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Nature and Science in Poetry

MUCH has been written on the essential characteristics of poetry, and many opinions have been expressed upon the relative values to be attached to form and content, metre and rhythm, imagination and emotion in its composition. In the evolution of the various species of poetry from classical epic to modern verse, almost as many styles can be observed as meanings are attached to the range of science. Early poetic conceptions of manifestations of Nature are represented in Nature myths, which may be regarded as the beginning of poetry, and are developed to a supreme standard in the creations of Greek mythology.

Some of the greatest poets have enriched their verse by the study of natural phenomena—Lucretius, Milton, Dante and Goethe, for example, each made accurate use of the scientific knowledge of their times. In English poetry dealing with Nature—the country-side as apart from precise science—Thomson in his "Seasons" brought about a great development of interest in the natural world related to universal human nature. Even closer contact was revealed by Wordsworth, who accepted Divine thought as pervading all Nature and the poet as responding to the moods with which he was in close communion.

Keats and Shelley, Tennyson and Browning all saw beauty and power in Nature, and each has given us works in which great poetic perceptions are mingled with passionate human feeling. Keats by perfect phrase and exalted fancy expressed the poetic love of Nature for her own sake, as in his thoughts on the song of the thrush in "Nature's Child" :

> O fret not after knowledge!—I have none,
> And yet my song comes native with the warmth.
> O fret not after knowledge!—I have none,
> And yet the Evening listens.

Shelley, on the other hand, in "Queen Mab", written when he was only eighteen years of age, showed himself to be acquainted with existing knowledge of the sun and stars, the structure of the universe and other astronomical studies. Similarly, Wordsworth as the contemplative lover of Nature differs from Tennyson who observed her features in minute detail and recorded them with faithful affection. In his felicitous combination of science and poetry Tennyson reveals naturalism at its highest and best. Robert Bridges in "The Testament of Beauty" similarly

shows how observations of Nature and science may be presented in classical literary style and illustrate that "This spiritual elation and response to Nature is Man's generic mark".

Though poetry and science represent different attitudes towards Nature, they are not mutually destructive and may be complementary to one another. The purpose of poetry is not to present facts but to express stimulating thoughts in a perfect setting of words. While science seeks to secure uniformity in verifiable truths, the essence of poetry is diversity of conception. To the scientific imagination the atom is a microcosm in which the movement of each electron plays a particular part; and it is upon the nature and consequences of the movements of such particles that attention is concentrated. The desire is to see things as they are, whereas the poet aims to display the emotional feelings aroused by them. Coleridge defined the difference between the two types of mind when he wrote: "The proper and immediate object of science is the acquirement or communication of truth; the proper and immediate object of poetry is the communication of pleasure."

The two intentions are not, however, necessarily opposed. It is common to-day to disparage Victorian verse, yet no poet has surpassed Tennyson in the application of scientific truth to poetic purpose or in his wealth of allusions arising out of a knowledge of Nature's operations and laws. Interest in scientific studies increased his range of selection and opened his eyes to new phenomena and ideas. His poems abound in descriptive beauty, and though many are so well-known as to have become almost trite, yet it is permissible again to quote a selection from them to show how Nature knowledge may be successfully united to poetry. What a perfect picture of the last stage of metamorphosis of an insect is afforded, for example, by the words from "The Two Voices":

To-day I saw the dragon-fly
Come from the wells where he did lie.

An inner impulse rent the veil
Of his old husk: from head to tail
Came out clear plates of sapphire mail.

He dried his wings: like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew.

The constellation of Orion, which commands attention in the sky at night during winter months, approaches the setting sun as spring comes on and is eventually lost in the twilight. This is a mere statement of common observation, but in "Maud", Tennyson paints the scene with the brush of an artist:

It fell at a time of year
When the face of night is fair on the dewy downs,
And the shining daffodil dies, and the Charioteer
And starry Gemini hang like glorious crowns
Over Orion's grave low down in the West.

Rain and river, ice and sea, are continually wearing away the land surface of the earth, while internal forces are lowering the general level of land in some places and raising it in others. Many geologists have described this wear and tear, rise and fall of the earth's crust, but none could display the changes more graphically than Tennyson does in the well-known stanzas from "In Memoriam":

There rolls the deep where grew the tree.
O earth, what changes hast thou seen!
There, where the long street roars, hath been
The stillness of the central sea.

The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds they shape themselves and go.

The constantly changing face of Nature is frequently revealed in Shelley's poetry, as in his "Ode to the West Wind" and "The Cloud", in which poetic imagination endows natural themes with almost living spirit. Every schoolboy knows the lines:

I am the daughter of earth and water,
And the nursling of the sky;
I pass through the pores of the ocean and shores;
I change, but I cannot die.

To understand the full significance of the poem in which this verse occurs requires a knowledge of the cycle of transformations of terrestrial waters not commonly possessed by men of letters. From invisible moisture to cloud, from cloud to shower, rain to spring and rivulet, to stream and river, and then to the sea to be distilled afresh into the air and return again to the earth—such is the lesson in physiography beautifully expressed by Shelley.

A perfect example of poetic expression applied to a common natural phenomenon is afforded by a sonnet on a shooting star which appeared some years ago in an American magazine, and impressed itself upon our memory, though the title of the magazine and name of the author have been forgotten. The appearance of a shooting star is due to a small portion of cosmic matter, often no

larger than a pea, being drawn into the earth's atmosphere and being consumed through the intense heat produced by its rapid movement. In the following verse the poet, while accurately describing what occurs, brings human feeling into the expression of it, and it is his thought rather than the explanation which makes his verse beautiful.

> Far better 'tis, to die
> the death that flashes gladness,
> than alone, in frigid dignity,
> to live on high.
> Better, in burning sacrifice,
> be thrown against the world
> to perish, than the sky
> to circle endlessly,
> a barren stone.

Another fine example of the transformation of a scientific fact into poetic beauty is afforded by Francis Thompson's lines :

> All things by immortal power
> Near or far,
> Hiddenly
> To each other linkèd are,
> That thou canst not stir a flower
> Without troubling of a star.

It required a poet thus to apply the universal law of gravitation to human influences, and to touch the heart while giving a thought upon which even a mathematician may well ponder.

Poetry is not, indeed, the expression of logical thought or scientific principle, but rather the revelation of human feeling and the art of combining words in metre and phrase which impress the mind in much the same way as music. Campbell did not want "proud philosophy" to teach him the beauty of the rainbow and Keats set forth the same doctrine that "all charms fly at the mere touch of cold philosophy", yet a poet familiar with the optics of rainbow formation might well find in them a source of inspiration. Just as emotion does not manifest itself in exactly the same way in any two persons, so everyone sees a different rainbow and is the sole centre of the "triumphal arch" which he sees. The particular display of colours admired by him is for him alone, and millions of raindrops falling through the air contribute to his pleasure by their refractive effect upon sunlight. To attempt to explain the formation of a rainbow in verse would not be poetry but a literary outrage, yet the natural events which lead to a consciousness of the wonder furnish a worthy theme for a muse with poetic insight.

If the attitude presented by Keats and Campbell were true, its consequence would be to deprive every student of elementary optics of the possibility of enjoying the sight of a rainbow. It would be just as illogical to suppose that appreciation of music must be denied to all who have a knowledge of acoustics, or that when a chemist knows the constitution of a synthetic perfume he loses his sense of smell. Knowledge does not necessarily prevent poetic conceptions or strangle imaginative thought. All that it does is to place mystery on a different and a higher plane, and for a single wonder it substitutes a thousand for interpretation by poetic imagery.

Writing at the beginning of the nineteenth century, Wordsworth looked forward to the time when the poet would find inspiration in aspects of scientific achievement and industrial progress. He suggested that :

> The remotest discoveries of the Chemist, the Botanist, or Mineralogist, will be as proper objects of the Poet's art as any upon which it can be employed, if the time should ever come when these things shall be as familiar to us, and the relations under which they are contemplated by the followers of these respective sciences shall be manifestly and palpably material to us as enjoying and suffering beings. If the time should ever come when what is now called science, thus familiarised to men, shall be ready to put on, as it were, a form of flesh and blood, the Poet will lend his divine spirit to aid the transfiguration, and will welcome the being thus produced, as a dear and genuine inmate of the household of man.

It can scarcely be said that Wordsworth's vision has come true and that literary genius has found inspiring themes in the great achievements of modern science. We may broadcast our music and messages around the whole world, yet they cannot be heard without tuning in to the ether waves which carry them. Scores of poems have been written upon the song of the thrush, but no poet has let his imagination play upon the wonder of the song of a nightingale in a Surrey wood being heard in New York City actually before the sound reached a listener a few hundred yards away. While our masters of literature are unresponsive to such vibrations originating in scientific discovery, they neglect a rich field of human feeling from which precious gems of thought could be derived.

A welcome exception is Dr. Alfred Noyes, who, in the three volumes of "The Torch Bearers", has given us a stimulating epic of scientific discovery

relating to the heavens, the earth, and man's control of natural forces. Among men of science themselves several may be mentioned who have passed from the laboratory into the garden of poetry and have successfully cultivated beautiful flowers in it. In the first rank of these must be placed Sir Ronald Ross, whose poems are richly resonant to the vibrant soul of man ever seeking the truth and striving for it even through suffering. Sir Charles Sherrington and Prof. Julian Huxley are other men of science who have produced melodious music from the lyre of poesy, but Ross stands alone in style and vision as a poet of science.

In a little volume recently published entitled "The Poetry of Geology" (London : Thomas Murby and Co., 1933. 6*s*. net), Mr. K. K. Hallowes, who for eighteen years was a member of the Geological Survey of India, makes a strong appeal for the creation of a new school of poets of science, who will reflect the truth in Nature with accuracy and charm. His book consists of a thoughtful essay in which he points to the rich field of science which awaits interpretation by poetic genius, and he himself contributes thirty poems, mostly sonnets, in illustration of geological aspects of his theme. With his view that the aim should be "to enshrine the most accurate science in the most beautiful poetry" we are in complete agreement, but we do not believe that it can ever be achieved by merely expressing scientific truths in verse if the divine afflatus is lacking. Alfred Austin was accurate enough when he wrote the famous couplet on the illness of the Prince of Wales in 1871 :

> Across the wires the electric message came,
> He is no better, he is much the same.

No one could, however, suggest that such doggerel has any claims to be classed as poetry. We are not so unkind as to place Mr. Hallowes' verses in the same category, for some of them show him to have true poetic instinct as well as the gift of clear expression. There is, however, nothing but plain description in a verse like the following, which is a fair sample of a number of others in the book :

> One morn through fields of wheat of emerald blade
> I took the road to Selwa. Far away,
> O'er Jhingrai hung, a cloud of smoke blue-grey
> Told how farm hands an early breakfast made ;
> And when I reached upon the hill a glade
> Of stunted trees I started to survey,
> And found a bed of limestone in decay,
> Between two Deccan lava-flows inlaid.

This might be the introduction to a geological report in verse and would just as suitably be described in prose. Poetry must embody new conceptions and creative thought and not be photographic images. While, therefore, we join with Mr. Hallowes in regretting that achievements of modern science have failed to inspire contemporary poets, we are sure that the human heart will not be touched by soulless descriptions of natural events or phenomena. "Poetry," as Leigh Hunt said, "is the utterance of a passion for truth, beauty and power, embodying and illustrating its conceptions by imagination and fancy." There can be no inspiring poetry of science without the possession of these spiritual attributes and the artistic instinct which will clothe them in garments of blissful words and radiant phrases. When the poet of science does arise he will not necessarily have had, as Mr. Hallowes believes, "a thorough university training in science, practical as well as theoretical", but his mind will be sensitive to the wonder of scientific discoveries and the insight they afford into natural things from the atom to the celestial universe, and through appreciation of them he will be uplifted to planes of creative thought and sublime teaching.

First Aid for the Research Worker

Physico-Chemical Methods. By Prof. Joseph Reilly and Prof. William Norman Rae. Second edition, revised. Pp. xv+822. (London : Methuen and Co., Ltd., 1933.) 42*s*. net.

FOR what qualities does one look in a volume of some eight hundred pages, weighing a generous three and a half pounds, and bearing the title "Physico-Chemical Methods" ? Such a work might be no more than an orthodox laboratory manual—presumably of an advanced and critical type, dealing, in common with its fellows, with a description of certain orthodox experiments, and prefaced by a more or less perfunctory account of general principles and processes. These manuals, provided for the members of a generation which may plod, with such enthusiasm as their education has left them, through a series of standardised experiments in preparation for the inevitable standardised examination, do not provide material assistance for the serious researcher. His outlook is very different ; his problems are not so clear cut ; many of the processes which he has learnt

require serious modification; he is called on to use instruments the range and technique of which are outside those of the instruments to which he has hitherto been accustomed; and if he has been trained as a chemist, he may have to learn that such fundamental processes as that of taking a temperature accurately are not so simple as they seem to be. The physicist, on the other hand, who adventures into physico-chemical research, is apt to treat a little too light-heartedly the question of the purity and purification of the compounds with which he has to deal.

The book under review, valuable possession though it may be for the undergraduate student, is primarily occupied with the needs of the research worker. Scarcely any aspect of experimental physical chemistry is omitted. The laboratory and its equipment; general processes such as glass-blowing, distillation, sublimation and the like; hints on photography; a résumé of methods of calculation; these form but a selection from the general topics of which the work treats. It provides, moreover, a conspectus of modern methods for the determination of various physical constants, and, in this region, the authors have been at great pains to put in the reader's hands a critical summary of modern methods for the measurement of viscosity, surface tension, the properties of gases and vapours, thermal measurements, and measurements of optical and electrical properties.

Here, as is almost inevitable, there is room for considerable difference of opinion concerning what should be inserted and what omitted. We take it that the authors' main object is to put before the research worker who desires to determine accurately certain physical constants, such a digest of the best methods as shall absolve him from the necessity of an extended search through the literature of the subject. Their accounts, indeed, are in most instances detailed enough to permit the worker to whom the literature is difficult of access to make for himself a precision determination of the more important physical properties of substances. There are, however, one or two odd lapses which will, we trust, be rectified in future editions. It would, for example, take up little more space, and be much more convincing, if a drawing of Callendar's apparatus for the measurement of the absolute coefficient of expansion of a liquid were substituted for that of the drawing, really quite out of place in a work of this standard, of the school form of Dulong and Petit's apparatus.

Again, in the section dealing with the measurement of the principal specific heats of a gas, it is very important that the student should be given some hint of the manner in which a determination of, say, C_p, is extrapolated to obtain the limiting value at infinite volume. This is typical of very necessary information concerning processes which tend to be overlooked, if the information is not supplied. It is certainly a waste of valuable space to devote three pages of the book to a detailed discussion of the simpler types of the apparatus of Clément and Desormes and of Kundt for the determination of the ratio of the principal specific heats, omitting all reference to the work which has been done in improving experimental technique since 1895—the date of the most recent paper quoted in the text.

The method of calibration of a mercury thermometer by the separation of a thread which is then moved along the tube is surely *vieux jeu*, yet four pages are devoted to a detailed description of this method. The very useful section devoted to a description of methods for the measurement of surface tension would be improved if the essentials of Rayleigh's dimensional argument concerning the drop-weight method were more clearly brought out, and the beautiful experimental work of Harkins and his colleagues presented in detail. In this section, too, the addition of one small meniscus curve to Fig. 256, which illustrates a method described by the reviewer and Mr. Dowson, has sufficed to obscure the description in a remarkable degree.

The section dealing with the balance is very full and critical. It may be worth noting that a paper has recently appeared, possibly too late to be considered in this edition, which discusses in detail the form of the knife edges and places the usual argument for the variation of sensitiveness with load in a different light.

These are, however, small matters—if such points were multiplied twenty-fold they would still remain inconsiderable in a volume of so wide a sweep—and the reviewer, who has found the book most useful, mentions them in no captious spirit. In its revised form the book merits a hearty welcome, and Prof. Donnan does not pitch his praise too highly when he says that "no chemical laboratory, whether it be in a university or in a works, and no serious student of chemical science can afford to dispense with this important treatise".

ALLAN FERGUSON.

Spiders and their Allies

Les arachnides (scorpions, araignées, etc.) : biologie systematique. By Lucien Berland. (Encyclopédie entomologique, Vol. 16.) Pp. 485. (Paris : Paul Lechevalier et fils, 1932.) 150 francs.

ALTHOUGH this book bears the general title of "Arachnida", 325 pages are devoted to spiders, while important orders like the mites, scorpions and Solifugæ receive less than 40 pages between them, and the Ricinulei and Palpigradi are dismissed in a few paragraphs. The doubtfully-related Pycnogonida and Tardigrada are omitted, but the Linguatulidæ are included. There is no mention of *Limulus*. Thus the book is, in effect, the third 'biology of spiders' to be published in Europe since 1928, and in view of the increasing attention which the Arachnida are attracting, it seems unfortunate that the opportunity was not taken to give other orders a fuller treatment.

Apart from this difference in proportion, each group is described in the same orderly way, with an account of structure, habits and classification, written in a style of pronounced clarity and copiously illustrated. Inevitably, much is a repetition of the work of others, and M. Berland pays a graceful compliment to his predecessors. But he surpasses the majority of them in one respect, which seems to us to be of the highest importance. "Comment interpreter ces faits ?" he writes on p. 392, and elsewhere shows that he "ne se contentait pas d'une simple constation de fait". Accordingly, he gives reasoned discussions of the facts of adaptation, mimicry, venom, courtship and other topics, which form the most valuable portions of his book. In particular, he emphasises the fact that while there are many examples of adaptation to particular environments, there exist many more cases of spiders occupying the same environment with no special adaptation to it. Therefore the structures which are usually described as adaptations can have, in fact, no survival value, since other species can survive without them.

In this connexion, it is surprising that M. Berland quotes Peckham's work on colour vision in wolf-spiders with no reference to Loeb's interpretation of this behaviour as an instance of phototropism. But he shows throughout a refreshing contempt for any theory, however famous, which fails to explain facts, and is agreeably ready to conclude a discussion with the wise admission—"We do not know." His methods are seen to the greatest advantage in his masterly chapter on the distribution of spiders, and the same high praise is merited by his account of fossil arachnids. Both these chapters surpass anything of the kind previously available.

The anatomical part is adequate, although it is limited to external features, and the treatment of abdominal somites is not quite satisfactory. In the chapter on the classification of spiders M. Berland proposes a new system of two sub-orders with only 46 families in five groups. One of these is called the Uloboridea, and corresponds exactly with Simon's Cribellatæ. Although the vexed question of bringing together all cribellate spiders is discussed, we cannot think that this arrangement is justifiable, save as a measure of practical convenience in diagnosis. Since Petrunkevitch's classification has recently been revised by its author, a further discussion of this subject here is unnecessary.

To each chapter is appended a bibliography. Many of these are rather meagre and most of them betray a relative neglect of German contributions.

Any book to the preparation of which its author devotes five years is of course bound to be overtaken by the advance of knowledge, and examples of this will be noticed by those actively engaged in arachnology. But this book is a great achievement, and the points to which we have alluded scarcely affect its value to the general zoologist, who should accord it the welcome it manifestly deserves.

T. H. S.

Chemical Engineering

Unit Processes and Principles of Chemical Engineering. By Prof. John C. Olsen ; in collaboration with Crosby Field, Alfred L. Webre, Theodore Baker, James W. Lawrie, F. W. Sperr, Jr., Charles L. Bryden, Robert M. Keeney, P. H. Emmett, Andrew M. Fairlie, L. D. Vorce, Percy E. Landolt, George A. Prochazka, Jr., J. L. Warner. Pp. xiv+558. (London : Macmillan and Co., Ltd., 1932.) 25*s*. net.

THIS is an American textbook ; England still lacks one made at home which her would-be chemical engineers can read. The subject continues to make progress in Great Britain and the United States and, thanks largely to the influence which the sister Institutions of Chemical Engineers are exerting in both countries, it is being increasingly well taught at a number of centres. At one time there was some uncertainty in defining the scope

of the subject, but now it is more or less clear that it includes certain industrial operations, many of them general in industry but making up in the aggregate a chemical process. Such operations include evaporation, distillation, filtration, drying, and the like. Their control and the design of the plant require a specialist with wider knowledge than is usually possessed by the mechanical engineer; he must have chemical knowledge as well as one of stresses and strains, must understand corrosion as well as strength of materials.

The large number of mistakes still made in the design of chemical plant, the difficulty of getting suitable plant for special purposes, all emphasise the need for the chemical engineer and for a suitable course of training for him. This is not the place even to attempt to discuss what this should involve, but opinion seems to be crystallising that it should comprise the study of unit processes.

Such is the plan of the book edited by Prof. Olsen, who occupies the chair of chemical engineering at the Polytechnic, Brooklyn, in collaboration with thirteen experts, who are responsible between them for the sixteen chapters which make up the book. In this way it is ensured that each unit process is described by one who is thoroughly acquainted with it from practical knowledge. The sections naturally vary in quality, particularly in their English; if some of the plant is as bad as the English, it should have a short life. There can be no reason why chemical engineering students should not be taught to express themselves correctly; the clear use of words is surely as important as that of figures.

The book is well printed, contains diagrams and some modern illustrations, and follows conventional lines. It is certainly packed with information. Perhaps the most novel feature is the section on plant location, compiled by J. L. Warner, in which this subject is discussed in a skilful and attractive manner. In the past, plants had a habit of locating themselves, often wrongly; to-day the utmost thought is given to finding the theoretically ideal location, again not always with success. So many factors come into play that the ideal is hard to achieve, though sometimes, as, for example, at the great Billingham works of Imperial Chemical Industries Ltd., a triumphant success is scored. E. F. A.

Short Reviews

Flora of Syria, Palestine and Sinai: a Handbook of the Flowering Plants and Ferns, Native and Naturalized, from the Taurus to Ras Muhammad and from the Mediterranean Sea to the Syrian Desert. By Dr. George E. Post. (American University of Beirut: Publications of the Faculty of Arts and Sciences: Natural Science Series, No. 1.) Second edition, extensively revised and enlarged by John Edward Dinsmore. Vol. 1. Pp. xliv+639. (Beirut: American Press; London: Oxford University Press, 1932.) 42*s.* net.

POST'S "Flora of Syria, Palestine and Sinai" has been a work of reference for those engaged in studying the flora of the Near East since its original publication in 1896. It is based mainly on Boissier's "Flora Orientalis" and, like that great classic, has for some time needed drastic revision. The present (second) edition, of which the first volume is noticed here, retains the essential features of the original but has been considerably enlarged by the inclusion of many more species, mostly discovered in the area since 1896, and some additional figures. Since the whole work has been re-set, it seems unfortunate that Post's descriptions, often inadequate for purposes of exact identification, were not re-written. Many of the figures too should have been re-drawn.

The increase in our knowledge of the flora of Palestine and adjacent territories in recent years, largely due to the botanical activities of the editor of the new edition and his colleagues and to Dr. Eig of the Hebrew University, Jerusalem, is indicated by a comparison of the new volume with the original flora. Thus, Post accepts 9 species of *Papaver*; Dinsmore records 21. The species of *Trifolium* have increased from 55 to 65; of *Astragalus* from 115 to 133; of *Silene* from 58 to 70. It should be pointed out that the new species in this volume are not here validly published since they are unaccompanied by a Latin diagnosis. It is to be hoped that a map will be included in the final volume. W. B. T.

Organic Chemistry for Medical Students. By Prof. George Barger. Pp. xi+249. (London and Edinburgh: Gurney and Jackson, 1932.) 12*s.* 6*d.* net.

PROF. BARGER has written this book through the conviction that the chief reason for including organic chemistry in the medical curriculum is to provide a basis for biochemistry. Necessarily, therefore, the book contains a good deal of matter which will appeal mainly to the medical student in his later years of study. It may be felt, indeed, that an attempt has been made to include too much within the space available, and that such advanced topics as stereoisomerism, glucosides,

and heterocyclic compounds are reviewed before the ground has been sufficiently prepared. Even without increasing the space allocated to the more elementary sections of the subject, the treatment could be made clearer for the beginner by the adoption of an improved system of paragraphs and headings, and by the more frequent use of illustrative diagrams.

The few drawings of apparatus here reproduced are evidently not the work of a chemist: they are badly proportioned (for example on pp. 4 and 18), and in one of them (p. 20) a Liebig condenser is shown with a jacket devoid of an inlet or outlet. The biological and pharmacological sides of the subject are excellently expounded, and it is this aspect of the book which is the most distinctive and attractive.

Plant Sociology: the Study of Plant Communities. Authorized English translation of "Pflanzensoziologie". By Dr. J. Braun-Blanquet. Translated, revised and edited by Prof. George D. Fuller and Prof. Henry S. Conard. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xviii+439. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 27*s.* net.

PLANT ecologists will welcome this English translation of a book which, for the last five years, has been perhaps the most stimulating and comprehensive exposition of the subject available. The volume is not a translation only, since the editors, who have had the full co-operation of the author throughout, have introduced certain subjects not appearing in the original and have included the results of research published since 1927.

Perhaps the most interesting sections to English readers are those on the organisation of plant communities and the systematics of phytosociology. The former gives a clear account of Braun-Blanquet's methods of practical community-analysis, and the latter will open English eyes to the very rapid progress which has lately taken place in the floristic classification of plant communities.

The book has been admirably translated and is fully illustrated by plates and diagrams.

Philips' Vitamin Charts. 40 in. × 30 in. Chart No. 1: *Vitamin Values of Foods.* Chart No. 2: *Diseases resulting from a Lack of Vitamins.* (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1932.) Mounted on tanjib, with rollers, 8*s.* 6*d.* net each.

THESE charts should prove of utility to those engaged in lecturing to students, or to other audiences not likely to be adversely affected by somewhat lurid colour illustrations of patients suffering from deficiency diseases. The colours applied on the first chart to common food stuffs and their packages also tend rather to the melodramatic, but in all cases the articles represented, like the deficiency diseases, are reasonably recognisable. In both charts a certain amount of accuracy has necessarily been sacrificed to the process of generalisation, for example, in ignoring the complexity of vitamin B, failing to distinguish between carotene and vitamin A, using beriberi as the sole illustration of vitamin B deficiency, and overlooking the presence of vitamin C in fresh meat. Nevertheless, provided the charts are used as convenient illustrative summaries by speakers and lecturers already conversant with the subject, these minor deficiencies, and the fact that they will tend to get further out of date in detail, need do no more than partly discount their undoubted value. A. L. B.

The Principles of Optics. By Prof. Arthur C. Hardy and Fred H. Perrin. (International Series in Physics.) Pp. xiii+632. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 36*s.* net.

THOSE who have learnt their optics as a branch of applied mathematics abounding in elegant problems devoid of any but an artistic value, will find (if they are young and mentally flexible) very refreshing reading in this remarkable volume. Readers of a more rigid habit of mind may find the occasional lack of a logical proof a little irritating.

Over and above the conventional course of geometrical and physical optics to which we are all accustomed, we find very stimulating and suggestive discussions of such topics as photography, light sources, light-sensitive cells and physical photometry, colour, optical glass, the manufacture and testing of optical parts, the principles of design, telescopes, microscopes, photographic objectives, projection systems and stereoscopy.

The book is a noteworthy addition to an important series, and may be recommended alike to the academic and to the technical student.

A. F.

Steam Power Plant Engineering. By Louis Allen Harding. Pp. viii+777. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 62*s.* 6*d.* net.

THIS book has been described as the "Compleat Power Engineer". The author of it has been president of an American technical society, professor of mechanical engineering in an important college, a contributor to more than one important handbook, and the head of a firm. From the immense amount of data he has collected he has been able to compile a most comprehensive work which will prove of value to every power engineer who uses it. The thirteen chapters deal in turn with fuels, boilers, draught, firing appliances, boiler accessories, feed water apparatus, pumps, steam engines, turbines condensing plant, power plant cycles, valves, pipes and fittings, and lastly arrangements of steam power plants.

The book is designed to cover a complete course in steam generation and utilisation; it contains many references to recent papers on the subject and considerable data about the large American power stations.

The Work of the R.R.S. *Discovery II*, 1931-33

By D. DILWYN JOHN

THE "Discovery" Investigations have been in progress since 1925 and some accounts of them have appeared in previous issues of NATURE*. Their purpose is research into the economic resources of the Falkland Islands and their Dependencies, and more particularly into the most important of them: the whale populations and the whaling industry of the waters of the latter. The whaling researches aim at a full knowledge of the biology of the whale species, and their relationship to their environment, by which alone the industry can be restricted so that it does not bring about the destruction of the whale stocks, and its own destruction, through overfishing. They have been directed along two lines: work upon the whales themselves by zoologists stationed at whaling factories; and work upon the environment of the whales at sea from research ships. The present article is concerned with the latest of the researches at sea, which have been chiefly hydrological and planktonic.

The Royal Research Ship *Discovery II* was built in 1929 and was described in NATURE of November 23 of that year. On her first commission, from November 1929 until June 1931, the work was under the personal guidance of Dr. Stanley Kemp, the director of research. The vessel sailed from London for her second commission on October 3, 1931, immediately after the visit paid to her by members of the British Association attending the Association's centenary meeting in London. Her first work in antarctic waters was to repeat and extend in the Falkland sector the hydrological and plankton survey which had been made there in each of the previous six seasons by the vessels of the "Discovery" Committee. The lines of stations comprising the survey were so arranged as to constitute sections across all the water masses which go to make up the whaling areas of the Falkland Dependencies. At all points the work was carried as far south as possible, that is, to the edge of the pack-ice.

The survey was begun in the west in November with a line southwards from the western entrance of the Magellan Strait along the 75th meridian (Fig. 1). The ice was comparatively far north: the Bransfield Strait was packed in in late November; there was heavy pack immediately to the north of the South Orkney Islands in early December which ran in that latitude eastwards to the longitude of South Georgia.

The end of December was spent in making close series of observations around South Georgia. The island lies partly in the path of a current which flows in a north-easterly direction out of the Weddell Sea. Our work in earlier years had shown that this water from the Weddell Sea is peculiarly rich in plant and animal life—in marked contrast to the water of the Bellingshausen Sea to the west—and it was supposed that the explanation would be found in its history. A stream of water enters the Weddell Sea from the coasts of Coates Land and the lands east of it and sweeps around the sea before flowing out as the north-easterly current. We particularly wished to obtain a series of observations extending far south into the Weddell Sea to the stream of water entering from the east.

In January 1932 we found streams of light pack-ice to the east of the southernmost of the South Sandwich group. They offered no serious obstacle to the passage of a steel ship and we steamed south through them. The season was early and the wind remained southerly: it seemed safe to suppose that the ice through which we were moving would become more and more dispersed as time passed. In 70° S., just after we had entered the stream of water flowing in from the east, we met with a wall of heavy, rafted and impenetrable pack. We turned north to leave the sea by following a course more westerly than that of our passage south so that we might, so far as possible, follow the course of the circulation in the sea. After a very short time the ice floes became larger and heavier and more closely packed; there was no sun, the temperature fell and the open water between the floes became frozen. The new dark ice offered in itself a surprising resistance to our passage; together with the heavy floes it made it difficult and even dangerous.

The stations of this survey of the Falkland sector are shown in Fig. 1. With very few exceptions they were all 'full stations', that is, comprised both hydrological and plankton observations: water samples were taken from a close series of depths from the surface to the bottom; a closing net was fished vertically through six successive layers of water from 1,000 metres to the surface; a phytoplankton net was fished through the upper 100 metres; and a large stramin and a small silk net were towed obliquely behind the ship from 250 to 100 metres and from 100 metres to the surface. All stations later referred to as 'full stations' were of this kind.

The winter months, April–September, of 1932 were spent in almost circumnavigating the antarctic by making a series of V-shaped cruises and one W-shaped cruise from South Africa east-about to South America (Fig. 2). The turning-point of each V-shaped cruise was the edge of the pack-ice fringing the continent. The second turning-point of the long W-shaped cruise between New Zealand and South America had to be made before the ice was found because of shortage of fuel.

The antarctic work of earlier commissions had been confined almost entirely to the Falkland sector, the scene in earlier years of all the whaling

* See NATURE, October 30, 1926; May 19, 1928; September 28, 1929.

in the antarctic with the exception of a little in the Ross Sea. The Falkland sector receives, in both the surface and deep layers, water from the east which has had its origin in the Indian Ocean and water from the west from the Pacific. In other words it lies *in the path of circumpolar movements;* its conditions can be fully understood only when they are known. It was, in part, the necessity for this knowledge, and in part the recent expansion of whaling through pelagic methods around the greater part of the antarctic continent, which led to the circumpolar cruises in the winter of 1932. At the same time these cruises made possible continuous observations throughout the winter and through all but one sector of the antarctic on the important plants and animals of the plankton, chief among them the whale-food, *Euphausia superba*.

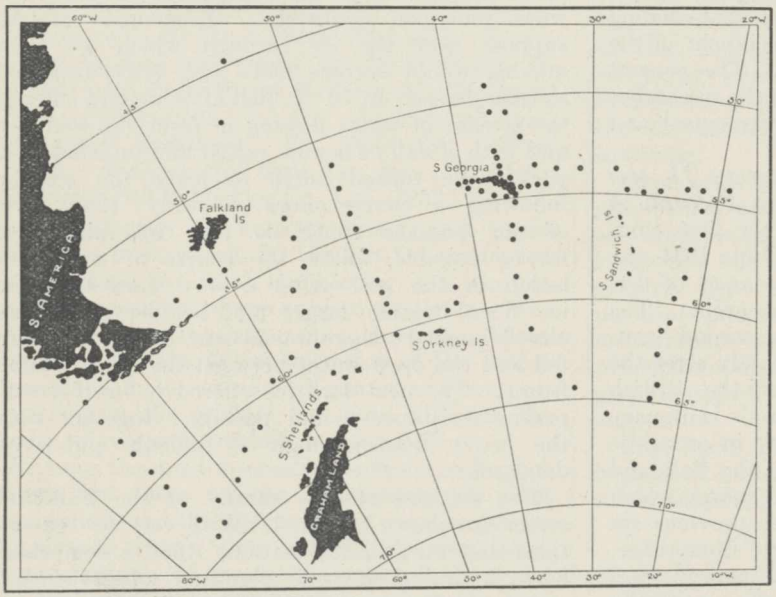

FIG. 1. Chart showing the positions of stations made by the R.R.S. *Discovery II* in the Falkland sector of the antarctic in the season 1931–32.

On all the cruises, a full station was made each night, and additional observations at the edge of the pack-ice where whale-food, *Euphausia superba*, was always taken. The positions of the stations are shown in Fig. 2. On each cruise the vessel crossed and re-crossed the boundaries, known as *convergences*, between antarctic and sub-antarctic, and sub-antarctic and sub-tropical waters. These are the antarctic and sub-tropical convergences, separating surface waters of very different character and distinctive floras and faunas. On our circumpolar cruises we defined their positions, for the seasons of our observations, around the hemisphere.

The spring and summer months, early October until December, of the 1932 season were spent in making a similar survey of the Falkland sector to that of the 1931–32 season. (Fig. 2, compare with Fig. 1.) The ice conditions were very different. In the 80th meridian, to the west of Graham Land, the pack-ice lay south of the antarctic circle in late October. The Bransfield Strait was ice-free in early November and we were able to make close observations, a repetition of those earlier seasons, in it. The South Orkneys were free of ice in late November; the pack lay a little distance to the south of them and ran in a north-easterly direction to beset the southernmost of the South Sandwich group (early December). Some of the stations of this survey, including those in the Bransfield Strait and those to the east of South Georgia, were repeated in February 1933.

The month of January was the only period of the commission, apart from those occupied in refitting, which was spent in work not hydrological and planktonic. It was spent in adding to the valuable coastal survey work which had been done in the Dependencies of the Falkland Islands in earlier years by the *Discovery II* and by a separate survey unit. A complete running survey of the South Orkney Islands, with numerous soundings, was made. The existing charts were very unsatisfactory: the position assigned to the group as a whole needed correction and the coast lines of all but Laurie Island, which was surveyed by Bruce in 1903, were inaccurately shown. The survey was made by the chief officer, Lieut. A. L. Nelson, R.N.R. Large collections of rocks, plants and animals were made at seven widely separated points in the group.

The month of March, 1933, was occupied in making a V-shaped cruise in the only sector of the antarctic not covered by the winter cruises—that between South America and South Africa. The turning point, the edge of the pack ice, was in the high latitude of 69° S. in longitude 9° E. The end of this cruise at the Cape marked the completion of the fifth circumnavigation of the antarctic. The four previous ones, two of which were British, were those of Cook (completed in 1775), Bellingshausen (1819–21), Briscoe (1830–32) and that of the *Norwegia* in 1930–31.

The longitude of 9° E. was chosen as the meridian for the turning point of the last antarctic cruise so that the commission might end with a line of stations up the chain of deep basins lying to the south of, and running up, the east Atlantic. This line was similar to one made in the west Atlantic on the homeward passage of the *Discovery II* on her first commission. Both lines were designed to make clear the details of the interchange of water which takes place between the antarctic and the Atlantic, by a circulation of which the effects extend north of the equator. Some of the hydrological results of the observations in the west

Atlantic in 1931 were given by Mr. G. E. R. Deacon in a letter in NATURE of August 15, 1931.

Throughout the commission the deep water echo-sounding machine was in constant use. Soundings were taken with it every half-hour, that is, for roughly every 4½ miles steamed. Many soundings had been made in the Falkland sector by the *Discovery II* on her first commission; those made on the circumpolar cruises were in seas where extremely few, if any, had been recorded before. More than 9,000 soundings were taken in all. The deepest was of 8,200 metres in the South Sandwich Deep.

The scientific staff of the *Discovery II* consisted of four zoologists, one hydrologist and his assistant. It has been shown that by far the greater part of the commission was spent in making exactly similar hydrological and plankton stations. The hydrologist and his assistant were able to analyse all the water samples as they were taken; three of the zoologists, working together but each specialising in particular groups, found it possible to make quantitative analyses of the daily oblique hauls of macroplankton from the upper 250 metres. (The vertical hauls of smaller plankton could not be analysed on a moving ship even if there were time.) In this way the changes in the water masses from depth to depth, place to place and time to time, and correlated changes in the forms and stages of life, could be followed as the work proceeded. But much remains to be done. For this reason, and for the reason that papers on the plankton collections and hydrological results of earlier commissions, which would have to be considered before describing the results of more recent work, are shortly to be published in the "Discovery Reports", no attempt to describe the results of the last commission will be made here.

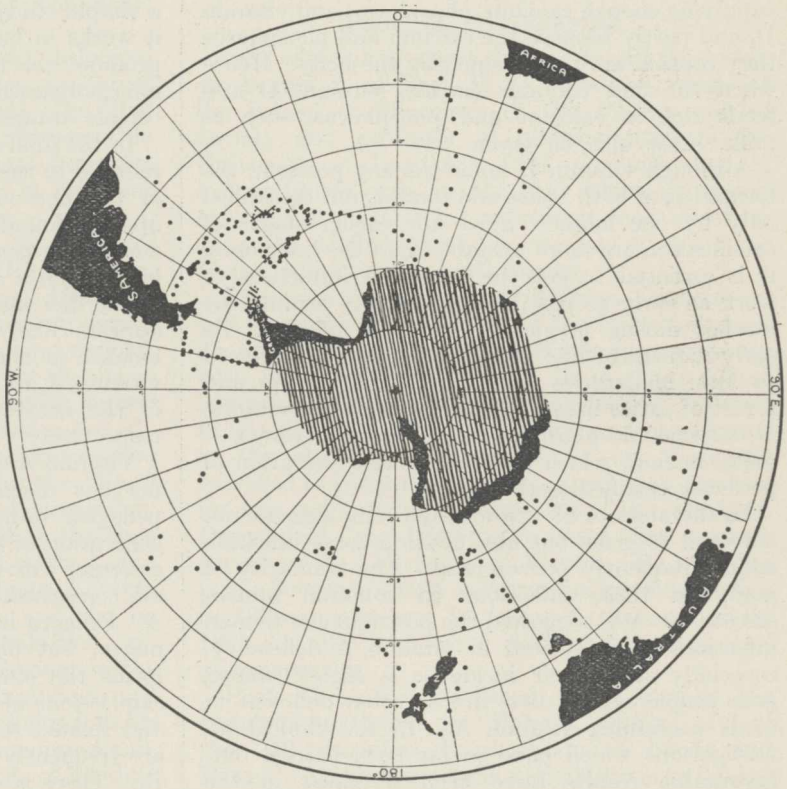

FIG. 2. Chart showing the relation of the circumpolar cruises and those of the survey of the Falkland sector in 1932–33.

The fourth zoologist was in charge of one of the new and improved models of Prof. A. C. Hardy's continuous plankton recorder (the earliest model was described in NATURE of October 30, 1926). It was streamed behind the ship whenever possible: in all, about 9,000 miles. Many of the silk rolls exposed were examined on board.

The experience gained with an older type of whale-mark, followed by many experiments, has led to the adoption of a new type of the simplest description: a piece of tubular metal 10 in. long with a rounded leaden head. It is fired by a charge designed to make it penetrate the blubber and bury its head in the muscle below, so that it would easily be found in the process of flensing.

A spare whale-catcher was hired from a whaling company in South Georgia in December 1932 and was sent to sea for whale-marking purposes under Mr. G. W. Rayner. Five hundred darts were taken. Whales were numerous near the island and in 18 days nearly all the darts were fired: 263 were registered as hits but many whales received more than one dart; it is probable that 220 individuals were marked. This was a very satisfactory result. A small number of the darts have already been recovered from whales captured by the South Georgia company a few days after the darts were fired. It is as yet too early to judge of the value of the experiment, for soon after the marking cruise the whaling season closed.

The very end of an entirely successful commission was marked by tragedy. In the Bay of Biscay, within two days of England, the captain, Commander W. M. Carey, was lost overboard. He had commanded the *Discovery II* on her first commission, and during four years in the service of the "Discovery" Investigations he had developed a very strong interest in the meteorological and pack-ice conditions in the antarctic and to their study he had devoted much time and attention. The success of the vessel's work was due in great part to his skill in navigation and control and to his interest in the investigations. Those who worked close to him will remember still longer his constant good humour and good fellowship.

Fat-Soluble Vitamins and Nutrition

THE significance of vitamins A and D in human nutrition and in the genesis of certain diseases was discussed by Prof. E. Mellanby in his Cameron Prize lecture for 1932 which has now been published (*Edinburgh Med. J.*, vol. 40, p. 197; 1933). After a brief review of the work leading up to our present knowledge of vitamin D, Prof. Mellanby emphasised the importance of considering the relationship of the vitamin to other factors in the diet, such as calcium, phosphorus and the cereals; cereals are rickets-producing substances, partly because they lead to increased growth without, at the same time, supplying enough calcium, phosphorus and vitamin D, and partly because the calcium and phosphorus they contain are not retained by the body. Hence when the diet contains cereals, vitamin D and foods rich in calcium and phosphorus, such as milk, must also be given.

Although vitamin D holds the key position, the formation of both bones and teeth is not controlled only by one factor. Since the earlier stages of calcification are more unstable than the later ones, it is essential to get the beneficial influences to work as early as possible, by suitably feeding the mother during pregnancy and the infant in its early months of life. Prof. Mellanby also referred to Mrs. Mellanby's work on the prevention and arrest of caries in children by diets rich in vitamin D, calcium and phosphorus, and devoid of cereals—diets, in fact, which also favour the formation of perfectly calcified teeth.

In the absence of vitamin A, young animals not only fail to grow but also develop some infection which frequently proves fatal. The similarity of many of these infections to common human diseases at once suggested the possibility of human infections being related to vitamin A deficiency, especially since their incidence is higher among poor people, whose diets are so often deficient in foods containing vitamin A. In the clinical investigations which have so far been carried out, favourable results have been obtained in the prophylaxis of puerperal sepsis (Green, Pindar, Davis and Mellanby) and in the treatment of puerperal septicæmia (Green and Mellanby), as well as in that of pneumonia (Donaldson and Tasker) and measles (Ellison).

On the other hand, Orenstein was unable to confirm the favourable results of Donaldson and Tasker in pneumonia, and negative results have been obtained when vitamin A has been given to infants as a preventative of the common cold (Wright, Frosst, Puckel and Lawrence). Ellison found that vitamin A had no preventive action in middle-ear disease accompanying measles, although it significantly reduced the mortality from this disease, as well as the severity of the pulmonary infections.

Science Service reported, on September 10, 1932, an experiment by an industrial firm, when 185 of its staff were given one tablespoonful of cod liver oil daily for four months from December until March. 102 failed to develop colds and 96 lost no time during the experiment. The number of hours of absence per person was 12·8. In a control group of 128, only 42 failed to develop colds, 52 lost no time and the hours of absence per person were 25·1. During the previous year, when no cod liver oil was given, the hours of absence were 20·4 and 17·4 for the two groups respectively.

Prof. Mellanby suggests that the action of vitamin A, like that of vitamin D, may not be a simple study. It may ultimately be found that it works in harmony with some dietetic factor to promote the resistance of mucous membranes to micro-organisms, while other factors such as cereals antagonise its influence.

In the final section of his lecture, Prof. Mellanby referred to the relationship of vitamin A to disease of the nervous system. Degeneration of nerve fibres is found in both the central nervous system and in the peripheral nerves of puppies which have been given a diet deficient in vitamin A: cereals in the diet make the degeneration worse. It thus appears likely that night-blindness and loss of balance in animals produced by diets deficient in vitamin A are largely due to degenerative changes in the nerves responsible for sight and balance respectively.

Vitamin A deficiency may play a part in human nervous diseases, such as convulsive ergotism, pellagra, lathyrism and subacute combined degeneration of the spinal cord. Young animals can eat ergot with impunity so far as nervous symptoms are concerned, provided the diet is rich in vitamin A. Pellagra is associated with the eating of white maize, but does not occur where yellow maize forms the staple cereal: it is possible that the skin lesions of this disease are of a trophic nature and related to nerve degeneration, although they are frequently ascribed to a deficiency of vitamin B_2. There is evidence that the curative and preventive effect of whole liver in subacute combined degeneration is due to a fat-soluble factor—probably vitamin A—and therefore quite distinct from the water-soluble factor which is curative in pernicious anæmia. In testing the effect of diet upon this disease, it is advisable not only to give a diet rich in vitamin A and carotene (fish and mammalian liver fats, egg yolk, cabbage, carrots, etc.) as well as calcium (two pints of milk daily) but also to reduce the cereal intake with a corresponding increase in the intake of potatoes.

There is some evidence that the infections developing in animals on diets deficient in vitamin A may be due to removal of the normal trophic control from degeneration of the afferent nerve fibres. The infective lesions and degeneration of nerve fibres would thus be intimately associated.

Obituary

DR. OTTO STAPF, F.R.S.

DR. OTTO STAPF, whose death occurred on August 3, at the age of seventy-six years, was born at Ischl, in Austria, in 1857. He studied at Vienna under Prof. Wiesner, and from 1882 until 1889 was assistant to Prof. Kerner von Marilaun, the author of the famous "Natural History of Plants". During this period, Dr. Stapf travelled extensively in Persia and made a valuable collection of plants. In 1887 he became *Privatdocent* at Vienna and while occupying this post accepted, in 1891, the assistantship for India at the Royal Botanic Gardens, Kew, thus commencing a connexion which lasted, officially and unofficially, until his death.

In 1899, Dr. Stapf was appointed principal assistant at Kew and, ten years later, keeper of the Herbarium and Library, a post which he filled with conspicuous success until his retirement in 1922. From 1908 until 1916 he was botanical secretary to the Linnean Society and in 1908 was elected a fellow of the Royal Society.

Dr. Stapf's main contributions to botanical science were on the floras of the Orient, India, Borneo, Malay and Africa. Between 1885 and 1889, while at Vienna, he published several papers on the flora of Persia and neighbouring regions, and in 1889 appeared his monograph of the genus *Ephedra*. On going to Kew, his attention turned towards India and later to Africa, and especially to African grasses, which family he monographed both for the "Flora Capensis" and for the "Flora of Tropical Africa", on which he was engaged in conjunction with Mr. C. E. Hubbard at the time of his death. In addition, Dr. Stapf worked on a wide range of special groups of plants, notably *Aconitum*, *Pæonia* and *Apocynaceæ*, and also on the problems of geographical distribution, especially in relation to the western element in the British flora. On the work he accomplished until his retirement, Dr. Stapf must be considered, in his breadth of outlook and mastery of taxonomic detail, one of the leading systematic botanists of his day.

In 1922 Dr. Stapf relinquished his official duties, and immediately entered upon another sphere of activity for which he is perhaps more widely known than for his purely taxonomic work. He became editor of Curtis's *Botanical Magazine* and of the "Index Londinensis". The latter is a revision of Pritzel's "Iconum Botanicarum Index" and comprises a complete list of all known illustrations of plants. The first volume appeared in 1929 and two years later the work was completed in six handsome volumes containing entries down to the year 1920. It remains as a memorial to his unremitting labour and exceptional organising ability, and is of inestimable service to all workers in systematic botany.

During the years of his retirement the *Botanical Magazine* occupied the greater part of Dr. Stapf's time. In his hands each article was a miniature monograph, giving full and valuable historical, taxonomic and distributional information on the plant in question, and thus often arousing botanical interest in those who had previously looked at plants largely from a horticultural point of view.

Dr. Stapf had many friends, both among his botanical colleagues and also, due to his association with the *Botanical Magazine*, among professional and amateur horticulturists. The loss of his commanding presence and charming personality, no less than his wide botanical knowledge and experience, will be deeply felt by all.

PROF. H. G. GREENISH

IT is with much regret that we record the death, on August 2, of Prof. H. G. Greenish, dean of the School of Pharmacy of the Pharmaceutical Society and professor of pharmaceutics in the University of London. Prof. Greenish had a serious illness early in the year which prompted his resignation, and his retirement took effect on July 31. Unfortunately, he was not to enjoy the leisure which was so well earned.

Born in 1855, the son of Thomas Greenish—a late treasurer and president of the Pharmaceutical Society—Prof. Greenish served his apprenticeship with his father and received his early technical education in the school of which he was destined to become the dean. After acting as demonstrator in the chemical department for one year, he travelled to Dorpat where he engaged upon research for two years under the direction of the late Prof. Dragendorf, and thence he went for a short period to the University of Vienna. He returned to the Society's school as lecturer in materia medica in 1890 and became professor in that subject in 1893, his title later being changed to professor of pharmaceutics.

Prof. Greenish's published works include the standard textbooks in "Materia Medica" and in the "Microscopical Examination of Foods and Drugs", and his numerous contributions to science —mostly memoirs of original work on the botany and pharmacognosy of drugs—gained for him an international reputation. The award of the Hanbury medal, and the receipt of an honorary degree from the University of Paris, were fitting tributes to the quality of his work.

Prof. Greenish freely gave his services in the compilation of many editions of the "British Pharmacopœia", and he was joint editor with the late Sir Nestor Tirard of the 1914 edition. All the successive editions of the British Pharmaceutical Codex have also benefited by his unstinted labours. During the War his services were requisitioned in the development of the cultivation of medicinal plants in Great Britain and in the investigation of a number of war-time problems.

Although Prof. Greenish will be remembered by posterity for his numerous contributions

towards the advancement of his science, and for his manifold services to pharmacy in general, he will still live in the minds of his students as a beloved teacher. His personality was such as to endear him to his colleagues and commanded almost homage amongst all who were privileged to serve or study under him. The School of Pharmacy owes its individuality to its dean, and in the affections of its old students—scattered in many parts of the world—the 'Square' and 'the Dean' are inextricably bound together. The tradition—which is the school—has developed round the spirit of its dean, the best memorial to whom would be that the school of the future should be worthy of its past—and of Prof. Greenish.

Mr. W. J. Lewis Abbott

THE death is reported of William James Lewis Abbott, the well-known archæologist, at the age of eighty years, at St. Leonards-on-Sea. He was by calling a jeweller, and early in his career took up the scientific study of gem-stones, a subject on which he instituted classes and became a lecturer at the Polytechnic. Extending his studies to geology, his interests centred particularly on the more recent deposits of the south coast of England. It was inevitable at that time that he should be attracted to the investigation of the earliest evidence of man's handiwork, and the associated animal remains, in these deposits. As one of the pioneers in the study of man's first efforts in the shaping of stone implements, Abbott's views were those of a practical man and based upon his experience and study of the character of the material in which he himself had worked. He maintained that a scientific knowledge of the nature of stone was an essential preliminary to argument based upon technical considerations of form. Throughout his life a lover of a specialised terminology, he coined for this study the name 'lithoclasiology', as he had christened his earlier researches 'gemmology'.

Abbott's mind was fertile in theory, more so perhaps than balanced in its conclusions; but he must nevertheless always be held in esteem by archæologists as a pioneer and a substantial contributor by a long series of discoveries to the advancement of archæological studies in Britain. Of these discoveries the most noteworthy was the recognition of Tardenoisian microliths in kitchen-middens at Hastings, when this industry was scarcely known, and the discovery in 1880 and 1888 of eoliths in the Forest Beds of Cromer associated with remains of *Elephas meridionalis*. His discoveries were recorded from time to time in the *Journal of the Royal Anthropological Institute* and other scientific publications. His extensive collections have found a home in the British Museum (Natural History) and the Wellcome Historical Medical Museum.

WE regret to announce the following deaths:

Dr. Humphrys Foord, formerly librarian of the Royal Dublin Society, on August 12, aged eighty-eight years.

Dr. A. W. J. MacFadden, C.B., formerly senior medical officer in charge of the Food Department of the Ministry of Health, on August 16, aged sixty-four years.

Dr. V. H. Veley, F.R.S., lecturer in science in the University of Oxford in 1879–1903, joint translator of "The Handbook of the Polariscope" and author of "The Micro-Organism of Faulty Rum", on August 20, aged seventy-seven years.

News and Views

Bicentenary of Dr. Thomas Hornsby

ON August 28 occurs the bicentenary of the birth of Dr. Thomas Hornsby, who for forty-seven years held the Savilian professorship of astronomy at Oxford. Born in Oxford, he became an undergraduate of Corpus Christi College and took his degree of B.A. in 1753 and that of M.A. in 1757. On June 6, 1761, he observed the transit of Venus at Shirburn Castle, the seat of George Parker, second Earl of Macclesfield (1697–1764), who was then president of the Royal Society, and after Bradley's death in 1762 he was appointed to succeed him in the Savilian chair, a post he held for the remainder of his life. He was one of the many who observed the later transit of Venus of June 3, 1769, and he contributed to the Royal Society an account of the observations made by himself and others, and deduced the solar parallax of 8·78″. In 1772 he was made first Radcliffe Observer and to him fell the task of superintending the erection and equipment of the Observatory at a cost of some £28,000, and he was also responsible for the editing of the first volume of Bradley's observations. To his other duties was added that of the Sedleian professorship of natural philosophy and he was also made Radcliffe Librarian. He died at Oxford on April 11, 1810, at the age of seventy-six years, and was succeeded in the Savilian chair by Abraham Robertson (1751–1826), who previously had held the Savilian professorship of geometry.

Commemorative Service to Sir Ronald Ross

AN eloquent tribute of praise for the life and work of Sir Ronald Ross was paid by Mr. John Masefield, the Poet Laureate, at a commemorative service held at the church of St. Martin's-in-the-Fields on Monday last, August 21. It was on August 20, 1897, that Ross first detected the malaria parasite in its disguised form in the wall of the stomach of an anopheles mosquito. He was thus able to prove not only where the cells of the parasite appeared in the tissues of the mosquito but also that a particular species bred by him from the larva stage, and fed on a

malarial patient, was involved in the transmission of malaria. This discovery, made after dissecting more than a thousand mosquitoes, solved a mystery that had baffled all previous workers, and gave mankind the means of preventing malaria through mosquito control. On the day following this brilliant achievement, Ross wrote his hymn of praise beginning "Before Thy Feet I fall", now included in many hymnals. The hymn was sung by the crowded congregation which assembled at the service on Monday, after Mr. Masefield had delivered his address. He referred to Ross as a man of science through whose investigations many places on the earth, in which white men could formerly scarcely hope to survive, had become tropical health resorts, and he paid striking testimony to Ross's genius also in the provinces of poetry, art, music and mathematics. Some of Ross's verses were afterwards read by Mrs. Dale Roberts and Miss Judith Masefield. The selections included extracts from "In Exile" and "The Monsoon", and the poems "India", "Thought and Action", "Indian Fevers", "The Star" and "Petition".

Determinations of the Speed of Light

A CENTRAL NEWS message from New York states that a well defined periodic variation in the speed of light has been registered in the experiments now being carried out at Mount Wilson which were begun by Michelson. The message refers to a passage in the annual report of the director of the Mount Wilson Observatory, which was received in Great Britain some time ago. As is well known, Michelson found that atmospheric irregularities, the astronomer's 'bad seeing', interfered with his attempts to determine the velocity of light using long bases, from Mount Wilson to neighbouring peaks. He was led to the heroic task of constructing a vacuum base a mile long, and a tunnel of thirty-six inch diameter and a mile long was constructed. It is so well made that a vacuum of two or three millimetres of mercury can be maintained in it. The last report stated that it was hoped to conclude the work in August, so that we may hope for full details before very long. The periodic term that the report mentions is presumably of a purely instrumental character. Our readers will remember that it has sometimes been urged that the precise observations of the velocity of light which have been made from time to time do show a definite secular change of the velocity (see, for example, Ghenry de Bray, NATURE, **120**, 602, Oct. 22, 1927, and **127**, 522, April 4, 1931), but the view has so far found little support from men of science generally.

New Department in the British Museum

AN important change in the organisation of the British Museum collections is announced. A new department has been constituted under the name of the Department of Oriental Antiquities and of Ethnography, which will combine parts of the Department of Ceramics and Ethnography and of Prints and Drawings. The existing Department of Ceramics and Ethnography, as such, will cease to exist. The ethnographical collections henceforth will form a sub-section of the new department. This will also include antiquities and objects of art from the Near, Middle, and Far East, as well as India (in so far as these are not already included under the Department of Assyrian and Egyptian Antiquities or the Greek and Roman Department), and with them will be shown the oriental paintings, prints and drawings now included as a sub-department in the Department of Prints and Drawings. Mr. R. L. Hobson, keeper of the Department of Ceramics and Ethnography, will be keeper of the new department, with Capt. T. A. Joyce as deputy keeper, in charge of the sub-department of ethnography. For many reasons the innovation will be welcomed. The separation of oriental paintings and drawings from other forms of oriental art has been an anomaly ever since they ceased to be the mere hobby of the dilettante collector, and became the subject of serious scientific study. It should be realised that the constitution of a new department can be regarded as really progressive only in so far as it is impermanent—a stage towards the formation of a comprehensive collection of oriental art and antiquities, fittingly housed and adequately displayed—and ethnography is viewed on a scale of values which makes of it something more than a sub-section of part of its own subject-matter.

Man and the Machine

IN an address to the World Federation of Educational Associations at Dublin on "The Craftsman and the Changing World", Mr. J. Wickham Murray gave a brilliant picture of the modern world, indicating the extent to which we have passed from a non-scientific age to a scientific age, from a manual age to an age dominated by the machine. That domination has not only affected the life of the individual, impairing, for example, his power of making a quiet judgment, but also has vast social consequences such as those frequently referred to by the term 'technological unemployment'. Despite the new industries created by science the growth of mechanical power is continually displacing men and women. To suggest even in these conditions that a return to handicraft is required is to miss the significance of the machine age. Mr. Murray suggested that the only remedy is a courageous attempt to obtain control of the machine, believing that by its controlled development the standard of life might be indefinitely extended. Craftsmanship should not be in competition with the industrial world but in complement with it, assisting it to secure the ability to make firm, wise, far-seeing and unhurried judgments. Mr. Murray believes it should be the duty of the craftsman to inspire and teach the economic and industrial world and emphasises the kinship between art and craftsmanship. The influence of the craftsman in this way offers our civilisation its best hope of regaining the capacity for thought and judgment, and the poise of which the turmoil and superficiality and distress of the machine age tend to rob us.

A Pest of Tobacco

THE somewhat sudden appearance of a new tobacco pest, *Ephestia elutella*, in the British Isles

has caused serious alarm amongst those engaged in the trade. The moth had hitherto been regarded mainly as a pest of cocoa, but in 1929 large stocks of tobacco in London were found to have become infected. The gravity of the situation called for a thorough investigation of the matter and the results of the inquiry carried out by H. H. S. Bovingdon have been published under the auspices of the Empire Marketing Board (H.M. Stationery Office; price 1*s*.). The pest is readily imported from a number of countries and infestation is chiefly incurred by bales damaged in transport, a fact which negatives the discovery that a wrapping of tarred brown paper covered with hessian acts as a deterrent to the moth. *Ephestia* has a distinct preference for bright cigarette leaf, and though it attacks both kiln and air-cured tobacco it will not feed upon the fire-cured material. As regards measures of control, vacuum fumigation with ethylene oxide is a successful if costly procedure, but the reconditioning of tobacco by a modern machine or storage at low temperature will also destroy all stages of the pest.

News from China

A CORRESPONDENT in China sends us the following items of scientific news:—Prof. Chenfu Wu, of Yenching University, Peiping, has been granted a travelling professorship by the Rockefeller Foundation for use during his furlough year 1933–34 to complete his catalogue of Chinese insects. He will spend part of his time at Cornell University and the rest visiting museums in England and on the Continent.—Prof. Chihwei Luh, of Yenching University, Peiping, has been granted a fellowship by the China Foundation, which he will use at the University of Chicago during his furlough year 1933–34 for further work in neuroanatomy and psychology.—The Alpha Chapter in China of the Biological Honor Society Beta Beta Beta held its annual meeting on June 9 at Yenching University for the initiation of new members and election of officers. Prof. C. L. Liu, of the Biology Department of the Peiping Normal University, presided over the initiation.—At the eighth annual meeting and dinner of the Peking Society of Natural History, held on April 28, Dr. H. H. Hu, of the Fan Memorial Institute of Biology, was elected president of the Society, to serve for the year 1933–34. At the same meeting, announcement was made of the election of Dr. Sven Hedin as honorary member of the Society. The special event of the Society's annual meeting and dinner was the awarding of the King senior medal to Dr. C. Ping, director of the Biological Laboratory of the Science Society, Nanking, in recognition of his work on palæozoological subjects and also of his work as a teacher of young Chinese scientific workers in whom he has awakened and cultivated a truly scientific spirit. Mrs. T. S. Oldroyd, of Stanford University, California, has been elected a corresponding member of the Society.

Hong-Kong University

IN the *Engineer* of July 28, Prof. C. A. M. Smith, Taikoo professor of engineering in the University of Hong-Kong, refers to the coming of age of the University, its growth and development, and in the interest of both England and China pleads for a closer co-operation between the University and British industry. The University was opened in March 1912 by the Governor of Hong-Kong, now Lord Lugard, Prof. Smith being the only professor on the staff. To-day there are 15 full-time professors —3 for engineering, 6 in the medical departments and others for mathematics, physics, chemistry, economics, education and English. In 1912 the annual revenue was less than 90,000 (Hong-Kong) dollars, it now exceeds 1,000,000 dollars. The residential system is compulsory, there being seven halls of residence, and students have come from all the 18 provinces of China. The British staff, now numbering 28, takes a keen interest in all the social activities of the University and the Chinese undergraduates have a good record of athletic contests with Europeans and Chinese in the colony. All the engineering equipment in the University—much of it presented—is British, all instruction is in English and British textbooks are used. A thorough training in engineering is given, but it is often desirable for students to proceed to works in England on completing their course. The University, says Prof. Smith, is not merely a local affair, but an Imperial asset. "It is, in a sense, the contribution which Hong-Kong makes to the whole Empire, as well as to China."

French Locomotive-Testing Station

IN *Engineering* of August 4 is a description of the new locomotive-testing station at Vitry-sur-Seine, Paris, which was formally inaugurated on July 29. The plant has been designed by the Office Central d'Etudes de Matériel de Chemins de Fer (O.C.E.M.) and erected on a site belonging to the Compagnie du Chemin de Fer de Paris à Orléans. The main plant is contained in a building about 180 ft. × 80 ft. The essential elements of a locomotive-testing plant consist of a testing bench with supporting rollers on which the driving and coupled wheels of the locomotive revolve, brakes to absorb the power and a dynamometer to record the pull on the drawbar. There are also means for recording the fuel and water consumption and apparatus for measuring steam and water temperatures and pressures, and the vacuum in the smoke box, furnace and ash pit. In the new plant there are eight pairs of rollers of which six pairs can be coupled up to the hydraulic brakes, which were supplied by Messrs. Heenan and Froude, Ltd. Each of the brakes can absorb up to 1,200 horse-power, the permissible rim speed of the rollers is 100 miles per hour and the permissible weight per roller 15 tons, the plant thus being capable of dealing with heavier and more powerful locomotives than are in use in France at the present time. There are several locomotive-testing plants in various countries, some of which were described in Mr. H. N. Gresley's paper, "Locomotive Experimental Stations", read to the Institution of Mechanical Engineers in 1931. The only testing plant in Great Britain is that laid down by the Great Western Railway Co. at Swindon in 1905; but it has often been

advocated that a modern plant should be set up by the railways in conjunction with the Department of Scientific and Industrial Research. No steps, however, have yet been taken in this direction.

Lightning Current Recorders

THE engineers of the staff of the General Electric Co. of America have computed that about 75 per cent of all interruptions to electric service are caused by lightning. In the *Electrician* of August 4 an account is given of a simple magnetic device which has been largely used for recording the currents that flow in the earth conductors of the lattice towers when the line is struck by lightning. Small pieces of magnetic material called magnetic links are mounted on brackets and installed within a few inches of the leg of the tower. At the present time, more than 2,000 of these links are in use on high voltage lines. The link is so placed and designed that the magnetism induced in it is proportional to the highest value of the lightning current. Line patrolmen working under the research staffs of the power companies test the links periodically for magnetisation. The magnetised links are sent to the research laboratories. By inserting them in a measuring instrument called a 'surge-crest' ammeter the pointer of the instrument indicates the maximum value of the lightning current. Currents up to 25,000 amperes have been measured. As the resistance of the 'earth' at the tower is sometimes high, this current may be reflected into the service line with ensuing damage or interruption of the power current. The overhead earth wire at present largely used as a safeguard against lightning was the outcome of previous experimental researches on voltages induced by lightning.

Freshwater Biology

THE report of the Freshwater Biological Association of the British Empire for 1932 shows notable progress in research, membership, and interest of universities and public bodies. The laboratories at Wray Castle, Westmorland, were inspected by a large number of the public on open day, August 10. The field apparatus was shown, as well as specimens of living animals and rare plants, including *Hydrilla verticillata*, a plant moderately abundant in Esthwaite Water, but unknown in any other locality nearer than East Prussia. The light-intensity at various depths in Windermere has decreased within the last decade, indicating enhanced numbers of blue-green Algæ due to increased pollution. The Bernheim rectifier photocell has come into favour because of its chromatic sensitivity and convenience in handling, galvanometer measurements giving direct values. Accurate work with a large system of thermocouples has revealed in Windermere a warm upper layer of water, or epilimnion, separated by an oscillating temperature discontinuity from a colder lower layer or hypolimnion. Inflowing streams carry warmer water, and floods, accompanied by wind operating as a mixing agent, tend to warm the lake, with a consequent increase in diatom numbers and improvement in trout fishing. The behaviour of Planaria (flatworms) shows that the normal movement of the animals against the current is reversed during the reproductive stage, and also when the water is impure, a reaction which is more delicate than any system of chemical measurement. The epidermis of Planaria is sensitive to light, and its reactions to different temperatures are being studied in a thermostatically controlled observation tank. A new method of controlling a respirometer was shown, applied to estimating the rate of exhalation of carbon dioxide by newts. Colorimetric and electrical apparatus were shown for the measurement of salt concentrations, and microscopes showed the annual growth lines on fish scales.

Archæological Survey of Colorado

IN America the distribution of a physically homogeneous population over a wide and geographically diversified area has given a special significance to the study and determination of cultural similarities and differences and their distribution, for which in archæological studies, survey work is the first essential. The value of the intensive local survey in this connexion is illustrated by the third report of the Archæological Survey of Eastern Colorado, covering the work done in 1932, which is issued by the Department of Anthropology in the University of Denver. Dr. E. B. Renaud, professor of anthropology and director of the Survey, with his assistants and the help of residents, covered 4,071 miles, in which much previously archæologically unknown country was visited and more than a hundred new sites recorded. A journey of reconnaissance was also made in Nebraska. The point of special interest is that Prof. Renaud records the discovery of basketry and other remains in caves south-west of Fowler and north-east of Beulah. It now becomes known for the first time, through the systematic work of the Survey, that the Basket-Maker culture, previously recorded in Utah, Arizona, New Mexico, south-west Colorado and western Oklahoma, also extended so far north as the Arkansas basin in north-eastern Colorado. A second addition made in this season's work to the distribution map of prehistoric culture is the record from many new districts in Colorado and also Nebraska of Yuma and Folsom artefacts, the flaked points believed by many to have been used by hunting peoples of the Upper Pleistocene. On the other hand, the study of the pottery which appears in this report inculcates the necessity for caution in generalisation while the work of the survey is still incomplete. In the previous season the number of sites on which undecorated pottery and pottery decorated with the impressed cord pattern were found was about equal—twenty-three to twenty-five—but this year the decorated pottery sites outnumbered the undecorated by more than three to one.

Magic and Games

IN an interim report issued by the Smithsonian Institution, Washington, on recent investigations by Miss Frances Densmore in collecting songs among the Indians of the south-eastern United States, reference is made to magic connected with the

Choctaw ball game, which is of some interest in its bearing on the attitude of those affected by magic towards the magical activities with which they are in contact. Writers on magic and witchcraft, whether occurring among primitive peoples or surviving in civilised communities, frequently distinguish between 'white' and 'black' magic, the former being beneficial to the individual or the community, the latter entirely malevolent. The distinction is purely empirical. The character of the magical act, whether 'good' or 'bad', depends on its relation to the individual or the community. In all instances the principle is identical; and in many the same act may appear as both 'good' and 'bad' according to the point of view. Thus in the example recorded by Miss Densmore, she was informed by an old Choctaw medicine man that in the ball game the opponents made use of magic which rendered the ball invisible or diverted it in its flight. It was, therefore, the duty of the medicine man to chant a song while the game was in progress, which countered the magic of their opponents by keeping the ball visible and guiding it straight. The magic of the opponents in this statement was obviously regarded as 'evil'; but what was the opponents' view of the prophylactic?

German Chemical Abstracts

Chemisches Zentralblatt, the German counterpart of *British Chemical Abstracts*, has recently published the concluding volume of its collective index for 1925–1929. The occasion is of interest, since it records a successful attempt to place the indexing of highly technical chemical literature on a more systematic basis, and so to distribute the 'signposts' in the index as to make their signs and directions more easily visible. By increasing the number of catchwords, material which is technically related can be the more readily assembled, an arrangement which is of particular value in fields forming the boundaries of the chemical domain. Among the difficulties incidental to the new plan is the change in the exact significance of words which attends increase in our knowledge. The chemistry of vitamins, for example, has in the period indexed advanced to a degree which has in many cases rendered necessary a new comparison of entries in the annual indexes with the original literature. As an example of his treatment of an extensive subject the editor, Dr. Maximilian Pflücke, directs attention to the arrangement of material under the general heading "Iron". Entries are here divided into five principal sections: historical, occurrence, ores, pure iron, and technical iron. The last two sections are each divided into five subsections, and the latter are again appropriately subdivided, so that (excluding numerous clearly differentiated entries under "iron compounds"), there are nearly forty major headings, with a very large number of indented minor headings. Similar treatment has been accorded to entries under "blood", "urine", "essential oils", "enzymes", "fats", etc. A convenient provision is the insertion of cross-references to pages in the formula index. The editor envisages a more extensive application of his system of indexing in future volumes.

Mechanics of Leonardo da Vinci

NEARLY 150 pages of vol. 19 of the *Atti della Società Reale de Napoli* are devoted to a valuable and interesting memoir by Prof. R. Marcolongo of the University of Naples on the mechanics of Leonardo da Vinci, which may be considered a sequel to his memoir on the geometro-mechanical research of Leonardo published in 1929. The publication by the Royal Commission Vinciana of the Codex Arundel of the British Museum, the Codex Forster of the Victoria and Albert Museum and of some defective pages of the Codex L. da Vinci of the Turin Library allow the author to correct errors of recent British and German publications dealing with the work of Leonardo da Vinci. He deals first with statics, describes the state of the subject in medieval times and shows what sources of information were available at the end of the fifteenth century. Then follow chapters on Leonardo's writings on the lever and balance, the idea of moments, the composition of forces, equilibrium on inclined planes, centres of gravity, pulleys, resistance of materials and the arch. Under dynamics, he begins by describing Greek and medieval sources and then deals with Leonardo's contributions under the headings force, impact, weight, laws of motion, motion on inclined planes, projectiles, and impact.

Cotton Crop in 1931–32

THE Administrative Council of the Empire Cotton Growing Corporation has issued its report for the year 1931–32. After summarising the principal activities of the Corporation, the special problems encountered and the progress made in eighteen cotton-growing countries of the Empire are described. From the crop table, which shows the outputs for the last eleven years from these countries (India excepted), it is evident that the total yield for the year under review was the highest so far recorded, a remarkable fact in view of the prevailing economic depression. The explanation lies in the exceptionally heavy yield obtained in the Sudan and in the area under cotton in Uganda having been extended to help compensate the growers for the low market prices. A further encouraging fact is that the world's consumption of cotton from the new fields during this year was also the highest yet obtained. As regards research work, the production of types of cotton resistant to leaf curl and the jassid pest respectively deserve special mention. The former has already greatly improved the prospects of the growers in the Sudan, while the latter is proving highly successful in many areas, including Nyasaland and parts of Tanganyika.

Scenes from the East Indies

PROF. V. VAN STRAELEN, director of the Royal Museum of Natural History, Brussels, has published a general account of the journey undertaken by their Royal Highnesses, Prince and Princess Leopold of Belgium, in the Dutch East Indies, on which he accompanied them. (Memoires du Musée Royal d'Histoire Naturelle de Belgique, Hors Serié, 1933.)

The trip was undertaken mainly with the view of making scientific collections for the Museum. This account is notable for the numerous and beautiful illustrations; 92 phototype plates are included in addition to no less than 180 photographic illustrations in the text. These photographs illustrate scenery, particularly vegetation, native types, architecture, etc., and in many cases are exceptionally clear. Naturally the photographs include very good illustrations of palms, mangroves, lianes, epiphytes, etc., and two exceptionally fine illustrations of that remarkable parasite, *Rafflesia arnoldi*.

The Ministry of Health

In the fourteenth annual report of the Ministry of Health, 1932–1933 (H.M. Stationery Office. 5*s*. net), recently issued, the subjects dealt with fall under the main headings of public health, housing and town planning, local government and local finance, poor law, national health insurance and contributory pensions. A separate section deals with the work of the Welsh Board of Health, and the annual report of the chief medical officer of the Ministry is published separately. Expressed as a percentage of total births, vaccinations have declined from 44·8 in 1926 to 39·0 in 1931, with a corresponding increase in declarations of conscientious objectors from 40·9 to 46·7. Samples of foods and drugs analysed numbered 137,981, the largest number ever recorded. Of these samples, 7,019 or 5·1 per cent were adulterated or not up to standard, a slight increase over the two previous years. Infant mortality (deaths of infants under one year per 1,000 births) in England and Wales was 64·6 in 1932, the lowest recorded except in 1930 when it was 60·0.

Child Welfare Work in Uruguay

The progressive character of some of the South American Republics is well illustrated by the record of pre-natal, infant, and child, welfare work in Uruguay, contained in the *Boletin del Instituto Internacional Americano de Protección a la Infancia* for July (17, No. 1. Montevideo. Text in French, with Spanish and English summaries). The work appears to be much on the lines of that in Great Britain, with pre-natal clinics for expectant mothers, school clinics, free meals and milk rations for the needy, open-air schools, day nurseries for the children of working mothers, playgrounds, gymnasiums, and the like. The associations are partly voluntary and partly State-aided. In Montevideo, children under one year are vaccinated against smallpox, and after that age against diphtheria.

Progress in a Local Scientific Society

Annual reports of scientific societies so frequently record declining membership in these days that it is gratifying to see an increase from 200 to 220 in the records for 1932 of the Natural Science and Archæology Society of Littlehampton. The report also shows evidence of the activity of the members in field work. A good start has been made with lists of the Lepidoptera, Odonata, and birds of the district, the last including a record of a flamingo seen on the West Sussex coast in January 23, 1933; and the archæological section has excavated a Romano-British settlement at Shepherds' Garden. Evidence of the increasing interest taken by the public in these matters is shown by the attendance of close upon 15,000 visitors at the Museum with which the Society is intimately associated.

Announcements

Brief reference was made in Nature of August 19, p. 270, to the geological excursion to the Lower Palæozoic rocks of the Welsh borderland and Severn valley which precedes the Leicester meeting of the British Association. An outline programme is now available. The excursion, which is under the leadership of Prof. W. W. Watts, will begin on September 1 and accommodation is being arranged at Much Wenlock; it will end on September 6 at Leicester. Further particulars can be obtained from Miss G. M. Bauer, 387 Harborne Road, Birmingham.

A translation into French of the discussion on "The Evolution of the Universe" held at the centenary meeting of the British Association in London in 1931 (see Nature, 128, 699, Oct. 24, 1931) has recently been published (pp. xii+68. Paris: Gauthier-Villars et Cie, 1933. Price 15 francs). The discussion is translated by Prof. Paul Couderc, who has also contributed an introduction.

In issuing a second edition of its guide to national information services and to the international loan and exchange of literature, the International Committee of Intellectual Co-operation has rendered a further service to the co-ordination of bibliographical and library work. The information originally supplied on special or national library services in different countries has now been supplemented by particulars of the conditions under which the books are lent, and of postal facilities and customs regulations affecting the exchange of books. Information on photostat services where such exist, and the inclusion of the names and addresses of institutions which are prepared under reciprocal conditions to loan the works held in their libraries, make this pamphlet a highly useful and important guide to existing official machinery for the exchange of scientific literature between different countries.

Applications are invited for the following appointments, on or before the dates mentioned:—Two draughtsmen in the Directorate of Technical Development of the Air Ministry—The Secretary, Air Ministry (S.2), Adastral House, Kingsway, W.C.2 (Sept. 4). A lecturer in the Department of Pure and Applied Science (Chemistry) at Loughborough College—The Registrar (Sept. 9). A temporary lecturer in economics in the University College of the South West of England, Exeter—The Registrar (Sept. 9). A research physiologist for the Imperial Chemical Industries, Ltd., Millbank, London, S.W.1—The Medical Officer (Oct. 1).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Conduction in Poor Electronic Conductors

IN an early paper on the "Heat Motion in Solids and Liquids"[1] I have shown that in the case of ionic crystals the conduction of electricity must be due not only to the dissociated ions, but also to the 'holes' left in the crystal lattice by the removal of these ions, and behaving exactly like movable ions of the opposite sign.

A similar situation is met with in the case of poor *electronic* conductors. The positive ion which is left by an electron escaping from a neutral atom under the action of light or heat can be neutralised by an electron jumping on to it from one of the surrounding neutral atoms, which in its turn becomes ionised. This process is equivalent to the displacement of the 'hole' over the same distance in the opposite direction.

It can be shown from very general principles that a positive 'hole' must move in a crystal lattice, jumping from one atom to another in the same way as a bound electron would move and forming a negative ion in a lattice of neutral atoms. This idea has been recently applied by Fowler to the interpretation of some properties of semi-conductors[2]. Fowler has, however, visualised the positive 'holes' mainly from the point of view of their stationary states in the crystal lattice when they are not connected with any particular atom, whereas in many cases it is much more convenient to treat them (just as the electrons) as moving charges which can be located at every moment in a definite point of the lattice.

This conception provides us with a simple explanation of the results obtained in this laboratory by Nasledov and Nemenov on the extra-conductivity acquired by a cuprous oxide plate throughout its volume when a small portion of it is illuminated. If the positive ions ('holes') remained fixed (for example, anchored to the atoms of some impurity), the negative electrons set free in the illuminated region would scarcely be able to escape from it, for this would immediately produce a potential difference, due to the spatial separation of the opposite charges, and tending to prevent this separation, that is, to stop the electrons. If, however, the positive 'holes' possess a high mobility, comparable with that of the electrons, they will diffuse away from the illuminated region *along with the electrons*, to regions of smaller concentration, tending to a perfectly homogeneous distribution throughout the whole body and thus increasing the conductivity of regions in the shadow. This process must, of course, be accompanied by a gradual recombination of the electrons and 'holes', until a stationary state is reached, when the excess of positive and negative charges diffusing to any region is just compensated by their recombination.

The fact that under uniform illumination of the whole body the (additional) conductivity is proportional to the *first power* of the light intensity and not to the square root of it, clearly shows that the recombination process takes place indirectly, the electrons and 'holes' being trapped *separately* on some inner defects of the crystal—presumably the surfaces of inner cracks, where the charges are adsorbed and which act like catalysts for the recombination process, just as do the walls of a discharge tube in the case of the conduction of electricity through a rarified gas. The fraction of the charges of each sort disappearing per unit time and volume, must under this condition be proportional to the first power of their concentration and not to the second one, as in the case of direct recombination.

The above considerations can easily be put in a quantitative form. Let us imagine that a dielectric is illuminated along a certain plane only, the plane $x = 0$, say. So long as the electrons and 'holes' have different mobilities, they will tend to diffuse with different velocities which will result in the creation of a potential gradient $E = \delta\varphi/\delta x$, tending to retard the faster particles and to accelerate the slower ones.

We will consider the simplest case when the particles of opposite signs have the same concentration $n_+ = n_- = n(x)$ throughout the body, the electrical charge being thus concentrated in the illuminated plane and on the electrodes. Under this condition, which forms the basis of Nernst's well-known theory of the concentration electrolytic cell, the electrical field E will be independent of x, and we shall have for the steady state the following equations :

$$\frac{\delta}{\delta x}\left(D_{\pm}\frac{\delta n}{\delta x} \mp \varepsilon u_{\pm} E n\right) - \gamma n = 0, \qquad (1)$$

where D is the diffusion coefficient, u is the mobility and γ is the trapping coefficient (which for the sake of simplicity we shall assume to be the same for the electrons and the 'holes'), the sign + referring to the 'holes' and the sign − to the electrons (ε being the magnitude of their charge). The coefficients D and u are connected with each other by Einstein's well-known relation :

$$D/u = kT, \qquad (2)$$

where T is the temperature of the body. It must be kept in mind that the electrons and perhaps the 'holes' too can have a Maxwell distribution of velocities corresponding to an effective temperature $T_{\mp}$ which is much higher than that of the body—just as in the case of Langmuir's 'plasma'.

So long as E is constant, the differential equations (1) are solved by the function

$$n = n_0 e^{-\alpha x}, \qquad (3)$$

where α and E are determined by the two algebraic equations

$$\alpha^2 D_{\pm} \pm \varepsilon\alpha u_{\pm} E - \gamma = 0, \qquad (4)$$

Solving these equations, we easily find, with a view to (2) :

$$\alpha^2 = \frac{\gamma}{2kT}\left(\frac{1}{u_+} + \frac{1}{u_-}\right) \qquad (5)$$

and

$$\varepsilon\alpha E = \frac{kT}{2}\gamma\left(\frac{1}{D_+} - \frac{1}{D_-}\right) = \frac{1}{2}\gamma\left(\frac{1}{u_+} - \frac{1}{u_-}\right), \qquad (6)$$

whence

$$\varepsilon E = \left(\frac{1}{2}\gamma kT\right)^{1/2} \frac{u_- - u_+}{\{u_+ u_- (u_+ + u_-)\}^{1/2}}. \qquad (7)$$

Dividing (6) by (5) we get further

$$\varepsilon E = kT\frac{u_- - u_+}{u_- + u_+}\alpha,$$

or multiplying this equation by x and replacing Ex by φ (potential difference between the illuminated

plane and the given point) and αx by $\lg n_0/n$, according to (3):

$$\varphi = \frac{kT}{\varepsilon} \frac{u_- - u_+}{u_- + u_+} \lg \frac{n_0}{n}. \qquad (8)$$

This is exactly the same relation between the potential difference and the concentration as that derived in Nernst's theory of the concentration cell. It is noteworthy that it does not contain the trapping (or 'recombination') coefficient γ. According to our theory, the Dember potential difference (quantitatively investigated by Joffé) should be given by equation (8), in the limiting case of very strong light absorption. It is thus possible, in principle at least, to determine experimentally both the ratio of the mobilities of the electrons and 'holes' (from equation (8)) and the trapping coefficient γ, the reciprocal of which is equal to the mean life of an electron (or of a 'hole') in the free state, from the equation (3). Experiments to test this equation are in progress.

J. FRENKEL.

Physico-Technical Institute,
Leningrad.
July 10.

[1] *Z. Phys.*, 1926.
[2] *Proc. Roy. Soc.*, June, 1933.

The Tidal Strain on the Earth

IN the early days of exact geodynamics, under the inspiration mainly of Lord Kelvin (cf. Thomson and Tait, "Nat. Phil."), the problem of detecting the effect of the moon on gravity, for a yielding earth, excited much attention, leading to pendulum observations by George and Horace Darwin that, however, turned out to be more important for the incipient science of seismology. It appears[1] that the problem has now been successfully approached in the manner that was to be expected, namely, by use of the Eötvös gravity balance.

It is the disturbances of the various local partial gradients of the field of gravitational force due to the moon that are sought, deducting, however, the partial compensation arising from tidal yielding of the earth. Putting the two together, the instrument would not be expected to show any horizontal disturbance of the field to be observed, because it hangs always transverse to the horizontal directions for which the component of total gravity is exactly null. The disturbance arising in the vertical gradient of the field is due to the direct attraction of the moon diminished by the attraction of the distribution of lunar tides. The latter could be calculated in the static Newtonian manner if there were no tidal lag and no tide in the solid earth; actually the oceanic tidal lag would introduce a small time-lag such as is reported in the phase of the graphs of the total lunar disturbance. The period of oscillation shown on the graphs is 24·8 hours, that of the lunar disturbance, but as reported with no trace of the presence of the tidal effect, of half that period, which ought to disturb the form sensibly from a simple case of sines by introducing its first harmonic; and explanation is demanded. It is the differential lunar attraction of the radial gradient multiplied by the radius of the earth that operates in raising the tide, whose reaction against the direct lunar disturbance of gravity depends on the form of the tidal terrestrial spheroid thus produced, and varies with locality in a manner amenable to discussion by harmonic analysis.

It would appear that a general terrestrial survey, primarily directed to mapping the lunar disturbance of gravity, may provide an effective and easy observational solution, to be verified by its own internal consistency, of the outstanding problem of the nature and amount of the tidal deformation of the earth, which is crucial for theories of its internal constitution. As regards it, geodesists have hitherto had to rely, unless very recently it has been different, on the mathematical estimates for tides of long period by Kelvin and Darwin, reinforced by recent observations of Michelson on tidal changes of level of a water-surface in a long horizontal pipe: though a new observational science of seismology is now feeling its way directly, on the foundations sketched by J. Milne in Japan, into the nature of the deep seismic earth-tremors.

It may be well to note that the attraction of the moon, with its 24·8 hour period, being compensated by the inertial motion of the solid earth to which the suspension is attached, would not itself show on the record, but only its radial gradient whose period is the tidal one; as regards the tidal reaction there would likewise be a reduction of the amount because the suspension partakes in the tidal heave of the solid earth.

JOSEPH LARMOR.

Holywood, Co. Down.
Aug. 1.

[1] K. Hartley, *Physics*, April 1933; as briefly reported in *Science Abstracts*, p. 675. [It appears from a rough estimate that an instrument of a hundred times the usual sensitiveness would be required.]

Conduction through Roots in Frozen Soil

DURING the past few days, I have been able to demonstrate that the roots of *Betula odorata*, Bechst., the tree which goes farthest into the arctic in these northern parts of Lapland, can conduct water actively through at least half a metre of 'tjale' (hard-frozen soil), and moreover that such conduction is little, if at all, slower than that which at the same time of year takes place through roots at 4°–5° C.

While the wood of living trees seemed quite dry in winter, I noticed that as soon as the day temperatures rose appreciably above zero and the snow began to melt, the trees became in most cases so full of water that a twig cut off and bent immediately began to drip at the cut end. Investigation soon showed that the water was not absorbed by little roots near the surface where the ground thawed first, for in some cases such roots were totally inadequate, while in others, tjale or solid ice extended right to the surface. I therefore made more extensive excavations in soil that was frozen hard to a depth of 50 cm. Like the damp unfrozen soil just below, this tjale was at a constant temperature of 0° C., and roots lying in it were not frozen but wet. Where cut they exuded drops of water which tasted quite sweet —in one case from a root that was found to extend 40 cm. upwards through the tjale before being joined near the bole of the tree by the first branch root that could have supplied an exudation of such copiousness.

The trees being already full of water were not absorbing any more, for the atmosphere was damp and the buds only beginning to swell. Roots supplied with dilute eosin solution (red ink was used) failed to absorb the stain even when they were warmed, so trees had to be dug out and stood to dry with the buts and proximal ends of the roots still in the parent

tjale. After twenty-four hours, water was absorbed actively, and conduction upwards through as much as 50 cm. of solid and very hard tjale was directly demonstrated by the red staining of roots the ends of which, cut in the air, had been stood in tubes of eosin.

That the rates of movement of water in roots in the tjale, and in air or soil at a higher temperature, are similar, was suggested by the comparable rates of dripping from the cut ends of roots of similar size lying near together in these different media, and by the similar rates of absorption of eosin (supplied as drops from a pipette) by two lengths of the same root held vertically, the one in the air and the other still in a block of tjale. It was finally confirmed on digging out another tree. The roots, still in the tjale, were covered with snow and the tree allowed to dry out until they absorbed water, when a pair of similar size and age, that had lain side by side, were cut and supplied with eosin after the tjale round one of them had been thawed. At the end of half an hour, they had each become stained up to about 20 cm. of their length.

In the snow the daily fluctuations in air temperature are damped down until at a depth of 40–50 cm. below the surface they remain constant and high, so that even with the air temperature at −30° C. they never seem to be below −6° or −8°, and during the snow melt are always 0° C. Far from the tjale "joining permanent ground-ice which presumably extends to a great depth", actual digging shows that it is here at a latitude of nearly 70° N. rarely more than 60 cm. thick even in the mountains, while the temperature not far below it may be appreciably above zero. The main factor determining its thickness, after the water that is essential to its formation, seems to be snow. Where there is a deep covering from early in the winter, the tjale is often only 20–30 cm. thick, while the greatest depth at which I have found it in the birch forest is 85 cm. Many birch roots extended below this, some to more than two metres, while the temperature of the soil became higher as I dug deeper until it was +2° C. at 265 cm.

NICHOLAS POLUNIN
(Department of Botany, Oxford).
Near Punta pr. Sörkjosen,
Nordreisa i Troms,
Norway.
June 1.

Summer Mortality of Cockles on some Lancashire and Cheshire Dee Beds in 1933

DURING the last two years frequent visits have been made to the cockle beds in the north-west part of Morecambe Bay, and lately also to the beds in the Dee Estuary, Cheshire, in connexion with a study of sex, spawning and spatfall of *Cardium edule* and its allies.

The results of these studies will be given later, but it is relevant to note here (1) that the spawning of *Cardium*, though difficult to follow, appears to begin about the month of April and (2) that the young spat of this species can usually be found on the beds in quantity towards the end of June. While inspecting the grounds in the east of Cark sands this year, it was noticed that whereas in April the beds were normal, that is, with only a few living cockles lying out of the ground, in May, large numbers of individuals were found dead, lying on the surface of the sand with the rotting flesh still retained within the shell. As spawning had been in progress, it was suspected that the mortality might be generally associated with—or a result of—spawning under such conditions as existed in 1933.

To test this view, the beds in the Dee Estuary and others in the remote west of Cark sands (Morecambe Bay) were inspected without delay. On both these beds large numbers of cockles with the *dead fish within the shell* were again found covering extensive areas. The calm weather occurring at this period permitted the cockles to lie relatively undisturbed on the surface of the sand. Estimates of the number of dead related to the quantity of healthy per unit area will be given later with a discussion on the effects of tide and other considerations; in May there were 4–5 recently dead per square metre on the Dee beds, as is shown in Fig. 1, while a greater concentration of dead occurred on the Cark beds.

This degree of mortality continued during June and July; about five per square metre with dead

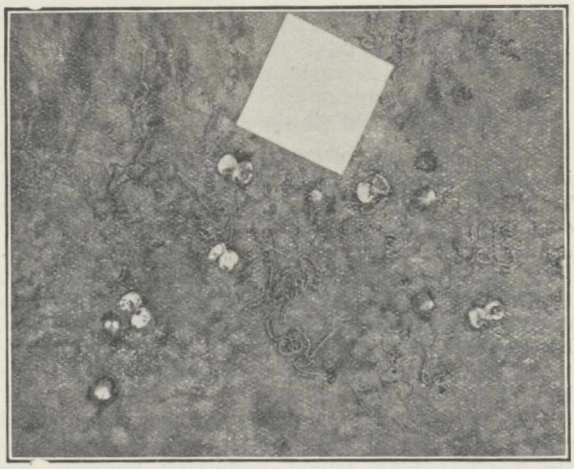

FIG. 1. Photograph of a small typical undisturbed area of the Dee cockle bed on May 31, 1933, showing (*a*) four dead cockles with the flesh in the shell, (*b*) one empty shell, (*c*) six weak individuals; all lying on the surface of the sand. The abundant cockles living *in situ* below the surface of the sand show up as separate light areas along with worm casts of *Arenicola*. The white area is a 15 sq. cm. tile. (× about 1/10).

flesh in the shell being still present on quiet parts of the Dee beds on July 19 and a similar quantity on parts of the Cark beds on July 22. Contrary to expectation, it is clear that the flesh persists in the cockles for a considerable time after death, remaining in many cases until it becomes foul, so that it is difficult to obtain a reliable estimate of the total mortality. The early mortality in May on the Cark beds was estimated at 5 per cent of the population.

The cause of this high death-rate has not yet been specially investigated; the mortality is definitely associated with post-spawning conditions and rather warm quiet weather, and may very well occur as a normal post-spawning phase especially in warm summers. There are apparently no records of summer mortality in the literature on *Cardium*[1,2], but the phenomenon is probably not unknown to cockle-fishermen in certain districts, and is perhaps empirically related to the summer closure of the beds in the southern English fishery districts[2]. In stormy summers, dying cockles would be washed away as they appeared on the surface of the sand; in cold

summers there may be no noticeable death-rate. Parasites, overcrowding and pollution are important possible factors in the mortality observed, but the small proportion of parasitised individuals found, and the occurrence of recently dead cockles in sparsely populated areas, indicate that these two factors are not of sufficient importance to account for the high percentage of deaths observed, while pollution of a chemical kind can probably be eliminated on general biological grounds, for example, abundance of young shrimps and gobies.

The object in writing this preliminary notice of these observations is to direct attention to the need for *ad hoc* researches on the problem over a number of years in the interest of public health.

J. H. ORTON.

Department of Zoology,
University of Liverpool.
July 24.

[1] J. Johnstone. Liverpool Marine Biological Committee. Memoir No. 2, Liverpool, 1899.
[2] F. S. Wright. Fishery Investigations, **2**, 9, No. 5, Min. Agric. and Fisheries, London, 1926 (1927).

A Scottish Occurrence of *Craspedacusta sowerbii*, Lankester

MAY I record what is, I believe, the first Scottish occurrence of the trachyline *Craspedacusta sowerbii*, which was proved by Payne[1] and confirmed later by Flower and Boulenger[2] to be synonymous with *Microhydra ryderi*, Potts.

The medusoid phase, previously discovered in England, France, Germany, in the *Victoria regia* tanks of the botanic gardens, and also in China, the United States and the Panama Canal zone, appeared suddenly in a tropical aquarium kept at my home in Liberton, Edinburgh.

The production of medusæ was first observed about 8 a.m. on the morning of May 20, 1933, and they continued to appear until about 2 p.m. Altogether 70–80 medusæ were counted, but in spite of careful search no trace of the polyp form was discovered. The temperature of the tank was constant (75° F.). The larger plants were *Vallisneria spiralis* and *Elodea canadensis*. The whole plant and animal stock originally came from the Derham Fish Farm, Herts, but on inquiry there Mr. Derham stated that he had never seen the medusæ in his tanks. A certain amount of the water in my aquarium, however, came from the Braids Pond, south Edinburgh, while from time to time small quantities of water and scraps of vegetation from bog pools on Balerno Moor, near Edinburgh, have been introduced while feeding the fish on *Daphnia* and *Cyclops* obtained from these pools.

It was a curious fact that the medusæ should not have been noted before during the four years I have kept the tank undisturbed, but it may be significant that on the morning on which the medusæ appeared, my pair of paradise fish laid eggs and there was an enormous increase in the numbers of a certain species of bdelloid rotifer inhabiting the tank and also of *Carchesium polypinum* in the tank.

The development of the very early stages of the medusæ would appear to have been more rapid than that observed by Boulenger (loc. sit.) and Potts[3], since those I examined immediately after their appearance already had sixteen well-developed tentacles, the eight adradial being slightly shorter than the others. During the fortnight I was able to keep the medusæ alive, however, there was no further sign of development of any sort.

VERNON D. VAN SOMEREN.

Department of Zoology,
University of Edinburgh.
July 14.

[1] *J. Morph.*, **38**, 387; 1924.
[2] *Proc. Zool. Soc. Lond.*, 1005; 1928.
[3] *Quart. J. Micro. Sci.*, **50**, 623; 1906.

Influence of Iodoacetic Acid on the Blood Sugar Level

I HAVE previously reported[1] that iodoacetic acid causes a hyperglycæmia in rabbits and that it reverses the effects of insulin by causing the blood-sugar to rise after hypoglycæmia. In an endeavour to find out whether this was due to mobilisation of liver glycogen or to an inability of the tissues to utilise blood-sugar, a series of perfusion experiments has been carried out. Rabbits' hind legs were perfused with blood and the rate of fall of the blood-sugar was followed. In certain of the experiments sodium iodoacetate was present in the whole preparation in a final concentration of from 1 in 2,000 to 1 in 6,000, calculated as free acid. The utilisation of sugar was found to be impaired to a considerable extent, both in the presence, and, more so, in the absence of insulin, as these figures show. The sugar used is calculated and stated as mgm. per kgm. of legs per hour.

Normal perfusion (average of 3) .	96
Perfusion with iodoacetate (average of 5)	19
Perfusion with insulin (average of 4) .	164
Perfusion with insulin and iodoacetate (average of 5)	84

If a great deal of evidence did not exist showing that lactic acid in the blood stream is probably not a precursor of muscle glycogen, these experiments would not preclude the possibility that glucose was degraded to lactic acid before being utilised by muscle tissue. If this is not so, then it appears that iodoacetate can inhibit the reaction glucose → glycogen as well as that of glycogen → lactic acid.

The expenses of this work were defrayed by grants from the Royal Society and the Medical Research Council.

J. T. IRVING.

Department of Physiology,
University, Bristol.
July 13.

[1] Irving, *J. Physiol.*, **75**, 4*P*; 1932.

Vitamin C in Blood and Urine?

HARRIS has showed that the reducing capacity of animal tissues titrated against 2·6 dichlorophenolindophenol (as indicated by Tillmans and Szent-Györgyi) in acid solution, coincides with the biological activity.

Harris believes, however, that the reducing substance of tumour tissue is not, or not entirely, due to vitamin C (perhaps in this case a toxic effect of the tumour tissue plays a rôle). This shows that the test with the indicator must be used with due understanding. Euler showed that urine also contains a reducing substance. We have made the following experiments with blood and urine.

Blood.

The trichloroacetic acid filtrate shows no, or very little, reduction (man, rabbit, pig, guinea-pig). After treatment with hydrogen sulphide in slightly acid solution during 6 hours and after driving off the hydrogen sulphide by nitrogen, the reduction has much increased, so the reducing substance is present in the reversible oxidised state (average of 16 different observations in men, 0·5 mgm. before reduction and 2·05 mgm. after reduction calculated as vitamin C per 100 c.c. blood).

1. People using much fruit and vegetables showed more reduction in their blood than those using more cereals.
2. Guinea-pigs on a scurvy-producing diet gradually lose the reducing substance.
3. Adding vitamin C to blood (*in vitro*), it quickly passes into the reversible oxidised form.
4. Intravenous injection of decitrated lemon juice (rabbit) causes increase of the oxidised state of the substance.
5. In alkaline solution the substance is rapidly destroyed. The substance is precipitated by lead acetate in neutral or slightly alkaline solution, not in acid solution.

Treating the precipitate with acid, the reducing substance is reobtained.

Ascorbic acid also shows all these properties.

Urine.

The substance is only present in the reduced form (in contradistinction to blood).

1. People using much fruit produce more reducing substance.
2. Intake of much decitrated lemon juice gives rise to a greater output of the substance.
3. Intravenous injection of decitrated lemon juice into the rabbit causes a production of the oxidised form in the urine.
4. Guinea-pigs on a scurvy-producing diet gradually lose the reducing substance.
5. The substance shows the same behaviour with lead acetate as indicated with blood (No. 5).

Mercuric acetate does not precipitate pure ascorbic acid solution or vitamin C from lemon juice, but the vitamin is reversibly oxidised and can be obtained quantitatively from the filtrate after reduction with hydrogen sulphide. As mercuric acetate solutions precipitate cysteine and glutathione, it is possible in this way to separate this and other substances from vitamin C. The substance in urine also is not precipitated with mercuric acetate.

So far as our researches go, we think it very probable that the reducing factor in blood and urine is indeed vitamin C.

In cerebrospinal fluid also a substance can be found, reducing the indicator above mentioned. The substance was present in the reduced state. By spectrographic analysis we found a maximum of absorption at 2650 A., just as for ascorbic acid. The quantity of absorption at 2650 A. was of the same magnitude as if the reducing substance was ascorbic acid (determined by the indicator).

M. VAN EEKELEN.
A. EMMERIE.
B. JOSEPHY.
L. K. WOLFF.

Laboratory of Hygiene of the
University of Utrecht.
July 29.

Vitamin A in the Retina

I HAVE found vitamin A in considerable concentrations in solutions of the visual purple, in intact retinas, and in the pigment-choroid layers of frogs, sheep, pigs and cattle. The non-saponifiable extracts of these eye tissues display in detail all of the characteristics of vitamin A-containing oils.

The blue antimony trichloride coloration given by retinal and choroid layer extracts, when observed spectroscopically, exhibits the sharp, strong band at 620 mμ specific for vitamin A. More concentrated preparations also display the characteristic fainter band at 580 mμ, recently shown to be due to a foreign material which in natural oils always accompanies vitamin A in varying concentrations[1]. Both bands fade rapidly after mixing with antimony trichloride, while a secondary absorption at about 500 mμ appears which is responsible for the red coloration in later stages of the reaction. This last phenomenon also is characteristic of impure vitamin A preparations.

Absorption spectra have been measured of the chloroform solutions of oils from the retinas and pigment layers of sheep and oxen, and from pig retinas. The extinction coefficient ($\log I_0/I$) rises without inflection from 500 mμ to a single broad maximum between 320 mμ and 330 mμ. This is the characteristic vitamin A band. The smoothness of the absorption curves between 500 mμ and 400 mμ is an indication that no other carotenoids are present in these extracts, since all the other known carotenoids possess one or more absorption bands in this region[2].

Feeding experiments on rats suffering from avitaminosis have been performed at the Pharmacological Institute of Hoffmann - La Roche et Cie., Basle, using an extract of ox retinas, from which the sterins had been frozen. The results of these experiments with a first preparation have now been received. This oil, tested with antimony trichloride, had shown in the Lovibond tintometer a colour intensity of 20 C.L.O. units. The purest vitamin A preparations test at about 10,000 C.L.O. units. Therefore this oil contained about 0·2 per cent vitamin A. Rats displaying the symptoms of avitaminosis were cured by administering a daily ration of 1 mgm. of the oil; 0·3 mgm. was found to be inadequate. By the antimony trichloride test, 1 mgm. of the oil contained 2γ vitamin A. The purest preparations of Karrer and his co-workers are capable of maintaining growth in rats when fed in a daily dosage of 0·5γ[3]. Since the vitamin requirement is appreciably greater for curing diseased rats than for maintaining growth in normal animals, the agreement is adequate.

Some time after these experiments had been begun, I learned of work from two other sources which, to a degree, anticipates the present results. Holm[4] has found that fresh calf retinas fed to rats suffering from avitaminosis are capable of curing xerophthalmia and restoring normal growth. Smith, Yudkin, Kriss and Zimmerman[5] have obtained similar results with dried pig retinas; choroid tissue proved ineffective. In neither contribution is the presence of vitamin A exclusively indicated. Of the other known carotenoids, carotene possesses all of the described characteristics. It is also not clear in the light of the present work why the latter authors found choroid tissue without effect; or why alcohol extracts of their preparations did not respond to the arsenic

trichloride test, since alcohol is a good solvent for vitamin A.

The physiological significance of the presence of considerable quantities of vitamin A in the eye tissues will be discussed in detail in a more complete communication elsewhere. Most interesting is the relation of the presence of the vitamin in the eye to the optic disorders which are the specific symptoms of its absence from the diet: xerophthalmia, keratomalacia and—most pertinent to the present work—night-blindness.

GEORGE WALD
(National Research Fellow in Biology).
Chemical Institute, University of Zurich.
Aug. 6.

[1] Karrer, P., Walker, O., Schöpp, K., and Morf, R., NATURE, **132**, 26, July 1, 1933.
[2] Von Euler, H., Karrer, P., Klussmann, E., and Morf, R., *Helv. Chim. Acta*, **15**, 502; 1932.
[3] Karrer, P., Morf, R., and Schöpp, K., *Helv. Chim. Acta*, **14**, 1036; 1931.
[4] Holm, E., *Acta Ophthal.*, **7**, 146; 1929.
[5] Smith, Yudkin, Kriss and Zimmerman, *J. Biol. Chem.*, **92**, *Proc.*, xcii; 1931.

A Reaction in the Skin occurring during the Latent Period following X-Radiation

THE latent period between the application of X-rays to living tissues and recognisable changes in them, is a mystery which has so far all but defied investigators.

The reaction here described is, therefore, of special interest since it occurs within twenty-four hours after the application of X-rays.

If, during the afternoon the skin of a rat be exposed through a small hole in a lead screen to approximately a U.S.D. of X-rays, and immediately afterwards a solution of pyrrol blue be inoculated into the circulation, then the next morning there will be seen a blue mark on the skin precisely corresponding to the hole in the lead screen.

This appears to indicate that the radiated capillaries have been altered so that the dye passes through them more readily than through normal capillaries.

So far as I am aware, only three other biological changes have been observed within a few hours after exposure to X-rays, namely: (1) the inhibition of mitosis when dividing cells are radiated; (2) the disappearance of lymphocytes from the circulation when small rodents are given a generalised exposure to X-rays; and (3) the sticking of lymphocytes to the walls of the capillaries in radiated areas of skin.

It is to be hoped that this new reaction with pyrrol blue, when fully exploited, will elucidate some of the hidden changes which occur during the latent period.

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London, W.1.

Method of Preparation of Radium E

IT is well known that the preparation of sources of radium E presents considerable difficulties, particularly if it is required to separate this element from large quantities of radio-lead. The purpose of this communication is to indicate a new method of preparation.

The radium E is precipitated from a very slightly acid solution of the nitrate of radio-lead by means of pyrogallol in the presence of a suitable quantity of antimony. This reaction is very sensitive and is specific for the elements antimony[1], bismuth[2], the isotope of radium E, and polonium[3]. Under suitable operative conditions radium E and polonium are practically completely precipitated with the antimony. The precipitate is collected on a filter of fritted Jena glass G4, washed thoroughly, dissolved in warm nitric acid (1 part in 3), and evaporated to dryness.

Separation from the antimony is effected by electrolysing the nitrates in presence of tartaric acid and ammonium tartrate[4] using platinum electrodes and a tension of 1·9–2·0 volts. The yields obtained in the electrolysis up to the present vary from 47 to 80 per cent (52–88 per cent allowing for the decay of the radium E during the electrolysis).

The quantities of radio-lead employed varied between 10 gm. and 300 gm. containing 9·4 and 350 microcuries, respectively, of radium E ($7{\cdot}5 \times 10^{-11}$ gm. and $2{\cdot}8 \times 10^{-9}$ gm.).

The investigation is being continued with the view of improving the yield and applying the method to larger quantities of radio-lead.

M. HAÏSSINSKY.
Institut du Radium, Paris.
July 26.

[1] Feigl, *Z. analyt. Chem.*, **64**, 41; 1924.
[2] Feigl and Ordelt, *ibid.*, **65**, 448; 1925.
[3] M. Haïssinsky, *C.R.*, **192**, 1645; 1931.
[4] cf. Schmucker, *J. Amer. Chem. Soc.*, **15**, 203; 1893.

Interaction between Soot Films and Oil

I HAVE investigated some of the phenomena mentioned by Mr. J. H. Coste[1] and Dr. S. C. Blacktin[2] under this heading. There appear to be two distinct actions concerned: (*a*) The 'Blacktin effect'[3], consisting of periodic concentric light and dark zones, produced by 'posing' the drop of oil on the film, due possibly to the advancing surface of the oil carrying particles from the light zones and banking them up in the dark zones. (*b*) When the drop of oil is allowed to fall from a height of 2 or 3 cm., the above effect is swamped by a different phenomenon, which is due to a liberation of gas from the film, as Mr. Coste has shown.

Briefly, the figure formed consists of a central zone, from which scarcely any soot has been removed, surrounded by a circle of very small clear spaces, which are in turn surrounded by the intermediate zone. Each of the spaces in this resembles the central zone, but is smaller (half the diameter), and has more carbon removed. Some of the intermediate zone spaces show an orbital ring of small bare spaces, as does the central zone. The outer, or peripheral, zone consists of one to three circles, each concentric with the other zones, composed of small bare circular patches, about twice the diameter of those surrounding the central zone. Outside this, the remains of an (*a*) effect may be seen. These details are taken from a figure formed by a drop of cedarwood oil falling from 3 cm.

Low power observation after the oil has fallen shows one large bubble arising from the central zone, and rising to the surface much more quickly than do those arising from the intermediate zone spaces. These latter in turn rise faster than the small bubbles from the outer zone bare spaces. The reason for this is seen on letting the preparation stand for two or three minutes, when the bubbles reach the surface and burst. The large ones, from the intermediate zone, leave a circular area of coarse carbon granules.

The smallest bubbles, from the bare spaces, leave a complete skin of carbon, ruptured in one place only. The central bubble gives rise to a very fine deposit of carbon, only a fifth to a tenth of that from an intermediate zone bubble.

The density of the bubbles is thus determined by the carbon load which they have carried away from the film. I have been unable to find any signs of the formation of clear spaces by the concentration of the removed carbon round their edges. Indeed, the observation just quoted seems decisive.

If the second effect (formation of gas bubbles) is due to the adsorption of gas by carbon during the formation of the film, one would expect that a film formed in a stream of ammonia gas would give a much more marked effect on impact, since charcoal is stated to adsorb ten times as much ammonia by volume as it does air[4].

On forming a film in a stream of ammonia, however, no difference could be observed in the figure formed from one formed in a similar way on a film made in air. It seems probable, therefore, that the gas is not adsorbed by the carbon, but is entrapped between successive layers of the film. This would account for the fact that no evolution of gas occurs from the surface of the film, even the central bubble (the most superficial to arise) having to raise a fine coat of carbon before it is liberated.

It is possible that the circle of clear dots formed round the central zone is due to a shock transmitted to the deepest layers of the film during the formation of the central zone.

D. MALCOLM CARDING.

Clare College, Cambridge.
July 19.

[1] NATURE, 131, 691, May 13, 1933.
[2] NATURE, 131, 873, June 17, 1933.
[3] NATURE, 129, 401, March 12, 1932.
[4] Partington, "Inorganic Chemistry", p. 657.

Nuclear Spin and Magnetic Moment of Tin

PREVIOUS investigators have failed to record any fine structures in the spectra of tin[1]. By the use of a Fabry-Perot interferometer I have examined the spectrum of Sn II emitted by a hollow cathode discharge, and obtained structures in several lines. Aston reports 11 tin isotopes within the range 112–124, and of these, 76 per cent are even whilst the percentage abundances of the odd isotopes are 115 = 0·4, 117 = 9·8, 119 = 11, 121 = 2·9.

The line $6s.^2S_{1/2}-6p.^2P_{3/2}$ has the following structure (intensities in brackets).

$$+53(3)\quad 0(15)\quad -152(1)\text{cm.}^{-1}\times 10^{-3}.$$

Other lines show $6p.^2P_{3/2}$ to have a negligible structure so that only $6s.^2S_{1/2}$ is split up. The intensities show that the strong component, which is at the centre of gravity of the structure, is due to the even isotopes, and as the intensity ratio of the outer lines is 3 : 1 the nuclear spin is $\frac{1}{2}$. This must be true at least for 117 and 119, since the satellites are about 21 per cent of the total intensity. The value for the spin is checked by the fact that the intervals from the centre component are in the ratio 1 : 3 within experimental limits.

Only the stronger of the two expected satellites has been found in $6s.^2S_{1/2}-6p.^2P_{1/2}$ owing to falling off in plate sensitivity.

The $5d.^2D_{5/2}$ term shows broadening in the even isotope term and a doublet structure greater than that of $6s.^2S_{1/2}$ whilst $5d.^2D_{3/2}$ also shows a definite, although unresolved, broadening, due doubtless to even isotope displacement. These structures are almost certainly due to perturbations by the neighbouring $s.p^2.^2D_{5/2\ 3/2}$ terms[2].

The structures in both $6s.^2S_{1/2}$ and $5d.^2D_{5/2}$ are inverted, the higher F term lying deepest, hence the nuclear magnetic moment is negative as in the case of cadmium. The $g(I)$ factor when calculated by Goudsmit's formula[3] is $-1{\cdot}81$.

Full details will be published elsewhere.

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Aug. 1.

[1] Murakawa, *Z. Phys.*, **72**, 793; 1931.
[2] Lang, *Phys. Rev.*, **35**, 445; 1930.
[3] Goudsmit, *Phys. Rev.*, **43**, 637; 1933.

Vanadium Oxide Bands

MECKE and Guillery[1] identified only four band heads given in Kayser's "Handbuch der Spectroscopie" (6, 786, 1912) as due to the oxide of vanadium and assigned them their vibration quantum numbers. These are the (1,0), (0,0), (0,1) and (0,2) band heads. Prof. Ferguson[2] has recently photographed the bands and measured thirty-one heads from low dispersion spectrograms between λ4800 and λ8700. The bands have now been photographed under high dispersion and more accurate data have been secured. The measurements have also been extended in the shorter wave-length region as far as λ4500. The band-heads are double with a separation of about $2{\cdot}8\nu$ between them. The equation of band head wave numbers remains, however, practically the same as that given by Prof. Ferguson.

A preliminary analysis of the rotational structure of (0,1), (0,0) and (1,0) bands shows that the band system is due to a $^2\Sigma\rightarrow{}^2\Sigma$ transition. The following rotational constants have been approximately evaluated.

$$B''_e = 0{\cdot}526\text{ cm.}^{-1} \qquad B'_e = 0{\cdot}489\text{ cm.}^{-1}$$
$$r''_e = 1{\cdot}62\text{ A.} \qquad r'_e = 1{\cdot}68\text{ A.}$$

A detailed account of the analysis and more precise value of the constants will be published elsewhere.

CHANDRASEKHAR GHOSH.

Applied Physics Laboratory,
University College of Science and Technology,
Calcutta.
June 27.

[1] *Phys. Z.*, **28**, 514; 1927.
[2] *Bureau Standards J. Res.*, **8**, 382; 1932.

Karagwe-Ankolean Rocks as a Repository of Gold

WITH reference to the penultimate paragraph of Dr. Parkinson's article on "Central African Volcanoes" in NATURE of June 10, may I be permitted to state, in the interests of accuracy, that the Karagwe-Ankolean rocks of Kigezi, Uganda, were known to be repositories of gold, in the sense that they are also repositories of tin, before the auriferous alluvials and lodes of Kakamega were discovered.

E. J. WAYLAND.

Geological Survey Office,
P.O. Box 9,
Entebbe, Uganda.
July 17.

Research Items

Perforated Double-Axe from Co. Mayo, Ireland. Mr. L. S. Gogan, deputy keeper of Irish antiquities, National Museum, Dublin, describes and figures in *Man* for August a double-axe of stone recently found at Curraboy Knox, near Ballinrobe, Co. Mayo, which is now in the National Museum. It lay at a depth of 1 ft. in yellow clay thought to be lacustrine in origin, on an area now drained, known as Lough Killosheheen. What is thought to be a hearth-site was found some twenty yards away, and 100 yards to the south are the remains of a lake-dwelling. The axe is probably unique. From the points of view of form, decoration and technique, it is a masterpiece. There can be no doubt of the intentional reproduction of the double-axe form. There is nothing like a cutting-edge, but one of the bevels is more acute than the other. The sharper edge is about $\frac{1}{8}$ in. thick and is decorated with incised border lines which form part of the ornament of the faces. The back edge is about twice as thick, and is decorated with a larger number of grooves drawn parallel to the curve of the edge. Obviously the axe was not intended for use, but was a votive offering, insignia, or sacrificial weapon. A spall has been taken off the cutting edge, but although the fracture is ancient, there is nothing to show whether it is contemporary with the date of manufacture. The basis of the ornamentation is a large depressed X of which the terminals are joined by arcuate lines decorating the edges. The triangle, or secant, corresponding to the cutting edge, is completely filled with lines radiating from the apex, the corresponding secant being only partially so filled. The upper opening alone of the perforation is ornamented with a double border line. The decoration is a stylisation, or modification, of the decorative motif of European perforated stone-axe types under the influence of a native binding technique.

Cultural Distributions in the South-Eastern United States. Certain mounds excavated in the Mississippi Valley have produced evidence of a characteristic culture to which the name Hopewell has been given. The outstanding feature of this culture is the decoration of the pottery, which consists of bands of various dimensions outlined with deeply incised grooves, the areas outside or between these grooves being roughened uniformly either with roulette, zig-zag, punctate or cord marks. In a large proportion the area below the rim has been decorated with incised cross-hatch lines and an encircling line of cross-hatched cones. The dominant tempering material is grit. Mr. Frank M. Setzler has recently discussed the distribution and the problem of the origin of the Hopewell culture in relation to a description of pottery from Marksville, Louisiana, discovered by the late Gerard Fowke in 1926 and Dr. J. R. Swanton in 1930 and similar in type to that of the Hopewell culture (*Proc. U.S. Nat. Mus.*, 82). Comparison between the two wares shows a resemblance which is unlikely to be due to the independent invention of so complicated a technique of decoration. The Hopewell mounds show definite evidence of contact between north and south, in tortoise shells, barracuda jaws, and other articles from the Gulf. Future investigation may prove that the Hopewell culture in the north is an amalgamation of certain characteristics—mound building, pottery, barracuda jaws, tortoise shells—derived by trade and contact from the south, and a definite group of characteristics—realistically carved stone pipes, copper and obsidian—which originated with and were developed by the Hopewell people themselves. The few similarities which are noted, in addition to the pottery, do not seem sufficient at present to establish the two mounds at Marksville especially under consideration as typical Hopewell mounds, though this does not offset the resemblances between the pottery.

Parasites of Scottish Mammals. Drs. T. W. M. Cameron and Ivan W. Parnell give the results of the examination for internal parasites of a large number of wild mammals, native and introduced, in Scotland (*Proc. Roy. Physical Soc., Edinburgh*, 22, 133; 1933). In many cases the species are those found in domesticated stock, and the possibility exists that the wild animals may act as a reservoir, either increasing the numbers of parasites present in stock or introducing new species to domestic animals. Six new species are described from roe deer, the introduced Japanese deer (*Sika nippon*), stoat, weasel, mole, and hedgehog, that from the last-named being referred to a new genus *Spiruroides*. The paper, a useful contribution, would have been still more useful had the authors stated (1) the locality from which each specimen was obtained; for example one red and one grey squirrel were examined, but no locality is given, and it cannot be assumed, at the present stage, that the parasites of these two individuals are universally distributed in squirrels throughout Scotland; (2) the relative frequency of occurrence and numbers of the parasites in any host; and (3) in all cases the authorship of specific names.

Economic Biology of the Caplin (*Mallotus villosus*). In various fishing regions of the North Atlantic, at certain seasons, the caplin forms the main food of the cod. The results of a detailed study of the caplin in Newfoundland waters—carried out by Prof. G. F. Sleggs, of Memorial University College, St. John's—have recently been published in a Report of the Newfoundland Fishery Research Commission (vol. 1, No. 3. March, 1933. Price 1 dollar). The paper presents a compilation of previous knowledge concerning this fish together with the results of recent scale studies, length-frequency analyses, and oceanic investigations by the present author. Caplin abound in the inshore waters of Newfoundland in June and July. They migrate in dense shoals into the creeks and inlets, with which the coast of Newfoundland is richly provided, in order to spawn. The Newfoundland summer inshore cod fishery is the result of an inshore caplin-pursuit migration on the part of the cod. The migration appears to be from deep water to the adjacent land. The fish appear to move in relation to an upper temperature limit of about 10·5° C. The southernmost limit of their geographical distribution, during the annual spawning migration, coincides approximately with the climatic isotherm of 45° F. (annual mean). For spawning purposes the caplin shows preference for shingly places. The shoals of spawning fish approach close to the water's edge and the eggs are deposited abundantly from high-water mark down to a depth of about 3 or 4 fathoms. Soon the spawn is concentrated in a narrow

intertidal zone by the piling action of the waves, and very large numbers of eggs are destroyed by desiccation and by the attacks of beach flies of the genus *Fucellaria*.

Posterior Cranial Apertures in Cyprinidæ. The hinder end of the cranium in the Cyprinidæ and some allied forms bears a pair of large openings the origin and meaning of which have been investigated by Chranilov (*Trav. Soc. Nat. Leningrad*, 61, 84–167) who proposes to name them fontes posteriores cranii. The mesenchyme in the metotic region of the cranium probably results from the breakdown of a number of sclerotomes and all trace of segmentation in it is lost. As a result, the metotic primordia of the chondrocranium show no indications of metamerism and they develop without correlation with the metameric structures of the hinder end of the head. In the Cyprinidæ, the foramina for the exit of the characteristic occipital nerves give some indication of segmentation in the occipital region. The subdural lymph space in the skull communicates by a space traversing the posterior cranial aperture with the lateral lymph space (saccus lymphaticus paravertebralis). This joins with a similar cavity (spatium lymphaticus perivesicalis) and with that round the head kidney (spatium lymphaticus perirenale). The saccus paravertebralis communicates with a space in the vertebral column by branches accompanying the second and third spinal nerves. All these cavities develop in a loose mesenchyme and form a series of lymph spaces inside and outside the skull and vertebral column. It is suggested that the presence of the space passing through the posterior cranial aperture allows of the equalisation of pressure on the two sides of the skull.

Canadian Cestodes. Prof. R. A. Wardle has published a list of fifty-three Cestodaria and Cestoda hitherto recorded as parasitic in Canadian animals (*Canad. J. Res.*, vol. 8, No. 4, 1933). He notes that *Gyrocotyle urna* is not uncommon in the intestine of the chimæroid *Hydrolagus colliei* off British Columbia, and that two twin individuals are usually present in each infested host. *Diphyllobothrium latum* is stated to be common but localised in distribution in man, dog, bear, mink and cat in Manitoba; it was present in 81 per cent of 500 dogs from the vicinity of Lake Winnipeg in 1931. Twenty-eight species of tænioid cestodes are recorded. There is apparently no record of the occurrence of *Tænia solium* in man in Canada, "although there is no doubt of its occurrence", or of *T. saginata*, though it is probably a common parasite of man, and Prof. Wardle has the cystic stage from Western Canadian cattle. He suggests that there is no evidence that enteric infestation with cestode parasites is seriously inimical to a mature animal and states that the intestine of fresh-water fishes is commonly blocked with tapeworms, but out of many thousand such fishes which he examined he cannot recall a single case of malnutrition. There is, however, considerable evidence that such infestation may result in malnutrition in an immature animal; there is epidemic mortality in Canadian hatcheries in young trout and salmon attributable to occlusion of the gut by cestodes, and such fish show all the signs of malnutrition. Larval cestodes which are in locations other than the gut are known to cause serious disturbance of the organs in which they occur.

Interspecific Hybrids in *Hibiscus*. A study of interspecific hybrids between *Hibiscus esculentus* and *H. Manihot* has been made by Dr. Torao Teshima (*J. Fac. Agric., Hokkaido Imp. Univ.*, vol. 34, part 1). Various species were crossed but seeds were only obtained when *H. esculentus* was pollinated by *H. Manihot*. The failure of the reciprocal cross is attributed to cytoplasmic differences between the species, the rate of pollen-tube growth being the same in every case. The F_1 shows remarkable hybrid vigour, the average height of the parent species being respectively 228 cm. and 30 cm., while that of the F_1 is 393 cm. The hybrid also has larger flowers but is intermediate in many characters of leaf, capsule, trichome and seed. The progeny from backcrossing showed great variation, including a few reversions. *H. esculentus* has $n=36$ chromosomes and *H. Manihot* has $n=30$. In the F_1 hybrid about 66 chromosomes could be counted, but they do not pair in pollen meiosis. Instead they divide once forming a pollen dyad, each cell having 66 chromosomes. Some irregularities also occur. The backcrossed plants were triploid ($36_{II}+30_I$) and showed many meiotic irregularities with lagging chromosomes and multiple spindles, the chromosome counts in different plants ranging from 48 to 70. Those with the higher numbers showed the greater fertility. Some of the F_2 plants produced only large diploid pollen grains; they were tetraploid, with $36_{II}+30_{II}$ chromosomes. Offspring which resembled *H. esculentus* were found to have 36 or 37 bivalent chromosomes.

Seismicity of the United States. A valuable map showing the distribution of earthquake activity in the United States is given in a recent paper by Mr. N. H. Heck, chief of the seismological division of the U.S. Coast and Geodetic Survey (*Matériaux pour l'Étude des Calamités*, pp. 3–22; 1933). Extending across the continent, there is naturally a wide range of seismicity in the United States. While the Pacific coast alone is a portion of a major earthquake belt, there are several regions, such as that surrounding New Madrid, that have been visited by great earthquakes. There are also extensive areas with little known earthquake activity. Mr. Heck defines 37 earthquake regions in the country; one of them is submarine; of the rest, there seem to be only three in which earthquakes capable of causing damage more or less slight have not occurred since 1868. In the eastern section, the seismic zones (including that of Charleston) have a general north-east to south-west trend; in the central section (including that of New Madrid), north to south; and along the Pacific coast (including that of California), north-west to south-east. The latter band apparently passes out to sea in northern California, and this probably accounts for the moderate activity of Oregon and Washington.

Luminous Night Clouds in Norway. Carl Størmer's recent paper "Height and Velocity of Luminous Night Clouds observed in Norway, 1932" (Publication No. 6 of the University Observatory, Oslo) continues the study of the remarkably high clouds to be seen occasionally in the summer months both in the northern and southern temperate latitudes, that was begun by O. Jesse, who published a series of papers dealing with these between the years 1885 and 1891. These night clouds are described as somewhat similar to cirrus in appearance but "of a shining blue-white silvery colour". A long series of measurements of their height was made photographically at Berlin

and some adjacent observing stations, and gave mean heights varying between 80 and 89 kilometres, heights vastly greater than those of cirrus clouds. Jesse found velocities ranging from 100 to 300 metres per second from east-north-east in the case of the clouds of July 2, 1889, and velocities of more than 100 metres per second were observed to be of frequent occurrence. He found, further, that the usual drift was from north-east before midnight and from east-north-east after midnight. Størmer's apparatus and observing stations used for the measurement of auroral heights served also for these cloud measurements, and the apparatus and method are described in this paper. Photographs were obtained on the nights of July 10–11 and 24–25, 1932, and gave heights ranging from 74 km. to 92 km. with a mean of 81·4 km., thus confirming Jesse's figures of 82·1 km. for 1889–1891. The clouds of July 10–11, 1932, were found to be moving from north-north-east, with a velocity between 44 and 55 metres per second. No emission lines were found in a spectrum of those observed on July 24–25. The observations are held to be insufficient to allow definite conclusions as to the nature of such clouds to be drawn. Apart from meteor trails, they are the only objects available for studying the winds so high up in the stratosphere.

Polish on Metals. R. C. French (*Proc. Roy. Soc.*, A., June) has investigated the structure of the surface layer formed on metals by polishing, using the electron diffraction pattern as an index to the surface arrangement. The metal specimens used were copper, silver, chromium and gold, and in every case the diffraction patterns showed sharp rings after treatment with emery, and blurred rings after polishing. The author interprets these experiments as showing that an amorphous layer is formed by the polishing process. This explanation is contrary to that given by Germer, who suggests that the disappearance of the rings is due to the suppression of diffraction by thin upstanding ridges of metal. In the present experiments, however, definite, though broad, rings were observed and it seems probable that these are really formed by scattering from an altered surface layer.

Ionisation Constants of Carbonic Acid. The thermodynamic equilibrium constants of the first and second ionisations of carbonic acid: (1) $H_2CO_3 \rightleftarrows H^{\cdot} + HCO_3'$; (2) $HCO_3' \rightleftarrows H^{\cdot} + CO_3''$, are of considerable importance, since they intervene in many biological investigations. MacInnes and Belcher (*J. Amer. Chem. Soc.*, July) have made a careful redetermination of the constants $K_1 = [H^{\cdot}]\,[HCO_3']\,\gamma^H\gamma_{HCO_3}/[CO_2]\,\gamma_{CO_2}$ and $K_2 = [H^{\cdot}]\,[CO_3'']\,\gamma_H\gamma_{CO_3}/[HCO_3']\,\gamma_{HCO_3}$, in which square brackets denote molar concentrations and γ the activity coefficient. The terms referring to CO_2 denote that substance in solution as CO_2 and as H_2CO_3; it appears from other investigations that less than one per cent of the dissolved CO_2 is in the form of H_2CO_3. The measurements have been made by means of galvanic cells without liquid junctions and with the glass electrode, the liquid being in equilibrium with gaseous CO_2 at a known partial pressure. Very full experimental details are given. The value of γ_{CO_2} is taken as 1 and $[CO_2]$ is assumed proportional to the pressure, both approximations being justified in the discussion. The asymmetry potential due to the glass electrode was eliminated. The final results at 25° are $K_1 = 4{\cdot}54 \times 10^{-7}$ and $K_2 = 5{\cdot}61 \times 10^{-11}$. The first figure is considerably at variance with published and generally accepted values of the constant obtained from conductivity measurements, but is in close agreement with a redetermination by that method described in the paper, and also agrees with the potentiometric measurements of Michaelis and Rona. The second constant agrees, in order of magnitude, with published work based on equilibrium measurements.

Astronomical Topics

Orbit of Comet 1907 IV (Daniel). This comet was discovered on June 9, 1907, by Z. Daniel, at Princeton, New Jersey. It was a conspicuous object of the second magnitude during the summer of 1907, its head being 2′ in diameter, with a fairly sharp nucleus. It was under observation for 12½ months, the number of observations being about 600. A definitive study of its orbit has recently been published by U. Baehr (*Astr. Nach.* 5965). Nineteen normal places were formed, 12 in 1907 and 7 in 1908. The perturbations by Jupiter and Saturn were examined and found to be very small. The following are the final elements:

T	1907 Sept. 3·9614468 G.M.T.	
ω	294° 25′ 55·79″	1910·0
Ω	143 2 53·70	
i	8 58 4·56	
q	0·5121729	
e	0·9987929	

Period, 8740 years ± 56 years
Aphelion distance, 848 units.

Variation in the Light of Vesta. It is well known that the light of many of the asteroids is variable. The *Bulletin of Kwasan Observatory*, Japan, for January 30, 1933 contains a paper by T. Kanamori, which gives 27 photometric observations of Vesta, made between December 17 and 24, 1932. The individual determinations range from mag. 6·71 to 7·76, but on adopting a mean light-curve the range is found to be half a magnitude, from 7·2 to 7·7, the period of variation being 3 hours. The variation may arise either from irregularity of shape or unequal albedo in different regions. In either case the light-range is likely to change with variation in the axial presentation of the planet, though the period should not alter. In the case of Eros the light-range is sometimes nearly 2 magnitudes, at other times it practically disappears.

The Planet 1933 *HH*. This planet, which was recently announced from Johannesburg as a new one of unusual brightness, proves to be identical with No. 192, Nausicaa, which has been known for half a century. Ephemerides are only calculated for the asteroids for the dates when they are nearly in opposition, which is the reason for the delay in making the identification. Nausicaa is among the brightest of the whole family. *Kleine Planeten* for 1933 gives an ephemeris for October and November next. Opposition will occur on November 3; the planet will then be in R.A. 2^{h}33^m, N.Decl. 28° 5′; its magnitude will be 7·8, so it will be an easy object with a good binocular.

Neutrons and Protons in Atomic Nuclei

By PROF. H. S. ALLEN, F.R.S.

HEISENBERG has discussed the hypothesis that the nucleus of an atom is composed of neutrons and protons only, the neutron being regarded as a fundamental entity and *not* as a combination of an electron and a proton. On this view, the nucleus is formed of n neutrons and p protons, and p is also the number of planetary electrons required to form an electrically neutral atom. Thus p, the charge number, is identical with Moseley's atomic number, Z, which determines the position of the element in the periodic table. The mass number, A, is the sum of n and p. For example, the nucleus of an ordinary hydrogen atom consists of a single proton, while that of the hydrogen isotope of mass 2 consists of one proton and one neutron. The helium nucleus or α-particle, which may form a constituent of heavier nuclei, is composed of two protons and two neutrons.

Importance is attached to the value of the *ratio* of n to p, which is supposed to determine disruption of a radioactive nucleus. The question as to whether these numbers are odd or even is also of moment. For light elements, n is very nearly equal to p, never differing from it by more than one or two units. E. C. Pollard[1] concludes that the height of the potential barrier of a light nucleus is proportional to the atomic number, and claims that this is in agreement with Heisenberg's suggestions.

The accompanying table gives the values of p and n and the mass number A for hydrogen and the elements in the two short periods at the beginning of the periodic table. The more abundant isotopes are printed in heavy type. A study of the table brings out several interesting points with regard to their distribution. In the first period, helium with its single isotope is followed by three elements, Li, Be, B, for which the more abundant isotope has $n=p+1$. Then come three elements, C, N, O, for which the condition for abundance is that $n=p$. The period ends with fluorine, F, having only one known isotope. In the second period there is another type of symmetry, and there is a well defined alternation in the position of the more abundant isotope as we pass from group 0 to group VII. The figures in the table are also of interest in connexion with the artificial disintegration of the atomic nucleus.

There is no difficulty in extending the table so as to include other periods, but the results tend to become more complicated as the atomic number increases.

HYPOTHETICAL NUCLEAR STRUCTURE OF LIGHT ELEMENTS

showing the number of protons (p) and neutrons (n).

H $1p$ $A=1$ **0n** $A=2$ $1p$ $1n$

0	I	II	III	IV	V	VI	VII
He $2p$ **4 2n**	**Li** $3p$ 6 3*n* **7 4n**	**Be** $4p$ 8 4*n* **9 5n**	**B** $5p$ 10 5*n* **11 6n**	**C** $6p$ **12 6n** 13 7*n*	**N** $7p$ **14 7n** 15 8*n*	**O** $8p$ **16 8n** 17 9*n* 18 10*n*	**F** $9p$ **19 10n**
Ne $10p$ **20 10n** 21 11*n* 22 12*n* 23 13*n*	**Na** $11p$ **23 12n**	**Mg** $12p$ **24 12n** 25 13*n* 26 14*n*	**Al** $13p$ **27 14n**	**Si** $14p$ **28 14n** 29 15*n* 30 16*n*	**P** $15p$ **31 16n**	**S** $16p$ **32 16n** 33 17*n* 34 18*n*	**Cl** $17p$ **35 18n** 37 20*n* 39 22*n*

[1] NATURE, **131**, 97, 398; 1933.

Forestry Practice

SIR FRANCIS D. ACLAND, a forestry commissioner, has undertaken a most timely piece of work in publishing a small brochure on "Forestry Practice—A Summary of Methods of Establishing Forest Nurseries and Plantations with Advice on other Forestry Questions for Owners and Agents" (Forestry Commission, Bulletin No. 74, H.M. Stationery Office, 1933). This little book, replete with practical advice, should prove of the greatest value to proprietors of land who are engaged in planting, and should give encouragement to, and provide knowledge for, those who hesitate to improve their properties by this form of monetary outlay.

After referring to the results given in the "Census of Woodlands", published by the Commission in 1928, it is pointed out that the existing reserves of mature coniferous timber in Great Britain are equivalent to less than a six months' consumption. The younger crops, though well distributed through the various age-classes, are on the same small scale. Oak planting in particular has gone out of fashion and future supplies of home-grown oak are endangered. The total area of woodlands tends to diminish and the productiveness of the area under coppice and coppice-with-standards will probably be reduced. There is thus plenty of room for improvement, and those who plant for the future should not be deterred by present unfavourable prices. As regards the decrease in area of existing coppice-with-standards woods, when the standards consist chiefly of oak, there is unfortunately little doubt that they are in some counties disappearing at an alarming rate under the ruthless operations of the timber lumberer.

The author's advice to the landowner is strongly supported by the opinion expressed by Lord Clinton, when chairman of the Forestry Commission. Speaking at an annual meeting of the Scottish Arboricultural Society, he said: "I am not at all confident that the State can properly undertake the full duties of afforestation" (NATURE, **122**, 231, August 18, 1928).

It is impossible here to discuss the treatment of

the brochure at length. It follows well-known lines and is divided into five parts: nursery work; formation and establishment of plantations; utilisation and markets, including a note on timber conversion by Sir George Courthope, and timber preservation; financial questions; and practical experience of private owners, being an interesting summary of replies by landowners to a questionnaire on forestry matters.

Two small points merit notice. On the subject of establishing oak crops Sir Francis correctly says that "it is essential to plant densely; it is, therefore, specially desirable to choose the cheapest suitable plants and the cheapest satisfactory planting method. One year seedlings have proved entirely satisfactory". A caution is however required. If the area is infested, even to a small extent, with cockchafer grubs, it will be found that a percentage of the young plants will be cut and killed either in the first or second year after planting; whilst transplants, apparently, to a great extent escape.

The second point is on the subject of 'firming'. Sir Francis points out the importance of firming and packing the soil round the roots of the planted plants. The percentage of plants annually lost owing to a failure to attend to this important matter must be high. He recommends the use of the heel of the foot instead of the sole in firming. In the majority of cases this is true. It has been observed, however, that in a heavy clay soil, if the plants are rammed home with the heel and a few dry weeks supervene, the pressed soil becomes a compact block into which moisture cannot penetrate, and the plants so treated die. The summer of 1929 and the prolonged east winds of 1932 provided numerous examples which appeared to support this contention.

Sounding the Ionosphere

DR. LAL C. VERMAN, Department of Electrical Technology, Indian Institute of Science, Bangalore, describes in a communication to the Editor a new system for continuous recording, by cathode ray oscillograph, of the equivalent heights at which radio signals are reflected by the ionosphere. The required radio signal pulses, with a duration of 100 μ, are produced by a generator using a cold-cathode neon-discharge tube (Verman, Paper No. 10 Math. and Physics Section, Indian Science Congress, Patna, Jan. 1933). The sending and receiving stations are 5 km. apart, and the pulse-emission and linear-time-base frequency of 125 per sec. are derived by locking at each station to a 62·5 cycle per sec. electricity supply network.

In the systems already described, the received ground-ray pulses and the ionospheric echo-pulses are applied, after amplification, to the vertically deflecting plates in the cathode ray oscillograph, the linear time-base sweeping horizontally. Ratcliffe and White limit the vertical excursion by an appropriately adjusted valve circuit, and record through a slit coinciding with the level of limitation. Appleton, Builder, and the other workers in the King's College, Radio Research Station, and Tromsö network record through a slit coinciding with the undeflected base-line. Thus one set of workers photographs the bright images of the artificially flattened tops of the echo components, the other photographs the dark gaps produced by echo-departures from the undeflected bright base-line.

Dr. Verman does not utilise the vertically-deflecting plates but applies the echo-pulses, after high-gain amplification, to the Wehnelt cylinder used for focusing the electron jet of the oscillograph. The bright image of the linear time-base is thus interrupted by dark gaps which result from defocusing of the electron jet by the amplified echo e.m.f.'s. By the provision of a suitable time-constant in the audio-frequency amplifier the duration of the interval of defocusing, and thence the width of the dark gap, is made to indicate the approximate intensity of the corresponding echo. As in the other systems, the equivalent path-differences are measured by the distance, on the time-base scale, between the beginnings of ground-ray and echo pulses.

The system, in this form, shares with those already mentioned the disadvantage that when, as is done in all these systems, the time-constant is adjusted to give some measure of echo-intensity by the interval between the steep initial rise and some convenient reference level on the relatively slow exponential decay of the output e.m.f., the separating power of the system in respect of closely adjacent echoes, and in particular of close magneto-ionic doublets, is impaired.

Dr. Verman proposes to modify his system by using an amplifier of very small time-constant in association with a cathode ray oscillograph, of the type which is suitable for television, providing for quantitative modulation of the light-intensity. The separating power of the system will then depend only on the duration of the received echo pulses, and the intensity of the echoes will be measured by the photographic density of the base-line image. Details and a discussion of possibilities are promised in a later communication.

Leverhulme Research Fellowships

ANNOUNCEMENT was made in NATURE of June 3, p. 795, intimating the establishment of a scheme of research fellowships, in accordance with a direction in the will of the first Lord Leverhulme that the income arising from part of his estate should be devoted to the granting of scholarships for research and education.

A notice inviting applications under the scheme was published, and by the closing date, June 19, a large number had been received. Application was invited from 'experienced workers' and especially from men and women prevented from carrying out research either by pressure of routine duties or by any other cause. From the applications received, seventeen selections have been made by the Advisory Committee and approved by the Trustees, and are for varying periods up to two years. The names of the fellows and the subjects of the researches are:

Dr. E. C. Bullard, demonstrator in geodesy in the University of Cambridge: gravity and magnetic measurements in the Great Rift Valley, East Africa.

Mr. C. R. Burch, physicist, Metropolitan-Vickers

Electrical Co., Ltd.: theory of aspherical optical systems and their experimental investigation.

Dr. F. Fraser-Darling, chief officer, Imperial Bureau of Animal Genetics, Edinburgh: the ecological study of a herd of Scottish red deer, with special reference to behaviour.

Mr. C. S. Elton, director of the Bureau of Animal Population in the University of Oxford and University demonstrator in zoology: fluctuations in numbers of wild mammal populations.

Dr. H. G. Farmer, Glasgow, editor of the *Musicians' Journal*: Arabian music.

Mr. D. H. Hammick, fellow and tutor in Oriel College, and University demonstrator in chemistry, Oxford: investigations on the interaction of nitro-compounds with aromatic bases and hydrocarbons.

Dr. H. S. Hatfield, London: the behaviour of crystalline substances in electric and magnetic fields.

Dr. L. S. B. Leakey, fellow of St. John's College, Cambridge: the prehistory of East Africa.

Lieut.-Col. D. L. R. Lorimer, late of the Foreign and Political Department: anthropological and linguistic research in the Gilgit region of the Karakorum and Hindukush.

Mr. A. G. Lowndes, Marlborough College, Wiltshire: the polygraphic process; ultra-rapid cinema photomicrography.

Mr. C. K. Ogden, of Magdalene College, Cambridge: the language factor in civilisation.

Mr. S. G. Roberts, assistant lecturer in economics in the University of Manchester: developments in tariff theory and practice.

Mr. J. Sykes, head of Department of Economics in University College, Exeter: local expenditure in Great Britain in pre- and post-War periods.

Dr. E. J. Thompson, lecturer in Bengali in the University of Oxford: British-Indian history previous to 1857.

Miss J. A. Wales, employment officer in the Ministry of Labour, secretary to the Chelsea and Fulham Juvenile Advisory Committee: methods of vocational guidance for young people, as used in Germany.

Prof. J. Dover Wilson, professor of education, King's College, London: work on the text of Shakespeare.

Mr. W. F. K. Wynne-Jones, lecturer in physical chemistry in the University of Reading: the nature of acids and bases.

University and Educational Intelligence

VOCATIONAL guidance and vocational training for pupils of secondary schools in small provincial towns and rural districts form the subject of an article published in the May number of *School Life*, the official organ of the United States Commissioner of Education. The writer, who is the director of a vocational research bureau in the State of New York, describes a plan, recently adopted in a town of 2,500 inhabitants in that State, whereby boys and girls are successfully shepherded into suitable occupations. Their individual aptitudes are first discovered by an examination in the research bureau of data cards, prepared in the school, exhibiting school histories of achievements, histories of objective tests, family histories of vocations and hobbies, personal characteristics as noted by several people, and so on. The training indicated by the aptitudes thus ascertained is provided by organising the co-operation of local commercial and industrial firms. The pupils work during school-time in the shops and offices of the co-operating undertakings and credit for this practical work is given to those who are candidates for the high school diplomas. This plan is said to be an adaptation of one that has been successfully operated in Bedford, England.

THE public schools of the present and the future formed the subject of an address by the headmaster of Rugby on August 4 to students attending the City of London vacation course in education. Mr. Lyon paid a tribute to the work of the assistant masters through whose agency, he said, a movement is going on inside the public schools which is making them better than they have ever been. In respect of risks of moral corruption, of estrangement from home and parents, of loss of individuality and of fostering a certain class consciousness there has been improvement, he said, even in the past ten years. To anybody disposed to regard the English public schools as obsolescent may be commended a perusal of a recent issue of the *Stoic*, the Stowe School magazine, which contains an account of the celebration on June 16 of the completion of the first ten years of the school's life, and a verbatim report of the speech of H.R.H. the Prince of Wales who honoured the school with a visit on that day. The enrolment of 99 with which the school started in May 1923 has increased to 500; it has furnished recruits to all the Services and most of the professions and already two of its old boys have been presidents of the Oxford Union. The extent and variety of extra-curricular activities, as disclosed in the magazine, indicate the existence of ample scope for the development of individual bents.

EDUCATION in New South Wales in 1931 cost the State, excluding the cost of buildings, additions, repairs, etc., £4,194,731, which was at the rate of £1 13*s*. 5*d*. per head of the population, a lower rate than in any previous year since 1924, whilst the cost per pupil, £12 14*s*. 8*d*. (calculated on mean average attendance), was the lowest for ten years. According to the recently published report of the Department of Public Instruction, the administrative difficulties incidental to having to provide out of a drastically retrenched budget for a largely increased enrolment were to a great extent successfully overcome. The difficulty of obtaining employment, due to the economic depression, caused large numbers of pupils to remain at school and thus swell the school population, which overflowed into residences and any makeshift shelter that could be found. Secondary school pupils constituted 8·6 per cent of the total school population as compared with 4·5 per cent in 1921. Occupations entered by pupils on leaving school are shown in tables covering five years, and these show very markedly a 'back-to-the-land' movement. Of boys leaving secondary schools, 12 per cent became clerks and 22 per cent entered pastoral or agricultural employment, the corresponding percentages in 1927 having been 29 and 12 respectively; whilst of girls 5 per cent became clerks and 78 per cent remained at home as compared with 14 and 66 per cent respectively. The decrease, already referred to, in cost per pupil, amounted to 24 per cent in three years (1928–31) and may be compared with a drop which has lately taken place in the United States of America in the cost per pupil of elementary and secondary schools in three years (1929–32).

Calendar of Nature Topics

Spawning of Trout

The breeding season for non-migratory trout is generally stated to be in October and November, but that is certainly too limited a statement, for already in late August in some rivers trout are spawning. Since the question of the spawning time of the trout (*Salmo trutta*) has entered into recent legislative discussions, attention may be directed to the need for more precise data as to the dates on which spawning trout have been actually observed, so that a greater approach to accuracy may be obtained regarding the spawning period in different river environments.

Much has yet to be discovered in regard to the physical factors influencing spawning. Artificial fertilisation of trout eggs may give a greater percentage of successes than natural fertilisation (Gray, 1920). Scheuring, Huxley and others have found the viability of trout spermatozoa to be less in freshwater than in weak saline solutions, suggesting that in regard to reproduction the trout is not yet fully adapted to freshwater life. An interesting point arises as to whether the trout exhibits any tendency to undergo a pre-spawning period of abstinence from food. While it is not suggested that no food is taken as in the case of the salmon, there is some evidence to show that feeding falls off markedly following the attainment of high condition early in the summer.

Breeding Habits of Common Adder

The adder (*Vipera berus*, Linn.) pairs in April and May. So far as is known, female adders considerably outnumber males. The young, 6–8 in. long, are born in late summer or early autumn, the most numerous births occurring in the end of August and the beginning of September. In twenty-three dissections of gravid females, Leighton (1901) found an average of thirteen young. It is traditionally believed that young adders enter the mouth of the parent for safety when alarmed, but no proof of this is yet forthcoming. Adders are not often seen, even when looked for, and still less frequently seen with their young. As the young appear to disperse early and the capacity of the parent's gullet is limited, it follows that if the reported swallowing does occur it can only be observed during a restricted period probably from mid-August until September. During the earlier part of this period, gravid females may be sought in sunny dry situations, the hotter the better. Leighton has recorded that the majority of adders collected by him came from one of three situations—ant-hills, the edges of rides cut through bracken, or the warm stones in disused quarries. Yet an intelligent gamekeeper on an adder-frequented estate on Deeside informed the writer recently that in his experience the establishment of ant-hills in a wood was certain to drive away the adders. Apparently more observation is required.

Food of the Adder

The adder has a varied food list. Ranging over the whole of northern Europe and across northern Asia to Saghalien, widely though irregularly distributed in central and southern Europe, it eats weasels, mice, voles, shrews, moles, birds, slow-worms and other lizards, frogs, salamanders and slugs, while the young feed on worms and insects (Boulenger, 1913). To this list Leighton adds smooth newts, water-voles and young rats. He found slow-worms and mice to be the staple diet in the Monnow valley and water-voles along the banks of the river Monnow. A male adder 24 in. in length contained two water-voles, the lower of which was partially digested. Sambon (1913) recorded one species of nematode and two species of trematodes from adders.

Snails of the English Chalk Downs

The white and black and white snails (*Helix virgata*, *H. caperata*, *H. itala*) which are familiar objects in England on the chalk downs and sward near the sea are extraordinarily resistant to heat and cold and drought. They live freely exposed in quite short grass through the hottest summer and are on the move throughout the winter except in hard frost; the conditions which prevail on the top of Ivinghoe Beacon afford a good example of what they can tolerate, and *H. itala* is abundant there. Their pale shells are no doubt some protection and in sunny weather they climb up any available stalks and so get away from the overheated ground, partly closing the mouths of their shells with a thin film of dried mucus. They evidently have also some mechanism for preventing water loss, the elucidation of which demands experiment. In addition, they all have the habit of breeding in the late autumn and winter instead of in the spring and early summer as most snails do; the eggs and young thus escape the destructive effects of dryness and heat, and as they can grow at comparatively low temperatures they are a good size before they have to face the summer.

Sheep Dipping

The dense fleece of the sheep provides shelter for an astonishing number of parasites, and constant care is necessary to keep them under control. On many farms in Great Britain dipping will now be in progress. The operation is officially regulated as regards nature of dipping solution and method and time of exposure to it. The main pest in view is the sheep scab mite *Psoroptes communis*, the bites of which set up such irritation that great loss of condition takes place in affected stock. The parasite working on the surface is very vulnerable and in 1931 no less than 259 dips were officially recognised as effective against it. Studies of the life-cycle indicate that two dippings are necessary, the first to kill the adults, and the second to catch the young hatching from eggs that have resisted the poison. Other skin and wool parasites of sheep are held in check by the procedure. The warm, damp weather of August provides favourable conditions for the egg-laying of the green bottle fly *Lucilia sericata*, the larvæ of which feed on the sheep. Special dips containing sulphur are used for discouraging the fly from laying in the fleece, and summer dipping, with this end mainly in view, is a common practice.

Well-Harvested Wheat

Conditions are seldom too dry for wheat in Great Britain. Wet weather at harvest depreciates the crop in many ways. Sprouting in the shocks in the field is by no means uncommon; heating in the stack is quite frequent. Seldom is it possible to thresh from the field, for although wheat may be threshed when it contains so much as 30 per cent of water, a more or less prolonged storage in the stack is required to reduce the moisture content of the grain to a reasonable

figure; since damp grain suffers loss by heating in stacks or bins, or it may go mouldy. The water-content depends very largely on the weather at harvest. In the wet years of 1922 and 1924, for example, the early-threshed British wheat carried 18–20 per cent of water, a degree of moisture which renders the grain liable to the above losses and is rather too high for milling purposes. The harvest of 1933 will have been secured under extraordinarily good conditions. We may expect the moisture content of the wheat grain of the early deliveries to approach that obtained in 1921, when the early threshings were sending in grain containing only about 13 per cent of water. This is a degree of dryness approaching that of some of the United States wheat, but still much moister than Australian or Indian samples. Such wheat stores without loss and needs the addition of a certain amount of water to bring it up to the optimum moisture-content for grinding.

Societies and Academies

London

Geological Society, June 28. G. Delépine: Upper Devonian goniatites from Mount Pierre, Kimberley District, Western Australia. The dominant type is a *Sporadoceras* belonging to the group of *S. contiguum* (Münster). There are also other new species—a *Pseudoclymenia* near *Ps. applanata*, Schindewolf, a *Dimeroceras* near *Goniatites mammiliferus*, Sandberger, and a *Tornoceras*. The presence of such species relegates the red goniatite limestones of the Devonian rocks of Mount Pierre to the Middle Famennian (zone 3 of Wedekind) horizon. W. B. R. King and W. H. Wilcockson: The Lower Palæozoic rocks of Austwick and Ribblesdale. The Lower Palæozoic rocks outcrop in the valleys beneath the almost horizontal Carboniferous Limestone in the neighbourhood of the Craven faults. They are arranged in a synclinorium, pitching in a direction about 70° east of south and striking more or less parallel to the North Craven fault, thus making an angle of about 25° with the strike of the Ingletonian rocks of Chapel le Dale. It is maintained that the Ingletonian rocks are faulted against the Lower Palæozoic strata. The oldest fossiliferous horizon appears to be referable to the higher beds of the Caradocian series.

Dublin

Royal Irish Academy, June 12. J. J. Hartley: The geology of north-east Tyrone and the adjacent parts of Co. Londonderry. The relation between (1) the Ordovician rocks of Pomeroy, (2) the Igneous complex of north-east Tyrone, and (3) the Dalradian schists which are in contact with the complex, are discussed. It is considered that the above order gives the correct succession in time, series (1) being the newest, while two considerable time-intervals separate the three groups from each other. J. A. Adamson and G. F. Wilson: The petrography of the Lower Carboniferous rocks of north-east Ireland. Detailed examination of these rocks suggests that they were derived from a land of acid igneous and metamorphic rocks lying to the north with important contributions from the igneous complex of Co. Tyrone, the Dalradian rocks of Donegal and the inlier of north-east Antrim and the Ordovician rocks of Co. Down.

Paris

Academy of Sciences, July 10 (*C.R.*, 197, pp. 101–204). Armand de Gramont: The different vibratory regimes of a quartz parallelopiped. G. Friedel: A new type of macles. A discussion of the Zinnwald macle of quartz discovered by Drugman and the macle of alum recently described by M. Schaskolsky and A. Schubnikow. H. Devaux: The wetting of insoluble substances and the remarkable powers of attraction existing at the interface of non-miscible liquids. Various elements, about twenty in number, in a fine state of division are not perfectly moistened by water. Many insoluble compounds behave similarly. Q. Borůvka: An extension of the formulæ of Frenet in complex space and their real image. Hans Lewy: A new formula in linear elliptic equations and an application to Cauchy's problem. Raphaël Salem: A property of Fourier's series of functions with summable square. Jean Leray and Jules Schauder: Topology and functional equations. Ch. Fousianis: Some properties of increasing functions. Jean Louis Destouches: The principles of a general mechanics. Y. Rocard: Hydrodynamics and the kinetic theory of gases: the theory of surface tension. Caïus Jacob: Some problems concerning the flow of perfectly compressible fluids. Emile Belot: The age of the universe and the age of the earth. J. Comas Sola: The observation of a shooting star. Henri Marcelet: A capillarity phenomenon observed with marine animal oils. F. Prunier: A new expression of the radiant vector of Poynting. Léon and Eugène Bloch: Extension of the spark spectrum of copper between 400 and 240 A. R. Siksna: Fluorescence with atomic lines of antimony vapour. Prot. and Mlle. N. Goldovsky: New methods for the examination of metals from the point of view of their heterogeneity and their resistance to corrosion. The alloy is placed in a solution of an electrolyte with an indicator with a *p*H range between 4 and 12. This method has been successfully applied to the control of thermal treatment, riveting and welds. An alternative method uses very thin test pieces (0·1 mm.) and is specially useful in detecting liability to pitting. G. Kravtzoff: The electrolysis of copper salts of organic acids. The presence of cuprous oxides in the copper deposited has been proved. Privault: Study of the *M* level of magnetised iron. Wenli Yeh: The radioactivity of some of the rare earth elements. Contrary to the results of Libby-Latimer, lanthanum was found to be inactive. Erbium shows a strong activity, but the purity of the preparation has not yet been proved. Neodymium shows a weak radioactivity. M. Valadares: The spectrography by crystal diffraction, of the γ- and X-rays of the radium family. Pierre Girard and P. Abadie: The composition of the electric moments in the polyalcohols. The moments of associated dipoles. R. Etienne: Displacements of equilibrium by variation of mass. Picon: The chemical properties of the zirconium sulphides. The three zirconium sulphides described in an earlier paper have been treated with various chemical reagents and the results are given. Generally the activity of the reagents on these sulphides diminishes as the proportion of sulphur in the compound is smaller. The physical and chemical properties of the three sulphides are so distinct that they may be regarded as three distinct compounds. Peng Chung-Ming: The action of boric acid on the chlorides and

nitrates of the alkaline earths. This reaction gives tetraborates of the type $4B_2O_3.MO$. MME. GUAISNET-PILAUD : The stereo-isomeric phenylmethylethyl and phenylmethylpropyl betaines. G. DUPONT and E. URION : The true nature of the supposed dihydropyrocatechol. MLLE. DENISE SONTAG : The direct halogenation of the arylaliphatic alcohols. CHARLES DUFRAISSE, ROGER VIEILLEFOSSE and JEAN LE BRAZ : Some applications of the antioxygen effect to fighting fire. The extinction of flames. Study of the proportions of various halogen compounds necessary for extinguishing a coal gas flame burning under defined conditions. L. GLANGEAUD and BOUTIRON : The chemical and mineralogical modifications of the Miocene marls from the Génie spring (Algeria) in contact with a granite laccolite. V. AGAFONOFF and ST. PAVLOVITCH : The so-called thermal analysis applied to the study of the soil. F. DAGUIN and J. LACOSTE : The extension of the Cretaceous in the southern Prerif and other new observations concerning these regions. JACQUES BONDON and LOUIS NELTNER : The Cambrian series of the plateaux of Draa (South Morocco) and the presence of the Georgian in this series. L. BAUD : The clay-limestone conglomerate in the region of Kayes and Bafoulabé (Western Sudan) and its stratigraphical position. ED. SAURIN : The anthracolithic and the 'red earth' of the neighbourhood of Yunnanfou (Yunnan). M. and MME. H. LABROUSTE : The analysis of Rayleigh waves. J. GAUZIT : The study of atmospheric ozone by a rapid method of visual photometry. The method described has been used at Montpellier for six months and results are given. The values are higher than those obtained for the same months at the same place by Duninowski. PAUL CORSIN : The discovery of a flora in the lower Devonian of the Pas-de-Calais. A. GUILLIERMOND : The structure of the Cyanophyceæ. PH. JOYET-LAVERGNE : Contribution to the study of the oxidising power of the chondriome. E. MIÈGE : The reappearance, by spontaneous hybridation, of a species of *Hordeum* (*H. intermedium*). E. BLANCHARD and J. CHAUSSIN : Wheat, a plant with silica. Wheat is richer in silica than other cultivated plants. The silica content is fairly constant and is of the same order as the amount of phosphoric acid. MARC DE LARAMBERGUE : The development of the genital apparatus in the two forms (*A* and *B*) of *Bullinus contortus*. PAUL CHABANAUD : The atrophy of the nadiral nasal organ in certain heterosome fishes. A. PACAUD : The action of lecithine and of magnesium chloride on the life and reproduction of *Cladoceros*. O. BINDER : The absence of α-cellulose in the tubercle bacillus. The author concludes that α-cellulose is not present in the tubercle bacillus. LUCIEN SEMICHON and MICHEL FLANZY : The organic acids of grape juice. P. NOËL BERNARD and JEAN GUILLERM : The transmissible lysis of the cholera vibrion. G. MOURIQUAND and MLLE. J. SCHŒN : The protective influence of gestation on vitamin C deficiency.

ROME

Royal National Academy of the Lincei, March 19. FRANCESCO SEVERI : The theory of the series of equivalence on an algebraic surface : invariance of the fundamental conception (1). E. ALMANSI : Deformations of elastic strips (5). S. AMANTE : The reduction to canonical form of a special class of matrices (2). R. L. GOMES : Simultaneous canonical transformation of several matrices neither Hermitian nor unitary. MARIA PASTORI : The general expression of isotropic tensors. A. ROSENBLATT : The equations to the partial non-linear derivatives of the second order, of elliptic type. In a recent study of the equation to the partial derivatives, $\Delta u = F(x,y,u,p,q)$, Lipschitz's condition was replaced by a more general condition. Further simplification of this condition is now considered. N. SPAMPINATO : Compound algebras endowed with moduli by means of their normal semi-algebra. T. BOGGIO : The equations of the dynamics of systems. Movement in a linked system, composed of ν points and mobile under the action of given applied forces, is determined by Lagrange's dynamic equations, from which Hamilton's canonical equations, etc., are derived. By the introduction of a euclidean space $S_{3\nu}$ of 3ν dimensions, a point Q may be defined as the image of the system. The motion of Q is defined by an equation of the same form as that governing the motion of a point on a line or surface of ordinary space. From such a very simple equation, Lagrange's dynamic equations, etc., may be rapidly deduced. B. FINZI : Movements of surfaces, lines, and points associated with groups of waves. E. FROLA : The dynamics of free transversal vibrations of beams, and the dynamics of the points representing the elastic lines in spaces of infinite dimensions. A. CASTIGLIONI : Quinoline and lignin. Tests made with a large number of different woods show that lignin may be detected by means of either a 1 per cent solution of quinoline in alcohol, followed by concentrated hydrochloric acid, or an aqueous 10 per cent solution of quinoline hydrochloride or sulphate, an intense wine-red colour being obtained. Contrary to statements in the literature, γ-methylquinoline gives only a faint pink coloration. A. FERRARI and C. COLLA : The importance of the crystalline form in the formation of solid solutions (10) : thermal analysis of the anhydrous systems, $CoCl_2$–$PbCl_2$ and $FeCl_2$–$PbCl_2$. These systems form eutectics at 424° and 421°, corresponding with 76·5 and 71·5 per cent respectively of $PbCl_2$. The curves representing the primary crystallisation approximate closely to branches of hyperbolæ. F. P. MAZZA and G. STOLFI : The dehydrogenase of the higher fatty acids contained in the liver. The existence in liver extracts of an enzyme capable of mobilising the hydrogen of higher fatty acids has been definitely proved, the point of attack of this dehydrogenase being the ionised carboxyl of the acid. The enzyme differs from succino-dehydrogenase and is not found in the muscles, kidneys, or pancreas. C. ARTOM : Abortive ovogenesis and aberrant spermatogenesis in prosobranch molluscs of the genus *Valvata*. V. ZAGAMI and V. FAMIANI : The nutritive value of the proteins of leguminous seeds. The protein constituents of beans, peas, and lentils act as efficiently as casein in correcting the protein deficiency of cereals in the diet of rats.

WASHINGTON, D.C.

National Academy of Sciences, (*Proc.*, 19, 277–348, March 15). FREEMAN DEVOLD MILLER : The space motions of stars in the Orion and Scorpio–Centaurus clusters. An investigation of stars of classes *B*0–*B*9 leads to the view that *B* stars in each region form a single homogeneous cluster. No evidence is obtained of two star streams in the space motions ; their apparent existence is due to the presence of the two large moving clusters. WILLARD J. FISHER : The penetration of iron meteorites into the ground.

The work of Piobert, Morin and Didion (1839–40) on the penetration of targets by round shot, applied to the case of small meteors the ultimate velocity of which is little affected by their extra-terrestrial velocity, leads to an equation for penetration which accords well with the rough data available. Penetration even of large meteorites is small but unless they fall among rocky uplands, they are not likely to be found by the prospector. CHARLES A. KRAUS and FRANK E. TOONDER: (1) Trimethyl gallium, trimethyl gallium etherate and trimethyl gallium ammine. Preparation and properties of these compounds. The starting point is the reaction of gallium trichloride with dimethyl zinc. (2) Chlorination products of trimethyl gallium. L. O. BROCKWAY: The three-electron bond in chlorine dioxide. Electron diffraction photographs lead to the probable value of $1{\cdot}58 \pm 0{\cdot}03$ A. for the chlorine-oxygen separation. This is in good accord with the value predicted if the molecule contains a three-electron bond. No definite conclusion regarding the bond angle is obtained. WILLIAM DRAPER HARKINS: The neutron, atom building and a nuclear exclusion principle. (See NATURE, Jan. 7, 1933, p. 23.) A full statement is given in particular of the view put forward in the last paragraph of that communication. CARL V. WELLER: Biological significance of protective mechanisms inherent in the myocardium. The pattern of the myocardial arterial blood system increases in complexity with age; in cases of congenital syphilis and in human trichinosis, the myocardium is relatively little affected; these are examples of some protective mechanism of a vital organ which is of considerable biological significance. LEONARD G. WORLEY: (1) Metachronism in ciliated epithelium. Metachronism—ability to beat in sequence—involves two activities, one of which relates the beating of cilia of different cells, while the other concerns the beating of cilia of an individual cell. (2) The intracellular fibre systems of *Paramecium*. By microdissection, the ectoplasm has been stripped off specimens and examined fresh. On the dorsal side longitudinal fibres occur; in the vicinity of the cytostome, there are cross fibres in addition to the longitudinal ones. No evidence was obtained of the 'fibres of Rees'. F. A. BROWN, JR.: The controlling mechanism of chromatophores in *Palæmonetes*. The common prawn has four pigments, red and yellow (in one type of chromatophore), white and blue. Two substances, not hormones, carried in the blood seem to be necessary, one to contract the red chromatophores, the other the white ones. The blue pigment is not discussed. J. M. ODIORNE: Degeneration of melanophores in *Fundulus*. Melanophores of *Fundulus* in white surroundings contract and degenerate, slowly and progressively, the pigment granules aggregating at the edges of the scales and being lost later at the surface of the body. This is not due to inanition. G. A. MILLER: Groups in which either all the operators or all the subgroups of the same order are conjugate. DINSMORE ALTER: An extremely simple method of periodogram analysis. The method is stated to be as powerful as the correlation periodogram and to take one third the time; all calculations are made on an ordinary adding machine. GEORGE D. BIRKHOFF: Some remarks concerning Schrödinger's wave equation. It is claimed that by the method used, the position of the wave equation is fixed mathematically. GUSTAV A. HEDLUND: On the measure of the non-special geodesics on a surface of constant negative curvature. *Symposium on climatic cycles.* JOHN C. MERRIAM: Introductory remarks. A. E. DOUGLASS: Evidences of cycles in tree ring records. C. G. ABBOT and Mrs. A. M. BOND: Periodicity in solar variation. W. S. ADAMS and S. B. NICHOLSON: The nature of the solar cycle. ISAIAH BOWMAN: Correlation of sedimentary and climatic records. (See NATURE, Aug. 5, p. 193.)

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1932. Pp. x+304+10 plates. (London: H.M. Stationery Office, 1933.) 5*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1451 (T.3126): Wind Tunnel Interference on Streamline Bodies. By C. N. H. Lock and F. C. Johansen. Pp. 21+8 plates. 1*s*. 3*d*. net. No. 1505 (T.3316): Statistical Method of Investigating Relations between Elastic Stiffnesses of Aeroplane Wings and Wing-Aileron Flutter. By H. Roxbee Cox. Pp. 30+9 plates. 1*s*. 6*d*. net. No. 1513 (I.C.E. 896, 897, 897a): Heats of Formation of Nitrous Oxide and Carbon Dioxide. Part 1, by J. H. Awbery and Dr. Ezer Griffiths; Part 2, by R. W. Fenning and F. T. Cotton. Pp. 43+12 plates. 2*s*. 6*d*. net. No. 1533 (Strut. 93, 116): Loads in a Fuselage under Combined Bending and Torsion. By G. W. Mullett. Pp. 30+2 plates. 1*s*. 6*d*. net. (London: H.M. Stationery Office.)

Clifton College Scientific Society. Report for the Years 1930–1933. Pp. 16. (Bristol.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 6, June. Abstracts Nos. 963–1109. Pp. 185–216. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Scottish Society for Research in Plant Breeding. Report by the Director of Research to the Annual General Meeting, 13th July 1933. Pp. 32. (Edinburgh.)

OTHER COUNTRIES

U.S. Department of Agriculture. Technical Bulletin No. 365: Biology of Brachymeria Fonscolombei (Dufour), a Hymenopterous Parasite of Blowfly Larvae. By Raiford A. Roberts. Pp. 22. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the Imperial Academy. Vol. 9, No. 6, June. Pp. xvii-xviii+227–283. (Tokyo.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Vincent, for the Year 1932. Pp. v+39. (Kingstown: Government Printing Office.) 6*d*.

Proceedings of the United States National Museum. Vol. 82, Art. 18: Synopsis of the Calanoid Crustaceans, exclusive of the Diaptomidae, found in Fresh and Brackish Waters, chiefly of North America. By C. Dwight Marsh. (No. 2959.) Pp. 58+24 plates. (Washington, D.C.: Government Printing Office.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 32, Part 4: Untersuchungen über die Hefekatalase. Von Mosuke Matsuyama. Pp. 109–199. (Tokyo: Maruzen Co., Ltd.)

Proceedings of the Rhodesia Scientific Association. Vol. 32, 1932 33. Pp. 118+8 plates. (Salisbury.) 5*s*.

Borough of Durban: Durban Museum and Art Gallery. Annual Report for Municipal Year 1931–1932. Pp. 8+4 plates. (Durban.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 119: The Cryoscopy of South African Milk. By Dr. L. Denis-Nathan. (Division of Chemistry Series, No. 128.) Pp. 24. (Pretoria: Government Printer.) 3*d*.

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