuous tract of high density following the Thames Valley and the lower parts of the valleys of the Brent, Lea, Wandle, Medway and Stour, the chalk of Wessex and in the Breckland. There is evidence of considerable occupation on the Essex boulder clay. The distribution of the Iron Age settlements and of the slightly later phase of the Cattuvellaunian dynasty tells the same tale. These settlements were inherited with but little extension by the Romans and finally consolidated and extended as regional nuclei by the Nordic invaders. The recognition of this 'intermediate' group of soils renders clearer the very partially true connotation of the 'valleyward movement', as a progression to plains and low plateaux of a definite soil constitution.

Archæological Exploration in Palestine, 1932–33. In the course of a survey of the work of archæological exploration in Palestine carried out by the American School of Prehistoric Research in recent years (*Proc. Amer. Phil. Soc.*, Philadelphia, **72**, No. 3) Dr. G. Grant McCurdy, director of the School, gives a brief account of the results obtained in the excavations carried out under the direction of Miss Garrod in the cave of Mugharet et-Tabun (Cave of the Oven) in 1932–33. A section 5·25 m. thick shows a sequence of levels ranging from mixture of Mousterian and recent at top through five other levels down to an early Mousterian or perhaps Acheulean, with many superb hand-axes, at bottom. The last-named has yielded an abundance of flint implements totally different from anything in the levels above, and resembling the very old Mousterian of High Lodge. The tooth of an elephant was found in the level which is probably contemporary with the interglacial horizon at Ehringsdorf-Taubach, and possibly of the same age as that recently reported from Ouum Qatafa, south of Jerusalem. Human skeletal remains have been found in level 4 (Mousterian with Levallois affinities and points of Still Bay type). These include a femur, a massive lower jaw, and a practically complete skeleton (? female). In the skeleton the bone of the skull is relatively thin and the development of the frontal torus is in marked contrast with the comparative delicacy of the rest of the skeleton. The massive lower jaw is comparable to those found by McCown in the Mugharet es-Sukul, but it is to be noted that while the lower jaw of the complete skeleton is chinless, the massive jaw, found 90 cm. deeper, has a fairly well developed chin. Is the difference racial or individual and abnormal ?

Inbreeding in Ayrshire Cattle. The Ayrshire breed of cattle is of relatively recent origin, the Herd Book Society dating only from 1877, while Shorthorns were a fairly pure breed in 1800 and Jersey cattle have maintained remarkable purity for nearly 150 years. Ayrshires were derived from the indigenous cattle of the south-west of Scotland graded up at intervals by English cattle, notably the Teeswater and Holstein breeds about 1750. West Highland blood was also introduced about 1800, but definite breeding records began three-quarters of a century later. The pure breeding history has been accompanied by two ideals, the production of milkers and non-milkers. A study of the inbreeding since 1877 has been made, using the methods of Sewall Wright. The coefficient of inbreeding for the whole herd showed a progressive increase to the relatively low value of 5·3 in 1927. No difference was found as between the amount of inbreeding of cows and bulls, and a large part of the inbreeding was traced to two particular sires. High milk-yielding cows showed a low amount of inbreeding, due to the belief that inbreeding was detrimental to milk yield. This assumption is, however, shown to be unfounded, since high milk producers (1,000 gallons and above) are as inbred as average milk producers. The coefficient of inbreeding for the whole breed increased about 100 per cent between 1917 and 1922.

Branchial Derivatives in the Frog. Y. Ikeda (*J. Fac. Sci., Imp. Univ. Tokyo*, Sect. 4, Zoology, vol. 3, Pt. 2, 1933) has investigated the branchial derivatives of a Japanese frog, *Rhacophorus schlegelii*. The development of the thyroid is already well known and did not form part of the investigation. The thymus arises solely from the first branchial pouch. The carotid gland is a thickening of the first branchial artery and is not derived from the pharyngeal epithelium. Two other bodies homologous with the carotid gland are found on the second and third branchial arches respectively. The first epithelial body (parathyroid) arises from the third branchial pouch, the second body from the fourth pouch ; they later become separated from the pharyngeal epithelium and they persist in the adult on the dorsal wall of the external jugular vein. The post-branchial body arises from the posterior visceral wall where the fifth branchial pouch would be expected to occur. The gill remnants undergo seasonal variations ; they and their blood-vessels enlarge in autumn and decrease in summer. They are not identical with the ventral 'Kiemenrest' of Maurer ; the latter or pseudo-thyroid appears towards the end of metamorphosis and has nothing to do with the gill. The properi-cardial body, which lies in front of the pericardium, and the procoracoideal body, which is formed as a pair of elevations on the floor of the opercular cavity, do not belong to the branchial derivatives.

A Method of Quantitative Microchemical Analysis. L. T. Fairhall and Ruth G. Howard (*J. Roy. Micro. Soc.*, 53, Pt. 2, June 1933) describe a microscopical method of determining minute amounts of precipitated substances. The precipitation tube consists of a capillary tube about 6 cm. long and 0·2–0·3 mm. in internal diameter, closed by canada balsam at its lower end and terminating at its upper end in an open bulb of about 0·5 c.c. capacity. The present series of experiments was carried out chiefly with calcium salts, and the tubes calibrated in terms of known amounts of calcium as oxalate, care being taken to obtain crystals of fairly uniform size and form. An electric tapper shakes the precipitated crystals into the lower part of the capillary tube, which is then placed in a wooden holder and centrifuged. The measurement of the precipitate is made by means of a low power microscope with eyepiece micrometer, the tube being mounted on a small carriage on the mechanical stage of the microscope. To facilitate accurate reading the two opposite faces of the capillary tube were ground optically flat and polished. The procedure for calcium in blood serum is described, and the figures given show an average error of about 5 per cent in the determination of the calcium in one tenth of a cubic centimetre of serum. The method is suggested for such body fluids as peripheral lymph or synovial fluid, available only in small quantity, or for the blood of very small animals, which is obtainable in such small quantity that a macro-analysis for calcium is out of the question.

Possible Drift of Greenland. In 1932 Dr. H. S. Jelstrup went to Greenland to determine the exact position of Sabine Island with the view of comparing the result with those of Sabine in 1825 and Börgen and Copeland in 1869 and 1870. He discusses his results in "Détermination Astronomique a Sabine-Öya" (*Skrifter om Svalbard og Ishavet*, No. 58, Oslo 1933). The new determination gave a position 615 metres west of the latter. Comparisons with Sabine's position proved unsatisfactory since the exact point of his observations could not be traced. Dr. Jelstrup discusses the bearing of these observations on Wegener's theory of drift. The older figures were based on careful lunar observations at different dates within a year and there is little reason for supposing that their inaccuracy is of a greater order than ±83 metres. Dr. Jelstrup's observations, with the help of radio time signals, are naturally less liable to error and he gives his own possible margin of error as ±22·5 metres. Thus he argues that the total difference of position being considerably greater than the sum total of the probable errors, the observations lend support to Wegener's theory of a drift of Greenland towards the west, and he estimates the drift to have been at least 250 metres in 62 years and probably more.

Rainfall in Holland. Publication No. 102 of the *Koninklijk Nederlandsch Meteorologisch Instituut, Mededeelingen en Verhandelingen*, No. 34a, is in part a continuation of the earlier No. 15 of the same series. In it Dr. C. Braak deals rather thoroughly with Dutch rainfall. Some of the records extend back to 1849, but the period used for the maps of mean monthly and quarterly rainfall is 1891–1930. There are numerous tables dealing with the diurnal range of rainfall, the frequency of rainfall of various intensities, of very heavy showers—referred to as "cloudbursts"—and of these quantities in relation to the direction of the wind. The wind has to be taken into consideration when an attempt is made to explain the lesser of the two maxima in the diurnal curve of mean hourly rainfall; the secondary maximum, which generally comes at about 6 a.m., and is most marked in the coastal regions, is attributed apparently to convergence between the land breeze and the general eastward drift over the ocean in these latitudes, but in the detailed application of this theory anomalies appear to be found and the whole subject obviously bristles with difficulties. One part of the work is purely statistical, and is designed to help engineers concerned with the disposal of the water that descends during exceptional downpours. Among the numerous rainfall tables one (Table 37), which gives the general rainfall for Holland month by month from December, 1848, until December, 1930, and the corresponding quarterly and annual figures, is of more than usual interest as a compact survey of the rainfall history of that country. For a large part of Holland, it appears that August is the wettest month, although for the south-east, July is the wettest, in common with the Continental area of midsummer maximum rainfall to the east; along the shores of the North Sea it is October that is wettest.

Excitation of Characteristic X-Rays by Protons. Gerthsen and Reusse (*Phys. Z.*, June 15) have been able to demonstrate the production of characteristic Al_K, Mg_K and Se_L radiations by proton impact and to find the excitation functions. The high-speed protons were produced by an energy-multiplying device depending on *Umladung* between neutral and charged particles and the energies ranged up to about 140 kv. The radiation was detected by a point-counter and its nature was verified by absorption measurements in copper and aluminium foils. The Al_K radiation began to be excited at about 40 kv. and its intensity rose rapidly at higher voltages. As a rough estimate, one quantum was excited for 10^5–10^6 incident particles at 140 kv. It may be noted that the energy transferred is greater than that given by the momentum relations for a proton striking a free electron, for in this case only 1/750 of the energy can be transferred as a maximum. The excitation potentials of the radiations observed lie between 1·3 and 1·5 kv.

A Rare Type of Optical Dispersion. The type of dispersion known as inclined dispersion of the bisectrices is, according to Tutton, seldom very pronounced, rarely exceeding a degree and generally being only a few minutes. It is therefore of interest to find that the compound acetone 2-4-dinitrophenylhydrazone in its stable modification exhibits a value of 2·5° at room temperature (Bryant, *J. Amer. Chem. Soc.*, August). The chief features of the crossed axial plane dispersion present in the metastable form are in harmony with Tutton's experimental generalisations, and the substance belongs to Tutton's second group ("Crystallography and Practical Crystal Measurement", Macmillan, 1922, vol. 2, Chap. xlix), in which the optic axial angle is more sensitive to changes of wave-length than of temperature. The wave-length of uniaxiality was 5440 A. The β and γ refractive indices are relatively close in magnitude, and the extremely high birefringence is somewhat at variance with Tutton's condition, requiring weak double refraction in order to produce wide separation of the optic axes in the two planes for the two ends of the spectrum.

Radio Studies of the Ionosphere

(1) By J. P. SCHAFER and W. M. GOODALL,
Bell Telephone Laboratories, Deal, N.J.

IN view of the interest which is being shown by various investigators in the ionisation in the upper atmosphere, in particular with reference to the existence of several new regions which we pointed out in our communication of April 5 to NATURE (issue of June 3)[1], we have thought it desirable to record the results of some of the more recent observations which we have made in this field[2].

As a result of daily measurements made near noon as well as a number of all-day tests which have been made from time to time, it appears that in the lower part of the *E* region and the lower part of the *F* region the ionisation in each is found to be substantially the same from day to day. Moreover, the ionisation in these regions attains a maximum shortly after noon and, in general, varies slowly with time in the manner that would be expected if the ionising agency which is effective in these regions, were constant in magnitude and originated at the sun. Tests made by us during the solar eclipse of August 31, 1932, indicate strongly that in *both* these regions this ionising agency is ultra-violet light.

As regards the three or more other regions, the ionisation appears to vary in a random manner from day to day and even in some cases from hour to hour. There appears to be no correlation between variations in one of these regions with those in another. The exact cause of these variations is not known but it seems likely that they are due to corresponding variations in the ionising agencies, or to changes in the atmosphere (for example, of density or of mass motion), or to both. Because of these variations it is not always possible to find all these

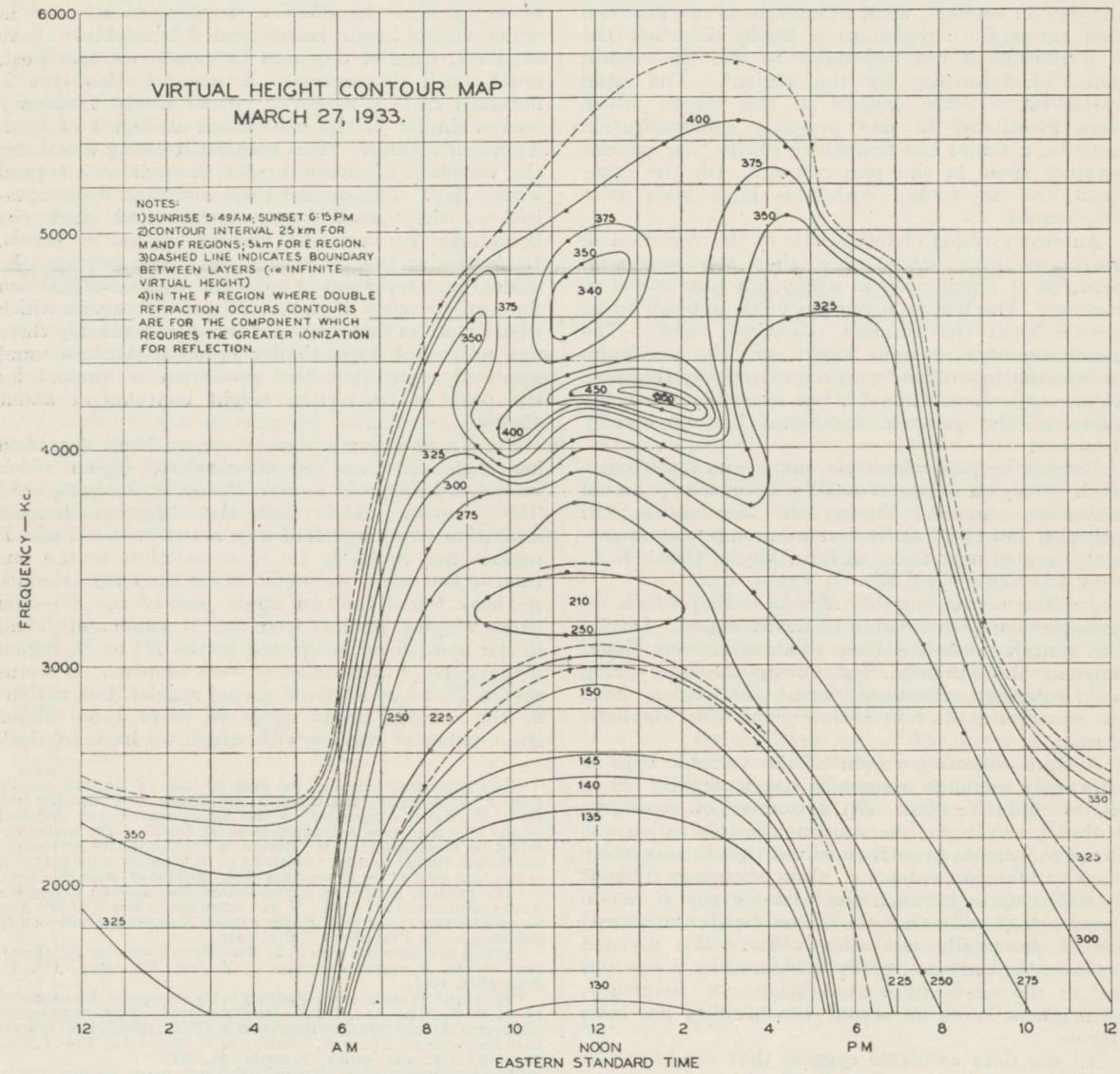

FIG. 1.

[1] NATURE (issue of June 3)

regions at the same time, since the ionic density of a higher region must exceed that of a lower region in order to be detected by radio measurements.

Probably the most important of these variable regions, from the point of view of radio communication, is the upper part of the *F* region. This region can usually be found throughout the day, but there are periods of three or four hours near noon on some summer days when the ionic density of this region is less than that of the lower *F* region and at such times, therefore, this region cannot be detected. It has also been found that sometimes in the middle of the day in summer, such reflections as are returned from the upper *F* region are so highly absorbed that it is difficult if not impossible to find the critical ionisation frequency for this region[3]. The rapid variations of ionic density in this region which were mentioned in our previous communication have been found less frequently during the present summer than in the past winter. On the other hand, the day-to-day variations have been more pronounced.

Another striking characteristic of the variation of maximum ionic density, is that the maximum occurred at about *noon in winter* but *near sunset in summer*. The winter noontime value appears to be greater than the summer noontime value. The maximum near noon in winter and the maximum near sunset in summer were approximately the same value until about June 21, but since that time the value of the summer maximum has apparently decreased.

During the past winter the upper and lower parts of the *F* region were not usually separated by actual ionisation minima. During the late spring and summer, however, an actual minimum was apparently formed near noon on most days. (Deal, N.J., 1932–33, latitude 40° N.)

Another of the variable regions is that which we have previously designated as the *M* region. During last winter, reflections from this region were found only in the forenoon, but during the late spring and summer, reflections from this region have on occasion been found throughout the daylight hours.

A third reflecting region of the variable type is frequently found to occur at a height slightly above the normal *E* region. On a number of occasions, both day and night, the ionisation in this region was found to increase to such an extent that it completely shielded all regions above it. It is often very difficult to differentiate between the parts of the *E* region because of the fact that the virtual heights measured are of practically the same value. The division between the parts is usually evidenced by a rise and fall in the curve of virtual height vs. frequency, although at times an actual discontinuity has been found.

All the data available suggest that conditions in the general *E* region of the ionosphere are particularly suitable for ionisation and that there are many different agencies or mechanisms which can cause ionisation in this region. It appears that ultra-violet light is responsible for the more or less steady daytime ionisation in this region. As regards the large increases in ionisation in this region which are often found (both day and night) to last from several seconds to several hours, several ionising mechanisms have been suggested. Among these agencies are the following: Meteors and meteoric matter (both radio[4] and visual[5] observations); charged particles or agency causing auroræ[6]; thunderstorms[7]; and changes in the composition of the atmosphere[8]. With such a wide range of possibilities and with the relatively limited data available it is difficult at this time to evaluate the relative importance of the different mechanisms.

In addition to the three variable regions mentioned above, it has been found on a number of occasions that the lower part of the *F* region is further subdivided into two distinct parts.

In Fig. 1 the virtual height, for March 27, 1933, is given as a function both of time of day and of frequency. It is in effect a 'topographical map' in which virtual height is substituted for altitude above sea-level, time of day and frequency for east-west, north-south dimensions. A map of this sort is obtained from a series of virtual height frequency curves similar to the one shown as Fig. 1 of Prof. Appleton's letter.[1] This contour drawing illustrates the variation of virtual height throughout a typical spring day. The dashed lines represent discontinuities in the virtual height curves and mark the boundaries between the various regions or layers. Beginning at the bottom of the figure at noon the dashed lines represent in order the separation between the various parts of the *E*, *M* and *F* regions, which were found on that day. On this particular day there was no actual discontinuity between the lower and upper *F* region but the separation is marked by the peak in the virtual height contours at about 4200 kc.

Finally as regards nomenclature, Prof. Appleton has suggested that the intermediate region which we have designated as the *M* region, be called the "E^{II}" region. Aside from the objection that an ionisation maximum half-way between the *E* and *F* regions has probably no more relation to the one than to the other, we prefer to use the letter *M* since we have found that an upper part of the *E* region exists which is distinct from the *M* region and should in our opinion be designated as the E^{II} or E_2 region if this type of nomenclature were adopted. It seems preferable to us to avoid giving special designations to the various layers until we know more about the number of regions with which we have to deal.

[1] Two interesting letters in the June 17 issue of NATURE, one by Prof. E. V. Appleton, and the other by Messrs. J. A. Ratcliffe and E. L. C. White, commented on this announcement and discussed similar or related results obtained in Great Britain. The results obtained by investigators at the Bureau of Standards have led them to conclusions similar to ours. Abstracts of their papers were published in the June issue of the *Proceedings of the Institute of Radio Engineers*.

[2] The material previously communicated was obtained during the winter months of 1932–1933. It was submitted in March of this year for presentation at the Fifth Pacific Science Congress and will soon be published in the *Proceedings* of that body.

[3] This is in conformity with T. L. Eckersley's discussion on absorption in the *F* region as given in *J. Inst. Elec. Eng.*, Vol. 71, September, 1932.

[4] That meteors are an ionising agency in the ionosphere was suggested by A. M. Skellett, *Proc. I.R.E.*, December 1932. Pulse experiments which give evidence of an ionising effect in the *E* region due to meteors have been conducted by J. P. Schafer and W. M. Goodall, *Proc. I.R.E.*, December 1932 and *Science*, November 25, 1932.

[5] Visual evidence that meteors sometimes leave glowing trains, presumably due to ionisation of gases, and that these trains are definitely restricted to the general level of the *E* region (70-100 km.) has been given by C. C. Trowbridge, *Astrophysical Journal*, 1907.

[6] Further evidence that the general *E* region is particularly sensitive to external ionising agencies is given by Störmer, who has shown that there is a pronounced maximum in the number of visible auroræ at heights of the order of 90-100 km. *Terrestrial Magnetism and Atmospheric Electricity*, Vol. 35, No. 4, December 1930.

[7] An effect of thunderstorms on the ionisation in the *E* region has been suggested by C. T. R. Wilson, *Proc. Phys. Soc.*, **37**, 32D; 1925. Appleton and Naismith, *Proc. Phys. Soc.*, 5, **45**, pp. 389, May 1933, and Ratcliffe and White, *Proc. Phys. Soc.*, pp. 399, May 1933, have published data tending to support the thunderstorm theory.

[8] Ivo Ranzi, NATURE, **130**, 368, Sept. 3, 1932, and R. C. Colwell, *Proc. I.R.E.*, May 1933, have found evidence of *E* region ionisation increases with corresponding changes in barometric pressure in the lower atmosphere.

(2) By D. F. MARTYN and A. L. GREEN, Australian Commonwealth Radio Research Board, University of Sydney.

WE have just received NATURE of June 3 and 17, containing letters by Messrs. Schafer and Goodall, and Appleton, Ratcliffe and White on the fine-structure of the ionosphere as observed in the United States and Great Britain. A series of experiments made in Australia in September and October 1932 have led us to similar conclusions regarding the existence of a layer of ionisation between the well-known *E* and *F* layers.

The observations consisted of a series of measurements of the equivalent height of the reflecting regions, using the frequency change method due to Appleton and Barnett[1]. They were made at five or ten minute intervals, usually from midnight until 7 a.m. (Eastern Australian Time) and covered a period of a month, with some gaps due to interference from atmospherics. The mean frequency employed was 1·43 megacycles per second (210 m.).

A typical graph showing the variation of equivalent height with time is shown in Fig. 1. It will be observed that at 0520 E.A.T. shortly before sunrise, the equivalent height of the *F* layer increased rapidly, and almost immediately afterwards decreased sharply to a value of 177 km. Thereafter the height fell more slowly until 0550 E.A.T., when a second rapid increase was followed by a jump down to the normal *E* layer.

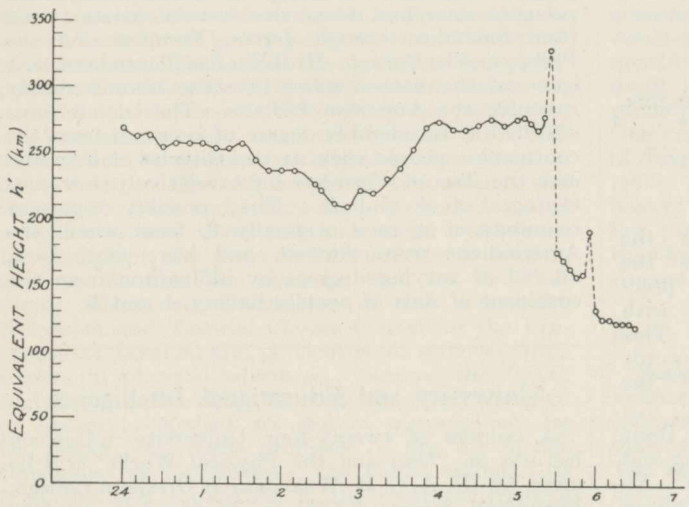

FIG. 1. (*h'*,*t*) Curve for frequency of 1·415 megacycles sec. Oct. 6, 1932.

Although no measurements of the polarisation of the downcoming waves could be made during the observations described, we consider it to be most improbable that the appearance of the intermediate height could be ascribed to double refraction in either the *E* or *F* layers. For the frequencies employed, separation of the ordinary and extraordinary rays should be small, while the nature of the height discontinuities before and after the appearance of the intermediate region is strongly suggestive of those critical ionisation conditions, accompanied by the appearance of abnormally great heights, which are frequently manifested during jumps between the *E* and *F* layers[2].

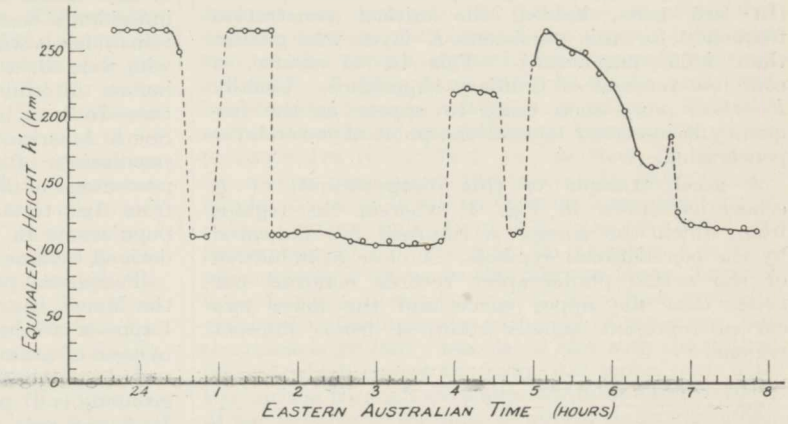

FIG. 2. (*h'*,*t*) Curve for frequency of 1·45 megacycles/sec. Sept. 6, 1932.

While we have found that it is normal for the transition from the *F* layer to the intermediate layer to occur abruptly, on at least one occasion we have observed this change to take place quite gradually, unaccompanied by those marked changes in the amplitude of the sky wave which are a well-marked feature of the normal and apparently discontinuous height changes. The temporal height variations for this morning are shown in Fig. 2. It will be noticed that after falling gradually from an equivalent height of 265 km. to 162 km. over a period of 1·3 hours, a discontinuity eventually occurs at the transition between the intermediate and *E* layers. The abnormal height occurring at 0645 E.A.T. was marked by an abnormally small amplitude of sky wave, and is therefore to be classed as a typical layer jump. The fact that a gradual and smooth transition can take place between the *F* region and the intermediate region under the solar ionising influence suggests that there is a close affinity between the ionised components in these two regions and militates somewhat against Appleton's tentative suggestion that the components of the ionosphere may be associated with the ionisation potentials of atomic and molecular oxygen and nitrogen.

[1] *Proc. Roy. Soc.*, A, **109**, 621; 1925.
[2] Schafer and Goodall, *Proc. Inst. Rad. Eng.*, **19**, 1434; 1931.

(3) By W. BRUCE ROSS and JOHN T. HENDERSON, Macdonald Physics Laboratory, McGill University, Montreal.

FROM January until July of the present year, a series of radio observations on the ionosphere has been undertaken at McGill University in connexion with the International Polar Year. The normal height of the *E* layer is rarely found to be below 100 km., regular measurements on 2·0 and 4·0 megahertz giving a modal value of 120 km. The modal value for *F* on the same frequencies is 260 km.

The following interesting abnormality has, however, been encountered. On six occasions between July 8 and August 1 we found that as the frequency was increased beyond the point where reflections from both layers were returned, the F echo completely disappeared, leaving the E echo still in evidence. The E layer was not penetrated until a considerably higher frequency had been reached. (In two tests, indeed, the critical penetration frequency for this persistent E layer was greater than 9·65 megahertz.) This is, of course, a complete reversal of ordinary experience. Usually E echoes very soon cease to appear as the frequency is increased beyond the point of lower layer penetration.

A good example of this disappearance of F echoes is shown in Fig. 1, wherein the regions from which the energy is returned are indicated by the conventional symbols. A close examination of the actual photographic records confirms our belief that the upper curve and the lower two curves represent signals returned from different regions.

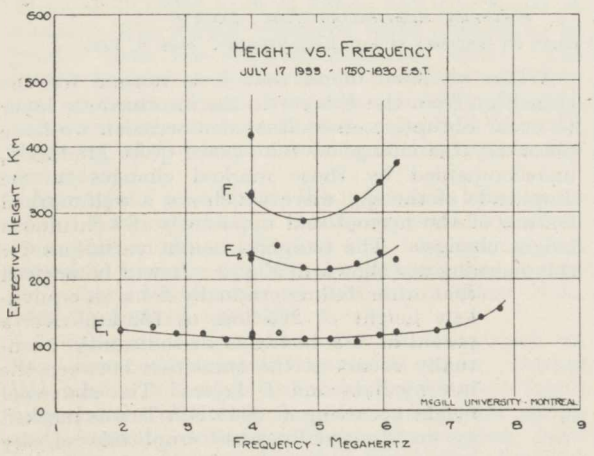

FIG. 1.

Occasionally echoes were received from the intermediate region, while at other times the two layers appeared to merge, giving a practically continuous distribution of heights, with no clearly defined line of demarcation. This phenomenon is also found in unpublished records obtained in Ontario during the week of the August 1932 eclipse.

In the present series of tests the method of Breit and Tuve has been employed, the transmitting and receiving stations being separated by 3·5 km. No means of checking polarisation was available. During this season there have been decidedly more thunderstorms than is customary in the district, but so far no correspondence has been traced between unusual echo phenomena and storms in progress in the vicinity. We recognise, however, that, as pointed out by Appleton and Naismith[1], it may be necessary to make a statistical analysis of storms in a much larger neighbourhood to establish a connexion. Magnetic data are now under examination for evidences of correlation.

[1] *Proc. Phys. Soc.*, **45**, 389, May 1, 1933.

Blood Groups and Racial Relationships

PROF. R. RUGGLES GATES described in a paper read on September 8 at Leicester before Section H (Anthropology) of the British Association the results of his recent work on the blood groups of the coastal Indians of British Columbia. Of 300 individuals tested, 14 per cent were A and the remainder 0 with the exception of two individuals who were B, a result which seems to indicate that before intermixture with white blood occurred, these Indians, like those in other parts of North and South America, were originally all 0. The present populations of north-eastern Asia now have a high percentage of B as well as A, hence the emigration from Asia to America must have ceased before the populations in Asia from which the Indians were derived became impregnated with A or B.

'Peripheral' peoples such as the Australian natives, the Maori, the Bushmen of South Africa and the Lapps of northern Europe have A, but no B except in cases of racial crossing. Among 400,000 individuals tested in all parts of the world, the pan-human blood grouping is 37 per cent 0, 38 per cent A, 18 per cent B, 7 per cent AB, A thus being older and more widespread than B. Both have spread through the human race by repeated mutations as well as by crossing and migration of races. Since the American Indians may be regarded as more advanced than the Australian aborigines and the Bushmen, who have A, and since they are believed to have entered North America in relatively recent times, there appears to be some difficulty in explaining the absence of both A and B from pure-blooded Amerindians.

Prof. Ruggles Gates offered the following as a possible solution. A fringe of islands and archipelagoes stretches down the eastern Asiatic coast from Sakhalin through Japan, Formosa and the Philippines to Borneo. Hrdlička has pointed out that some of the native tribes in these islands closely resemble the American Indians. The islands have afforded a considerable degree of isolation from the continent: people such as the Gilyaks of Sakhalin and the Tso of Formosa have relatively low percentages of A and B. They possibly represent remnants of a race originally 0, from which the Amerindians were derived, and have since been altered in varying degrees by infiltration from the continent of Asia of peoples having A and B.

University and Educational Intelligence

A COURSE of twenty-four University Extension lectures on "Man and the Physical World" will be given by Dr. A. C. R. Wakeman at Gresham College, Basinghall Street, E.C.2, on Wednesdays at 7.30 commencing on October 4. The course will be divided into two parts, namely, "History of the Advance of Physical Science" (October 4–December 20) and "Common Physical Phenomena in their Relation to Man" (January 10–April 11). Further particulars of this and other courses can be obtained from the University Extension Registrar, University of London, South Kensington, London, S.W.7.

EDUCATION in India in 1930–31 is briefly reviewed by the Educational Commissioner with the Government of India in a pamphlet recently issued from

the Central Publication Branch, Calcutta (pp. 82. 2*s*. 6*d*.). Statistics of enrolment of students show that the rate of expansion was much slower than in past years, whilst in the higher stages (post-secondary education) there was a decrease by 5 per cent, from 83,334 to 79,225. The prevailing financial stringency and economic depression coupled with the laxity of discipline engendered by the civil disobedience movement are mentioned in this connexion. The number of females under instruction, 2,375,593, shows an increase in all stages and now represents 1·8 per cent of the total female population, whilst for males the corresponding percentage is 7·36. The standard of instruction in the secondary stages is said to be slowly rising, at any rate in Government institutions. The use of the vernacular as the medium of instruction and examination is increasing and inspectors complain that since the change of medium was introduced the standard of written and spoken English has deteriorated. As regards primary schools, the most striking feature of the returns is the extent of wastage, especially in the first year, the number of pupils in class 2 being 2,124,478 as compared with 5,266,579 in class 1. The need of a clearing house for educational ideas and a medium for the diffusion throughout India of new methods has been felt since the abolition in 1923 of the Central Advisory Board of Education and Bureau of Education, and the Government has decided to revive them as soon as financial conditions improve. The report is disfigured by surprising clerical errors in the summary of statistics of education in rural areas on p. 3.

LONDON'S evening lectures and classes for teachers form an important part of its educational system, being designed to bring teachers into touch with the latest developments in educational methods, to give them opportunities of hearing leading authorities in various branches of learning and on current questions of importance. The London County Council's recently published handbook of its lectures and classes for teachers for the session 1933–34 gives particulars of 83 evening courses, most of which have a direct bearing on the problem of adapting instruction in the schools to the task of direct preparation and training for work and leisure under present-day, and probable future, industrial and social conditions. The pamphlet also gives useful publicity to courses, specially suitable for teachers, held by the University Extension Committee of the University Extension and Tutorial Classes Council of the University of London, and particulars of some daytime courses in physical education. Among the L.C.C. courses of outstanding interest are the following: on design in applied art and in pictorial art, by Dr. Roger Fry, Slade professor of fine art in the University of Cambridge; the Cizek method—its principles and application in the technical training of selected and unselected children respectively and adults, by Miss A. Philip Smith; physiology and hygiene for teachers in senior schools, by Prof. Winifred Cullis; international economics for the layman, by Sir Norman Angell; problems in human geography, by Prof. C. B. Fawcett; the League of Nations, by Mr. Wickham Steed; the European situation, by Dr. G. P. Gooch. It is noteworthy that no less than twenty of the courses fall within the category of art and handicraft. The science courses are characterised by an obvious design on the part of those who framed them to broaden and vitalise instruction in science.

Calendar of Nature Topics

Harvest Moon

In consequence of its orbital motion round the earth, the moon rises and sets later each day. The average difference from day to day is about 48 minutes, but owing to the difference of about five degrees between the plane of the moon's orbit and that of the earth's equator, the intervals between the times of rising from one day to the next, and between the times of setting, vary widely. Near the autumnal equinox the difference between the times of successive risings may be less than 15 minutes for several days about full moon. In 1933, for example, the moon is full on October 3 and the time of rising changes only from 4.33 p.m. (G.M.T.) on September 30 to 5.23 p.m. on October 4. This phenomenon is known as the 'Harvest Moon', because in early times it was believed to have been specially ordained to facilitate the gathering of the crops, but the name is probably associated also with the optical illusion which causes the rising full moon, seen near the horizon through the slight mistiness characteristic of fine weather in autumn, to appear unusually large, a symbol of plenty.

October Rains

In a normal year, the end of summer in England sees the soil moisture depleted by evaporation and the demands of crops or other vegetation. During the present century, September has been generally dry, and the replenishment of the underground supplies begins with the heavy rains of October. Although in this month cyclonic depressions are not quite so numerous or intense as in winter, the south-westerly winds associated with them are heavily charged with moisture from the Atlantic, which still retains much of the heat of summer, and the 'cyclonic rainfall' associated with these depressions makes October the rainiest month over the greater part of England. The only exceptions are mountain districts, where the stronger winds of winter give a heavy 'orographic' rainfall in December, and a few low-lying places in the east or Midlands where thunderstorms give a maximum rainfall in July or August.

Beetles and St. John's Wort

Beginning in September and continuing until February, individuals of the St. John's wort beetle (*Chrysomela hyperici*) lay their eggs upon the young under-shoots of the plant after which they are named. The eggs hatch in spring and early summer, and the larvæ, like the adults, which appear about July, feed ravenously upon the plant upon which they were born.

This restricted diet has been the reason for the selection of *C. hyperici* and its congeners *C. varians* and *C. brunsvicensis*, in an attempt to control one of the serious pests of Australian grazings. The pest began, as so many begin, in an unforeseen and innocent way. About 1880 a German lady obtained from her fatherland seeds of St. John's wort (*Hypericum perforatum* var. *angustifolium*), and planted them in her garden near Bright. From the garden the plant invaded and flourished upon the adjacent racecourse. The racecourse became the source of much evil. By

1902 the weed had covered some 8,000 acres, by 1905 more than 10,000 acres, and by 1916 the infested area in Victoria was estimated at 184,000 acres. To-day, Messrs. G. A. Currie and S. Garthside say in their Progress Report on St. John's wort control that the infested area in Victoria alone is estimated variously at 250,000 to 400,000 acres, while smaller areas in New South Wales and South Australia have been occupied by this weed pest.

Chrysomelid Beetles introduced into Australia

In Britain, St. John's wort has not run riot as in Australia, and the supposition is that the beetles named in the preceding paragraph may have played an important part in keeping it within bounds. It seemed possible, therefore, that in Australia these beetles also might prove useful enemies of the introduced weed. Aware that introduced animals have more often proved a curse than a blessing, Dr. R. J. Tillyard and his staff made careful investigations in Great Britain and in Australia to discover whether the St. John's wort beetles were able to survive on plants, particularly plants of economic value, other than the normal food-plant. Adult beetles and larvæ were enclosed with the plant to be tested and were allowed to feed upon it or complete a passive resistance and starve to death. Forty-six plants were tested in England and in no case did the beetles feed upon any.

The way was now clear for the transference of beetles from Britain to Australia, and shipments were begun in 1929 and 1930. There they were bred, and a new series of tests on Australian plants taken in hand. Forty plants were thus tested, and on none did the beetles feed. The beetles were liberated in October 1930 in various places where St. John's wort grew densely, and although survivors of the first liberation were found five months later, it was still too early, when the Report was published in 1932, to say whether the beetles were likely to establish themselves in numbers sufficient to effect destruction of the weed.

Manx Herring Shoals

Herring shoals which begin to arrive in Manx inshore waters in the Irish Sea in May, remain there until September, which sees the end of the fishing period. Herrings which are actually spawning are seldom taken by boats in Manx waters, probably owing to their nets not being deep enough, but offshore, spent fish in goodly numbers are taken from the middle of September onwards. The older fishes, which have spawned in previous years, do not arrive in Manx waters until their gonads are almost ripe, and they spawn during September.

W. C. Smith (Report of the Lancashire Sea Fisheries Laboratory, No. 40; 1931) describes the Manx herring shoals during the seasons of 1929, 1930 and 1931. Inshore migration becomes appreciable in mid-June, although it may be delayed until mid-July, and reaches a maximum at the end of July. Herring do not arrive in the offshore ground until mid-August, where fishing is good for a month. These shoals consist in the main of 'full' herrings more than three years old, with sixth year fish most abundant. It appears certain that a herring spawning ground is situated close to the Calf of Man.

Societies and Academies

LONDON

Institute of Metals (Silver Jubilee Autumn Meeting at Birmingham), September 18–21*. O. F. HUDSON: Wear in the polishing of plated and other surfaces. The following materials, using magnesia on wet parchment as the polishing medium, were examined: pure platinum, pure palladium, platinum plating on brass, palladium plating ('soft', 'hard', and burnished) on brass, nickel plating ('soft' and 'hard') on brass, silver plating, and brass (60 : 40). Considered as loss of thickness, the rate of wear of the palladium-plated specimens was found to be greater than that of the platinum-plated specimens, but considered as loss of weight, the wear of the palladium coatings was slightly less than that of the platinum coatings; whilst the precious metal coatings generally were more resistant than the same metals in massive form. W. HUME-ROTHERY: A graphical method for converting the weight percentage compositions of ternary systems into atomic or molecular percentages. The method is suitable for use where 60° ruled triangular paper is available. It permits the direct transference of a triangular diagram drawn on the weight percentage scale to one in atomic percentages, and the accuracy obtained is of the order 0·1–0·5 per cent, according to the precision of the instruments and of the ruled paper. BRINLEY JONES: Preparation of lead and lead alloys for microscopic examination. Time devoted to preliminary polishing is restricted, the true structure of the metal being revealed by chemical solution of surface layers. After the removal of recrystallised layers, sections may finally be prepared for high-power examination by a treatment of alternate polishing and etching, the final polishing being vigorous. D. G. JONES, L. B. PFEIL and W. T. GRIFFITHS: Precipitation-hardening nickel–copper alloys containing aluminium. The properties of nickel–copper–aluminium alloys with nickel contents from 10 to 45 per cent and aluminium contents up to 4 per cent have been investigated. The relationships between composition and capacity for hardening by heat-treatment have been studied by means of hardness tests on the heat-treated specimens. A study has also been made of the most suitable heat-treatments to produce the soft condition, and the stability at elevated temperatures of a selection of the alloys in the precipitation-hardened condition. H. O'NEILL, G. S. FARNHAM and J. F. B. JACKSON: An investigation of the heat-treatment of 'standard silver'. The precipitation-hardening of quenched 'standard silver' (7·25 per cent copper) has been investigated by Meyer hardness analysis. Precision X-ray spectrograms obtained with Cu-radiation from thick disc specimens of the heat-treated alloy indicate that surface preparation may considerably affect the lattice parameter results. Polishing should be avoided in this work, and etching may have bad effects. Quenched 'standard silver' when reheated for 30 minutes in the 300° C. region is in a sensitive condition, and appears to precipitate completely when deformed. If precautions are taken, the lattice parameters indicate a normal progressive precipitation of copper constituent as the quenched alloy is reheated at increasing temperatures. D. STOCKDALE: The constitution of the aluminium-

* Continued from p. 490.

rich aluminium–copper alloys above 400° C. A part of the work of Dix and Richardson on the solubility of copper in aluminium has been repeated and their results have been closely confirmed. A considerable range of solid solutions has been found near the composition $CuAl_2$, but no evidence for the existence of the compound $CuAl_2$ has been obtained. W. H. J. VERNON: Green patina on copper: examples from Elan Valley, Wales, and Dundalk, Ireland. The patina from a copper structure in mid-Wales contained 20·75 per cent basic copper chloride, as compared with 8·15 per cent in the patina from a copper spire at Dundalk, on the east coast of Ireland (approximate ratio 2·5 : 1); this result is attributed to the influence of prevailing winds. Basic copper sulphate constituted the bulk of the deposit in each case, relationship of formula with period of exposure confirming the conclusions of previous work.

PARIS

Academy of Sciences, August 21 (*C.R.*, **197**, 501–540). A. COTTON: The use of coloured indicators for detecting the heterogeneity of alloys. The use of indicators for detecting heterogeneity and resistance to corrosion of alloys described in a recent note by Prot and Goldovsky (*C.R.*, **197**, 136) was anticipated by Ch. Quillard six years ago (*C.R.*, **185**, 1281). HYACINTHE VINCENT: Anticolibacillus serotherapy. The results of its use in grave gangrenous appendicitis with local or general peritonitis. Acute appendicitis is regarded by the author as an infectious disease with a specific, but as yet unknown, virus. It is concluded that anticolibacillus serotherapy is the necessary complement to the surgical treatment of complicated malignant or toxic cases of appendicitis. L. BLARINGHEM: The habitus of flax in relation to its fecundity and selection. A. DEMOULIN: A class of families of quadrics with two parameters. HELMUT HASSE: Applications to the Abelian case of the theory of normal remainders in Galoisian extensions. G. VAN DER LYN: The existence of approximate integrals of the equation $y' = f(x, y)$. JACQUES VALENSI: The field of velocities behind propulsive aerial helices. MME. G. CAMILLE FLAMMARION and F. QUÉNISSET: The appearance of a white spot on the surface of Saturn. Description of the appearance and position of the spot on August 6. NICOLAS DE KOLOSSOWSKY: Contribution to the thermodynamical theory of liquids. NICOLAS DE KOLOSSOWSKY and W. W. UDOWENKO: The measurement of the molecular specific heats of some liquids. MAX MORAND and A. HAUTOT: New data on the structure of the *K* radiation of very light atoms. Description of results obtained for oxygen, nitrogen, carbon, boron and beryllium. G. JOURAVSKY, P. CHARCZENKO and G. CHOUBERT: The magnetic susceptibility of magnetites from some basic volcanic rocks. J. COULOMB: The discontinuous nature of Love's waves. CLAUDIUS LIMB: The visibility of Mont Blanc from the Fourvière Observatory. MLLE. C. BOURDOUIL: Some intermediate characters of the hybrids of the second generation between species of *Pisum* (*P. sativum* with *P. arvense*). ALPHONSE LABBÉ: The presence of siliceous spicules in the teguments of the Oncidiadeæ. HARRY PLOTZ: The rôle of the embryonic cells in the culture of the virus of bird plague. CL. REGAUD, G. GRICOUROFF and EUD. VILLELA: The formation of a hybrid race of muciparous epidermal cells, during the metaplasic transformation of the epithelium of the uterine canal, which precedes or accompanies cancer formation.

CAPE TOWN

Royal Society of South Africa, June 21. A. ZOOND and JOYCE EYRE: Pigmentary response in the chameleon. In strong diffuse daylight chameleons show a response to background. They become dark on a black background, and pale on a white one. Blind animals darken in the light. This response has been shown to depend upon the integrity of spinal reflex arcs. The threshold for the retinal photoreceptors is lower than for the dermal ones. In weak light the white background response is reversed. The animals become dark. A theory of nervous co-ordination is developed. A. J. HESSE: A study in bioccœnosis. The insect fauna dependent or biologically associated with the Western Province plant *Gnidia laxa* was studied during spring and summer. No less than seven orders of insects and members of the class Arachnida were found to be directly or indirectly dependent on this plant. The most important insects are discussed. Descriptions of the eggs, larvæ, pupæ and adults are given in detail of most of these insects. I. SCHRIRE and H. ZWARENSTEIN: The effects on the urinary creatinine of normal and castrated rabbits of injections of anterior lobe pituitary extracts. Such injections transiently increase the elimination of creatinine in normal male and female rabbits. In the castrated animals no change is apparent. There is evidence to show that the anterior lobe of the pituitary normally controls the creatinine excretion in the animal and that the hypertrophy of the anterior lobe after castration is responsible for the increased excretion of creatinine in the gonadectomised animals. The metabolism of injected creatinine by normal and castrated male rabbits. Castrated male rabbits excrete the administered creatine to a greater extent and over a longer period than is the case in the normal animals. This is believed to be due to the excess of anterior lobe secretion of the pituitary of the castrated animal.

ROME

Royal National Academy of the Lincei, May 7. F. SEVERI: The theory of the correspondences to valency on an algebraic surface (1): in the projective sense. R. FABIANI and G. PETRUCCI: New geophysical explorations in Sicily: general results and particular data on geomagnetic determinations. A number of regional and local anomalies emerge from the geomagnetic determinations. C. AGOSTINELLI: The orthogonal properties of the natural families of lines of a curved space. U. BROGGI: Repetition of the operation xd/dx. F. CONFORTO: A linear system of equations to partial derivatives integrated by the method of fundamental solutions. M. MANARINI: Rotational of a vector in the spaces S_n. E. GUGINO: The geodetic curvature of the dynamic trajectories of holonomous systems. M. LELLI: Mechanical similitude in the regular motions of viscous liquids. The laws of the similitude between the motions of viscous liquids in large and small systems are considered. G. AGAMENNONE: Considerations on the seismic hypocentres of the Latium hills. N. MORTARA: Experimental investigations on a generator of constant, high tension, continuous currents. The results of tests on the arrangement devised by Corbino are recorded. G. B. FLORIDA: Existence of the Upper Eocene in Cyrenaica. The presence of the Upper Eocene is proved by the discovery of nummulites. Both in Cyrenaica, where various levels are distinguishable, and in Egypt, the Upper Eocene is

characterised by the same association of species, at least in so far as the foraminifera are concerned. G. REVERBERI: Crossing experiments between eggs of *Ciona intestinalis* and sperm of *Phallusia mamillata*. M. MITOLO: Avitaminosis and intoxications (3): Experimental syndrome from avitaminosis A and chemical intoxication from metals and metalloids. Oral administration to rats suffering from avitaminosis A, of a mixture of metallic and non-metallic compounds in doses non-toxic to the normal animals, causes neither acceleration nor inhibition of the effect of the food-deficiency. Moreover, the toxicity of the inorganic compounds is not enhanced under such conditions.

SYDNEY

Royal Society of New South Wales, June 7. G. HARKER: The decomposition of chloroform by radiations from radon. The decomposition produced in different thicknesses of chloroform with filtered and unfiltered radiation from radon has been studied. Excess decomposition is produced near the source with unfiltered radiation but rapidly falls off in amount. Minute traces of impurities greatly influence the decomposition. Expressed in terms of energy, the amounts of X- and Y-radiation necessary for the decomposition of one gram molecule of the same sample of chloroform differ greatly. The figures found were 29·800 calories for X-radiation and 251·300 calories for Y-radiation. E. H. BOOTH and J. M. RAYNER: A magnetic survey in the vicinity of a granite bathylith. The paper deals with the north and east of Gulgong, New South Wales. The area covered by the survey is about eighty square miles. The contact is with Silurian (?) slates, the granite probably having intruded in later Devonian times. The contact is buried by about 100 ft. of alluvium, the gradient back to the exposed granite being slight (about 1 : 100). The contact is steep, the section passing off granite in half a mile or less, once the sharper fall commences. The maximum magnetic anomaly due to the granite is about 800 γ, the slates and soil being practically non-magnetic. A general geological and isodynamic map of the district is given, also six sections, magnetic and geological, across the area. The instruments were 'Askania' vertical magnetometers. The magnetic anomalies along the actual presumed line of contact are not readily interpreted.

Linnean Society of New South Wales, May 31. GERMAINE A. JOPLIN: The petrology of the Hartly district. (2). The metamorphosed gabbros and associated hybrid and contaminated rocks. The Cox's river intrusion, which occupies an area of about 900 acres, is situated on the river at a distance of about three miles below the crossing of the Jenolan Road. It has been shown that the differentiation of an earlier partial magma of gabbro gave rise to a slightly more acid core. The whole was then enveloped by a ring-like intrusion of a later more acid partial magma of quartz-mica-diorite, and as a result of this later intrusion the gabbros have suffered three types of metamorphism: (1) thermal metamorphism; (2) reaction or partial hybridisation; (3) hydrothermal metamorphism. H. J. CARTER: Australian Coleoptera. Notes and new species. (8). Thirty-six species are described as new—eight Buprestidæ, nineteen Tenebrionidæ, eight Cistelidæ and one Cerambycidæ. Tables are given for the species of *Cotulades* and *Byallius*. H. L. JENSEN: Corynebacteria as an important group of soil micro-organisms. Bacteria possessing the characters of the genus *Corynebacterium* were found to occur as a numerically important group of micro-organisms in Australian soils, accounting for 8–65 per cent of the numbers of bacterial colonies developing on plates of dextrose-casein-agar. They appear to be active in the decomposition of organic matter in soil, particularly in the later stages of the process. They are probably identical with certain organisms previously recorded as rhizobia.

Forthcoming Events

Wednesday, Oct. 4

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 3.—Prof. Henry E. Armstrong: Inaugural Sessional Address.

Friday, Oct. 6

PHYSICAL SOCIETY, at 5.45—(at the Royal Institution, 21, Albemarle Street, London, W.1).—Dr. Herbert E. Ives: "Thomas Young and the Simplification of the Artist's Palette" (Thomas Young Oration).

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1491 (S. and C. 367, 368): Experiments on Swept-back and Swept-forward Aerofoils. By D. H. Williams and Dr. A. S. Halliday; with an Appendix by H. B. Irving. Pp. 22+19 plates. 1*s*. 3*d*. net. No. 1527 (T.3360): Binary Servo-Rudder Flutter. By Dr. W. J. Duncan and A. R. Collar. Pp. 23+2 plates. 1*s*. 3*d*. net. No. 1532 (T. 3308, 3308a): The Best Basis of Aircraft Performance Reduction. Part 1: Supercharged Engines, by J. L. Hutchinson and E. Finn; Part 2: Unsupercharged Engines, by E. Finn. Pp. 18+28 plates. 2*s*. 3*d*. net. (London: H.M. Stationery Office.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 19, No. 1, August. Pp. 486. (Plymouth.) 19*s*. 6*d*.

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1932. Pp. 227. (Harpenden.) 2*s*. 6*d*.

Proceedings of the Royal Society of Edinburgh, Session 1932-1933. Vol. 53, Part 3, No. 17: The Effect of Consanguineous Parentage uponMetrical Characters of the Offspring. By Prof. Lancelot Hogben. Pp. 239–251. 1*s*. 3*d*. Vol. 53, Part 3, No. 18: The Fæcal Pellets of *Hippa asiatica* By Dr. Hilary B. Moore. Pp. 252–254. 6*d*. Vol. 53, Part 3, No. 19: The Diffusion Coefficients of Bromine-Argon, Bromide-Methane, Bromide-Hydrogen Chloride, Bromine-Nitrous Oxide. By Dr. John E. Mackenzie and Dr. Harry W. Melville. Pp. 255–259. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society. Series A, Vol. 141, No. A845, September 1. Pp. 493–747+plates 10–17. 13*s*. Proceedings of the Royal Society. Series B, Vol. 113, No. B784, September 1. Pp. 345–495+plates 11–12. 10*s*. (London: Harrison and Sons, Ltd.)

Proceedings of the Royal Irish Academy. Vol. 41, Section B, Nos. 12, 13: On *Cleistopora geometrica* (Milne-Edwards and Haime), by Louis B. Smyth: On certain Carboniferous Corals with Epithecal Scales, by Louis B. Smyth. Pp. 167–178+plates 8–10. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

OTHER COUNTRIES

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 16: Fibre-Length Irregularity in Cotton. By Dr. Nazir Ahmad and Harirao Navkal. Pp. ii+10. (Bombay.) 8 annas.

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1932. Pp. 86. (Bangalore.)

India: Meteorological Department: Scientific Notes. Vol. 5, No. 52: Thunderstorms in South India during the Post-Monsoon Months, October and November 1929. By S. P. Venkiteshwaran. Pp. 63–68+8 plates. 1 rupee; 1*s*. 9*d*. Vol. 5, No. 53: A Note on the Rapid Fluctuations of Atmospheric Pressure and the Atmospheric Instability at Peshawar during 1928 and 1929. By S. Basu and S. K. Pramanik. Pp. 69–88+4 plates. 12 annas; 1*s*. 3*d*. (Delhi: Manager of Publications.)

Bulletin of the Madras Government Museum. New Series, Natural History Section, Vol. 3, Nos. 3 and 4: The Life-Histories of Decapod Crustacea from Madras, by M. Krishna Menon; Sagitta of the Madras Coast, by Dr. C. C. John. Pp. 55+11 plates. (Madras: Government Press.) 2.6 rupees.

The Indian Forest Records. Vol. 18, Part 7: Entomological Investigations on the Spike Disease of Sandal. 10: Melasidæ and Elateridæ (Col.). By E. Fleutiaux. Pp. 16. (Delhi: Manager of Publications.) 5 annas; 6*d*.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 85. 2ème partie: Rapport administratif (1932–1933); 3ème partie: Appendices. Pp. 75. (Copenhague: Andre. Fred. Høst et fils.) 7.00 kr.