

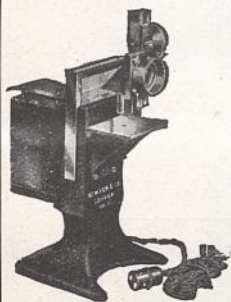
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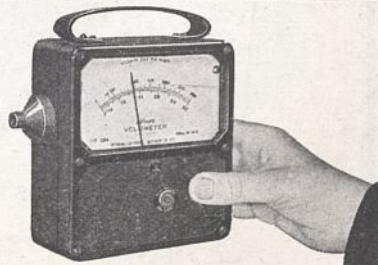
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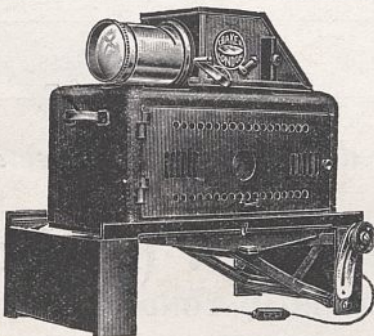
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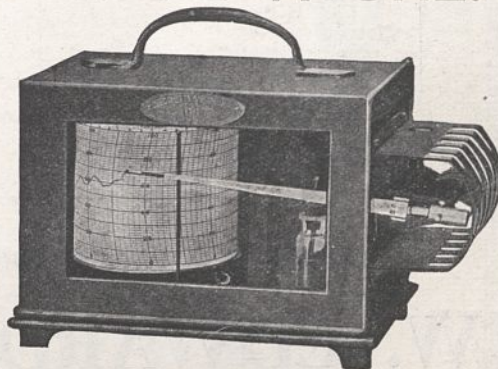
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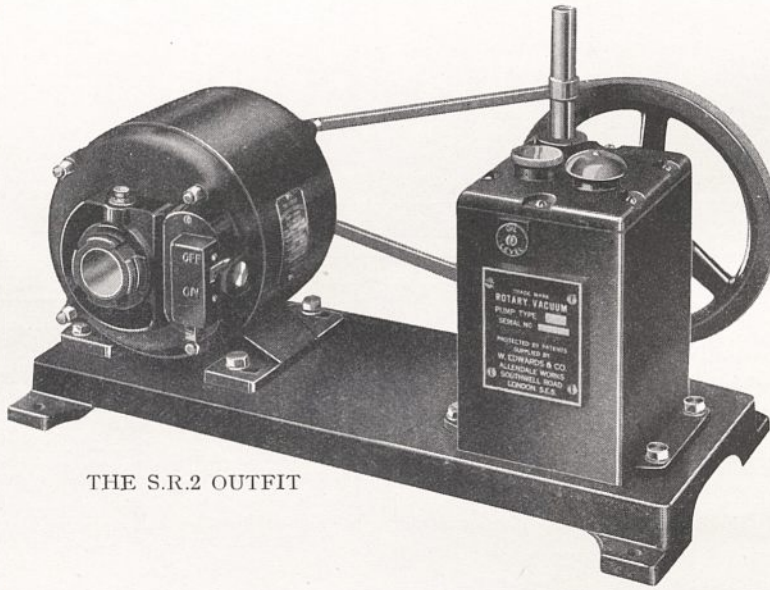
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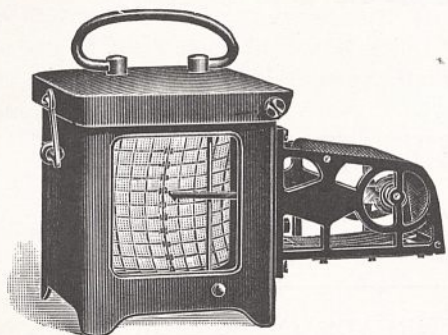
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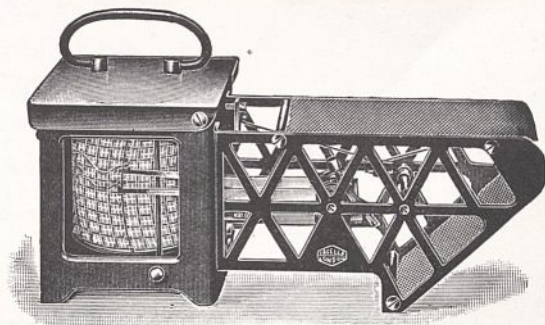
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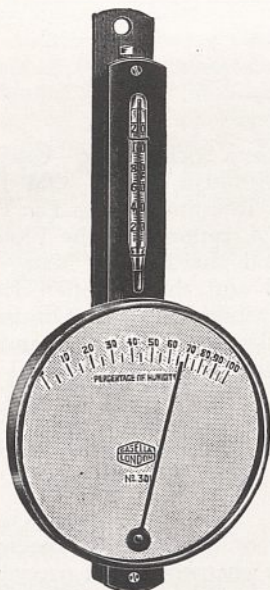
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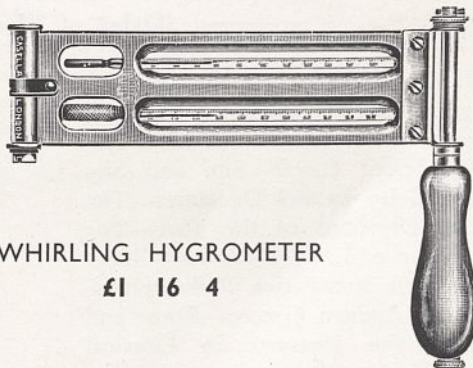
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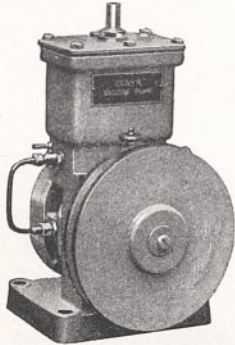
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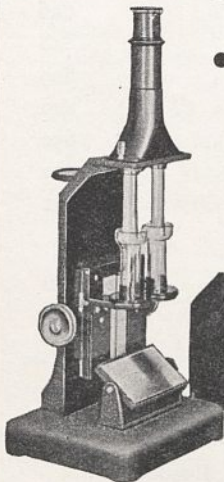
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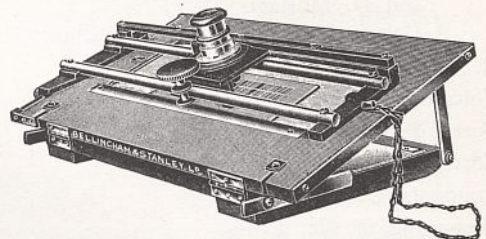
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SATURDAY, MAY 25, 1940

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## THE CONFLICT

“Arm yourselves, and be ye men of valour, and be in readiness for the conflict, for it is better for us to perish in battle than to look on the outrage of our nation and our altars. As the will of God is in Heaven, even so let Him do.”

WITH this quotation from I Maccabees, iii, 58-60, Mr. Winston Churchill closed his first broadcast message since he became Prime Minister. In calm and dignified terms, he outlined the position in the great battle raging across Belgium and into a corner of France. At the time of writing, the battle is continuing, and on it, the first since the War of 1914-18 in which the German armies have met major Allied forces, depends much of the future course of hostilities. But even if this battle goes against us, still the struggle must continue, for, in the Prime Minister's words, it is a “struggle for life and honour and freedom to which we have vowed ourselves”.

Now is the moment when the utmost effort must be made. Thanks to the conquest of the air, it is possible for the leaders of the Allied nations to keep in close personal touch, and to devise immediately ways of meeting the German menace from whichever direction it may come; though equally it may be urged that the progress of aviation and radio communication has made possible the onslaught of masses of tanks and other armoured vehicles, and the wholesale bombardment of hundreds of towns in the invaded countries. The answer surely is that force must now be met with force. After years of endeavour, it must be admitted that the principle of settling disputes by negotiation has not been accepted; the world was not ready for it. The task of educating mankind for peaceful progress has received a grievous setback. Nationalism, at first a puny weakling, has grown, passing through the stage of economic sufficiency of the national unit, until

now its chief exponent is aiming at domination of Europe and of the world, by utilizing to the full the fruits of scientific and engineering developments.

To meet the menace will require our whole effort. The immediate need is for more tanks, more aeroplanes, more munitions, to replace the ghastly wastage which is going on. Those whose duties are in this field will not fail the cause. But behind these workers must be an army, ever watchful, ever ready, to find ways of defeating new devices of the enemy and also to seek means of increasing the striking power of our Fighting Services. The interests of pure science and the pursuit of knowledge for its own sake must temporarily remain in abeyance. The whole of the intellectual power of Great Britain must be brought to bear on the task of winning the War. Mr. Duff Cooper, the new Minister of Information, broadcasting on May 18, compared Germany with “a mad gambler at roulette, who has gathered all her vast resources and staked them upon red”. It is well to bear in mind that Germany has indeed vast resources, in men, in material and in intellect, and her present rulers will exploit them all to the utmost. To meet this appalling menace will test our powers, but not beyond their capabilities.

Great Britain is now represented by a Government including men of most shades of political opinion, and its constitution under Mr. Churchill has been welcomed from all over the British Empire. France also has a Government formed on a wide basis. The two Empires are united in their determination to rid Europe of the tyranny which has come out of Germany. The battle is joined, and the enemy has shown us the importance of speed and efficiency. Yet more speed and efficiency must be our watchwords in the task before us.



## INTERNMENT OF ALIEN SCIENTIFIC WORKERS

IN his broadcast address to the nation on May 19, the Prime Minister emphasized that "there will be many men and women in this island who when the ordeal comes on them, as come it will, will feel a comfort, and even a pride, that they are sharing the perils of our lads at the front. . . ." It would be foolish for anyone to ignore the imminence of such peril, and criminal not to anticipate it with the utmost rigour. In the present circumstances, men of science in Great Britain, whether British, naturalized or alien, cannot expect to be shown any form of preferential treatment.

We have made a few random inquiries and find that certain aliens (research workers, academic staff and students) in those universities which are already included in the areas announced for special treatment have been interned. It seems impossible that any man of science, no matter what his political or other views may be, could, in the extremely grave circumstances and in view of the amazing revelations concerning the activities of 'fifth columnists' in other countries, take exception to the internment of alien scientific workers and students. Many have established themselves as first-rate scientists, and a glance through the correspondence columns of NATURE will reveal that they have contributed much to the advancement of science while resident in Great Britain. Yet there can be no reason for assuming that there are no dangerous elements among such men of science, any more than among other types of alien refugees. One communication in reply to our inquiry, however, states: "I feel that there is little case for interning *bona fide* pure research scientists. The numbers of such intellectual workers would surely be too few to affect matters." To this one might fairly ask, what is the minimum number below which such people would prove ineffective, and are we always absolutely certain of an alien's *bona fides*, scientific or otherwise.

On the other hand, another well-known man of science, in response to our inquiry, pointed out that "the problem of lightening the hard lot of the innocent without assisting the fifth column is not a particularly easy one". Still more pointed is the remark from a third reply that: "The attitude of people at this University *who have been interned* is

that the measure is obviously good from the country's point of view and they accept the matter philosophically." This contributor continues, "I think NATURE should hesitate before making any kind of *general plea for release of scientific people* who happen to be interned . . . there is always the possibility that some may be more interested than they seem to be in Nazi Germany, and the *first thing at the moment* is the safety of this country from all possible aspects." The contributor first quoted, however, after pointing out that there is little case for interning *bona fide* pure research scientists, continues: "I am sure it would be an excellent thing not only for general human standards, but also for our national war effort's efficiency, if NATURE were to take the whole matter up."

There is no question, in our view, of "general human standards". We know, from inquiries, that those interned are well treated, and some may even be released again soon. We doubt if the internment of these men of science will affect very much our *immediate* "national war effort's efficiency", and we dare to say that any such loss to science is far outweighed by the all-important elimination of risk.

NATURE has striven hard for intellectual freedom in thought, word and action, but now we are seriously up against "evil things". Unity in a common cause must be kept paramount at present. We have attained it, and it is with pride that NATURE directs attention to the brilliant contributions to our war effort that many of our men of science are making in the Fighting Services and research organizations immediately connected with them, to say nothing of the many scientific workers carrying on at the home front. That unity must be preserved until victory is won. No risk is too great in our efforts to preserve it. The activities of the 'fifth column' have revealed to us what subversive potentialities exist in many countries for upsetting whatever unity of purpose has been achieved. Most men of science, therefore, while undoubtedly feeling sympathetic towards our alien scientific guests, must, on the other hand, consider that any form of preferential treatment for scientific workers in this connexion would carry with it a grave element of risk which cannot be justified.



## THE PROGRESS OF PHYSICS

## Reports on Progress in Physics

Vol. 6. General Editor : J. H. Awbery. Pp. v+434. (London : The Physical Society, 1940.) 22s. 6d. net.

IT seems curious to contemplate that there are many physicists to-day, well below 'retiring age', who, like myself, began their study of physics under the fond delusion that, sooner or later, they would become masters of their subject. Physics, even then, comprised a considerable body of information, but not more than a student of reasonable ability and not unreasonable diligence might hope to have encompassed by the end of his university career. With Maxwell's electromagnetic theory of light as the keystone uniting the twin pillars of electricity and optics, it was felt that the main outlines of the structure of classical physics were firmly and eternally established. There were, of course, a few details to be filled in, and one or two untidy corners to be cleaned up. In particular, rather curious things happened when an electric discharge was passed through a rarefied gas ; but, after all, why *should* one pass an electric discharge through a rarefied gas, except to amuse the children at the end of a Christmas lecture ? It was confidently expected that, before long, some persevering Teuton would collate the whole subject in one stupendous tome, labelled "Physics", and there the subject would stand, logical, beautiful and complete. Alas ! we were soon to discover that, like Alice in Looking-Glass World, it took all the running that we could do to remain in the same relative position with regard to our knowledge of the subject. We have had to reconcile ourselves to the fact that physics to-day is no longer logical, cannot strictly be described as beautiful ('provocative' would be a more appropriate adjective) and seems unlikely ever to be complete.

Volume 6 of the annual "Reports on Progress in Physics" produced by the Physical Society, which has come to hand, and is the immediate cause of these reflections, contains more than thirteen hundred references to original publications, in spite of the fact that, in accordance with editorial policy, only about one third of the whole subject is covered each year. Imagination reels at the enormous output of new knowledge. The most painful diligence is inadequate to cope with it. All that the most industrious of us can hope to do is to cultivate our own corner of the garden, and trust to these invaluable reports to tell us something of what the other fellow is after.

To the physicist who wishes—as which of us does not ?—to have some appreciation of his subject as a whole, these annual volumes produced by the Physical Society are quite indispensable. Criticism in detail becomes both irrelevant and ungracious unless this indisputable fact is kept steadily in mind. Some "Reports" may be better than others, just as (so my younger friends inform me) "some beers are better than others", and in both cases it is probably largely a matter of taste. In the present volume one is immediately struck by the admirable catholicity displayed by the editor in his choice of subjects for report. Everyone realizes that in certain directions physics is advancing with incredible velocity. Reports on the meson, on induced radioactivity, on stellar evolution, the cyclotron, and liquid helium were almost inevitable. They are all definitely 'news', and could not well have been overlooked ; but it comes as something of a surprise to those of us who used fondly to imagine that it was "all in Rayleigh" to discover how much new work has been going on in sound ; and further, that it is possible to report important advances in such standard subjects as heat, fluid motion, and impedance networks. It is impracticable to enumerate all the separate reports (twenty-seven in number) contained in the present volume, but enough has been said to indicate the wideness of the front on which physics is advancing.

Glancing down the list of authors, one gains the impression that this year the Society has been fielding a rather younger team than usual. There are a few names of international repute, but for the most part the editor has relied on what (if the authors concerned will forgive the phrase) might be called "the rising generation". His team has certainly not let him down, but one has the feeling that some of them might perhaps have let *us* down a little more lightly. It is flattering when an expert says, "I shall assume that you know all about my subject up to, say, three years ago", and one is loath to shatter the illusion of omniscience which one has spent a lifetime in fostering. Nevertheless, one would (with M. Jourdain) be greatly relieved if the expert would "kindly proceed on the assumption that one did not know". The difficulty of striking a happy mean between the 'too elementary' and the 'too advanced' can readily be appreciated. It would, however, be a real tragedy should these excellent volumes of reports become too specialized to meet the needs of the average physicist. The specialist can be left to fend for himself.



An unusual postscript to the volume is provided by Dr. D. Owen (whose impending retirement will, we trust, set him free for still wider activities) in the form of an objective account of the teaching of physics in technical institutions. The whole subject of the training of physicists, and the proper relationship of the universities, the technical institutions and industry is one which demands urgent attention as soon as the times permit. The progress of physics and of industry in Great Britain depends largely on the wisdom which can be brought to its solution. At the moment, we

can but file Dr. Owen's report for future reference.

In a world up-side down, it is perhaps not surprising that a little of the type in this volume should be found to be suffering from the same complaint. A few of the diagrams might, with advantage, have been re-drawn. It is, however, such an achievement to have produced the volume at all under war conditions that one must not be critical. Let us hope that nothing will occur to prevent the appearance in due course of its successor. All physicists will await it with eager anticipation.

J. A. CROWTHER.

## HOW WE THINK AND WHY

### The Nature of Thought

By Prof. Brand Blanshard. (Library of Philosophy). Vol. 1. Pp. 654. Vol. 2. Pp. 532. (London: George Allen and Unwin, Ltd., 1939). 32s. net.

PROF. BLANSHARD is here exploring the debatable and largely unoccupied territory which lies on the borders of psychology, logic and metaphysics. His book might almost be described as a dissertation on the meaning of the prepositions 'of' and 'about' as they are used when we say we are aware of something or think about something. The author is a follower of Bradley and Bosanquet. As their point of view is not very popular at present, it is useful to listen to one who is a persuasive advocate of it and an acute critic of other views put forward recently by British and American philosophers and psychologists. He is clear and forcible in expression, as was Bradley, but more temperate. He is thorough in his treatment, as was Bosanquet, but not so difficult.

The first volume is concerned with perception, as the lowest stage of thought, and with ideas, thought freed from its primitive dependence on perception. The author reviews and criticizes the old image theory of ideas, the Behaviourist theory, those of the Pragmatists and various kinds of Realist, and then gives Bradley's view and his own very similar one. "Looked at from without," he says (p. 563), "the idea is seen to be approximating to its object; looked at from within, it is seen to be evolving toward definition and concreteness. And the two ends lie in line. To become more concretely defined is to approximate to the object, here and everywhere. The aim of thought is to fulfil itself in the reality." He then develops the intriguing but difficult doctrine of his school that

aims at obliterating the distinction between particulars and universals, and replacing the notion of the abstract universal by that of the concrete universal.

In the second volume there is first a very interesting discussion of the mental processes of reflection, observation and invention or creative thinking. Then follows one on the nature and tests of truth. The author maintains that coherence is the unique test of truth and is also descriptive of its character. Like other advocates of the coherence theory, he does not seem to meet quite fairly the objection that there might be many systems of truths, each internally coherent and yet incompatible with each other, like the non-Euclidean geometries. This leads him to undervalue what can be said in favour of self-evidence as the test of truth, in favour of the correspondence theory and even of the despised theory that truth depends on authority. That is to say, if thought is not simply to be chasing its own tail, there must be a starting-point in something immediately intuited. Again, thought appears to be of something which is not itself thought but rather an object for thought. The authority theory emphasizes, however mistakenly, the important point that truth is arrived at by a social process and that there exist experts who are less likely to be wrong than those who are inexpert.

The concluding discussion raises two most awkward problems; the problem of external and internal relations and the question whether the notion of cause implies that of logical necessity. The author argues that ultimately there are only internal relations, which implies, of course, that strictly speaking space and time are illusory. He makes, incidentally, some good criticisms of Logical Positivism.

A. D. RITCHIE.



# THE OLDEST KNOWN FOSSIL INSECT

BY D. J. SCOURFIELD, I.S.O.

ON January 18, I gave a detailed account, before the Linnean Society of London, of further specimens of the oldest known fossil insect.

It is still a quite commonly accepted belief that there is no authentic record of fossil insects from rocks earlier than those of the Carboniferous period. Since 1926, however, there has been good reason to believe that insects had at last been found in Devonian strata. In that year Hirst and Maulik<sup>1</sup> described and figured four heads of a small arthropod, which they named *Rhyniella præcursor*, and which they considered to belong to the Insecta. (The jaw-like structures also referred to by Hirst and Maulik, and afterwards named *Rhyniognatha hirsti* by Tillyard, although possibly belonging to a larval insect, cannot seriously be regarded as a definite record of a fossil insect.) These heads had been obtained from the Rhynie Chert, a siliceous deposit of Middle Devonian age, well known to palæobotanists for its beautifully preserved plant remains, and so called because of its occurrence at Rhynie, near Huntly, in Aberdeenshire.

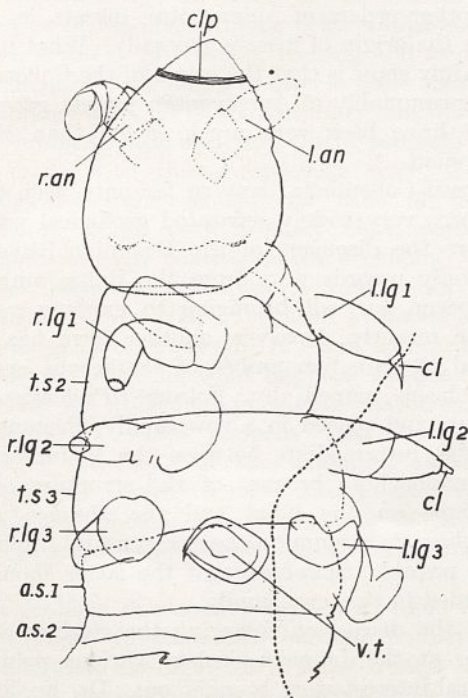


Fig. 1.  
HEAD, THORAX AND TWO ABDOMINAL SEGMENTS :  
WITH ANTENNÆ, PORTIONS OF THREE PAIRS OF LEGS,  
INDICATION OF VENTRAL TUBE, ETC. DORSIO-VENTRAL  
POSITION. FIGURE VENTRAL. (× 105.)

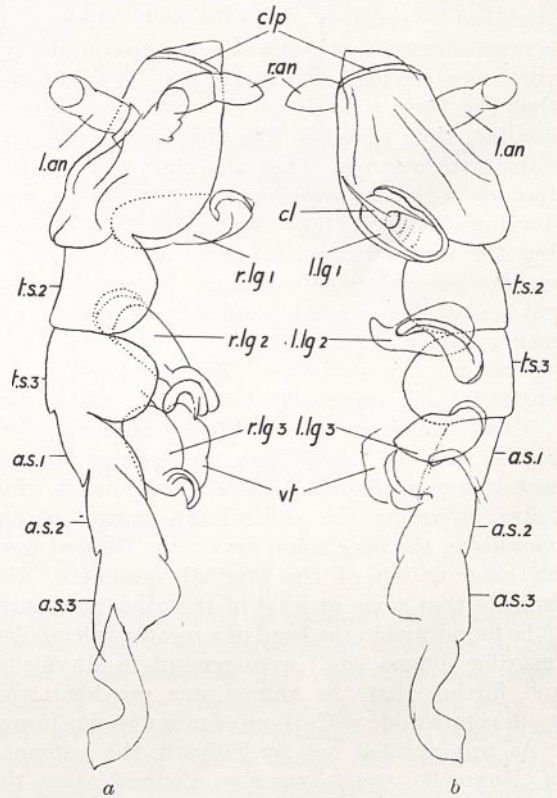


Fig. 2.

HEAD, THORAX AND THREE ABDOMINAL SEGMENTS :  
WITH ANTENNÆ, THREE PAIRS OF LEGS, ETC. LATERAL  
POSITION, BUT HEAD NEARLY DORSIO-VENTRAL. PROBABLY  
A CAST SKIN. *a* RIGHT SIDE, *b* LEFT SIDE.  
(× 105.)

It is true that some doubt has been entertained as to whether these heads were really insectan, but the late Dr. R. J. Tillyard<sup>2</sup>, after careful examination of the specimens, was convinced that they belonged to an insect of the order Collembola and might even be of a Podurid type. Coming from such an authority on fossil insects, this opinion seemed pretty conclusive. In view, however, of the great geological antiquity of the Rhynie Chert (some three hundred million years is a modern estimate of the age of the Devonian period<sup>3</sup>) there still appeared to be a possibility that such heads might have been attached to bodies differing somewhat from those of any other insects. This, however, has now been shown not to be the case, and it may therefore be confidently said that *Rhyniella* was a true Collembolan.

Since the publication of Hirst and Maulik's



and Tillyard's papers a number of further specimens of *Rhyniella* have been found in the same material, mostly by the late Rev. Wm. Cran. These are now in the Geological Department of the British Museum (Natural History), and are described in the current number of the *Proceedings of the Linnean Society*<sup>4</sup>, from which the accompanying illustrations are reproduced by courtesy of the Council. Three of the new specimens show heads attached to considerable portions of the bodies (Figs. 1 and 2). It will be seen that the body was elongated, with the segments distinct, thus bringing *Rhyniella* within the sub-order Arthropleona. They also show that the first thoracic segment (pro-thorax) was without a well-developed tergum, that there were three pairs of legs and that a ventral tube was probably present on the first abdominal segment. No specimen has yet been found with the posterior part of the abdomen intact, and it is impossible to say whether a 'spring' was present or not. The total length of the organism was apparently between 1½ and 2 mm.

Three additional detached heads have also been found, two of which are represented in the accompanying Figures 3 and 4. These heads, while fully confirming the collembolan nature of the mandibles, the conclusion drawn by Tillyard from his examination of the original specimens, also indicate that some at least of the other structures to be found within the head of a recent Collembolan (maxillæ, lingua, etc.) were present in *Rhyniella*, and further that the animal was provided with ocelli comparable with those of many recent forms.

As was pointed out by Tillyard, the antennæ of *Rhyniella* were typically Podurid, but the absence of a tergum on the pro-thorax indicates affinity with the Entomobryidæ, so that the position of the animal would appear to be intermediate between the two families into which the arthropleonid Collembola are usually divided. This, however, is not a point of very much importance. The remarkable fact is that in all essentials *Rhyniella* was so similar to modern Collembola that, so far as can be seen, it throws

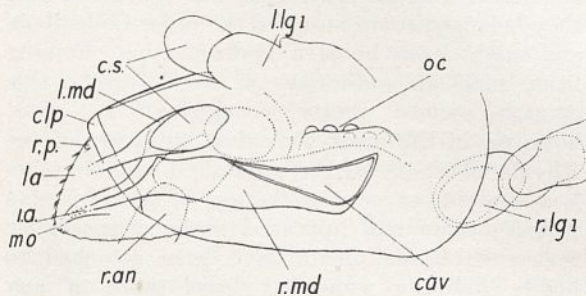


Fig. 3.

HEAD: WITH MANDIBLES, INDICATIONS OF ONE ANTENNA, OCELLI, ETC. NEARLY DORSI-VENTRAL POSITION, BUT SLIGHTLY TO ONE SIDE. FIGURE ALMOST VENTRAL. ( $\times 130$ .)

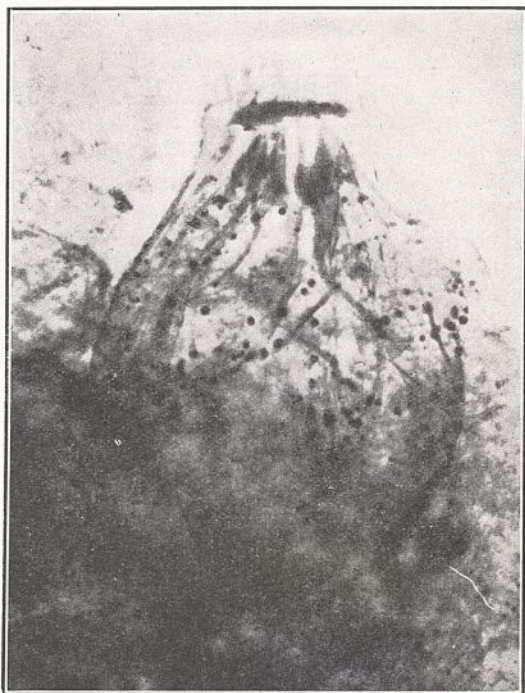


Fig. 4.

HEAD: WITH MANDIBLES, ANTENNÆ, PARTS OF FIRST PAIR OF LEGS, AND MUCH INTERNAL STRUCTURE OF UNDETERMINED NATURE (? MAXILLÆ, ? LINGUA, ETC.). DORSI-VENTRAL POSITION. ( $\times 200$ .)

no light even upon the affinities of that group to the other orders of Apterygotan insects, let alone upon the origin of insects generally. What it does certainly show is that the origin of the Collembola, and presumably of Apterygotan insects generally, must have been very much earlier than Middle Devonian.

Fossil Collembola have so far only been found in three very widely separated geological periods. Before the discovery of the Devonian *Rhyniella*, the only records were from the Baltic amber of Oligocene age, all belonging to existing genera. Quite recently, however, another form has been found in Canadian amber of Cretaceous age. It has been named by Folsom<sup>5</sup> *Protentomobrya walkeri* and placed in a new family, Protentomobryidæ, intermediate between the Poduridæ and Entomobryidæ, because of the structure of the antennæ on one hand and the absence of a pro-thoracic tergum on the other, as in *Rhyniella*. It is possible, therefore, that the latter should be included in this new family.

In the discussion following the reading of the paper at the Linnean Society various points of general interest were brought out. Dr. K. Jordan said that entomologists had been convinced, by the study of the morphology of recent Aptera, that these were primitive and not, like lice and fleas, late derivations from winged forms, and now



palaeontology has confirmed the conviction and turned an opinion into a fact. Dr. F. E. Zeuner thought that the proved occurrence of a specialized group of Apterygotan insects in Middle Devonian material showed that wingless insects were present before winged insects, and that the appearance of the latter coincided with the first forest vegetation on the earth. The earliest tree-like plants were Middle Devonian and it was conceivable that certain Apterygotan insects, which, however, must have been related to the Thysanura rather than the Collembola, took possession of this new kind of habitat and developed wings from lateral pleurae of the thorax acting as parachutes. Dr. W. T. Calman pointed out the great interest of the glimpse into past conditions afforded by the fortunate discovery of the Rhynie Chert. Prof. F. E. Weiss directed attention to the fact that whereas the plant remains in the Rhynie Chert are of very

primitive land plants not directly comparable to any existing groups, Rhyniella can be related to existing Insecta. Similarly in the Carboniferous period, well-developed insects occur comparable to some existing groups whereas the plants are essentially different from recent plants. There seems, therefore, to be a certain lag in the development of modern forms of plants as compared with insects.

<sup>1</sup> Hirst, S., and Maulik, S., *Geol. Mag.*, **63**, 69 (1926).

<sup>2</sup> Tillyard, R. J., *Trans. Entomol. Soc.*, 65 (1928).

<sup>3</sup> NATURE, **139**, 334 (1937).

<sup>4</sup> Scourfield, D. J., *Proc. Linn. Soc. Lond.*, April 25, 1940, p. 113.

<sup>5</sup> Folsom, J. W., *Univ. Toronto Studies, Geol. Series*, **40** (1937).

EXPLANATION OF LETTERING OF FIGURES.

<i>an.</i> Antenna.	<i>lg.</i> Leg.
<i>a.s.</i> Abdominal segment.	<i>md.</i> Mandible.
<i>cav.</i> Opening to mandible cavity.	<i>mo.</i> Mouth.
<i>cl.</i> Claw.	<i>oc.</i> Ocelli.
<i>cp.</i> Clypeus.	<i>r.</i> Right.
<i>c.s.</i> Cut by section.	<i>r.p.</i> Rounded projection at base of labrum.
<i>i.a.</i> Incisor area of mandible.	<i>t.s.</i> Thoracic segment.
<i>l.</i> Left.	<i>v.t.</i> Ventral tube.
<i>la.</i> Labrum.	

## THEORIES OF THE LIQUID STATE

BY PROF. N. F. MOTT, F.R.S.,

UNIVERSITY OF BRISTOL

A JOINT meeting of the Physical Society and of the Cambridge Philosophical Society was held at Cambridge on April 29 to discuss the properties of liquids. Among other subjects considered were the problem of melting and also the question of how one ought to calculate the viscosity of a simple liquid. It is extraordinary how difficult these problems are and how little progress has been made with them, especially since, if we exclude the quite exceptional case of liquid helium, it seems very unlikely that quantum mechanics has any bearing on the problems; thus all the physical principles necessary for the investigation may well have been available since the time of Clerk Maxwell. It is not so much the difficulty in picturing what happens when a solid melts, as the difficulty in giving mathematical expression to what happens that holds up progress. In fact, all the attempts at exact mathematical treatment start from models which simplify the phenomenon of melting in such a way that some of the essential features are probably lost.

The problem of viscosity appears in some ways as the most fundamental, because fluidity is, after all, what distinguishes a liquid from a solid, though the distinction is not absolute, since many solids, metals, for example, show creep at high temperatures under small stresses. Andrade<sup>1</sup>, in 1934, pointed out that the right order of magnitude

for the viscosity could be obtained on the assumption that each successive layer of atoms in the liquid glides over the next, and that each layer transfers all its momentum to the next once in each semi-period of vibration. The vibrational frequencies are taken from the characteristic temperature of the solid, and are assumed to have the same order of magnitude in the liquid. Perhaps the most important advance on this simple theory is that of Eyring<sup>2</sup>, who attempts to account for the temperature dependence of the viscosity. Eyring considers that one layer of atoms glides over another only at places where, owing to statistical fluctuations, the density is abnormally low; he expresses this by saying that 'holes' form in the liquid, and estimates from the temperature variation of the viscosity that the size of a hole is about one third of the volume normally occupied by an atom. This point of view makes an interesting contrast possible with the state of affairs in solids; whereas in liquids only a very small departure from the normal structure is necessary for glide to take place, in solids, according to recent theories, a 'dislocation' must be formed, which is a type of discontinuity with considerable energy extending over many atoms. According to Orowan<sup>3</sup>, creep is due to the thermally activated motion of such dislocations, and the slow creep rates are due to the large energies of activation involved.



We turn now to the question of melting. One of the oldest theories is that of Lindemann<sup>4</sup>, who deduced from the known characteristic frequencies of vibration of the atoms in a number of solids that at the melting points the amplitude of their vibrations was always about one seventh of the interatomic distance. Lindemann suggested that when the thermal vibrations reached this value the solid, so to speak, shook to pieces, and that melting was to be understood in this way. Recently Born<sup>5</sup> has considered the problem from a not dissimilar point of view. Born calculates the elastic constants of a crystal as functions of the temperature, and finds that when a certain temperature  $T_0$  is exceeded, the constant  $c_{44}$  becomes negative. The crystal is thus unstable with respect to shear, and, according to Born, must therefore melt at this critical temperature.

While it is certainly true that a crystal for which one of the elastic constants is zero or negative cannot be stable, I do not agree that  $T_0$  represents the melting point; the crystal will melt when the free energy  $E - TS$  of the solid phase is just equal to that of the liquid. This will occur when the energy  $E$  required to break up the crystal into the disordered state, which is equal to the latent heat, just balances the entropy gained by the same process. At the temperature  $T_0$ , since there is no resistance to shear, the former term should vanish and there should be no latent heat<sup>6</sup>. Thus the crystal will actually melt at a temperature below  $T_0$ . A similar criticism can be applied to all theories which attempt to derive the melting point from the properties of the solid alone; they give only an upper limit for the melting temperature, and to obtain a complete theory the free energy of the liquid must be calculated as well.

The great difficulty here is that, in spite of many attempts<sup>7,8,9</sup>, no satisfactory calculation has been made of the entropy  $S$  due to the departure of the liquid from the crystalline state. Eyring<sup>7</sup> has suggested that  $S$  should be equal to  $k \log(N^N/N!)$ , which is equal to  $Nk$ , where  $N$  is the number of atoms, but his arguments have been criticized from a number of sides<sup>10</sup>. I have made<sup>8</sup> a very tentative estimate of the entropy by regarding a liquid as a polycrystalline solid with very small crystal size and calculating the entropy due to the random orientation of the individual crystals. One trouble here is that we do not know how large to take the individual crystals.

If melting is to be regarded as the break-up of the single crystal into some disordered form, we have also to inquire why this disordering takes place at a definite temperature, and not over a range of temperature. Several workers recently<sup>9,11</sup>

have been impressed by the similarity between the phenomenon of melting and the order-disorder transitions in alloys. In transitions of this type, although there is in general a sharp transition temperature and a latent heat, the disordering process always begins below the transition temperature. Lennard-Jones and Devonshire<sup>9</sup> have given a theory of melting in which atoms of the solid are supposed to leave their normal positions as the temperature is raised and to go into interstitial positions; at a critical temperature the distinction between normal and interstitial positions is lost, and the lattice breaks up. In this theory, then, the disordering process does begin below the melting point. The theory is applied quantitatively to the solid rare gases; for other solids, however, it can scarcely provide a correct physical picture of melting; in ionic crystals, for example, the activation energy required to bring an ion into an interstitial position is known from the ionic conductivity<sup>12,13</sup>, and in metals it can be estimated from the coefficient of self-diffusion. The activation energies are much too large, and in any event the formation of an appreciable number of interstitial atoms before melting would lead to very large anomalies in the specific heat.

If one considers melting as a break-up into a polycrystalline form, perhaps a more plausible picture can be presented, though it does not seem possible to give it any mathematical justification. To take any little piece of the solid in the interior of a crystal and to turn it round so that it has a random orientation will obviously require a good deal of energy; although in principle such displacements may occur below the melting point in a solid, their number will be very small. When, however, *every* little piece of the crystal has been twisted round in some random way, we can well imagine that the work required for each piece is an order of magnitude smaller, just as it is easier to displace a brick when it is one of a heap piled up at random than when it is built into a wall. But arguments of this kind are perhaps unworthy of an exact science, and the theory of liquids badly needs their replacement by some powerful mathematical methods.

<sup>1</sup> Andrade, E. N. da C., *Phil. Mag.*, **17**, 497 (1934).

<sup>2</sup> Eyring, H., and Ewell, R. H., *J. Chem. Phys.*, **5**, 726 (1937).

<sup>3</sup> Orowan, E., *Proc. Phys. Soc.*, **52**, 8 (1940).

<sup>4</sup> Lindemann, F. A., *Phys. Z.*, **11**, 609 (1910).

<sup>5</sup> Born, M., *J. Chem. Phys.*, **7**, 591 (1939).

<sup>6</sup> Brillouin, L., *Phys. Rev.*, **54**, 916 (1938).

<sup>7</sup> Eyring, H., *J. Chem. Phys.*, **4**, 283 (1936).

<sup>8</sup> Mott, N. F., and Gurney, R. W., *Trans. Farad. Soc.*, **35**, 264 (1939).

<sup>9</sup> Lennard-Jones J. E., and Devonshire, A. F., *Proc. Roy. Soc.*, **A**, **169**, 317 (1939).

<sup>10</sup> Mott, N. F., and Gurney, R. W., Report on the Theory of Liquids, "Reports on Progress in Physics", **5**, 46 (1938).

<sup>11</sup> Wannier, G. H., *J. Chem. Phys.*, **7**, 810 (1939).

<sup>12</sup> Koch, E., and Wagner, C., *Z. phys. Chem.*, **B**, **38**, 295 (1937).

<sup>13</sup> Mott, N. F., and Gurney, R. W., "Electronic Processes in Ionic Crystals" (Oxford, 1940).



## THE COLOURING OF SIXTEENTH-CENTURY HERBALS

BY DR. AGNES ARBER

IN many copies of sixteenth-century herbals the woodcuts are coloured, but we have little direct information as to when, and under what conditions, the painting was done. For this reason it may be worth while to direct attention to certain points which seem hitherto to have escaped notice in connexion with the colouring of one of the most beautiful of these works—"De historia stirpium" by Leonhart Fuchs, published by Isingrin at Basle in 1542. In the description of maize (Cap. cccxviii) the following words occur: "Haec [pictura] in una vagina quatuor tibi granorum colores monstrat, cum tamen quaevis unius duntaxat coloris grana, nempe aut lutea, aut purpurea, aut rufa, aut subcandida omnia habeat. Quod nos, ne aliquem pictura deciperet, monendum esse duximus." This careful explanation that the grains are indicated in four colours—yellow, purple, reddish, and whitish—in one cob, though these variants would not, in fact, be found together, shows clearly that coloured copies must have formed an integral part of the edition, for Fuchs's words would be meaningless if the whole edition had been issued uncoloured.

In painted copies in the libraries of Winchester Cathedral, and of the Linnean Society\*, the four colours which Fuchs mentions in the text are represented in horizontal zones in the one maize cob in which the grains can be seen. In similar coloured copies in the University Library, Cambridge (Sel. 2. 81), and in the Library of Corpus Christi College, Cambridge, there is also an attempt at zoning, though the pigments are less well defined. I find, on comparing the general colouring of the two latter copies, that they show certain other points of agreement. For example, both in "Endivien" (endive) and in "Wegwart" (chicory) several flower-heads are shown in blue, while one is indicated in white. This is consistent with Fuchs's descriptions, in which it is noted that both these species are sometimes white-flowered (Cap. cclxii).

A more remarkable case is that of the woodcut called "Lamium" (Cap. clxxvi). It is a composite figure consisting of three shoots growing from a common base, and according to Fuchs's statement, these shoots are intended to represent the yellow archangel, a purple dead-nettle, and the white dead-nettle. In the two copies under comparison,

the flowers are distinguished in hue in accordance with the description, and the intention of Fuchs's tripartite picture is thus fully carried out. Moreover, the arrangement is identical in the two copies, the three shoots having yellow, pinkish-mauve, and white flowers, in the order from left to right. In the picture of "Prunus sativa", again, in both copies the tree is so painted as to have yellow plums to the left, blue in the middle, and pinkish-red to the right. Furthermore, in the picture of "Rosa", in both copies the left hand shoot bears white flowers, while those to the right are red.

These examples of accordance in individual details between the colouring and the text, and between different coloured copies, make it probable that the author to some extent controlled the painting. We know that uncoloured copies were also issued, for many of them have come down to us in the untouched state, and some are said to have been painted afterwards by their owners. It is scarcely likely, however, that an amateur, doing the work for his own pleasure, would have taken the trouble to follow out the peculiarities and idiosyncrasies of the text so accurately as has been done in the examples here cited. In the Cambridge University Library copy it is noticeable that the painting is better in its general scheme than it is in the detail, which has a certain rough, mechanical look, which might result from the colourist having to deal rapidly with a number of copies; this is not the kind of imperfection that one would look for in the work of an owner-artist.

Curiously enough, we happen to know something of a much later occasion on which the woodcuts from "De historia stirpium" were coloured before they were sold. In 1774, more than two hundred years after Fuchs's death, a certain Salomon Schinz, who had somehow obtained the blocks cut for Fuchs's herbal, used them to illustrate a book published at Zurich under the title of "Anleitung zu der Pflanzenkenntniss". He had the woodcuts coloured by the children of an orphanage—an economical method of producing *éditions de luxe*, which was apparently not unusual in the eighteenth century. It is pleasant to find that Schinz gives full credit to the orphans, whom he praises in his preface for the pictures, "Durch Euch, liebe Knaben, in Farben dargestellt".

Turning again to the sixteenth century, we may recall Dr. Sprague's crucial discovery<sup>1</sup> that a

\* For information on this point I am indebted to the librarians of Winchester Cathedral Library, and of the Linnean Society.



study of the painted copy of Otto Brunfels's herbal of 1530—"Herbarum vivæ eicones"—belonging to the Kew Herbarium Library, makes it probable that the original water-colours by Hans Weiditz, who illustrated the herbal, were used as patterns for the colours. This view would imply that the Kew copy was painted before it left the publisher's office.

The pieces of evidence so far considered are based on a study of coloured copies of the two primary German herbals of the Renaissance. In addition, we already possess evidence of a more factual kind, derived from the records of a great printing house—that founded by Christophe Plantin of Antwerp, who published the herbals of the 'triumvirate' of Low Country botanists—Dodoens, de l'Écluse, and de l'Obel. M. Bouchery, of the Museum Plantin-Moretus, kindly informed me by letter in 1938 that, in the Plantin Archives, numerous references occur to three women who were employed to colour herbals. These were Lisken Zegers; Myncken, the widow of Hans

Lieftrinck; and Lyncken, the widow of Abraham Verhoeven. Any student, to whom the original documents at Antwerp are accessible, might be able to unravel the exact part played by these painters in relation to the authors, and to the other artists who were members of Plantin's staff.

To sum up, we may say that the evidence here considered suggests that the colouring of sixteenth-century herbals by individual owners was less frequent than has often been supposed; it can indeed have happened but rarely that an amateur was capable of carrying so onerous a task to completion. There seems more probability in the alternative that the colouring was as a rule done officially before the books were sold. If further study shows this view to be of general application, it means that coloured copies deserve more attention than has hitherto been accorded to them, since they may prove to provide an authoritative commentary on the text, and to emphasize the intentions of the author.

<sup>1</sup> *Trans. South-East Union Sci. Soc.*, 43, 36 (1938).

## OBITUARIES

### Prof. Wilhelm Dörpfeld

WE regret to record the death of Prof. Wilhelm Dörpfeld on April 26, at the age of eighty-six. Born and educated at Barmen near Düsseldorf, Wilhelm Dörpfeld studied architecture in Berlin, and in 1877 was called from the Prussian Board of Works to be architectural assistant to Dr. Adler at the excavations of the German Archaeological Institute at Olympia, and in 1878 he became technical director. From Olympia he went to help Schliemann at Hissarlik, and collaborated in his publications "Troy" (1884) and "Tiryns" (1886). In 1883 he had married Adler's daughter, and in 1886 he became architectural adviser to the German School in Athens; and in 1887 its 'first secretary', that is, director. After Schliemann's death in December 1890 he continued his work at Hissarlik, revealing the significance of the 'Sixth City' in his "Troja 1893", and reviewing the whole series of discoveries in "Troja und Ilion" (1902).

Meanwhile at Athens he devoted himself to topographical and architectural problems, propounding some original views about the early water supply, and the ground plan of the Erechtheum and Propylaea. He gave remarkable open-air lectures on the sites, and conducted annually a large party of students through Greece, and later also through the islands and to Crete. In 1896, he published, with the philological aid of Reisch, his revolutionary book "Das Griechische Theater", contending that, in the earlier drama, actors spoke not from a raised stage but on the same level as the chorus. After much controversy, this is now generally accepted, though there may be doubt as to the date when the raised platform came into use and assumed the name of the original back-scene (*skéné*).

On the discoveries of prehistoric civilization in Crete, from 1900 onwards, Dörpfeld supported vigorously, but with insufficient local study, the conjecture of Koehler, his predecessor at Athens, that an Aryan culture could be distinguished from a pre-Aryan in the Ægean.

From 1905, Dörpfeld spent much time in excavation in Leucas, which he claimed as the Homeric Ithaca; but neither his rendering of the topography, nor his theory of a general southward shift of island names, nor his archaeological finds, have availed to establish the views embodied in "Alt Ithaka" (1927), nor his defence, in "Homer's Odyssey" (1924), of the notion of Helbig that the 'Mycenaean' civilization was of Phoenician origin, and of Conze that the primitive Hellenes practised 'geometrical' art.

After his retirement from the Institute in 1912, Dörpfeld lived in Germany, and held an honorary chair of archaeology at Jena; but he frequently returned to Greece, and even excavated at the reputed 'Pylos' of the "Odyssey", and in the prehistoric subsoil of Olympia. Latterly he spent much time in his beloved Leucas, and here he is buried in a tomb prepared by himself overlooking the sea of Odysseus.

Always robust, Dörpfeld was a distinguished figure at the International Archaeological Congress so recently as August 1939. He will be remembered with affection for his remarkable powers of exposition, his gift of inspiring friendship and enthusiasm for his views, his tenacious defence of ingenious theories; but above all for his simple open nature and his delight in the scenes and studies to which he devoted his life.

JOHN L. MYRES.



## Dr. C. Davison

WITH the passing of Dr. Charles Davison on April 28, at the age of eighty-one, at Cambridge, seismology has lost another link with the great pioneers of modern seismology which include the names of Mallet, Milne, Knott, Oldham, Omori, Imamura, Davison and others.

Born on May 1, 1858, at a time when Milne was about seven years old, Davison was the second son of Fleet Paymaster E. C. Davison, and was educated at Armstrong College, Newcastle-on-Tyne, and at Emmanuel College, Cambridge. He spent much of his life as mathematics master at King Edward's High School, Birmingham, and was the author of "Higher Algebra" and "Subjects for Mathematical Essays".

Davison's writings on earthquakes covered a very wide field, including standard and popular books, numerous technical papers and popular articles. He was the leading authority on British earthquakes, 1,191 of which, ranging over a thousand years, he dealt with in his book "A History of British Earthquakes". He had also described the Hereford earthquake of December 17, 1896, and written "A Study of Recent Earthquakes". In 1921 he completed his "Manual of Seismology" and later wrote books on "Great Earthquakes" and "Studies in the Periodicity of Earthquakes".

Since the time Milne was professor of geology and mining at Tokyo, Davison was continuously interested in Japanese earthquakes and Japanese seismologists, some of whom visited him in England. He was the author of the book on "The Japanese Earthquake of 1923" and has written shorter descriptions of many other Japanese earthquakes. The subjects of Davison's scientific and technical papers printed by the seismological societies of many countries, and contained in many geological, philosophical and other periodicals, covered descriptions of individual earthquakes, the history of seismology, velocities of seismic waves, sea waves arising from earthquakes, earthquake sounds, earthquake-recording instruments, earthquake distribution, deep-focus earthquakes, twin earthquakes, volcanic earthquakes, earthquake intensity scales for drawing isoseismal lines and others, the list being by no means exhaustive. To all these subjects he added something of importance. Should it ever become possible to predict the exact time, place and energy of an earthquake, precautions could be taken in advance and many lives and much property saved. Davison no doubt always had this in mind, since on July 31, 1930, he contributed an article to *The Times* on "Earthquakes and Human Life", and he has frequently since 1891 returned to his task of attempting to find any periodicities there may be in the occurrence of earthquakes. He often had occasion to consider the origin of earthquakes, and in 1887 contributed a paper to the *Philosophical Transactions of the Royal Society of London* on "The Distribution of Strain in the Earth's Crust resulting from Secular Cooling", to which G. H. Darwin added a note. For forty-six years, until shortly before his death, Davison was a frequent contributor to *NATURE* on seismological topics.

Before the days of self-recording seismographs Davison did many experiments with pendulums, and often vividly recalled the times when, between two days work, he frequently sat up all night watching his instruments, occasionally being rewarded by the thrill of seeing them move, due to the action of waves from a distant earthquake. For many years he was secretary of the British Association Earth Tremors (now Seismological) Committee, and on the occasion of the recent visit of the Association to Cambridge in 1938, Dr. F. J. W. Whipple and I visited him at his home. Unfortunately, on account of his age, Davison did not feel equal at the time to attending the meetings. He was passionately fond of music and literature, and had an excellent library of gramophone records of Beethoven's works. On March 19, 1934, *The Times* published an article by him on "Robinson Crusoe's Earthquake".

In 1886, Davison married Margaret Blanche Harris, of Great Chart, Ashford, Kent, and had a son and two daughters.

E. TILLOTSON.

I FIRST met Dr. Davison in 1902, when I joined the staff of King Edward's School, Birmingham. At that time the mathematical teaching of the School was under the guidance of a very distinguished teacher, Mr. Rawdon Levet. In the summer of 1903, Dr. Davison succeeded him as senior mathematics master. He made little or no changes in the organization of the teaching, and during the next twelve years a steady stream of able mathematicians passed from the School to the universities. Among them were the last two Senior Wranglers.

Dr. Davison was a tireless worker with a wonderful mastery of detail. He always made use of odd times. Much of his literary work was done in his class room between morning and afternoon school, when other members of the staff would be chatting in the common room. One at least of his many books was entirely written in this way. The report of an earthquake made him very busy, and one of his last pieces of work before he retired was, I remember, an investigation into the transmission of sounds due to the Silvertown explosion during the War of 1914-18.

When he retired from scholastic work in 1920, Davison had well prepared the ground for further academic distinctions. I, who had the privilege of succeeding him and carrying on the mathematical teaching of the School, am glad to put on record how much I owe to his inspiration and wise counsel during the years I served under him.

C. H. RICHARDS.

WE regret to announce the following deaths:

Prof. C. L. Boulenger, professor of zoology, Bedford College, University of London, on May 19, aged fifty-four years.

Mr. W. H. Massey, M.V.O., formerly consulting engineer to H.M. the King, on May 13, aged ninety.

Mr. Roger Smith, formerly electrical engineer to the Great Western Railway, president of the Institution of Electrical Engineers in 1919, aged seventy-seven years.



## NEWS AND VIEWS

### The Linnean Medallist for 1940

SIR ARTHUR SMITH WOODWARD, to whom the Linnean Medal for 1940 of the Linnean Society was presented at the anniversary meeting on May 24, was a student of Prof. Boyd Dawkins in Owens College. He entered the Geological Department of the British Museum in 1882, and spent more than forty years in that institution, retiring as keeper of the Department. Between 1889 and 1901 he published four volumes of a "Catalogue of Fossil Fishes", based on a personal knowledge not only of the splendid collection in the Museum, but also of all other important series preserved in all parts of the world. It is a unique publication, a survey by one man of the whole material of a group which has provided that solid basis on which all our recent advances of knowledge of this subject have been built.

But Sir Arthur's interests spread beyond fossil fish to fossil vertebrates in general, and he is very widely known for his collaboration with the late Mr. Charles Dawson in the discovery and interpretation of the Piltdown skull. It is generally recognized that his original interpretation of the many difficult problems, of the reconstruction of this skull from its fragments, and of its significance in the understanding of human origin, was nearer the truth than any other of the many put forward all over the world shortly after the discovery. Sir Arthur has added to the vast mass of detailed accurate information about the anatomy of fossil vertebrates which necessarily forms the body of his work, a series of most illuminating discussions of the broader aspects of palæontology in their bearing on the mechanism of evolution, which have commonly taken the form of presidential addresses to scientific societies.

### Linnean Society: Crisp Medallist

THE Crisp Award and Medal for 1940 of the Linnean Society was presented to Mr. D. J. Scourfield, in recognition of the importance of his paper on "The Oldest Known Fossil Insect", recently read before the Society and summarized on p. 799 of this issue of NATURE. The Award, which was established in 1912 by a donation from the late Sir Frank Crisp, formerly treasurer of the Society, is given "as a reward for the best paper, dealing with microscopical research by a Fellow, published by the Society since the previous award". By the terms of the donation it is given "at intervals of not less than five years" but, actually, the period has generally been much longer. No doubt it has been found difficult to define the type of research that could strictly be termed "microscopical", since there are few branches of biological work which do not require at least the occasional use of the microscope. In the case of Mr. Scourfield's paper, however, no doubt could arise, since it was only his unusual skill and long experience

in microscopical manipulation that enabled him to elucidate so convincingly the structure of these minute and obscure fossils from the Rhynie Chert. He had already done the same for another arthropod from the same deposit, the remarkable crustacean *Lepidocaris*, described in his well-known memoir published by the Royal Society in 1926. The debt that British biology owes to the work of amateur microscopists has often been pointed out. Mr. Scourfield worthily sustains the tradition of a long line of distinguished predecessors.

### Linen Industry Research Association: New Director

DR. A. J. TURNER has been appointed director of research of the Linen Industry Research Association in succession to Dr. W. H. Gibson. Since 1931 Dr. Turner has been head of the Spinning Department of the British Cotton Industry Research Association. Prior to that date, he was for six years director of the Technological Laboratory of the Indian Central Cotton Committee, Bombay. He has also held the posts of head of the Experimental Fabrics Section of the Royal Aircraft Establishment and professor of textile technology in the Manchester College of Technology and in the University of Manchester. Dr. Turner takes up his duties at Lambeg, Northern Ireland, on September 1 next.

### Fauna and Flora of the Low Countries

THE intense fighting over such a wide area of the Low Countries also threatens to damage fauna and flora of international interest, as in Norway (see NATURE of April 27, p. 663). In Holland there are well-known sanctuaries for seabirds that have attracted photographers from Britain for many years, and the Netherlands Society for the Protection of Birds has done much to preserve the breeding haunts. The sandy island of Texel near the Zuyder Zee is the breeding ground of many former British breeders which have now left their British nesting haunts. The black-tailed godwit is common on the polders, as are nesting ruffs at Wall en Burg polder, avocets, Kentish plovers, a few pairs of black tern nest, and of blue-headed wagtails, icterine and marsh-warblers, Montague's and marsh-harriers and spoon-bills at the inland lake of Muy, garganey, short-eared owls and various commoner species. Texel is preserved under the State Forestry Commission. Another Dutch preserve, the Naardermeer, has bitterns, ruffs, black terns and marsh-harriers. In winter the country is a great haunt of wild duck, and 140 duck decoys take 300,000 a year for the canning industry.

In Belgium, the Yser estuary is a reserve for waders, wild-fowl, etc., and there is another wild-fowl sanctuary near Nieupoort. These were under the Ministry of Agriculture. Interesting experiments have been made with the successful introduction of



the Scottish red grouse. The Flanders dunes have a very interesting flora, in many ways like that of the dunes of South Wales, western Lancashire or Norfolk. In the wet dunes and pools grow grass of Parnassus, round-leaved wintergreen, purple loosestrife, hemlock, storksbill, and on the dry ones, toadflax, bird's-foot trefoil, creeping willow, pink centaury, squinancy wort, burnet rose, Chinese box thorn, evening primrose, musk orchid, marsh helleborine, etc. The alien evening primrose on the Dutch dunes is associated with the important researches of de Vries and the doubling of chromosomes in *Oenothera Lamarckiana*. The famous Flanders poppies, increased by the calcareous nature of the soil following the bombardment of buildings in the War of 1914-18, had declined in numbers in recent years as the soil had returned to more normal type.

### The Food Industry in War-time

IN a lecture at the Royal Institution on May 21 in the series "The Nation's Larder", Dr. L. H. Lampitt, director and chief chemist of Messrs. J. Lyons and Co., Ltd., discussed "The Manufacture, Preservation and Distribution of Food". The food industry occupies a position between that of catering by households and catering of the canteen type. The economy to be effected by mass production is obvious because wastage is reduced to a minimum; all waste products are taken and so treated that they have an economic value, labour is reduced and—a very important point—the amount of fuel consumed is considerably less. A striking example is in the baking of cakes. An ordinary gas cooker as operated by a housewife consumes approximately 10 cub. ft. of gas for each lb. of cooked weight of cakes, assuming the housewife was making 4-5 lb. of mixed cakes. In the case of a travelling oven, producing thousands of cakes an hour, the consumption of gas for each lb. of cooked weight is about  $1\frac{1}{2}$  cub. ft. In the realm of the homely potato, the average housewife loses approximately 22 per cent in peeling and eyeing. In mass treatment, where peeling is carried out by mechanical means, the loss is only 11 per cent.

By far the greater proportion of the bread baked in Great Britain is produced by large mechanical bakeries, and it is not an easy task to change over plant producing loaves made from white flour to loaves made from brown flour. The utilization of edible products not previously generally used as food, or used in a different form, is comparatively simple. Examples are the *Ersatz* coffee of Germany made from roasted barley and the *Ersatz* tea made from mixed leaves and shoots. These make palatable drinks, but the effect on the body is not the same as the natural products. By complicated chemical reactions, oils of the paraffin type which are unabsorbed by the human organism can be transformed into edible fats, and this is probably being carried out in Germany to-day. The production of protein matter by the activity of specially selected strains of yeast was practised in Germany during the War of 1914-18, and factories for this purpose were in being last year.

### The Differential Analyser

IN the application of mathematics to many problems both of pure and of applied science, rate of change of a quantity is often related to the magnitude of that quantity itself. This situation is expressed formally by a 'differential equation'. The differential analyser, of which the first was designed and built at the Massachusetts Institute of Technology by Dr. V. Bush and his team, is a machine for evaluating by mechanical means the solutions of differential equations, and its main applications are to problems giving rise to such equations which cannot be solved by formal methods.

Prof. D. R. Hartree, professor of theoretical physics in the University of Manchester, described the principles and applications of such a machine in his Friday evening discourse at the Royal Institution on May 17. The machine consists essentially of a number of integrating units each of which is a precision form of continuously variable gear. These units can be interconnected in various ways by shafts and gearing so as to form a translation into mechanical terms of the differential equation to be solved. There is also a number of 'input tables' from each of which information, in the form of a graph expressing the relation between two of the variables in the equation, can be supplied to the machine, and means of recording the solution of the equation either in graphical or numerical form; there are also adding units each of which can form the sum of two terms in the equation. There are at present seven full-size machines of this kind in operation, and also in Great Britain, several small-scale ones, some built mainly of standard Meccano parts, and others workshop-built. It may be recalled that the differential analyser at Manchester was described by Prof. Hartree in *NATURE* of June 8, 1935, p. 940.

### Summer School in Social Biology

THE Educational Advisory Board of the British Social Hygiene Council is arranging a Summer School for Teachers and Social Workers at Westminster College, Cambridge, during August 1-8. The main interest of the School will be focused upon a "School-Leavers' Course in Human Biology" which has recently been prepared by the Educational Advisory Board to assist in meeting the urgent problems that have arisen affecting adolescents as a result of war conditions. Various aspects of the syllabus will be presented in the form of symposia, contributed to jointly by distinguished biologists and practising school teachers. These symposia and the ensuing discussions should be of considerable value in helping participating teachers to a deeper understanding of the natural endowments of their pupils. Another section of the School will deal with some of the problems in social biology which to-day have become a matter of vital concern for the peoples of the British Empire.

Prof. J. C. Ryle, regius professor of physic in the University of Cambridge, will be president of the School, and Mr. L. J. F. Brimble will be director.



The inaugural address will be delivered by Sir Walter Langdon-Brown, emeritus professor of physics in the University of Cambridge. The following speakers have undertaken to give lectures and take part in discussions: Prof. J. C. Drummond, scientific advisor, Ministry of Food; Dr. Leslie J. Harris, director of the Nutritional Laboratory, University of Cambridge; Dr. Grace Calver, physician, Children's Department, Tavistock Clinic; Mrs. C. Neville-Rolfe, past vice-president, Eugenics Society; Sir Drummond Shiels, medical secretary, British Social Hygiene Council; Mrs. E. J. Hatfield, North London Collegiate School; Mr. R. Weatherall, Eton College; and Miss V. D. Swaisland, British Social Hygiene Council. Further information can be obtained from the Education Officer, British Social Hygiene Council, Inc., Tavistock House South, Tavistock Square, London, W.C.1.

### International Relief Union

THE origin, aims, means and future of the International Relief Union are discussed by M. Camille Gorgé in a pamphlet recently issued by the Union (Geneva: International Relief Union). M. Gorgé points out that, for good or for ill, the States of the world have become so closely welded together that they form a great family from which no one member can dissociate himself without serious inconvenience or actual hardship. Although international co-operation has at present lost most of its vitality and force, sooner or later the nations must revert to the method of collective agreements, and use the instruments or machinery already established for that purpose. The International Relief Union, which was established by the Convention of July 12, 1927, was largely the outcome of a scheme elaborated by M. Giovanni Ciraolò to provide not only for immediate and organized relief for peoples overtaken by disasters, such as earthquakes or other catastrophes arising from natural causes, epidemics, famine, etc., but also for the scientific study of the causes of natural calamities, with the view of counteracting or limiting their effects. According to the Convention, the International Relief Union has a fourfold task: it must furnish first aid to the populations that are victims of public disasters, and co-ordinate, as occasion offers, the efforts made by other relief organizations; it must also encourage the study of preventive measures against disasters and seek to induce all peoples to render mutual international assistance.

The Convention did not come into force until December 27, 1932, and its financial resources were too limited for it to do its work freely and effectively. Special stress is laid upon the mobilization of the forces of good will against adversity beyond national frontiers, and upon encouraging scientific men to study how to combat or even counteract future disasters. Scientific workers are urged to co-ordinate research in all its branches so that the various communities may unite their concrete efforts, based on accurate data, to minimize the damage to the human family caused by great scourges. Aviation and

broadcasting have already done something to reduce the gravity of certain disasters, and fresh opportunities of foresight and defence continually arise. To assist scientific workers to explain their ideas and compare results in this field, the Union in June 1938 issued the *Revue pour l'étude des calamités*, replacing the *Matériaux pour l'étude des calamités*, previously published by M. Montandon in collaboration with the Société de Géographie de Genève. One of the first tasks of the Union in this field is to make a detailed study of the geography of natural disasters. A resolution of the first International Conference for Protection against Disasters, Paris, September 1937, recommended that the Union should consider the appointment of a Permanent International Committee for Protection against Disasters, collaborating with the Board of Scientific Documentation of the Union, and M. Gorgé briefly indicates directions in which such concerted scientific effort is required.

### Wood Pole Transmission Lines

IN order to examine the incidence of risks from shocks and fire due to the use of wood-pole transmission lines, tests were undertaken of primary insulation at 19, 11 and 6.35 kv. The work is described by G. T. Garwood in the *Electrical Review* of April 12. The structure on which the tests were carried out comprised a plain-sawn English oak cross-arm, 5 in. by 3 in., bolted to a red fir-pole, 32 ft. by 11½ in. in diameter at 5 ft. from the butt. The pole was sound in every way and had been creosoted. The instruments used for the tests were two electrostatic voltmeters. The resistance between the cross-arm bolt and earth was measured on frequent occasions in the period during which the test was being taken and also under varying conditions of dryness. The megger readings ranged from 200,000 ohms with the pole dry to 50,000 ohms with it wet. With the 11 kv. connexions a current of 140 micro-amperes could be obtained from below a plain earthing collar. As 15 micro-amperes may give a fatal shock to a normal man, if his heart lie in the circuit, the experiments showed that a plain earthing collar round the pole is insufficient protection. In the destruction tests, about ten minutes after the wetting of the pole smoke appeared from the cross-arm near the insulator pin. Longitudinal 'shakes' opened up in the cross-arm and showed signs of carbonizing. After about twenty minutes, smoke appeared from these shakes, the source of the smoke moving steadily towards the pole. After thirty minutes, smoke appeared from the pole top and 'tracking' with small intermittent flames at the earthing collar. Heavy smoke and flames appeared at the pole-top after seventy-five minutes and after eighty-five minutes the test was stopped, it being clear that the complete destruction of the structure was inevitable.

### Flavour of Bacon

THE Department of Scientific and Industrial Research has issued a report describing work carried out for the Food Investigation Board on the importance of various factors responsible for the pro-

(Continued on page 817)



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# NATURE

## SUPPLEMENT

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### SHORT REVIEWS

#### ANTHROPOLOGY AND ARCHÆOLOGY

##### The Discovery of Man

The Story of the Inquiry into Human Origins. By Stanley Casson. Pp. 340+16 plates. (London: Hamish Hamilton, Ltd., 1939.) 12s. 6d. net.

IT is remarkable, but none the less true, as Mr. Casson points out, that in the order of the development of the sciences man comes last to the most fascinating study of all—the study of himself. It is further notable that the study of man, affording so many avenues of approach, has so frequently, but no doubt inevitably, advanced by the investigation of what may be regarded as side issues. This appears here in the author's references to early developments in ancient and classical Greece, where, for example, the collection of ethnographical and geographical data was an outcome of the needs of navigation and commerce; and if history as conceived in the theory of Herodotus demanded a basis of ethnography, Thucydides turned no less to a line of investigation which was in effect archæological research.

Mr. Casson's entertaining and informative narrative follows the development of the various branches of anthropological inquiry through classical and medieval times and the Renaissance down to modern times. His wide acquaintance with the less-known paths of classical and post-classical literature has enabled him to record much that will be both new and of value to those who are interested in the earlier phases of scientific modes of thought. Coming to modern times, as an archæologist who himself has worked in the field, he is able to survey the record of workers in the various regions of the Mediterranean and the Near and Middle East with a firm grasp of the trend of discovery as a whole, and at the same time a just appreciation of the contribution of each individual investigator in the major fields of discovery.

On the ethnographical side, and in what is now termed cultural anthropology, Mr. Casson is not, it must be admitted, equally well equipped, nor in consequence is his record so complete, especially

when he deals with the descriptive and comparative studies in religion and law of English and French writers of the late sixteenth and the seventeenth centuries and the French compendia of races of the early eighteenth century, which led up to Montesquieu.

##### Escape with me! an Oriental Sketch-Book

By Osbert Sitwell. Pp. xv+340+16 plates. (London: Macmillan and Co., Ltd., 1940.) 12s. 6d. net.

IT is always of interest to the archæologist to note the reactions of others to the material in which he himself works. If they have the trained eye of the observer of men and cities, a sense of æsthetic values, combined with a gift of literary expression, he may hope to recapture from their observations something of the nature of the general complex of the culture as a whole which it is his purpose to recover from the evidence of the past, but which his preoccupation with details of research too often precludes him from viewing in true perspective. No one assuredly who desires a scientifically accurate account of Angkor or Peking would consult Mr. Sitwell's "Escape with Me" as a first-hand authority, yet from his vivid pen pictures of the line, mass and colour of the great complex of temple monuments at Angkor and his obvious sympathy with Eastern modes of life and thought, especially as lived in Peking, it is possible that the reader may attain a truer understanding than from more solid treatises in the archæological or historical sense.

It must not be imagined, however, that Mr. Sitwell's book, frankly escapist, is the fruit of hurried impression. Some months were spent by him in Peking, his contacts with the Chinese were as intimate as the circumstances allowed; and he made full use of Bodde's translation of "Annual Customs and Festivals of Peking" and Arlington and Lewisohn's "In Search of Old Peking", with results no less pleasing to the reader than gratifying to himself. Thereby in effect he was led to a judgment of Chinese culture and character in relation to current events or which there is much to be said.



## BIOLOGY

## Textbook of Biology

By Dr. E. R. Spratt and A. V. Spratt. Second edition. Pp. viii+692. (London: University Tutorial Press, Ltd., 1939.) 11s. 6d.

IN preparing the second edition of this work, the authors have completely revised the original text and figures and have added two new chapters dealing with Pinus and Angiosperms to meet the requirements of the Pharmaceutical Society's examinations. The material presented is intended to cater for students pursuing courses in biology for the intermediate science, pharmacy, and medical examinations of Great Britain, the higher school certificate, the preliminary medical, and other examinations of a similar standard. The greater part of the book is concerned with minute descriptions of the anatomical mechanisms of the plant and animal types met with in these various examination syllabuses. This is followed by a smaller physiological section, which is chiefly concerned with plants, and a chapter on ecology. The laws of heredity and evolution are summarily treated, while the appendix contains useful practical hints. The book is admirably illustrated with a considerable number of clear diagrams. Inaccuracies of the previous edition have been largely eliminated, although it is a little disconcerting still to read that *Pellia* "is branched to form many lobes, thus reminding us somewhat of the liver of an animal and giving the plant the name liverwort".

This is indeed a text-book and would only be of use as a source, and perhaps better, revision book for the examinations mentioned above. T. H. H.

## A Naturalist on Rona

Essays of a Biologist in Isolation. By Dr. F. Fraser Darling. Pp. x+138+28 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 7s. 6d. net.

DR. FRASER DARLING'S sojourn on the isolated island of Rona has repaid its hazards, since it gave him the opportunity of writing these essays as well as of observing that unique seal rookery during the breeding season. Many subjects are touched upon in the eight essays, ranging from the archæology of the primitive chapel and cell of St. Ronan, which the author partially restored, to display of birds, social life of animals, animal sanctuaries, and an excellent account of the habits of the grey seal. The essays are vivid in their description, are attractively written and are illustrated by some beautiful photographs. If occasional inaccuracies creep in they are not serious. For example, in his strong plea for the creation of sanctuaries in Great Britain, the statement that "before Theodore Roosevelt's time a few people had thought, rather ineffectually, about the protection of wild life", takes little account of the facts that Congress had set aside the Hot Springs Reservation in 1832, that the Yellowstone National Park was established in 1872, and that the American Ornithologist's Union had its law for the protection of

wild birds in 1886, quite apart from much effective legislation in other countries.

## A Catalogue of Yorkshire Fungi

By the late F. A. Mason. Completed from the Records of the late Alfred Clarke by Dr. John Grainger. Pp. xii+110. (London and Hull: A. Brown and Sons, Ltd., 1937.) 7s. 6d. net.

THIS Catalogue of Yorkshire Fungi (Limited Edition) is essentially an extension of Messrs. Masee and Crossland's "Mycological Flora" (1905), which attempts to bring up to date those records, supplemented from forays and individual efforts.

The new volume adds about 835 species and varieties, chiefly in the Basidiomycetes (660) and the Ascomycetes (110) sections. The X and - method of recording is unsatisfactory as it signifies the mere presence or absence of the species in an area of usually more than 1,000 square miles with no indication of frequency or otherwise, so that the old Flora will still be the only reference book giving both species and localities.

Apart from the above and a dateless title-page, the chief fault of the work is its omissions, primarily of sources: thus many species and V.C. records are absent, for example, August 1934 Goole district records have been placed in the East and not West Riding, no mention of Entomophthoraceæ for the East Riding, although seven of these species were listed in the *B.M.S. Transactions* 1932; while *Cordyceps entomorrhiza* is a misnomer for *Cordyceps gracilis*.

The Mycological Committee has reviewed the work and decided to publish amendments in the *Yorkshire Naturalist* that will greatly add to its utility.

J. W. HAIGH JOHNSON.

## Tertiary Siphonous Algæ in the W. K. Parker Collection, with Descriptions of some Eocene Siphonæ from England

By Lucien and Jean Morellet. Pp. ix+55+6 plates. (London: British Museum (Natural History), 1939.) 5s.

CALCAREOUS green algæ (of the Siphonales) are now almost confined to warm seas, but fossil representatives are being discovered widely. This catalogue describes an important series of specimens from a well-known Eocene locality in France, and for the first time some similar ones from England. The study of these fossils has required very close observation of minute specimens (the present collection had been classed as Foraminifera), bold hypothesis and good luck; this last is seen here for *Ovulites*. This common fossil was known as little shells shaped like a blown bird's egg. Specimens have now been described in which a chain of these are still held in position by the continuous skeleton of an encrusting Bryozoan; the new specimens show that *Ovulites* is very like the existing alga *Penicillus*.

The large number of specimens mentioned as *Incertæ sedis* indicate room for further study and further good luck.

TOM M. HARRIS.



**Bats**

By Glover Morrill Allen. Pp. x+368+31 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 17s. net.

THIS book is full of information of value to those specializing in the study of bats; but it is written for the general reader. It seems scarcely possible that anyone except a bat-specialist would want to know so many details about bats, and the innumerable names of different species can mean almost nothing to those who have not made a special study of the group. The biologist with special interest in the Chiroptera will find this a really valuable book written by an enthusiast, but will probably skip the unnecessarily large part devoted to popular superstitions about the order. The same amount of space could more profitably have been devoted to classification, which is scarcely touched upon. Many of the photographs are good. A large and useful bibliography is given.

**Ce qu'il faut savoir des insectes**

Par G. Portevin. Vol. 2: Coléoptères et hémiptères. (Savoir en histoire naturelle, Vol. 3.) Pp. 308+14 plates. (Paris: Paul Lechevalier, 1939.) 40 francs.

THIS is an excellent low-priced guide to the orders Coleoptera and Hemiptera. It is primarily a pocket manual designed to aid in the recognition of the chief members and, for this purpose, there are numerous keys to families and genera together with notes on some of the more characteristic species. The text-figures are clear and accurate and the plates are good.

**CHEMISTRY****Reports of the Biochemical Research Foundation of the Franklin Institute**

Vol. 5, 1938-1939. Pp. vii+42 papers. (Philadelphia: Franklin Institute, 1940.)

THIS collection of stimulating scientific publications shows how diverse biochemical techniques, recently discovered in various parts of the world, can be used to supplement one another in the elucidation of particular problems in the attack on disease. Thus in the chemical and microchemical sections the manometric respirometer methods of Warburg and of the Cambridge school together with the Linderstrom-Lang microtechniques are used to study metabolic and enzymic activities of tissues. The cyclotron is used for the production of radioactive elements which can afterwards be introduced into compounds of biochemical interest, for example, glutathione containing radioactive sulphur. In the physico-chemical and immunological departments, purification and analysis of therapeutic serum antibodies are carried out by the Svedberg ultracentrifuge, and the electrophoretic technique of Tiselius is applied to studies on antibodies from allergic sera.

The Biochemical Research Foundation, which was formerly known as the Cancer Research Laboratories, has now a wider outlook on disease. Its aims are: (1) the study of disease from a chemical

point of view; (2) the study of new compounds for their therapeutic and beneficial effects; and (3) the study of age and the diseases of age. Such problems are attacked from their fundamental basis. For example, pancreatic hormones having blood pressure lowering action and their isolation, one of the many lines of research undertaken by the Foundation, may seem to have little to do with the ageing process, but substances which reduce blood pressure, an age manifestation, have a great deal to do with it.

**Theoretical and Applied Electrochemistry**

By Prof. Maurice de Kay Thompson. Third edition. Pp. xxi+535. (New York: The Macmillan Company, 1939.) 22s. net.

THE new edition of this excellent book is entirely re-written, but it preserves all the valuable features of preceding issues. The first part is a compact treatise on modern theoretical electrochemistry which, on account of the concise style, covers all the important branches in a comprehensive and satisfactory way. The second and third parts deal with the applied electrochemistry of aqueous solutions, and with electric furnaces and their products, respectively, and here again the treatment is comprehensive and accurate. The amount of information contained in the book is surprising, and no important branches of the subject seem to have been missed. The literature references are very complete, and the illustrations are clear and well chosen. A particularly valuable feature is the large number of problems and exercises, for which not only answers but also concise solutions are provided. This is a thoroughly satisfactory book, and the author deserves high praise for the skilful and expert way in which he has brought the material together and for the clear and accurate presentation of it.

**GEOGRAPHY AND TRAVEL****This Way Southward**

The Account of a Journey through Patagonia and Tierra del Fuego. By A. F. Tschiffely. Pp. xvi+354+50 plates. (London and Toronto: William Heinemann, Ltd., 1940.) 15s. net.

MR. TSCHIFFELY, who had already won a well-deserved reputation as an adventurous traveller in the Americas on horseback, here records the events of another one-man expedition, though in this instance by car. From Buenos Aires he drove down the Atlantic coast of Patagonia to Tierra del Fuego and thence back to Buenos Aires along the western side of the continent by way of the Andes and across the continent. In all, 7,000 miles were covered, the return journey along the Andes involving a number of detours to avoid country unsuitable for the car. This was, indeed, the most difficult part of the journey, and frequently skirted country which is not only unexplored but also probably unexplorable except by air.

On the outward journey the author visited the famous Welsh colony founded in the middle of the



last century, in which in the younger generation knowledge of English has almost completely disappeared. His description of a country which has nothing to offer in the way of the picturesque is none the less of considerable interest in view of the economic development of a territory once regarded as an arid waste. If the outward journey was not without its incidents, the return, starting from the embarkation on the ice-encircled Lake Argentino, provided them in plenty, and from this point also Mr. Tschiffely is able to incorporate in his narrative episodes from the history of the country, beginning with the Conquistadores and the search for El Dorado down to the ill-fated attempt to develop sheep-farming on the Rio Baker. In describing what he saw of Tierra del Fuego the author tells his readers something of the Yahgan and Ona Indians, not as they are now, but as they were at the beginning of the century, his information being derived from Mr. Lucas Bridges, "the only living authority". His own experiences among the Tehuelche Indians, now mostly 'civilized', included visits to some of those who still live in primitive 'tent-villages', but whose life is sadly circumscribed by the loss of freedom of the land.

#### The Wandering Lake

By Sven Hedin. Translated from the Swedish by F. H. Lyon. Pp. x+293+30 plates. (London: George Routledge and Sons, Ltd., 1940.) 18s. net.

"THE Wandering Lake", originally published in Swedish, is the third volume which Dr. Sven Hedin has devoted for the benefit of a non-technical public to the activities of the members of his great expedition to Central Asia. On this occasion he deals with the explorations carried out in 1934, of which the most important from the scientific point of view was the examination of the conditions accompanying and arising out of the change in the drainage of the Tarim Basin, which took place in 1921. In that year the waters draining into Lake Kara Koshan were diverted into an ancient watercourse, the Kum-daria, in which water had not flowed for some sixteen hundred years, to form a lake in the Lop-nor depression. Kara Koshan, discovered by Prjevalsky in 1876-77 and identified by him with the ancient Lop-nor, is now becoming desiccated.

The dry ancient watercourse of the Kum-daria had already been traversed by Dr. Sven Hedin at the beginning of the century, when he discovered the ruined city of Lou-lan, and on the basis of his observations of physiographic conditions, ventured to put forward a hypothesis as to the position of the ancient Lop-nor and the physical conditions making it a wandering lake, which the course of events would now appear fully to justify.

Three years before the journey recorded in this volume, two members of the expedition had explored the delta of the Kum-daria where it enters the lake. Here the author records the events of a journey made by canoe with the object of ascertaining how far the stream was navigable. The story is told with the meticulous attention to detail to be

expected from the author, and includes a graphic picture of the lake—a remarkable body of water both in size and character.

## MATHEMATICAL AND PHYSICAL SCIENCES

### An Introduction to the Calculus

By Prof. K. R. Gungikar. Pp. xiv+341. (London: Oxford University Press, 1938.) 4 rupees.

THIS little volume has been designed as a first course in the calculus for Indian students. The treatment is the outcome of years of experiment and observation and the method followed is, as the author points out, rigorous in the long run. By this is implied that the refinements of modern rigour are gradually developed, as they should be, in accord with the fundamental principles of true teaching. This idea, which is not too frequently apparent in mathematical text-books, as distinct from those written especially for schools, has been well and consistently carried out. After a commendable foreword to the student, twelve instructive chapters follow which should ensure a firm foundation for future study of the calculus. Beginning with limits and continuity, occupying three chapters, the student is led to the derivative itself. The usual standard theorems concerning the differentiation of functions are then considered, together with second order derivatives, maxima, minima and the exponential and logarithmic functions. Integration is next introduced as the inverse of differentiation, its full significance being developed later in accordance with the aim of the writer. The final chapter, after summarizing a few of the more important standard results previously established, proceeds to discuss briefly Taylor's and Maclaurin's series, Rolle's theorem, partial fractions, hyperbolic functions and surface and volume integrals.

The text has been well written and is not only sound but also designed to stimulate the reader's interest. It is excellently illustrated with fully worked-out practical examples as well as with clearly drawn diagrams. Each chapter closes with an appropriate set of exercises for the student, and answers to these are supplied. The book should prove very useful to all mathematical students of this essentially practical subject.

### Geometrische Kristallographie und Kristalloptik und deren Arbeitsmethoden

Eine Einführung. Von Dr. Franz Raaz und Dr. Hermann Tertsch. Pp. ix+215. (Wien und Berlin: Julius Springer, 1939.) 18.60 gold marks.

THIS book is suitable for students engaged in a systematic course of formal and optical crystallography corresponding roughly to Part 1 of the Natural Sciences Tripos at Cambridge in those subjects. All the usual and essential features are included, and an introduction to the manipulation of the Von Federow universal stage will be appreciated by the more advanced worker. The knotty question of the real significance of conoscopic illumination is very ably handled, with a clear diagram to correspond.



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Volumes marked with an asterisk (\*) have been received at "NATURE" Office

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**Hogben, L.** La matematica nella storia e nella vita. Prima edizione italiana autorizzata, a cura di F. Morra. Ristampa riveduta. 2 vols. 8vo. Pp. xvi+916. (Milano: Ulrico Hoepli, 1939.) 24 lire.

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**Department of Scientific and Industrial Research: Food Investigation.** Special Report No. 49: The Function of Nitrate, Nitrite and Bacteria in the Curing of Bacon and Hams. By J. Brooks, R. B. Haines, T. Moran and J. Place. Roy. 8vo. Pp. viii+32. (London: H.M. Stationery Office, 1940.) 9d. net.\*

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**Thüringischen Geologischen Verein,** Herausgegeben vom. Beiträge zur Geologie von Thüringen. Band 5, Heft 5-6. Roy. 8vo. Pp. v+241-320. (Jena: Gustav Fischer, 1940.) 5.60 gold marks.

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**Green, Lawrence G.** Old Africa Untamed. Demy 8vo. Pp. 256. (London: Stanley Paul and Co., Ltd., 1940.) 15s. net.

**Martyr, Weston.** The Wandering Years. (Edinburgh and London: Wm. Blackwood and Sons, Ltd., 1940.) 7s. 6d. net.

**Plowden, Joan Meredyth Chichele.** Once in Sinai: the Record of a Solitary Venture. Demy 8vo. Pp. xv+302+8 plates. (London: Methuen and Co., Ltd., 1940.) 12s. 6d. net.



**Rydh, Hanna.** Argentine to Andes. Translated from the Swedish by Mary Sandbach. Demy 8vo. Pp. xii + 171. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 10s. 6d. net.

**Turnbull, Patrick.** Sahara Unveiled: a Great Story of French Colonial Conquest. Demy 8vo. Pp. 264. (London: Hurst and Blackett, Ltd., 1940.) 16s. net.

**Webster, Joan, and Webster, Peggy.** Footprints in Finland. Demy 8vo. Pp. 256. (London: Skeffington and Son, Ltd., 1940.) 12s. 6d. net.

**Williamson, J. A.** The Life and Growth of the British Empire. (Oxford Pamphlets on World Affairs, No. 29.) Cr. 8vo. Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 3d. net.\*

**Wyndham, Richard.** South-Eastern Survey: Sussex, Kent and Surrey. (Face of Britain Series.) Demy 8vo. Pp. 128. (London: B. T. Batsford, Ltd., 1940.) 8s. 6d. net.

### General Biology: Natural History Botany: Zoology

**Bartsch, J., und Bartsch, M.** Vegetationskunde des Schwarzwaldes. (Pflanzensoziologie: eine Reihe vegetationskundlicher Gebietsmonographien. Herausgegeben von der Reichsstelle für Naturschutz, Band 4.) (Jena: Gustav Fischer, 1940.) 12 gold marks.

**Bennett, Rodney.** What to Look For in the Country. Imp. 16mo. Pp. 128 + 4 plates. (London: University of London Press, Ltd., 1940.) 2s.\*

**Berrier, Henri.** Contribution à l'étude des substances du type auxinique dans le règne animal. (Suppléments au *Bulletin biologique de France et de Belgique*, 27.) Roy. 8vo. Pp. ii + 228. (Paris: Laboratoire d'évolution des êtres organisés, 1940.) 110 francs.\*

**Bounoure, Louis.** Continuité germinale et reproduction agame. (Collection des actualités biologiques.) Fcap. 4to. Pp. iv + 84. (Paris: Gauthier-Villars, 1940.) 45 francs.\*

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**Discovery Reports.** Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 18. Roy. 4to. Coast Fishes, Part 3: The Antarctic Zone. By J. R. Norman. Pp. 104 + 1 plate. 15s. 6d. net. On the Operation of Large Plankton Nets. By James W. S. Marr. Pp. 105-120 + plate 2. 3s. net. Crinoidea. By D. Dilwyn John. Pp. 121-222 + plates 3-6. 16s. net. Thoracic Cirripedes collected in 1925-1936. By C. A. Nilsson-Cantell. Pp. 223-238. 2s. 6d. net. The Leopard Seal *Hydrurga leptonyx* (de Blainville). By J. E. Hamilton. Pp. 239-264 + plates 7-13. 6s. 6d. net. Hydromedusae from the Falkland Islands. By the late Edward T. Browne and P. L. Kramp. Pp. 265-322 + plates 14-19. 12s. net. Madreporarian Corals, with an Account of Variation in *Caryophyllia*. By J. Stanley Gardiner. Pp. 323-338 + plates 20-21. 3s. net. Title Page and List of Contents. Pp. vi. 9d. net. (Cambridge: At the University Press, 1938-1940.) Complete vol., 55s. net.\*

**Gams, Helmut.** Kleine Kryptogamenflora von Mitteleuropa. Band 1: Die Moos- und Farnpflanzen (Archegoniaten). Pp. iv + 184. (Jena: Gustav Fischer, 1940.) 9 gold marks.

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**Mika, J.** Die exakten Methoden der Mikromassanalyse. (Die chemische Analyse, herausgegeben von W. Böttger, Band 42.) 8vo. Pp. xii + 180. (Stuttgart: Ferdinand Enke, 1939.) 18 gold marks.

**Molisch, Hans.** Abhandlungen. Band 1. Herausgegeben von Karl Höfler. Roy. 8vo. Pp. viii + 388 + 32 plates. (Jena: Gustav Fischer, 1940.) 30 gold marks.

**Prenant, Marcel.** Biology and Marxism. Translated by C. Desmond Greaves. Cheap edition. Demy 8vo. Pp. xxiii + 223. (London: Lawrence and Wishart, Ltd., 1940.) 6s. net.

**Schoenichen, Walther.** Biologie der geschützten Pflanzen Deutschlands: Eine Einführung in die lebenskundliche Betrachtung heimischer Gewächse. Roy. 8vo. Pp. viii + 248 + 16 plates. (Jena: Gustav Fischer, 1940.) 12 gold marks.

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**Street, A. G.** Country Calendar. (Country Library.) Demy 8vo. Pp. xiii + 231. (London: Eyre and Spottiswoode, Ltd., 1940.) 5s. net.

**Trew, Cecil G.** The Story of the Dog and his Uses to Mankind. Ex. Cr. 8vo. Pp. xiv + 193 + 12 plates. (London: Methuen and Co., Ltd., 1940.) 8s. 6d. net.

### Agriculture: Horticulture: Forestry

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**Wallace, Doreen.** How to Grow Food. (Home-Front Handbooks.) Cr. 8vo. Pp. 90. (London: B. T. Batsford, Ltd., 1940.) 3s. 6d. net.

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### Anatomy : Physiology

**Adamstone, F. B., and Shumway, Waldo.** A Laboratory Manual of Vertebrate Embryology: Anatomy of selected embryos of the Frog, Chick and Pig. Demy 4to. Pp. vii+87. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 7s. 6d. net.\*

**Barnard, W. G.** Elementary Pathological Histology. Second edition. Cr. 4to. Pp. x+76+54 plates. (London: H. K. Lewis and Co., Ltd., 1940.) 10s. net.

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### Anthropology : Archæology

**Bleek, Dorothea F.** More Rock-Paintings in South Africa: from the Coastal Belt between Albany and Piquetberg. Mainly copied by Joyce and Mollie van der Riet. With Notes by the same and an Introduction and Explanatory Remarks by Dorothea F. Bleek. Roy. 4to. Pp. xx+28+28 plates. (London: Methuen and Co., Ltd., 1940.) 42s. net.\*

**Krishna Iyer, L. A.** The Travancore Tribes and Castes. Vol. 2. Demy 8vo. Pp. liv+344+86 plates. (Trivandrum: Government Press, 1939.)\*

**Linton, Ralph,** Edited by. Acculturation in Seven American Indian Tribes. Med. 8vo. Pp. xiii+526. (New York and London: D. Appleton-Century Co., Inc., 1940.) 20s. net.\*

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**Williams, F. E.** Drama of Oroko: the Social and Ceremonial Life of the Elema. Demy 8vo. Pp. xxvi+464+62 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 30s. net.\*

### Philosophy : Psychology

**Bacon, Roger.** Opera hactenus inedita Rogeri Baconi. Fasc. 15: Summa Grammatica Magistri Rogeri Baconi necnon Sumule Dialectices Magistri Rogeri Baconi. Nunc primum editid Robert Steele. Demy 8vo. Pp. xxiv+372. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 30s. net.\*

**Brown, William.** Psychology and Psychotherapy. Fourth edition. Demy 8vo. Pp. viii+260. (London: Edward Arnold and Co., 1940.) 12s. 6d. net.\*

**Chakotin, Serge.** The Rape of the Masses: the Psychology of Totalitarian Political Propaganda. Translated from the fifth edition by E. W. Dick's. Ex. Cr. 8vo. Pp. xviii+299. (London: George Routledge and Sons, Ltd., 1940.) 7s. 6d. net.\*

**Hettinger, J.** The Ultra-Perceptive Faculty: an Experimental Investigation. Demy 8vo. Pp. 204. (London: Rider and Co., 1940.) 12s. 6d. net.\*

**Hook, Alfred.** The Human Mind: the Key to Peace and War. Demy 8vo. Pp. x+303. (London: Watts and Co., Ltd., 1940.) 8s. 6d. net.\*

**Hutton, Isabel Emslie.** Mental Disorders in Modern Life: an Outline of Hopeful Treatment. Cr. 8vo. Pp. xiii+204. (London: William Heinemann (Medical Books), Ltd., 1940.) 3s. 6d. net.\*

**Moore, G. E.** Proof of an External World. (Annual Philosophical Lecture, Henriette Hertz Trust, British Academy 1939.) (From the *Proceedings of the British Academy*, Vol. 25.) Roy. 8vo. Pp. 30. (London: Oxford University Press, 1940.) 2s. net.\*

**Myers, Charles S.** Shell Shock in France, 1914-18: Based on a War Diary. Cr. 8vo. Pp. xi+146. (Cambridge: At the University Press, 1940.) 4s. 6d. net.\*

### Miscellany

**Brown, H. B., and Jones, Sydney.** Introductory Applied Science: for Junior Technical Schools and Preparatory Science Courses in Evening Technical Schools. Vol. 1. Cr. 8vo. Pp. vii+208+ix. (London: Macmillan and Co., Ltd., 1940.) 3s. 6d.

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**Feather, Norman.** Lord Rutherford. ('O.M.' Series.) Cr. 8vo. Pp. x+195+8 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5s. net.\*

**Hooper, Sydney E.,** Edited by. The Deeper Causes of the War and its Issues. By W. G. S. Adams, Viscount Samuel, Sir Richard Livingstone, Ernest Barker, Gilbert Murray, Very Rev. W. R. Matthews, Sir Richard Gregory, Sir William Beveridge. Cr. 8vo. Pp. 206. (London: George Allen and Unwin, Ltd., 1940.) 5s. net.\*

**Kurtz, Albert K., and Edgerton, Harold A.** Statistical Dictionary of Terms and Symbols. Cr. 8vo. Pp. xii+191. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 12s. net.\*

**Lester, Bernard.** Applied Economics for Engineers. Med. 8vo. Pp. vii+464. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24s. net.\*

**Meade, J. E.** The Economic Basis of a Durable Peace. Cr. 8vo. Pp. 192. (London: George Allen and Unwin, Ltd., 1940.) 6s. net.\*

**Mess, Henry A.** Social Groups in Modern England. (Discussion Books, No. 73.) Cr. 8vo. Pp. 168. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1940.) 2s. 6d. net.\*

**Nicholson, Max.** How Britain's Resources are Mobilized. (Oxford Pamphlets on World Affairs, No. 30.) Cr. 8vo. Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 3d. net.\*

**Richter, Conrad.** The Trees. Cr. 8vo. Pp. vi+308. (London: Constable and Co., Ltd., 1940.) 7s. 6d. net.\*

**Universities of the Empire.** The Yearbook of the Universities of the Empire, 1940. (Published for the Universities Bureau of the British Empire.) Cr. 8vo. Pp. xlv+984. (London: G. Bell and Sons, Ltd., 1940.) 15s. net.\*



Whilst nothing very new is to be found in these pages, the reader will probably benefit by using this volume, mainly because the authors present their matter well, and incidentally by reason of the good practice which is obtained by following a well-known theme in a foreign language.

F. I. G. R.

## MEDICAL SCIENCES

### Medical Microbiology

By Prof. Kenneth L. Burdon. Pp. xii+763. (New York: The Macmillan Company, 1939.) 18s. 6d. net.

THIS work, which is intended both for students and their teachers, is divided into four parts and five appendixes. The first part, which deals with the fundamentals of microbiology, consists of sixteen chapters, including an account of the historical aspects of the subject, the various types of micro-organisms, their classification and nomenclature, and their destruction by physical and chemical methods. The second part is concerned with the laboratory study of micro-organisms, and gives a description of the apparatus, culture media, isolation of bacteria and the collection of specimens for bacteriological examination. In the third part, which deals with infection and resistance, sources of infection, modes of spread by water, milk and other foods, the part played by insects, natural and acquired immunity, vaccine and serum therapy, and anaphylaxis receive attention. In the fourth part the microbiology of important infectious diseases is studied, including tetanus, diphtheria, pneumonia, typhoid and paratyphoid fever, staphylococcus and streptococcus infections, etc. The appendixes are devoted to a comparison of metric and English scales, formulæ for the preparation of media, reagents and stains, important immunological tests, classified lists of references, and questions to which the answers will be found in the foregoing pages.

This comprehensive work, which is liberally illustrated, will form a useful handbook for the laboratory worker and clinician alike.

### Epidemiology in Country Practice

By Dr. William Norman Pickles. Pp. viii+110+1 plate. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1939.) 7s. 6d. net.

THE author, who is medical officer of health to the Aysgarth rural district in Yorkshire, is introduced in the preface by Prof. Major Greenwood in allusion to the Bristol physician and epidemiologist as "a second Budd", which, as the reader will find, is a high, but well-merited, compliment. Dr. Pickles not only appeals to other country doctors to keep records, as he has done for many years, of epidemic diseases, but also seeks to awaken the interest of the layman, whose help in this field he regards as inestimable. The work, which is remarkably readable, consists of a number of essays, some of which have already been published in various medical journals, dealing with certain common infectious diseases,

such as influenza, measles, scarlet fever, whooping-cough, mumps and chicken-pox, as well as less common infections, such as Sonne dysentery, pink disease, undulant fever, epidemic catarrhal jaundice, and the disease variously known as epidemic myalgia, Bornholm disease or devil's grip, the occurrence of which in Great Britain was first described by Dr. Pickles.

### Diet in Health and Disease

Edited by Sir Humphry Rolleston and Dr. Alan A. Moncrieff. (Published on behalf of the *Practitioner*.) Pp. 382. (London: Eyre and Spottiswoode, Ltd., 1939.) 14s. net.

MORE than thirty years have elapsed since the appearance of the last important British compendium on diet, edited by the late Dr. G. A. Sutherland, so that a new book on the subject was urgently needed. Most of the articles in the work have already been published in the *Practitioner*, but they have been revised and a few new ones have been added. The book contains twenty-eight chapters contributed by thirty-two specialists. The chapters on diet in health deal with the various forms of infant feeding, diet in childhood, old age, winter and summer, pregnancy and lactation, and in the tropics, while the chapters on diet in disease are concerned with sick-room menus and recipes, diseases of the various systems and allergic diseases. A special chapter is devoted to alcohol, the dietetic use of which has been greatly reduced in recent years. The up-to-date and practical advice in which the work abounds will render it a useful handbook to the practitioner and student.

### The Handicap of Deafness

By Irene R. Ewing and Dr. Alex. W. G. Ewing. Pp. x+328+3 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 12s. 6d. net.

THIS book contains a unique record of experience in a particularly arduous field of social science, and is likely indeed to fulfil the aims of its authors to provide a working source of information alike for the deaf and those who serve them. The difficulties which beset the management of the deaf are dealt with in a manner connoting wide knowledge and technical competence, and the lessons to be learned are both valuable and clearly defined. Particularly striking are the figures showing the time wasted in chronic deafness in adults before the initiation of lip reading, its importance in reinforcing any hearing aid, and the high percentage of deafened adults who can be considerably assisted by modern electrical apparatus.

The sections dealing with the measurement of deafness are eminently sound. Intelligibility of speech is very properly made the basic test, and the reviewer particularly welcomes the emphasis laid upon the necessity in such tests of excluding the influence of context. The method adopted of nonsense syllables is probably the best available, but more emphasis might have been laid upon the necessity



for highly trained personnel for its successful application; and there seems little reason why this in its turn should not in due course be placed upon an electrical basis. Some lack of accord between pure tone threshold tests and intelligibility in the earlier stages of deafness is recognized and accords with the more empirical observations of clinicians. One of the best chapters is that which describes deafness and its recognition in the young child. The influence of Mr. T. S. Littler's technical contributions is apparent throughout this book and is frequently acknowledged by its authors. C. S. H.

#### Biography of the Unborn

By Margaret Shea Gilbert. Pp. x+132. (London: John Murray, 1939.) 5s. net.

**T**HIS little book surveys in simple language the development of the human embryo during its nine months of intra-uterine life. Fertilization, the role of the sex chromosomes, the genesis of twins and the occurrence of malformations are also briefly dealt with. The descriptions are illustrated with numerous diagrams which clearly depict the changes that occur as growth proceeds from month to month.

The book gives an accurate summary of the subject, but is scarcely advanced enough or sufficiently scientific for the student or medical practitioner. For the layman who is interested in the subject, and for whom it is primarily intended, it can be recommended.

### METALLURGY

#### Metallurgy for Engineers

By E. C. Rollason. Pp. viii+272. (London: Edward Arnold and Co., 1939.) 10s. net.

**N**O words are wasted in this book, the purchaser of which receives about seven hundred per penny, together with some 150 illustrations, including many clever diagrams which amplify the text. Here indeed is value for money which no student can readily ignore. The most serious criticism which can be made of the book is that it is too concise and may encourage 'cramming'. Although the preface indicates that the book is intended for use in conjunction with a teacher, this does not absolve the author from responsibility, and one would like to see, in the next edition, fewer statements of fact and more explanations of basic principles.

#### Practical Microscopical Metallography

By Dr. Richard Henry Greaves and Harold Wrighton. Third edition, revised and enlarged. Pp. xi+272+60 plates. (London: Chapman and Hall, Ltd., 1939.) 18s. net.

**A** DISTINGUISHED research metallurgist collaborated with a virtuoso of the metallographic microscope to produce, in 1924, the first edition of this book. It has become the standard work on the subject, and one turns from the second edition with a tinge of regret, to greet the new friend. The authors still refuse to call it a text-book, although it is far

more than a series of annotated photomicrographs. Many of these are, as in the previous editions, superb, and most of them are excellent: one or two permit the average metallographer to regain his self-respect, at least for a moment. The descriptions of technique are even more extensive and the practical hints on low-power work are particularly welcome. Discussion of the 'austemper' process, photomicrographs of typical disintegration-proof 18-8 steels, and particulars of the electrolytic cyanide etch for precipitated carbides, might be included with advantage in the next edition.

### MISCELLANY

#### The Growth of Science

An Outline History. By A. P. Rossiter. (Published for the Orthological Institute.) Pp. 372. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 5s. net.

**T**HIS little book will prove very useful from many points of view. It gives an authoritative account of the leading stages of the history of science. Then it connects the various fields of science in a way which helps the reader to understand the unity of its development. Moreover, it gives a short explanation of the notions involved in the problems discussed. Finally, it gives a good illustration of what can be done in this field by a judicious use of Basic English. Controversial issues are wisely avoided; and as the book is short, one feels less the monotony of the basic vocabulary and syntax ably used by the author. In itself, this work is an excellent popular introduction to the history of science.

#### The Language of Gesture

By Dr. Macdonald Critchley. Pp. 128. (London: Edward Arnold and Co., 1939.) 5s. net.

**A**S students of human speech still concentrate primarily on its sounds rather than on the muscular movements which produce them, it is well that specialists like Dr. Macdonald Critchley should intervene. He has brought together, in 124 pages, a larger volume of valuable material than has so far been available. It is surprising, however, that though the author pays great attention to gesture language—including copious references to the scattered literature on the subject—he does not mention Darwin's observation on the sympathy of movement between man's hand and mouth, which constitutes the fundamental link between primitive descriptive gesture and the significant mouth movements of speech. Nor does he clearly define the difference between instinctive pantomime—such as that of the born deaf—which describes events as a whole, and the acquired sign languages—such as that of the Red Indians—in which each sign stands for a separate unit of thought, equivalent to a 'word'. The origin of these units of thought deserves thorough investigation.

The reference to Armenian sign language (p. 50) needs correction. The language is used exclusively by women—not by men. The descriptions of hand



gestures might have been made easier; "pronated", "adducted", etc., will be unfamiliar terms to many of the wide public by whom this excellent little book should be read.

#### Land Drainage and Reclamation

By Prof. Quincy Claude Ayres and Prof. Daniels Scoates. (McGraw-Hill Publications in Agricultural Engineering.) Second edition. Pp. xi+496. (New York and London: McGraw-Hill Book Co. Inc., 1939.) 26s.

THIS work is of the nature of a text-book and as such is particularly designed for American State colleges, in that the usual problems associated with each subject are asked at the end of each chapter. Survey with levelling is taught and then the technique of drawing, the open ditch method and the use of earth dams being especially carefully explained. Land clearing by grazing, cutting and burning encourages soil erosion which has to be controlled. This leads to the consideration of the terracing of fields and the use of check dams in gullies. Finally, sub-surface draining is considered, and the use of mechanical means in the cutting of the necessary trenches for drain pipes. Where there are wide areas of similar land as in Iowa and Texas the methods recommended can be applied. In Great Britain, with its much greater variation in topography and geology, this book will only be helpful in suggesting methods, the consideration of the drainage of each farm being a little research of its own.

#### Begin Here

A War-Time Essay. By Dorothy L. Sayers. Pp. 160. (London: Victor Gollancz, Ltd., 1940.) 6s. net.

MISS DOROTHY L. SAYERS, for the moment breaking free from her pre-occupations with the writing of detective stories and the drama, has presented her numerous public with a War-time essay. Her somewhat cryptic title expresses her firm conviction that now and not the end of the War is the time for pondering and planning the post-War world in which we are to emerge from the present struggle. Her vigorous call for constructive thinking on the part of the average citizen for whom she writes is based, as befits so informed a student of the medieval world, upon an acute analysis of the main currents of thought and emotion which contributed to making Europe of the Middle Ages something of a homogeneous whole. Possibly there is a tendency in a certain group of writers on historical topics to over-stress this unity. Be that as it may, Miss Sayers recognizes that the revival of learning and the growth of the spirit of inquiry made impossible a return to that unity of thought and emotion, with all its implications as a condition of peaceful relations among the people of Europe. It is the business of constructive thinking to arrive at a form of relation in modern civilization which in like manner will bring about not a static, but a dynamic, condition of peace. Miss Sayers is emphatic in pointing out that this is to be achieved not by consideration of the requirements of 'economic man' or psychological considerations

but only of the whole nature of man in which the part of emotion as well as reason attains free play.

#### Uses of Lac

By Dr. H. K. Sen and S. Ranganathan. Pp. 79+20 plates. (Namkum: Indian Lac Research Institute, 1939.) 1.4 rupees.

THIS little book is intended primarily to interest Indian manufacturers and industrialists as potential users of lac and shellac. The authors point out that since the consumption of lac in India is only 2-3 per cent of the exported amount, there should be considerable room for expansion in that country. The book, however, should have a definite appeal to the average reader, seeking knowledge of the origin and uses of this unique natural resin. Many of the more important applications of this raw material are briefly described and there are numerous practical recipes.

Among the large amount of data given, the table (p. 15) showing the export figures for the past twenty years is of particular interest inasmuch as it demonstrates that lac is more than holding its own in face of competitive synthetic resins.

The book is attractively printed with well-defined headings and sections, and amply illustrated by numerous photographs showing the diverse uses of shellac and its commercial products. The clarity of some of the illustrations, however, appears to have suffered in reproduction.

#### PHILOSOPHY AND PSYCHOLOGY

##### The Structure of Aristotelian Logic

By Prof. James Wilkinson Miller. (Psyche Monographs, No. 11.) Pp. 97. (London: Kegan Paul and Co., Ltd., 1938.) 10s. 6d. net.

THE principal aim of this able book is to effect the reorganizations required in traditional logic by the introduction of negative terms, which occurred technically during last century; and also to give a rigorous presentation of traditional logic as containing negative terms.

The former analysis of Aristotelian logic given by the author introduces new definitions, postulates and distinctions necessitated by the symbolization of the system. This formalization makes traditional logic look much poorer than the so-called recent generalizations of the subject. It could scarcely be otherwise; for this treatment of the Aristotelian system takes, so to speak, all the blood out of it. It is not its mere formalization that gives an inferential necessity to this system; but also and mainly its ontological and qualitative background. One without the other gives an unfair picture of traditional logic, especially as the author of the book assumes without proof that the fundamental principles of Aristotelian logic are less general than those of modern mathematical logic. As it is, however, the book should help to build up a more satisfactory valuation of Aristotelian logic, provided one takes into account most of the relevant subjects which the author omits deliberately in his discussion.



**Cosmology**

A Text for Colleges. By Prof. J. A. McWilliams. Second revised edition. Pp. x+243. (New York: The Macmillan Company, 1938.) 9s. net.

TO many readers this book will seem old-fashioned, with little reference to the technical problems which face the modern scientific worker. For one thing, the bibliographies given at the end of each chapter and at the end of the book show a complete disregard of the recent technical literature by leading specialists on mathematical and physical theory. Father McWilliams approaches his problems from a scholastic angle. But there is no reason for giving the impression that scholasticism is necessarily backward.

Many readers would be interested to know how the fundamental ontological and cosmological theories of scholasticism can be interpreted in terms of modern scientific discoveries; and this interpretation is, no doubt, possible. This book, however, is valuable in suggesting such an approach, provided one could go much further than the elementary details it takes into account. The argumentative method adopted is also refreshing. As to the controversial issues involved, the author repeats the classical solutions, where he could use, with greater effect, examples and arguments from recent scientific discoveries.

**PHYSIOLOGY****Nahrung und Ernährung**

Altbekanntes und Neuerforschtes vom Essen. Von Dr. Hans Glatzel. (Verständliche Wissenschaft, Band 39.) Pp. vii+256. (Berlin: Julius Springer, 1939.) 4.80 gold marks.

THE author of this book set himself the task of presenting the elements of the science of nutrition in a manner which would make them intelligible to every German citizen. An introductory section discusses food and nutrition in the animal kingdom and the physiological basis of nutrition. Dr. Glatzel then considers the composition and distribution of the foodstuffs within the Third Reich and the effective methods of conditioning, preserving and cooking. The role of the sense-organs in digestion is adequately described and, in the treatment of the hygiene of eating, the author takes great pains to emphasize the distinction between hunger and appetite. In dealing with food-requirements and the variations, the effectiveness of the Allied blockade in 1914-18 receives considerable prominence, indications being made to suggest that such a condition can never again be possible in Germany. Particular food-fads and dietetic methods are examined and, where necessary, exposed. In an excellent chapter the author discusses the significance of food and nutrition in myth and religion. In conclusion, nutrition is related to the social problem, due regard being paid to the organization of Germany's food economy. The real purpose of the book is revealed in its last sentence: "Von den Nahrungs-wahl jedes einzelnen, von seinem gutem Willen und seiner Einsicht hängt es aber auch ab, wie schnell und

wie vollständig wir das grosse Ziel erreichen: *Deutschlands Nahrungsfreiheit.*"

A glossary and suggestions for further reading are appended, although there is no index. T. H. H.

**The Newer Knowledge of Nutrition**

By Prof. E. V. McCollum, Dr. Elsa Orent-Keiles and Dr. Harry G. Day. Fifth edition, entirely rewritten. Pp. ix+701. (New York: The Macmillan Company, 1939.) 18s. net.

IT is like meeting an old and much-loved friend after many years to have in one's hand a new edition of "McCollum". This is the fifth and it appears after an interval of no less than ten years, which is a whole epoch in the recent history of nutritional science. In its preparation Prof. McCollum has had the assistance of two collaborators, Elsa Orent-Keiles and Harry G. Day, and I rather feel the work has to a slight extent lost individuality as a result. But that is a small fault to find with a work that so ably and so adequately reviews the wide range of human and animal nutrition. Indeed, instead of a slight sense of disappointment that the book has not quite the 'personality' earlier editions had, one should feel very grateful that Prof. McCollum and his two colleagues have succeeded in producing a little more than six hundred very readable pages from their survey of so vast a literature. It need scarcely be said that the work is indispensable to all who wish to keep abreast with nutritional science and its application to human and animal welfare. But Prof. McCollum must realize that having produced what has for long been regarded as a standard work, we shall all be greatly disappointed if we are obliged to wait ten years for the next edition. J. C. DRUMMOND.

**The Physiological Basis of the Art of Singing**

By Haydn Hemery. Pp. xviii+139. (London: H. K. Lewis and Co., Ltd., 1939.) 10s. 6d. net.

SINGING is without question an art, but there should be at least an element of science in the training of singers. The technique employed is very difficult to discover from conversation with teachers of singing. The difficulty is partly due to lack of common vocabulary, and too often also the same words are used by singers and scientists with quite different meanings.

The literature of voice training is comparatively small. The 'secrets' of the teachers have been for the most part passed down by word of mouth from one generation to the next. Mr. Hemery has attempted to supply the written deficiencies in a way in which teachers of singing can learn more of the scientific side of their work. The simple and clear anatomical diagrams are perhaps the most valuable part of the book.

For the scientific reader the book is scarcely satisfying, nearly every page leaving a number of queries in the mind. Moreover, the science is curiously mixed with unscientific statements, as, for example, in the numbered captions to one of the chapters, which runs thus: "Love is unification at an emotional level, for it is impossible to love and be wise."





# ELECTRONIC STRUCTURE AND CHEMICAL BINDING

**With Special Reference to Inorganic Chemistry**

By **OSCAR KNEFLER RICE**

*Associate Professor of Chemistry, University of North Carolina*

511 pages, 9 × 6, illustrated, 33/- net

**E**SSENTIALLY a discussion of the chemical bond as exemplified in inorganic compounds, this interesting new book has been written with a two-fold purpose :

1. To lay a foundation in atomic physics, of the depth and scope likely to be most useful for chemists in general, and capable of being used as an introduction for those who expect to specialize more particularly in the field.
2. To classify, on the basis of this foundation, the chemical compounds and to discuss numerous problems in chemistry having to do especially with the nature of chemical binding.

The early part of the book gives the student a foundation in atomic theory and chemistry. Here the author has steered a middle course between the superficial and the rigorous by presenting enough detail to give the student a feeling for the physical meaning of the quantum relationships, sufficient for an understanding of the latter part of the book, but avoiding the detailed mathematics and such topics as throw no light on the later development.

In the latter part of the book the author presents the application of the general principles to particular chemical systems. Here much attention is given to the nature and properties of chemical bonds. The general aim of these chapters is to give the student, by discussion and a wealth of illustrations, an adequate knowledge of the nature of chemical binding in the various types of compounds, and to show what can be done toward an understanding in relatively simple terms of the properties of compounds which are generally described in treatises on inorganic chemistry. This latter part of the book is strictly up to date. Everything included has received critical analysis and has been correlated with the book as a whole.

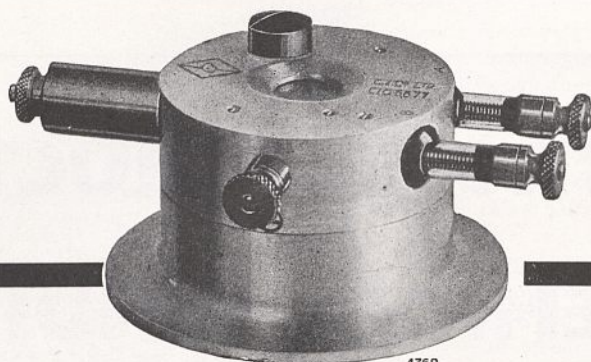
A limited number of exercises has been added at the ends of chapters.

## Contents

Preface	Transition from Covalent to Ionic Binding in Simple Gaseous Compounds
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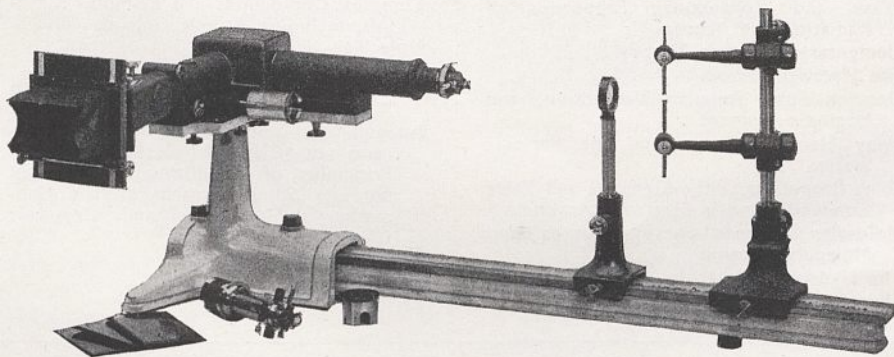
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duction of flavour in bacon and ham (Food Investigation Special Report No. 49. "The Function of Nitrate, Nitrite, and Bacteria in the Curing of Bacon and Ham". H.M. Stationery Office. 9d. net). Curing of pork for bacon and ham was originally a process of dry salting. Now, the pickle used is liquid, and the process is supplemented by injecting the pickle into the tissues of the carcass. The traditional pickling materials—salt and saltpetre—are still used in Great Britain, but it has long been known that the 'cured colour' is due to the formation of nitrite by the action of bacteria upon the saltpetre. The nitrite formed reacts with the blood colouring matter present to form a special pigment, nitroso-hæmoglobin. It is shown that a satisfactory English bacon can be made by using only sodium chloride and sodium nitrite in the pickle, and that bacteria and nitrate are not essential for the development of the flavour. A very small content of free nitrite, as low as ten parts per million in the final product, is sufficient to produce a satisfactory flavour and colour. The report indicates the possibility of recasting the present practice so as to give the curer better control over the quality of this product.

#### The Stoic

THE April number of the *Stoic* represents, not the "famed Athenian Porch", but Stowe School, which, starting at one of the great houses which flourished in the eighteenth century, has long since won its way to recognition on a par with older foundations. The school magazine is one of the best we have seen, including literary matter as well as the usual records of activities. Stowe is now responsible for two London clubs for boys. It produces its own films, which have dealt with several classes of animals and plant-life, while the Natural History Society, started last year, keeps a journal of work done which is well spoken of. The school evidently enjoys many things besides the normal curriculum. The illustrations make a good show and include a lively "Decorated Black-out Screen" designed by a young artist.

#### Earthquakes in the United States and in Italy

ON Saturday and Sunday, May 18 and 19, severe earthquake shocks were experienced in the south-western United States and in Italy. In the United States eleven shocks were felt at places so far apart as 800 miles in Southern California and Arizona. The town of Imperial is reported in ruins, with five people killed and many injured. Owing to the disruption of communications, further details are not yet available. The place most affected in Italy appears to have been San Servo.

#### Other Recent Earthquakes

REPORTS from the seismological observatories at Kew (England) and De Bilt (Holland) confirm that there were two large earthquakes on May 4 and one on May 5. At Kew the first commenced recording at 7h. 35m. 55s. G.M.T. on May 4, and the epicentre was estimated to be distant 8,500 km. The second was received at Kew at 21h. 10m. 7s. G.M.T. on the

same day, with an estimated epicentral distance of 4,770 km., and gave rise to ground amplitudes of 54  $\mu$ . The third commenced recording at 2h. 16m. 40s. G.M.T. on May 5 at Kew, and the estimated epicentral distance was 9,750 km. These readings have been confirmed by equivalent readings from De Bilt. Dr. G. van Dyk is of the opinion that the first on May 4 originated near the Aleutian Islands, which has recently been observed to be seismically active (*NATURE*, May 4, p. 701 and earlier issues) and that the second on May 4 may have come from an easterly azimuth.

#### The Night Sky in June

THE nights around the summer solstice on June 21 are shorter than 7½ hours in the latitude of London, reckoned from sunset to sunrise; excluding twilight (nautical) darkness lasts only about three hours. The moon is new on June 6 and full on June 19. Venus, which is still a brilliant evening star at the beginning of the month, draws rapidly towards the sun's place and is at inferior conjunction on June 26. Mercury is also an evening star in conjunction with Venus on June 12 and with Mars on June 17; on June 24 Mercury is at greatest elongation (25° east). Mars is getting less easy to see; it is close to Venus on June 7. Jupiter and Saturn are both morning stars, the former rising soon after 1h. 30m. U.T. on June 16, followed ¼ hr. later by Saturn. At dusk in mid-June, the red star Antares is about south. Arcturus has already southered, while Vega is some 3 hours before the meridian. The constellations, Bootes, Hercules and Ophiuchus contain some interesting double stars of which  $\epsilon$  Boötis (2.8"),  $\xi$  Bootis (5.1"),  $\alpha$  Herculis (4.8") and 70 Ophiuchi (6.6") are good examples. Between  $\eta$  and  $\zeta$  Herculis may be glimpsed the great star cluster, M13, the distance of which is of the order 35,000 light years. The outer part of the cluster can be resolved into stars with a 2½- or 3-inch refractor. The Scorpiid meteors are at their greatest frequency about June 4, their radiant point being north, following Antares.

#### Announcements

THE Editors of *NATURE* have decided that, for the time being, the receipt of the manuscript of contributions cannot be acknowledged. Furthermore, it is found essential to reduce the number of proofs sent to the author of contributions submitted to one. This proof must be accepted as an acknowledgement of receipt of the copy.

AMONG his personal assistants, the Prime Minister has appointed Prof. F. A. Lindemann, F.R.S., professor of experimental philosophy in the University of Oxford, for advice concerning statistics and research.

DR. H. SHAW, keeper in the Department of Physics and Geophysics at the Science Museum, has been appointed acting director of the Museum during the absence of Brigadier E. E. B. Mackintosh.



## LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 825. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Transformation of Mesotrons into Electrons

EVIDENCE for the transformation of mesotrons into electrons was recently reported in these columns<sup>1</sup>. This was obtained by the use of the cloud chamber, and consisted in the observation of a fast electron track emanating from the end of the track of a mesotron. What appears to be another instance of this phenomenon was recently observed in this laboratory, though on account of the tracks being rather old and accompanied by other old tracks the photograph is not as good as the earlier one. Apart from a further indication of the frequency of occurrence of the phenomenon, it does not give any new information.

The probability of catching a mesotron coming to the end of its range in a cloud chamber, with random expansions, is greatly enhanced if the chamber is large or contains gas at a high pressure. In the work previously reported a large chamber (60 cm. diameter, 50 cm. deep) operating at atmospheric pressure was used. (This chamber has since been operated at four atmospheres.) The present tracks were observed in a cloud chamber of moderate dimensions (20 cm. diameter, 16 cm. deep) containing argon at 80 atmospheres. A distance of 15 cm. in this chamber is equivalent in stopping-power to

about 2 cm. of water, or 16 metres of standard air. Actually the total length of track (old and new) of cosmic-ray particles observed up to date in the high-pressure chamber, and in the large chamber, is equivalent to about  $5 \times 10^6$  cm. of standard air. The observation in these experiments of two mesotron-ends thus corresponds to  $4 \times 10^{-7}$  mesotron-ends per cm. of cosmic-ray track in air. The number expected as the result of the slowing down of fast mesotrons (cf. ref. 3, p. 210) is equal to the product of the number of fast mesotrons (energy  $T$ ,  $\sim 5 \times 10^8$  volts) per unit energy interval per cosmic-ray particle, the rate of loss of energy in air by fast mesotrons (energy  $T$ ), and the decay factor for mesotrons of energy  $T$  under the conditions concerned,  $\sim 3 \times 10^{-4}$  per Mev.  $\times 3 \times 10^{-3}$  Mev. per cm.  $\times 0.6 \sim 5 \times 10^{-7}$  per cm. The rough agreement with the observed frequency, and a similar agreement regarding the number of slow mesotrons observed in earlier work<sup>2,3</sup> indicate that there is not a very high probability for the removal of a mesotron from the cosmic-ray beam by some hitherto unknown process, unless there is a creation of slow mesotrons which happens to compensate roughly for the removal of fast ones.

The photograph referred to above is reproduced in Fig. 1.  $AB$  and  $BC$  represent the tracks concerned. The appearance of these is consistent with a mesotron  $AB$  coming to the end of its range at  $B$  and transforming into an electron  $BC$ . The tracks in the neighbourhood of  $B$  show that the illumination was fairly uniform in that region. That  $AB$  is the track of a slow particle ( $v \ll c$ ) is shown by the relative high density of ionization along it as compared with  $BC$ . It might be pointed out that the length of dense track rules out an electron as the responsible particle, since at these pressures an electron is fast up to the last few millimetres of its range. (It will be noticed that a track which enters the chamber near  $A$  appears also to terminate in the gas with a faint track leaving the neighbourhood of its end. While this resembles a mesotron disintegration more than anything seen in all the other photographs (about 1,400) the conditions near the end of the track, such as weak illumination, are too poor to warrant any inferences. It may possibly be the track of opposite sign to  $AB$ , separated from it by the electric field.)

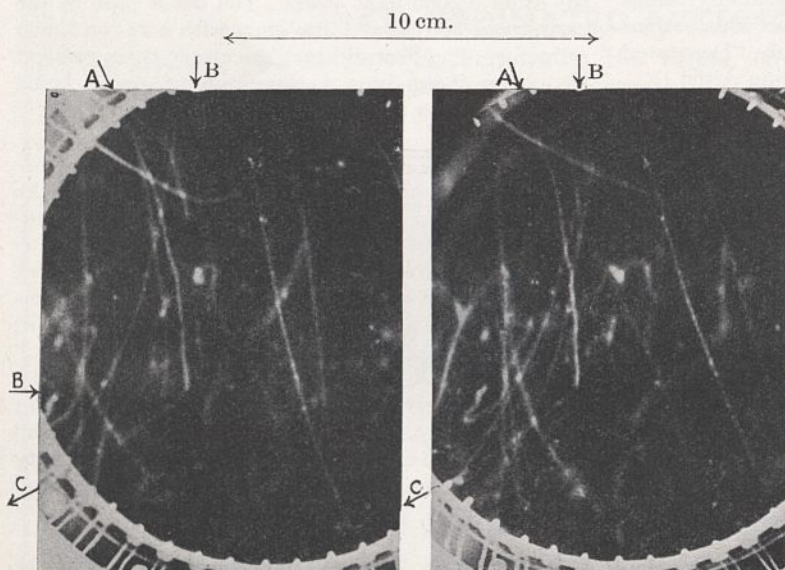


Fig. 1.

FOR STEREOSCOPIC VISION, THE LEFT-HAND PHOTOGRAPH SHOULD BE VIEWED BY THE RIGHT EYE, AND *vice versa*.





Fig. 2.

It is of interest to consider the probability of the occurrence of the tracks  $AB$ ,  $BC$  by the chance coincidence of the beginning of a fast high-energy track with the end of a heavy track. In all the other photographs taken with the high-pressure chamber, about 1,200, there is only one clear case of a heavy track—probably a proton—terminating in the chamber, and about half a dozen doubtful cases of tracks, not necessarily heavy, ending or beginning in the chamber. Even assuming that one fast track starts in the chamber in every photograph, which is a gross over-estimate, the above probability is then of the order of  $6 \times (\text{thickness of track})^3 \div (\text{volume of illuminated part of chamber}) \sim 6 \times (0.1 \text{ cm.})^3 \div (13^2 \text{ cm.}^2 \times 5 \text{ cm.}) \sim 10^{-5}$ . The corresponding upper limit to the probability of the chance imitation of the example observed in the large chamber reported earlier<sup>1</sup>, is  $1 \times (0.04 \text{ cm.})^3 \div (40^2 \text{ cm.}^2 \times 12 \text{ cm.}) \sim 10^{-8}$ . The probability of both examples being an accidental coincidence is accordingly much less than  $10^{-13}$ .

$AB$  is obviously distorted by scattering, while both  $AB$  and  $BC$  are probably distorted by air-motion and by the electric field (before condensation). Their radius of curvature ( $\sim 25$  cm. for each) has therefore no significance of value. It might, however, be mentioned that a mesotron of the same range, with a mass one tenth that of a proton, would have an overall radius of curvature of about 50 cm. due to the magnetic field (2,700 gauss) and a natural curvature, due to scattering, equal on the average to about 30 cm. (For a proton these would be greater by factors of about 5 and 3 respectively.) If the electron,  $BC$ , had half the mass energy of the mesotron ( $\sim 40$  Mev.), its radius of curvature due to the field would be about 50 cm., and about 350 cm. due to scattering.

We reproduce in Fig. 2 a photograph, taken under the same conditions as that reproduced in Fig. 1, showing two sharp tracks, which is about the average

number of sharp tracks per photograph. These are little disturbed by air motion. One is seen to produce two fast secondary electrons, the angles of projection of which indicate an initial energy of about 3 Mev., corresponding to a range of about 15 metres of air at N.T.P.

E. J. WILLIAMS.  
G. R. EVANS.

University College of Wales,  
Aberystwyth.  
April 7.

<sup>1</sup> Williams and Roberts, *NATURE*, **145**, 102 (1940).

<sup>2</sup> Williams and Pickup, *NATURE*, **141**, 684 (1938).

<sup>3</sup> Williams, *Proc. Roy. Soc., A*, **172**, 194 (1939).

## Classical Theory of Point Dipoles

It is well known that a limit to the validity of quantum mechanics is set by its neglect of the effects of radiation damping, and an indication as to where this limit occurs is given in electron theory by the classical equation of Lorentz, which takes radiation damping into account. Now the interaction of the meson field with a neutron or proton contains an explicit dipole term, and this leads to scattering cross-sections for mesons which increase quadratically with the energy. A classical treatment of radiation damping for a dipole would thus give us the limits of the quantum theory due to neglect of this factor. A non-relativistic attempt has already been made by Heisenberg<sup>1</sup> for a dipole of finite extension, but his results even in the limit of a point dipole do not agree with ours. We believe that this is because the usual method of calculation which he follows is inconsistent with the theory of relativity, for whereas the retardation of the field is taken into account, different parts of the dipole are assumed to move instantaneously in phase.

The method used by Dirac<sup>2</sup> for a point electron, and by me<sup>3</sup> in the classical theory of mesons, has been extended for finding the exact classical relativistic equations for the motion of a point-dipole described by a six-vector  $S_{\mu\nu}$ .

It will be shown in a paper with Corben that the flow of energy and momentum out of a world-tube of radius  $\epsilon$  surrounding the world-line of the dipole contains certain terms which tend to infinity as  $\epsilon \rightarrow 0$ , but these are all perfect differentials, and hence may be subtracted as in the previous papers. The flow of total angular momentum out of the tube (including the orbital angular momentum)<sup>4</sup> contains similar singular terms, but these are also perfect differentials and may be subtracted as before (the calculation of the singular terms is entirely due to Dr. H. C. Corben). Thus completely definite equations free from singularities can be found for the rotation and translation of a point dipole.

Using these results, I have been able to show the following:

The charge  $g_1$  and dipole moment  $g_2$  are independent constants, and the mass  $M$  and angular momentum of the spin  $I$  also appear as independent and arbitrary constants in the equations. Further, it is also true in the special case  $S_{\mu\nu} v^\nu = 0$  ( $v^\nu$  is the 4-velocity of the dipole), where the dipole is always a pure magnetic dipole in the system in which it has no translational motion. This is in definite disagreement with a paper by Kramers<sup>5</sup> in which a relation between the four constants was deduced.



The case where  $S_{\mu\nu}v^\nu$  is variable can be treated quite consistently, and *if* radiation damping be neglected, is mathematically simpler than the case  $S_{\mu\nu}v^\nu = 0$ . But when radiation damping is taken into account, the former is vastly more complicated than the latter. It is satisfactory to find that it is the simpler case which is the only one to occur in Nature. The complete rotational and translational equations when  $S_{\mu\nu}v^\nu = 0$  have already been given elsewhere<sup>6</sup> for the special case  $g_1 = 0, g_2 \neq 0$ .

In view of what has been said above, if we wish to consider only the rotational motion of the dipole, we may let the mass  $M$  of the dipole tend to infinity, in which case  $v_\mu$  and its derivatives vanish. The rotational equations then take on a particularly simple form, namely

$$I \dot{S}_{kl} = g_2(S_{km} F^{m_l} - S_{lm} F^{m_k}) - \frac{2}{3} g_2^2 (S_{km} \ddot{S}^{m_l} - S_{lm} \ddot{S}^{m_k}) \quad (1)$$

Here  $F_{\mu\nu}$  is the ingoing electromagnetic field. The last term gives the effect of radiation damping.

With these equations, the cross-section for the scattering of light of frequency  $\omega/2\pi$  by the dipole is<sup>6</sup>

$$6\pi \frac{\omega^2 \sin^2 \theta}{\omega^4 + 9I^2/4g_2^4} \dots \quad (2)$$

where  $\theta$  is the angle between the magnetic force of the light wave and the axis of the magnetic dipole. For small  $\omega$  this becomes

$$\frac{8\pi}{3} \frac{g_2^4}{I^2} \omega^2 \sin^2 \theta, \dots \quad (3)$$

which is the cross-section previously calculated on the quantum theory. It *increases* as  $\omega^2$ . For large  $\omega$ , however, the exact cross-section (1) becomes

$$6\pi \frac{\sin^2 \theta}{\omega^2},$$

and thus *decreases* as  $\omega^{-2}$ .

Although (2) is strictly valid only for the scattering of light, it may be used to give an estimate of the scattering of meson waves by neutrons, for, as has been shown in a previous paper<sup>3</sup>, the existence of the finite rest mass  $\mu$  of the meson only *decreases* the above cross-section for energies  $\hbar\omega \sim \mu$ , while the cross-section is not appreciably altered for  $\hbar\omega \gg \mu$ .

The equation (1) and the cross-section (2) show that radiation damping becomes important when

$$\hbar\omega \gtrsim \hbar\sqrt{\frac{3I}{2g_2^2}}.$$

Putting  $I = \hbar/2$  for a neutron, and the empirical value  $g_2 = g_1\hbar/\mu$  ( $\mu =$  meson mass) for the meson field, this gives

$$\hbar\omega \gtrsim \mu \sqrt{\frac{3\hbar}{2g_1^2}} \sim 2\mu.$$

(The velocity of light has been put equal to unity.) Thus we should expect the quantum theory of the meson neutron interaction to fail for energies higher than  $2\mu$ , but *this limit has really nothing to do with the mass of the meson and merely depends on the empirical magnitude of the constants  $g_2$  and  $I$ .*

It is interesting to note that, whereas for the scattering of neutral mesons by neutrons quantum effects do not set in until  $\hbar\omega \gtrsim M$  (where  $M$  is the neutron mass), the quantum theory already goes wrong for energies  $\hbar\omega \gtrsim 2\mu$  due to neglect of radiation damping. Thus, contrary to what happens in electron

theory, there is a region of energy  $2\mu < \hbar\omega < M$  where the classical formula (2) will be correct, but the quantum formula (3) quite wrong.

To apply the same formula to the spin of the meson and its interaction with *electromagnetic fields*, we put  $I = \hbar, g_2 = e\hbar/2\mu$ , and find that the quantum theory of this interaction should fail when

$$\hbar\omega \gtrsim \mu \sqrt{\frac{6\hbar}{e^2}} \sim 28\mu,$$

a limit which is much higher than the limit given above at which the theory of nuclear interaction fails.

An electron has no explicit  $g_2$  spin interaction with the Maxwell field, but *if* the above theory is applicable to its spin, then putting  $I = \hbar/2, g_2 = e\hbar/2m$ , we should expect the quantum theory of the electron to fail for energies

$$\hbar\omega \gtrsim m \sqrt{\frac{3\hbar}{e^2}} \sim \sqrt{3 \times 137} m,$$

that is, at energies much lower than  $137 m$ , which has been hitherto supposed.

Thus our theory shows that a proper consideration of radiation damping automatically cuts down the scattering due to the spin term, and hence there is no necessity whatever for the *ad hoc* introduction of higher spin states as has been done by Heitler<sup>7</sup> in a recent note. In a previous paper<sup>3</sup> it was shown that the finite mass of the meson does not lead to Heisenberg explosions, and our present calculations show that the  $g_2$  spin interaction does not give rise to these either.

The general theory will be published elsewhere with H. C. Corben when circumstances permit. Difficulties of communication have prevented a joint publication in the present instance.

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<sup>1</sup> Heisenberg, *Z. Phys.*, **113**, 61-86 (1939).

<sup>2</sup> Dirac, *Proc. Roy. Soc., A*, **167**, 148-69 (1938).

<sup>3</sup> Bhabha, *Proc. Roy. Soc., A*, **172**, 384-409 (1939).

<sup>4</sup> Bhabha, *Proc. Indian Acad. Sci., A*, **10**, 324-332 (1939).

<sup>5</sup> Kramers, *Physica*, **1**, 825-28 (1934).

<sup>6</sup> Bhabha, *Proc. Indian Acad. Sci., A*, in the press.

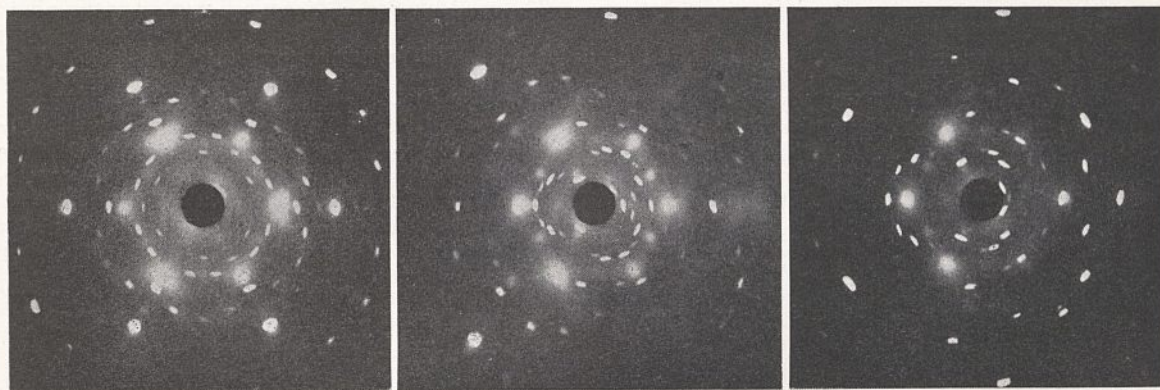
<sup>7</sup> Heitler, *NATURE*, **145**, 29-30 (1940).

## Anomalous X-Ray Reflections on Laue Photographs

Sir C. V. Raman and P. Nilakantan<sup>1</sup> have described a type of specular X-ray reflection to be found on Laue photographs of diamond taken with copper radiation normal to a (111) plane.

We wish to point out that similar effects have previously been observed by several workers<sup>2</sup>. In some of these cases the anomalies are due to mechanical strain or to age-hardening, but these explanations do not appear to account for all the observed phenomena, and a more general theory has been offered by G. D. Preston<sup>3</sup> in terms of the thermal vibrations of groups of atoms. His photographs of aluminium, sodium chloride and magnesium oxide show, in addition to the usual Laue diagram, a pattern of more diffuse spots which are greatly enhanced at high temperatures and remain even when the radiation is strictly monochromatized and the Laue pattern has disappeared.





a X-RAYS ALONG [0001] AXIS. b X-RAYS 10° FROM [0001] AXIS. c X-RAYS 15° FROM [0001] AXIS.  
 BENZIL; UNFILTERED COPPER RADIATION; 70 MIN. EXPOSURE AT 3.5 CM.

Many Laue photographs obtained in this laboratory over a period of years, using diamond, sodium, rock-salt and other compounds, show the effect; perhaps some of the most beautiful are those of benzil, here reproduced. It is significant that these anomalous patterns are much less sensitive to crystal mis-setting than are the ordinary Laue diagrams. In our opinion, further experimental evidence is desirable before any theory can be accepted as essentially correct.

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<sup>1</sup> NATURE, 145, 667 (1940).  
<sup>2</sup> Friedrich, *Phys. Z.*, 14, 1082 (1913). Faxén, *Z. Phys.*, 17, 266 (1923).  
 Burgers, *Z. Phys.*, 67, 605 (1931). Andrade and Tsien, *Proc. Roy. Soc., A*, 163, 9 (1937); 168, 313 (1938). Guinier, *C. R.*, 206, 1641 (1938). Wadlund, *Phys. Rev.*, 53, 843 (1938). Zachariasen, *Phys. Rev.*, 53, 844 (1938). Preston, NATURE, 143, 76 (1939); *Proc. Phys. Soc.*, 52, 77 (1940). Zachariasen, *Bull. Amer. Phys. Soc.*, 14, 5 (1939). Siegel and Zachariasen, *Bull. Amer. Phys. Soc.*, 14, 5 (1939).  
<sup>3</sup> *Proc. Roy. Soc., A*, 172, 116 (1939).

those of silk fibroin<sup>1</sup> and natural cellulose fibres<sup>2</sup> (see table). When the fibrils are stretched they prove to be strikingly photo-elastic; the retardation may increase by 30 per cent before the fibril breaks.

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<sup>1</sup> Ohara, K., *Sci. Pap. Inst. Phys. Chem. Res. Tokio*, 21, 104 (1933).  
<sup>2</sup> Frey-Wyssling and Wuhrmann, *Helv. chim. Acta*, 22, 987 (1939).

### Oxide Films on Alloy Steels

IN a recent communication<sup>1</sup>, T. Tokumitu concludes that the naturally occurring oxide film on stainless steels is  $\alpha$ -(Fe,Cr)<sub>2</sub>O<sub>3</sub>, and he bases this conclusion upon the fact that heating the natural oxide layer to 600° C. for one hour suffices to change the electron diffraction pattern from one of blurred rings which cannot be analysed, to a well-defined pattern of  $\alpha$ -(Fe,Cr)<sub>2</sub>O<sub>3</sub>. The crystalline structure adopted by the film on heating, however, may very well be different from that of the natural oxide, and even the chemical composition may be changed, since, unless the heating is carried out in an exceedingly good vacuum or its equivalent, the film may gain oxygen, and also, as Pfeil<sup>2</sup> has shown in the case of thick scales, diffusion of metal atoms towards the oxide surface occurs at high temperatures.

Furthermore, the work of Jackson and Quarrell<sup>3</sup> shows that when the electron diffraction examination of oxide films is carried out at room temperature, the results are apt to be misleading. Thus, with 'Armeo' iron and plain carbon steel specimens, oxide films formed and examined at temperatures of 350°, 600° and 950° C. gave patterns corresponding to Fe<sub>3</sub>O<sub>4</sub>, FeO and Fe<sub>3</sub>O<sub>4</sub> respectively, but on examination at room temperature all three surfaces gave the pattern which is generally attributed to Fe<sub>3</sub>O<sub>4</sub>. Indeed, it was possible to correlate the oxide structure with the temperature of formation by using the new high-temperature technique and to show, for example, that, on cooling, the Fe<sub>3</sub>O<sub>4</sub> formed above the A<sub>3</sub> critical point of the metal specimen passed through two transformations corresponding to Fe<sub>3</sub>O<sub>4</sub> → FeO → Fe<sub>3</sub>O<sub>4</sub>. In view of the possibility of such changes occurring in other cases, it is not advisable to attach

### Optics of the Artificial Nylon Fibre

THE fibrils of which the artificial 'Nylon' fibre is composed exhibit a remarkably high double refraction. Although their diameter is only about 19  $\mu$ , they show interference colours of the third order. For the calculation of the double refraction their slightly elliptical cross-section must be taken into consideration. The large and the small diameter can easily be measured under the microscope with slightly twisted fibrils. The double refraction of the fibrils examined amounts to 0.060, the lower index  $n_a$  being 1.520 and the higher index  $n_\gamma$  about 1.580. It is surprising how closely these figures agree with

	'Nylon'	Silk	Ramie
$(n_\gamma)D$ .. ..	1.580	1.584	1.599
$(n_a)D$ .. ..	1.520	1.529	1.532
Double refraction	0.060	0.057	0.067



too great an importance to the electron diffraction patterns of oxide films recorded at room temperature.

Recent application of the high-temperature method of electron diffraction to thin oxide films formed on a heat-resisting steel of the composition 0.47 per cent carbon, 0.72 per cent manganese, 1.7 per cent silicon, 12.9 per cent nickel, 13.1 per cent chromium and 3.1 per cent molybdenum, has shown that at temperatures up to 950°C. the oxide has a spinel structure. The spinel structure is possessed by a large number of oxides of the general type  $XO.Y_2O_3$ , and minerals are obtained in which the X positions on the lattice are shared among two or more metals, and there is also evidence that the X and Y atoms are interchangeable. Only small differences in lattice parameters are observed among the oxide spinels, and it seems, therefore, that the spinel structure is both exceedingly flexible and inherently stable. The relative instability of the  $FeO.Fe_2O_3$  spinel on 'Armco' iron must be regarded as exceptional and attributable to the fact that both X and Y lattice positions are occupied by atoms of the same metal, thus making possible the  $Fe_3O_4 \rightarrow FeO$  transformation. With the more general type of spinel oxide, containing at least two different metals, a corresponding change is not possible, and therefore the structure should be stable over a much wider range of temperatures. The oxide formed on nickel-chromium alloys has been shown to have a spinel structure and probably a composition corresponding to  $NiO.Cr_2O_3$ . There can be no doubt that in this case the spinel affords excellent protection against further oxidation at high temperatures.

In view of the foregoing, it seems reasonable to suggest that the oxidation resistance of heat-resisting steels is largely due to the formation of a stable spinel. Provided such elements as nickel, chromium and aluminium are present in sufficient quantities, the spinel structure should be stabilized and should, moreover, be able to accommodate almost any metal which may be added to the steel for the purpose of improving its mechanical properties at high temperatures. The absence of lattice changes on heating and cooling will prevent easy access of oxygen to the underlying metal surface and so greatly increase the oxidation resistance.

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<sup>1</sup> Tokumitsu, T., *NATURE*, **145**, 589 (1940).

<sup>2</sup> Pfeil, *J. Iron and Steel Inst.*, No. 1, 501 (1929).

<sup>3</sup> Jackson and Quarrell, Second Report of the Alloy Steels Research Committee, Special Report No. 24, Section 4, Iron and Steel Institute, 1939.

## Benzanthrones

In a previous publication<sup>1</sup> it was stated that, contrary to Schaarschmidt and Georgeacopol<sup>2</sup>, the ring closure of *o*- $\alpha$ -naphthylbenzoic acid gave a mixture of *meso*benzanthrone and 3:4-benzfluorenone.

Since then, Grieve and Hey<sup>3</sup> have reported the same results as Schaarschmidt and Georgeacopol<sup>2</sup>, without the isolation of 3:4-benzfluorenone. I had to repeat my experiments later, using different condensing agents (concentrated sulphuric acid, phosphorus pentachloride followed by aluminium chloride, and phosphorus pentoxide) at different temperatures. In none of these attempts, however, was *meso*-benzanthrone obtained free from 3:4-benzfluorenone.

The condensation of diazotized methyl anthranilate with  $\alpha$ - and  $\beta$ -methyl-naphthalene<sup>4</sup> at 25° gave, in a poor yield, a mixture of acids and *o*-2'-methyl-1'-naphthylbenzoic acid respectively. The yield was improved by altering the condition of the reaction.

*o*-4'-Methyl-1'-naphthylbenzoic acid was easily prepared by condensing 4-iodo-1-methylnaphthalene with *o*-iodobenzoic ester (cf. Baddar and Warren<sup>1</sup>). Cyclization of this acid gave also a mixture of 1'-methyl-*meso*benzanthrone and 2-methyl-3:4-benzfluorenone.

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<sup>1</sup> Baddar and Warren, *J. Chem. Soc.* 401 (1938).

<sup>2</sup> Schaarschmidt and Georgeacopol, *Ber.*, **51**, 1082 (1918).

<sup>3</sup> Grieve and Hey, *J. Chem. Soc.*, 108 (1938).

<sup>4</sup> Cf. Heilbron, Hey and Wilkinson, *J. Chem. Soc.*, 699 (1938).

## Action of Ions on Acetylcholinesterase

REFERRING to the publication of D. Nachmansohn<sup>1</sup>, we wish to direct attention to the fact that we have previously described<sup>2</sup> the effect of different divalent ions on the activity of acetylcholinesterase. We think that for some reason this paper did not reach Dr. Nachmansohn.

We have shown that manganese, magnesium and calcium ions are especially active; strontium and barium ions are active to a less degree. Inhibition experiments with sodium fluoride, sodium oxalate and others and the optimal concentration of  $Ca^{++}$  ( $M/500$ ) for reactivation after dialysis, revealed the outstanding position of calcium as an activator of acetylcholinesterase in horse serum. We agree with the fact that the electric organ of Torpedo is a far better enzyme material; but horse serum allowed us to demonstrate essentially the same facts as those observed by Nachmansohn, concerning the effect of divalent ions on the activity of acetylcholinesterase.

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<sup>1</sup> Nachmansohn, D., *NATURE*, **145**, 513 (1940).

<sup>2</sup> Massart, L., and Dufait, R., *Enzymologia*, **6**, 282 (1939).

(BY CABLE.)

D. NACHMANSOHN claims<sup>1</sup> that his findings concerning the activation of cholinesterase by electrolytes are "in contrast" to our results reported some time ago<sup>2</sup>. This statement is misleading, as his results were obtained under different conditions and therefore cannot be compared with ours.

The enzyme preparation from the electric organ of Torpedo used in Nachmansohn's experiments appears to have properties unlike those of our preparation obtained from horse serum. While both preparations will hydrolyse the same substrate, there are indications that we are dealing with different enzyme complexes. For example, the activity of the serum preparation is only slightly diminished by dialysis while Nachmansohn's preparation is almost completely inactivated; further, the serum enzyme, in contrast to Nachmansohn's preparation, may be treated with ammonium sulphate as well as evaporated to dryness without any loss of activity.



It is difficult to understand what Nachmansohn means when he says: ". . . the enzyme preparations . . . obtained from horse serum . . . appear to have been less active and of a lower degree of purity than those previously described" (by Nachmansohn), as 1 mgm. of both enzyme preparations hydrolyses 100 mgm. of acetylcholine per hour.

As pointed out in our communication, the effect of added electrolytes depends greatly on the concentration of the substrate, being much more pronounced at a lower concentration of acetylcholine (0.025 per cent). We are unable to find any evidence that Nachmansohn has carried out experiments under such conditions.

Without knowledge of our work, L. Massart and R. Dufait<sup>3</sup> in July 1939 reported that they had found an augmentation of cholinesterase activity by 0.002 mol. calcium which could be abolished by addition of oxalate. Though they found magnesium and manganese to act in a similar way they expressed the opinion that "calcium est l'activateur physiologique de la choline esterase du serum". As these authors used dialysed horse serum without any further purification in their experiments, it would appear that the degree of purity of the enzyme does not affect the results. We have recently repeated our experiments with a preparation of much higher purity (1 mgm. hydrolysing 200 mgm. of acetylcholine per hour) and have found it to act in exactly the same manner as previously reported by us.

It is suggested that the activation which Nachmansohn found with concentrations of potassium and sodium as high as 0.1 mol. is due to traces of bivalent ions. According to Nachmansohn's own experiments, these ions, if only present as impurities of the order of 0.01 per cent, would at least partly reactivate his enzyme preparation.

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<sup>1</sup> Nachmansohn, D., NATURE, 145, 513 (1940).

<sup>2</sup> Mendel, B., Mundell, D., and Strelitz, F., NATURE, 144, 479 (1939).

<sup>3</sup> Massart, L., and Dufait, R., *Enzymologia*, 6, 282 (1939).

## Connexion between Carbohydrate and Potassium Metabolism in the Yeast Cell

WILLSTÄTTER and co-workers<sup>1</sup> have shown that if glucose is added to a suspension of yeast cells, it disappears from solution and is built up into a polysaccharide (glycogen), inside the yeast cells. Only after this (in about ten minutes time) does the fermentation begin, as tested by the production of carbon dioxide.

Since it was found<sup>2</sup> that there are intimate connexions between carbohydrate and potassium metabolism in animals, and since it is well known that the carbohydrate metabolism of the yeast cells is in many ways similar to that of muscle, we tried whether potassium plays any part in the fermentation of sugar by the yeast cell.

The following experiments were made with a 20 per cent yeast suspension, and the figures given in the accompanying table are the amounts of sugar and potassium in 5 c.c. of centrifuged fluid. As can be seen from the table (and as has been repeatedly

found in many more experiments), the glucose disappears to the extent of about 90 per cent in ten minutes and almost completely in twenty minutes. The fermentation, as tested by the production of carbon dioxide, begins in six minutes, and the amount of carbon dioxide produced is given between the tenth and fifteenth minutes. These figures serve to give some indication of the intensity of the fermentation.

### CHANGES OF POTASSIUM AND GLUCOSE IN A 20 PER CENT SUSPENSION OF YEAST

(Glucose added at 0 min. All values are mgm. in 5 c.c. centrifuged fluid.)

Time (minutes)	With glucose		Same with M/2000 iodoacetic acid		Same with M/300 NaF	
	K	Glucose	K	Glucose	K	Glucose
0	0.672	33.0	0.686	31.5	0.677	33.1
10	0.196	3.75	0.852	26.2	0.625	29.3
20	0.288	1.5	0.953	18.1	0.562	20.0
40	0.352	—	1.087	10.8	0.495	11.3
60	0.571	—	1.317	8.7	0.855	1.7
120	0.828	—	1.773	6.2	1.505	—
CO <sub>2</sub> production starts Quantity between 10-15 min.	6 min.		8 min.		8 min.	
	16.2 c.c.		1.1 c.c.		1.35 c.c.	

Of special interest is the behaviour of the potassium, which is found to decrease rapidly in the fluid during the first ten minutes while sugar is being taken into the yeast cells. When the fermentation of sugar in the cells starts, the potassium is liberated again and reaches even higher levels than before in the outer fluid.

This experiment can be repeated several times with the same yeast suspension if glucose is repeatedly added when the preceding dose of sugar has been totally fermented. In every case potassium decreases in the fluid during the up-take of glucose and increases when the production of carbon dioxide begins.

Control experiments showed that when no glucose is added to the fluid, the potassium remains constant. It is unaltered by changes in hydrogen ion concentration, and since the concentration of sodium in the fluid remains constant during glucose up-take and fermentation, the behaviour of potassium appears to be specific and not due to general permeability changes.

The action of iodoacetic acid on these processes was studied in different concentrations. M/2000, as the table shows, retards markedly the up-take of glucose into the cells (that is, the polysaccharide formation) so that this is incomplete even after a hundred and twenty minutes.

The small quantities of glucose which are taken up are, however, fermented, the fermentation commencing after eight minutes, but only 1.1 c.c. of carbon dioxide was produced between the tenth and fifteenth minutes.

The behaviour of potassium after iodoacetic acid is most striking. No disappearance of potassium from the fluid is seen. There is only a slight increase in potassium when the fermentation of glucose in the cells begins. Thus iodoacetic acid has inhibited both the up-take of glucose by the yeast cells and simultaneously the up-take of potassium. The inhibition of fermentation in the cells appears to be only secondary.

Phlorrhizin has no effect in concentrations as high as M/750, and sodium cyanide has an action only at M/300, when it distinctly retards all processes, though to a lesser extent than iodoacetic acid. Sodium fluoride at M/300 behaved similarly.



It may be noted that baker's yeast contains about 4 mgm. of potassium per gm., of which about 15 per cent can be washed out, while the rest is retained. All experiments were made with yeast which, after washing for several hours, was in equilibrium with suspension fluid as regards potassium.

The experiments show that potassium is taken up by the yeast cells simultaneously with the glycogen formation, and that with the breakdown of glycogen it is again liberated. It is a probable assumption that this movement of potassium is connected with the production of phosphoric esters of the sugars as intermediate reactions in the polymerization and breakdown of glycogen. This would agree with our findings on the role of potassium in carbohydrate metabolism in animals<sup>2</sup>.

A detailed report will be published later.

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<sup>1</sup> Willstätter, R., and Rohdewald, M., *Enzymologia*, 8, 1 (1940).  
<sup>2</sup> Verzár, F., and Somogyi, J. C., *NATURE*, 144, 1014 (1939); 145, 781 (1940).

## Seed Disinfection

CERTAIN proprietary seed disinfectants and protectives which contain organo-mercury compounds as their fungicidal basis are now used extensively for disinfecting cereal seed prior to sowing. When correctly used they give an excellent control of many seed-borne diseases, but in some circumstances, injury to the grain may result, and it is the purpose of this note to indicate those conditions which may lead to such injury. These materials are also used for treating such seeds as peas, sugar-beet, etc., but the observations given here are confined to cereals.

In these seed disinfectants, the fungicidal salt is often a member of the series *R. Hg. X*, where *R* is a hydrocarbon and *X* an acidic radicle. In some cases mixtures of such salts are used. In this series there is a close relationship between composition and fungicidal power, the toxicity decreasing with the increase of the molecule of *R*. In certain circumstances such salts may produce a characteristic phytocidal effect when they are applied to, and held by, the grain in over-doses. The seed may be killed outright or it may commence to germinate and the coleoptile to appear, but further development is abnormal, characterized by thickening of the tissues of the coleoptile and stunting of the roots. Porter<sup>1</sup> reports that such seedlings have thickened leaf primordia with irregular crenations and lobes. Cell division is inhibited, the existing cells becoming enlarged and multinucleate, either with small nuclei or with large 'giant nuclei' which are polyploid.

We have observed that the primary roots are usually short and thickened, their development being arrested soon after they emerge. Root hairs are frequently absent, and in these cases the seminal roots are usually discoloured brown.

Typically abnormal seedlings seldom develop further, and neither they nor the killed seeds decay rapidly in the soil. We have noted this characteristic injury both in laboratory tests and in the field and we have investigated those conditions under which it may be induced. The effect of these dust disinfectants upon seed which has been treated and then stored under varying conditions has also been examined.

We have found that provided the grain shows relatively high initial germination, is of sound physical condition and is superficially dry when dusted with these materials, then no immediate injury to the grain is likely to result. If such seed has to be stored, then provided it is kept under dry, cool conditions, with adequate ventilation, it is unlikely that any significant loss of germination capacity will ensue during several months. With such well-conditioned seed it is not possible to give any markedly excessive doses, as the dust cannot be retained by superficially dry seed beyond a certain limit.

A factor of some importance appears to be the relative superficial moisture of the seed. If such seed is dusted, even at the recommended rate, that part of the bulk of seed upon which the dressing falls will retain excessive quantities. The subsequent mixing will result in a distribution throughout the bulk of a proportion of heavily over-dusted seeds. These may be killed or may produce abnormal seedlings, thus resulting in an uneven stand. Intentional or accidental application of dust to damp seed, at rates higher than those recommended, will tend to produce more markedly adverse results.

Injury may also result if dry and well-conditioned grain is treated at normal rates but is afterwards stored under damp conditions with poor ventilation.

The moisture content of the seed (as opposed to superficial moisture) is another factor we have investigated, but we have obtained little or no evidence that treated seed of a moisture content slightly above normal suffers any immediate and serious phytocidal effects. Preliminary observations suggest that seed of high moisture content which has been dusted at normal rates and then stored suffers loss of viability to no greater degree than does undusted seed of similar moisture content.

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<sup>1</sup> Porter, R. H., "Relation of Seed Disinfectants to Seed Analysis". *Proceedings of the Association of Official Seed Analysts of North America* (1936).

## Origin of the Frow Remedy for Acarine Disease of Honey Bees

IN 1927, Mr. R. W. Frow, of Wickenby, Lincolnshire, introduced the use of the remedy (since known by his name) as a cure for acarine disease. Mr. Frow informs one of us (A. D. B.) that he has no record of the origin of the formula, but believes that he read of it in a newspaper as a means of combating free-living acari.

We are anxious to trace the origin of the formula, which is:

Nitrobenzene . . .	2 parts (by measure)
Safrol oil . . .	1 part
Petrol (preferably 'Summer Shell') . . .	2 parts

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## A Colour Reaction of Diethylstilbœstrol (4,4'-dihydroxy- $\alpha$ , $\beta$ -diethylstilbene)

DODDS *et al.*<sup>1</sup> discovered a series of non-steroid œstrogenic compounds, 4,4'-dihydroxy- $\alpha$ ,  $\beta$ -diethylstilbene, or diethylstilbœstrol, being the most potent representative of this series. In addition to its œstrogenic effect, this compound has other effects in common with the steroid type of œstrogens; for example, it opens the vagina of infantile rats and mice, it stimulates the evolution of the uterus and prevents the appearance of 'castrate'-cells in the ventral pituitary.

Besides these effects, others have been found, for which the natural and artificial œstrogens are no longer interchangeable.

Mühlbock<sup>2</sup> reported on the inhibition of comb growth by the simultaneous administration of male substances with œstrogens. The natural œstrogens act in this way when administered subcutaneously or by inunction; diethylstilbœstrol, however, is active only when administered subcutaneously.

Loeser<sup>3</sup> claims that diethylstilbœstrol, in contradistinction to natural œstrogens, has no influence on the thyroid after intrauterine application. Levie<sup>4</sup> and Gaarenstroom and Levie<sup>5</sup> found that stilbœstrol hastens the involution of epiphyseal cartilage more than œstrone. Duyvené de Wit<sup>6</sup> observed no lengthening of the ovipositor of *Rhodeus amarus* by stilbœstrol.

These effects may be suitable for discriminating biologically between a solution of natural from one of artificial œstrogens, but are unlikely to provide reliable quantitative information on mixtures of the two substances. The exact estimation of small quantities of diethylstilbœstrol in solutions of œstrone or œstradiol has now been achieved, however, by means of a colour reaction.

Addition of a few drops of a 50 per cent solution of antimony pentachloride to a solution of a few

micrograms of stilbœstrol in chloroform produces a fuchsin-red colour, while in more concentrated solutions a bordeaux-red precipitate is obtained. By warming the mixture the reaction becomes more sensitive; 1  $\gamma$  of stilbœstrol per c.c. of chloroform can still be detected, which amounts to a dilution of 10<sup>-6</sup>. The colour attains its maximum intensity after 15 min. and remains constant for another 10-15 min.

For the detection of stilbœstrol in an oily solution of natural œstrogens the fatty and unsaponifiable substances must be removed prior to the colorimetric assay, because these substances would produce a dark brown discoloration. At a thousand times higher concentration, namely, 1 mgm./c.c., natural œstrogenic substances (steroids) produce a yellow-brown coloration with antimony pentachloride. The removal of these steroids from the solution will be described elsewhere.

It is important to use alcohol-free chloroform as a solvent, since in the presence of alcohol the red colour rapidly changes to blue-violet. For the colorimetric estimation a standard diethylstilbœstrol solution of similar strength to the unknown is used. The colorimetric assay has been successfully applied to the estimation of diethylstilbœstrol in the urine and the liver of dogs after subcutaneous injection of the hormone. The amounts found colorimetrically were the same as those ascertained by biological assay. The urine extracts were purified before carrying out the assay.

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April 24.

<sup>1</sup> Dodds, E. C., Golberg, Lawson and Robinson, *NATURE*, **142**, 34 (1938).

<sup>2</sup> Mühlbock, O., *NATURE*, **143**, 160 (1939).

<sup>3</sup> Loeser, A., *Z. exp. Med.*, **105**, 430 (1939).

<sup>4</sup> Levie, L. H., Thesis, Amsterdam (1939).

<sup>5</sup> Gaarenstroom, J. H., and Levie, L. H., *J. Endocrin.*, **1**, No. 4 (1939).

<sup>6</sup> Duyvené de Wit J. J., *Klin. Wochenschr.*, **18**, 1423 (1939).

## Points from Foregoing Letters

E. J. Williams and G. R. Evans submit photographs providing further evidence for the transformation of mesotrons into electrons, the first evidence for which was obtained at the same laboratory a short time ago. The experiments were carried out in a high-pressure cloud chamber containing argon at a pressure of 80 atmospheres.

H. J. Bhabha has extended his classical theory of mesons to include a treatment of the dipole moment, and shows that all the infinities can be removed. The cross-section for the scattering of neutral mesons by neutrons calculated from this theory agrees with the quantal result for small energies, but is much less than the latter for high energies, decreasing as the square of the energy. The result shows that the theory does not lead to Heisenberg explosions when proper account is taken of the damping forces.

In a note on the nature of oxide films on alloy steels, A. G. Quarrell criticizes the reasoning on which T. Tokumitsu based his conclusion that the

natural oxide film formed on stainless steel is  $\alpha$ -(Fe,Cr)<sub>2</sub>O<sub>3</sub>. Recent application of the high temperature electron diffraction technique leads to the suggestion that the oxidation resistance of heat-resisting steels may be due to the formation of a stable spinel oxide which undergoes no lattice changes on heating and cooling.

F. G. Baddar finds that *o*- $\alpha$ -naphthylbenzoic acid and *o*-4'-methyl-1'-naphthylbenzoic acid give on ring closure a mixture of a benzanthrone and a benzfluorenone. Interaction between diazotized methyl anthranilate and  $\beta$ -methylnaphthalene gives *o*-2'-methyl-1'-naphthylbenzoic acid.

R. Pulver and F. Verzár, in continuation of their experiments on the role of potassium in carbohydrate metabolism, show that in yeast cells intake of potassium is simultaneous with glycogen formation, and that with the breakdown of glycogen potassium is again liberated. This agrees with their previous findings on the role of potassium in carbohydrate metabolism in animals.



## RESEARCH ITEMS

## Age and Sex in New Guinea Skulls

In a study of skulls from New Guinea, now in the Field Museum of Natural History, Chicago, by W. D. Hambly (*Anthrop. Series*, 25, 3, 1940) attention is directed to certain conclusions in regard to age and sex emerging from craniometric investigation of the material of 222 skulls. 28 are excluded as juvenile. Of the remainder, 70 are female and 124 male, distributed into southern and northern groups. In the southern group a high mortality in both sexes occurs in the age-period 20-30 years, accounting for about 46.4 per cent of the population. There is a noticeable decline in mortality at the age of 30-40 years, the rate falling to 12.5 per cent, but with a rise for 40-45 years, though for survivors there is a fair expectancy of reaching 50 years. About 16.7 per cent females and 15.8 per cent males pass the 50-year mark. In the northern group the rate in the years 20-30 is high, that of females reaching 65.4 per cent in the years 20-25. For males and females together from 20 to 30 the rate is 54.3 per cent. From 30 to 40 the rate is 13.8 per cent, with a fair expectancy of reaching 50 years. The survivors of this age number 18.8 per cent. The explanation may be taken reasonably as the more dangerous pursuits of the men (war and head-hunting) and the child-bearing of the women in the earlier period. In regard to differentiation of sex characters in the crania, males have greater cranial capacity, a longer, broader skull, and greater dolichocephaly than the females. They have also greater cranial height, a longer vertical arc and greater arcs over glabella, ophyron, and from nasion to opisthion; but in three respects, namely, nasal index, facial index and facial angle, the difference between male and female population is not so well emphasized. Comparison of craniometrical data from East Africa, Australia, New Guinea, and New Britain suggested a considerable admixture of Negro traits in the Pacific regions. There are mathematical grounds for believing in the probability that Tasmanians are an Australoid-Melanesian people.

## War-time Mortality in London

THE issue of the *Lancet* of April 20 contains an interesting study by Dr. Percy Stocks, medical statistical officer to the Registrar-General, of the mortality during the first seven months of the War, or more precisely from July 1939 until March 1940. He points out that a very substantial saving of life at ages under five years was the chief explanation of the remarkable fall in mortality from pneumonia, bronchitis, diarrhoea and whooping cough. Moreover, the expected epidemic of measles did not take place. Although children of school age did not benefit from school closure and dispersal to the same extent as children of pre-school age as regards mortality, deaths from diphtheria, measles and whooping cough sank to a very low level. On the other hand, during the winter period young adults showed a remarkable increase in mortality which was mostly caused by respiratory tuberculosis, respiratory diseases (other than pneumonia) and heart diseases, but the deaths from pneumonia did not increase appreciably during the severe weather. There was also a very decided

increase in mortality among adults over 45 during the cold weather of January and February, mainly due to respiratory and heart diseases, but the proportionate increase in pneumonia was much less than that for influenza, bronchitis and other respiratory diseases. In conclusion, Dr. Stocks shows that under black-out conditions the increase in deaths due to this cause was least in the weeks when there was a full moon and most serious during the two preceding weeks.

## Bird Migration and Gonad Development

FROM certain experiments, Rowan concluded that birds released when their gonads were at winter minimum or spring maximum showed no inclination to migrate, and that migration was associated with recrudescence or regression of gonads. The suggestion has been tested by Albert Wolfson, who contrasted experimentally the actions of migratory and resident races of juncos (*Condor*, 42, 93, March-April 1940). The experiments were carried on over two years, and were devised and executed with thoroughness. Juncos were trapped before the period of migration, and were kept in large cages until the wild migrants had departed and were nesting and probably incubating in their northern breeding haunts. Histological examination of samples of the retained birds showed that by this time the gonads were fully developed. When released the resident and migratory races behaved differently; the former remained and were constantly recaptured in the neighbourhood, the latter disappeared, and were not seen or recaptured until the time when the wild migrants returned in the following autumn. Rowan's theory, therefore, does not meet the case, and the author, in a series of critical comments on Rowan's experiments and conclusions, indicates just where in his opinion these failed to give an accurate interpretation.

## Parthenocarpy

CONSIDERABLE practical importance is attached to the fact that the ovaries of various fruits may be stimulated to development by foreign pollen quite incapable of effecting fertilization, so that seedless fruits may result. Sadao Yasuda has been studying this subject since 1928 and has recently published a general account of his experiments (*Mem. Fac. Sci. and Agric.*, Taihoku Imperial University, 27, No. 1; Dec. 1939). Ovaries of egg plants gave fruit with *Petunia* pollen but the reciprocal cross is without effect; similarly tomatoes arose from action of the pollen of the egg plant but the reciprocal cross would not work. Various combinations were thus tested, and successful combinations for parthenocarpic fruits showed no connexion with the systematic position of the plants. It was shown that if pollen could germinate and the tubes penetrate deeply into the style, parthenocarpy resulted. The growth of the pollen tubes seems influenced by a special substance in the style; this substance is produced originally in the ovary, a point checked by ingenious experiments with grafted styles. Where the pollen tube can influence ovary development the effect is produced before the tube reaches the ovary; it is only



necessary that the tube should penetrate deeply into the style. Ovaries can grow into seedless fruit if injected with extracts of suitable pollen grains. Pollen grains of the proper species, too old to fertilize ovules and give seeds, may still contain this fruit-producing stimulus and may thus induce seedless fruit production.

#### Origin of Wheat

S. N. PATHAK (*J. Genetics*, 39, 437-467; 1940) has examined cytologically several species of *Triticum*, *Aegilops*, *Secale*, and *Oryza*. The morphology of the chromosomes shows that *T. monococcum* and *T. Aegilopoides* alone contain two pairs of *Sat* chromosomes—all the other species had one pair of these chromosomes with secondary constrictions in common. The number of nucleoli corresponds to the number of secondary constrictions and satellites: there are four in the diploid and tetraploid and six in hexaploid species of *Triticum* and *Aegilops* and two in diploid *Secale cereale*. The presence of four satellites and a quadrivalent in *T. monococcum* indicates that the basic chromosome number 7 is a derived one. Five is believed to be the original basic number of this group of species. It is suggested that *Triticum vulgare* may have resulted from a cross between *Aegilops squarrosa* and a tetraploid wheat. It is shown that one of these, *Triticum durum*, has dissimilar chromosome sets corresponding to the *A* and *B* genomes and has probably been derived from a diploid *Triticum* species with one pair of *Sat* chromosomes and an *Aegilops* species having secondary constrictions.

#### Seed Coat Colour in the Bean

H. A. K. LAMPRECHT (*Hereditas*, 26, 65-99, 279-304; 1940. *Z.I.A.V.*, 77, 186-194) describes the genetics of the various colours and markings of the seed coat of *Phaseolus vulgaris*. The striped, marbled and sprinkled coat colours are shown to depend on the multiple allelomorph series *Rrs-Rma-Rst-Rr*. The genes formerly designated *M* and *S* are thus shown to be allelomorphic with *R* and *r*; linkage tests show that the *R* series is strongly linked with the seed coat colour gene *C*. Heterozygous *Cc* or heterozygous *Rr* seeds are marbled and are naturally inconstant. Several genes, *Arc*, *Bip*, *diff*, and *exp*, have been found to affect the distribution of colour. They show incomplete dominance, therefore intergrading types are frequent. Dots of colour on the seed coat is due to a recessive gene *punc* or to a dominant gene *Mip*. The latter controls the distribution of colour around the micropyle. Rough seed coat is due to a recessive *asp*. The recessive gene *mar* causes the presence of a ring of colour around the hilum when another gene *j* is present. It is shown that *mar* always causes the appearance around the hilum similar to that of *J*. Thus recessive *j mar* simulates the effect of dominant *J* in that region.

#### Linkage Studies in Barley

D. W. Robertson and O. H. Coleman (*J. Genetics*, 39, 401-410; 1940) describe two new chlorophyll-deficient seedling types in barley which are determined by the genes *or* and *y* respectively. These genes are placed by linkage experiments in group I with crossover percentages of *or-f* 8.69, *f-y* 0.81, *y-v* 31.27 (*f* gives chlorina seedlings and *v* gives six-rowed barley). Therefore, three seedling lethal factors are placed close together and at some distance from the non-six-rowed - six-rowed determining gene.

#### Smut Fungi of the Sugar-Cane

THE taxonomy of smut fungi which attack the sugar-cane has been somewhat uncertain in the past. Dr. B. B. Mundkur has, however, recently studied a considerable range of fresh and herbarium specimens of the fungi, and reaches the conclusion (*Kew Bull.*, No. 10; 1939) that the smut upon the culms of sugar-cane consists of one species, *Ustilago scitaminea*, and two new varieties, *U.s. Sacchari-Barberi*, and *U.s. Sacchari-officinarum*. Detailed descriptions of these organisms, and of *U. consimilis*, which also occurs upon the same host, are given.

#### Photochemical Oxidation of Hydrogen

AN investigation of the photochemical oxidation of hydrogen in hydrogen-oxygen mixtures with light of 1719-1725 Å. at 1140-95 mm. pressure, by H. A. Smith and A. Napravnik (*J. Amer. Chem. Soc.*, 62, 385; 1940), shows that, with increasing oxygen content, the quantum yields of ozone increase while those of hydrogen peroxide and water decrease. At lower pressures the formation of water shows chain characteristics. The formation of ozone has a negative temperature coefficient in the range 25°-280°, while the temperature coefficients for the formation of water and hydrogen peroxide are positive and may increase with great rapidity above 230°. The results are interpreted on the assumption that the primary photochemical reaction is  $O_2 + h\nu = 2O$ , followed by interaction of oxygen atoms with oxygen and hydrogen molecules, the first by triple collisions:  $O + O_2 + M = O_3 + M$ , and the second by triple collisions with an oxygen molecule as third body:  $O + H_2 + O_2 = H_2O + O_2$ . The possibility of hydrogen as the third body is not excluded. The oxygen atoms may also react with hydrogen molecules:  $O + H_2 = OH + H$ , the hydroxyl radicals reacting with hydrogen to form water and atomic hydrogen:  $OH + H_2 = H_2O + H$ . The atomic hydrogen reacts with a mixture of hydrogen and oxygen at room temperature to form hydrogen peroxide, first forming  $HO_2$  by a triple collision:  $H + O_2 + M = HO_2 + M$ , and the  $HO_2$  may react in the gas phase or on the walls to form hydrogen peroxide:  $HO_2 + HO_2 = H_2O_2 + O_2$ .

#### New Supernovæ

DR. J. JOHNSON of the California Institute of Technology reports from Mount Palomar the discovery, on a photograph of February 16, 1940, of "a new object, star-like, not moving, about 13th magnitude, located at the southern tip of the edge-wise spiral NGC 5907". Plates taken with an 18-in. Schmidt camera on February 18 and March 1 confirm the reality of the object, which is presumably a supernova. The parent nebula is well placed for northern observers now and for the next three or four months. Harvard Announcement Card 519 helps in fixing the time of outburst by stating that at the position given no object brighter than magnitude 14.6 shows on the patrol plates of February 3, and none brighter than magnitude 13.2 on February 11. Dr. F. Zwicky reports that he has found a supernova of apparent magnitude 16 on a film taken with an 8-inch Schmidt telescope on Palomar Mountain on December 4, 1939. It is in the spiral nebula at R.A. 0h. 54m., S.Dec. 5° 20' (1939.0) and is about 16" north-west of the nucleus. It is presumed that it attained a maximum brightness, mag. 15, on November 20. The spiral in which it appears is estimated to be seven million parsecs distant.



## VOLCANISM IN FRENCH SOMALILAND

M. E. AUBERT DE LA RÛE has recently travelled extensively in French Somaliland (November 1937–May 1938) for the purpose of conducting field work, which he has since examined critically (*Bull. Volcanolog.*, ii, 5, 71–108; 1939). It is very plain from the report that volcanism has had an important role in the building up of this region of tropical Africa near the Gulf of Aden. At the moment there is no active volcano in the land but in numerous places there are fumeroles and hydrothermal springs which are the last stages of volcanic activity. In order of age (oldest first) the volcanism may be roughly classified as: (1) Old Basaltic Series, (2) Rhyolitic Series, (3) Recent Basaltic Series, (4) very recent eruptions, and (5) present day volcanic phenomena which include (a) fumeroles and (b) thermal springs.

The Old Basalts in the form of dykes and lava flows were incident after the deposition of the Infra-Cretaceous sandstones. They were observed by M. Dreyfuss in the Ali Sabien mountain complex and they have been observed in the Mabla mountains by M. Dreyfuss and M. Teilhard de Chardin. M. E. Aubert de la Rûe has been able to identify them over a much wider area. In the Issa area they form the base of the Guelileh Valley, and they may be seen under the rhyolite flows of the dissected plateau of Damer-Kada. The Boura mountains, previously considered entirely rhyolitic, in reality have a basaltic base which in places attains an altitude of 750 metres and which is surmounted by tuffs and rhyolitic lava flows. In the Dankali area the Old Basalts appear at the base of the rhyolitic Hassa-Ali chain. They are to be found at the entrance to the Orgoïta Ravine at the foot of the Yagueri Mountains a little to the north of the Yoboki Pass. The series from the base upwards consists of Old Basalt, greenish rhyolitic tuff, rhyolitic obsidian, and rhyolite. In places the basalts attain an altitude greater than 1,000 metres. This is so in the high valley of Magaleh and at the col Adhali-Daba to the north of Tadjourah, where they reach a height of 1,140 metres. This Old Basaltic Series is often greatly altered, containing siliceous concretions, calcite veins, zeolites, stillbite and heulandite. When not decomposed the basalt presents a very varied appearance in different localities.

The Old Basalts are followed by the Rhyolitic Series, the age of which is uncertain because there are no sedimentary rocks interstratified with them. M. E. Aubert de la Rûe has been able to show that at least in some places the rhyolites were produced before the basaltic eruptions had ceased. One such case is in the Mabla Mountains where, under the path from Letabolo to Baté-Ero, one can see a rhyolite flow about 10 m. thick between two basalt flows. The Rhyolitic Series may be observed throughout the colony, and does not appear to have a greater thickness than 500 m. The rhyolites, in places prismatic and very fresh, are elsewhere frequently altered. The obsidians are opaque or translucent, grey, grey-green, or black, the latter often having been mistaken for coal. Pantellerite and comendite, described by Lacroix and Arsandaux, have been found near Hol-Hol and in the Mabla Mountains.

The lava flows may be compared with the 'coulees stratoïdes' of Yemen described by M. P. Lamare, and have often been eroded into extremely steep pitons. The centres of eruption are most difficult to determine and the different 'Massifs' are regarded not as the vestiges of ancient volcanoes as in the region near Aden but as the remains of rhyolitic plateaux. This agrees with the opinion of P. Lamare, to whom the Mabla massif appears to be a horst.

The rhyolitic series is followed by the Recent Basaltic Series, but in between the deposition of the two was a long interval of time during which a good deal of erosion took place. This may be seen at a number of places but particularly in the valley of Magaleh in the Goudah massif where the whole sequence may be observed. The Recent Basaltic Series appears to be due to a series of fissure eruptions which took place with great regularity. Here and there, between two of the lava flows there exists a well-cemented, reddened conglomerate usually containing pebbles of basalt but sometimes pebbles of rhyolite. The series is fairly uniform, fine grained, and generally having a doleritic texture. It nearly always contains olivine but never in great quantities. Occasionally it is porphyritic with large phenocrysts of plagioclase. Some Andesitic flows, chiefly in the Arta massif and near the Koranke-Hada-E-Kouridjabet Mountain, accompany the Recent Basaltic Series. The thickness of the lava in the flows usually varies from 3 m. to 5 m. There are no intercalated tuffs to separate the flows but Aubry found in the Assal Basin under 200 metres of labradorite a lacustrine sedimentary deposit with Unio, Corbicules, Linnées, Planorbis and Mélanies about three metres thick. Similar phenomena have been observed elsewhere in the colony. The smallish volcanic cones visible from Djibouti in the region to the south-west have been formed by scoriaceous lavas and are of mixed Strombolian-Hawaiian type. Perhaps Mount Garbi is a volcanic cone, and if so it is the largest in French Somaliland (1,650 m.).

It is difficult to draw a demarcation line between the Recent Basaltic Series and the very recent eruptions, but it is probable that man was already on the earth when the volcanoes of Ghoubet-el-Kharab erupted. The basaltic flows, interstratified with the Quaternary cones of dejection at the lower end of the slopes of the Mabla Mountains, are probably fairly recent and have been affected by very recent faults in the valley of west Ababolé. The last stages of volcanic activity may be found in the fumeroles and hot springs now existing. A typical fumerole is in the south-east of the plain of Hanleh about 3 km. 500 m. to the east-north-east of Garbes. It is called by the Danakils 'the smoking mountain' and consists of a band a few score metres wide and about 400 metres long orientated in a north-west-south-east direction. In this region the basalt has been largely decomposed to a red clay which is often at a temperature of 100° C. Aqueous sulphurous vapour at 100° C. escapes from the ground through a multitude of small fissures sometimes silently and at other times with a slight whistle. Near the region there are incrustations of white gypsum, saccharoïde and kalinite.



There are numerous regions with hot springs in the colony. A typical one is at Asbahalto on the eastern bank of Lake Abbé, called by the Danakils 'the evil smelling water'. Here innumerable thermal springs have deposited walls of travertin which have the appearance of ruins, about 5-10 m. high on the average. This travertin is composed chiefly of calcium carbonate together with a little magnesium carbonate. Superficially it is clear grey whilst in the interior it is yellowish white, having a spongy structure and being somewhat friable. The denticulated walls and small pitons are aligned roughly

east-west and probably follow the fault lines. A spring at the foot of Badikoma has a temperature of 100° C., gave a fairly alkaline reaction and when evaporated left a residue of 2.48 gm. per litre. This consisted of silica 0.090 gm., calcium carbonate 0.109 gm., calcium sulphate 0.485 gm., magnesium chloride 0.032 gm., potassium chloride 0.054 gm., sodium chloride 1.648 gm., sodium bromide 0.0035 gm., together with organic and miscellaneous material 0.0585 gm. Other hot springs abound in the plain of Hanleh, in the valley of west Kouri, in Goum, Halol, and in Obock.

## FOREST PRODUCTS RESEARCH BOARD

THE report for 1938 of the Forest Products Research Board recently issued (London: H.M. Stationery Office, 1939. 1s. 6d. net) is dated June 1939. Remembering that the outbreak of war was to come so soon after its completion, there are one or two points which appear to merit particular mention. The chief, perhaps, is the research on composite wood, for which the Board had had under consideration detailed proposals for the provision of equipment.

The interest which this subject has aroused would seem to indicate that all the substitutes which have replaced wood have apparently had little influence upon the great demands still being made on the forest. The Board's report states, with reference to composite wood: "We are impressed with the need for systematic research on the properties of this class of materials in order to build a foundation of technical knowledge such as has been accumulated in the case of 'solid' wood by many years of work at various universities and laboratories in the past." In view of the importance which the processes of manufacture and the interrelations of the materials used have on the properties of the final products, the need for systematic research is evident. New methods of test and investigation may have to be developed to

deal with these products, the properties of which differ fundamentally from those of 'solid wood'. Inquiries regarding these products were rapidly increasing, even though the laboratory has disclaimed possession of any real technical knowledge of them. The industries interested cover every field in which natural wood has hitherto been used, and several in which the use of wood has practically been abandoned.

The report of the Director of Forest Products Research is issued with the above. Inquiries in every department of the Laboratory's activities continued to be numerous. As one example of the work undertaken, the experimental work on the production of charcoal in portable steel kilns is proving successful. Charcoal is being increasingly used for various industrial purposes, particularly in the manufacture of Rayon; and the manufacturer in Great Britain has been very dependent on foreign supplies of it. Hitherto, charcoal which has been made in portable kilns has contained too great a percentage of volatile matter; the experimental kiln now in use is said to go far in removing this objection. A leading firm of Rayon manufacturers has stated that charcoal produced by certain burnings is equal to the best obtainable from any source.

## CORTICAL LOCALIZATION OF INTELLIGENCE

H. M. HILDRETH, at the meeting of the American Association for the Advancement of Science, Columbus, Ohio, December 1939, presented a statistical study of the cortical localization of intelligence.

The problem involves the correlation of an independent physiological variable with a dependent psychological variable. Since in studying human beings it is not possible to destroy predetermined parts of the cortex by operation, an experimental group of individuals whose brains had been damaged by disease or by natural organic changes had to be used. The psychological variable could be measured by using well-established tests of intelligence. The group studied consisted of individuals found to be suffering from cerebral arteriosclerosis, in which disease small areas, apparently occurring at random, are destroyed throughout the brain. From a

psychopathic hospital of 4,000, all the patients who after complete examination were found to be suffering from this disease were selected, and from this group were eliminated those who showed signs of any disease, for example, brain tumour, that might conceivably affect intelligence. This gave a selected experimental group of 201 subjects. A control group of 201 normal individuals was also selected, comparable except that they had no signs of arteriosclerosis. Previous records of intelligence and school attainments were available.

It is argued that if all the subjects are now given an intelligence test, since the two groups are matched, then the performance of the normal group might be taken as what the other group would have been if it were not suffering from arteriosclerosis.



To find out the effect of the disease the two groups were compared in the various Binet tests, the frequency and percentage of each group passing the given tests being tabulated and the percentage of deterioration on each test calculated.

On the hypothesis that the ability to pass a given

test is cortically localized, a randomly distributed deterioration would be expected. Such was not the case. The experimental findings supported the hypothesis that intelligence is a function of the whole brain, against the hypothesis of specific localization.

## LONDON'S WATER DURING 1938

THE recently issued report of the Metropolitan Water Board\* tells of the unceasing supervision exercised over London's water supply during 1938. The total output from the Board's works was 111,438 million gallons, a slight increase over the previous high record of 1937, the average daily supply to consumers being 312.77 million gallons, of which 65 per cent was derived from the Thames.

Some 50,000 samples were analysed during the year, of which about 30,000 were routine bacteriological, and 4,700 routine chemical, examinations, the main purpose of which is to determine that all the processes—storage, filtration, purification, distribution—are working satisfactorily so as to ensure a pure and safe supply to consumers. Based upon the *Bact. coli* test, 99 per cent of all samples were of first-class quality (absence of *Bact. coli* from 100 ml.)—a highly satisfactory record.

Of researches conducted in the Board's Laboratories, much attention has been directed to improving the *Bact. coli* test, and the method for isolating coliform organisms when present, for the purpose of differentiating the type. New procedures were also investigated for improving the method of isolation of *Clostridium Welchii* and the Streptococcus organisms that are sometimes of service for assessment of the potability of a water.

The occurrence of *Bact. paratyphosum* B, a microbe that causes a form of enteric fever, in Epping sewage has been noted since 1931. This specific organism is still present in the sewage, in fact was somewhat more numerous than it was in 1937, and as a precaution chlorination of the effluent has now been established as a permanent measure. Investigations on improved methods for the isolation of this organism are in progress.

Complaints are sometimes received concerning the

\* Metropolitan Water Board. Thirty-third Annual Report on the Results of the Bacteriological, Chemical and Biological Examinations of London Waters for the Twelve Months ended 31st December, 1938. By Lt.-Col. E. F. W. Mackenzie, Director of Water Examination, Metropolitan Water Board. (P. S. King and Son, Ltd., 14 Great Smith Street, Westminster.) 10s. 6d.

taste of the water, and no less than 11,360 'taste' tests were carried out during the year by the expert tasters of the Board's staff. Complaints of taste are generally attributable to some defect at the works, the commonest being an overdose of chlorine. Earthy or musty tastes result from decomposition of, or fungoid growths in, filter bed skins during hot weather, and characteristic tastes are produced by decomposing plankton. In one instance, a musty taste occurred in the water drawn from the cold water tap in a kitchen, and was traced to two species of fungi growing in the tap. Organisms belonging to the Actinomyces are capable of producing earthy tastes, and this subject is under investigation.

Certain algae and diatoms are subject to periods of sudden excessive growth, and are liable to cause trouble in reservoirs and filter beds. Thus, it was reported that a 'brown' growth had arisen in one of the reservoirs, and microscopical examination showed that this was caused by excessive growth of a diatom, *Stephanodiscus Hantzschii*, which was clogging the secondary filter beds. By treatment with alum this trouble was overcome. Investigations are being carried out in the Biological Section with the view of ascertaining the cause of these fluctuations in the number of the algal and other living forms in the water; they may depend upon peculiar variations in the silica, phosphates and other mineral constituents of the water which are known to take place at certain seasons of the year. An account is given of the appearance in a reservoir of *Oscillatoria rubescens*, a blue-green alga, and of the chemical conditions prevailing. In August when this organism became very numerous, pH values were higher, temporary hardness was lower, and concentrations of PO<sub>4</sub> were rising rapidly to a very high level compared with March, when the organism was scanty.

Notes are given on the occurrence of certain rare Copepods and other forms of microscopic life, numerous tables are included, and the report is illustrated with several excellent plates.

## ECONOMICS OF WAR COSTS

THE problem of paying for the War is discussed in an Oxford Pamphlet on World Affairs (Oxford: Clarendon Press. 3d. net) by G. Crowther and a broadsheet issued by Political and Economic Planning (P.E.P.), which have both appeared under that title. The real problems of paying for the War, the broadsheet points out, are economic, political and psychological; for the limits of war effort are

not financial but social, psychological and economic. The size of the output of war material depends on the willingness of people to work harder and make their capital resources last longer, and above all, on the way they react to reductions in their standards of life. The methods of financing the War are vitally important, since they determine the distribution of its cost between different groups of people and may



have a profound effect upon the distribution of income after the War. The best method can only be decided after a careful examination of social claims and resistances, and once the method is decided financial technique can be used to implement policy.

The P E P broadsheet, taking the national income of Great Britain as £5,700 millions, and the current national expenditure at more than £2,500 millions, points out that the increased revenue must be drawn from increased production, the use of overseas assets and the diversion of output. Mainly it will be a burden for the present. Diversion of output from capital maintenance is estimated as offering savings from £300 to £500 millions, while for the diversion of resources from the production of goods for private consumption varying estimates are given. The four main methods by which the Government can gain control over the resources which it needs are taxation, borrowing, through the medium of the price mechanism and by direct Government control.

In regard to taxation, the broadsheet points out that the bulk of additional income tax revenue must come from the middle incomes, where its incidence is comparatively light, and the importance of devising a comprehensive family allowance scheme is stressed. Reviewing other taxation possibilities, the scope for a tax on luxuries is indicated; the inevitable heavy taxation of those with low incomes will be resented unless the Government makes it quite clear that those who are comfortably or luxuriously off are being taxed in earnest. Discussing Mr. Keynes' proposals for forced saving by paying a proportion of all wages and salaries in the form of a blocked deposit not available for spending until after the War, the broadsheet points out that the scheme offers a means of preventing standards of living from rising, or of reducing them without incurring major political opposition. Further research into the limits of the voluntary type of saving is also required.

In regard to borrowing, the raising of loans directly from the public is not inflationary, but borrowing from the banks is almost bound to be inflationary. This is the third method by which the Government can gain control of the requisite resources, and both the broadsheet and Mr. Crowther point out the objections to inflation. Mr. Crowther urges that we should first concentrate on raising taxation to the highest supportable level on rich and poor alike. We should then see what could be done by rationing to increase the genuine savings that can be borrowed. Only when we have exhausted these deliberate and scientifically planned devices should we turn to the haphazard, incalculable and inequitable method of inflation. Certain measures of Government control over the economy are an indispensable adjunct to inflation, such as price control and its corollary rationing.

Mr. Crowther argues that the fundamental task of war finance is to transfer resources from consumption to the purposes of war, and he insists that, while totalitarian war cannot be financed entirely out of taxation, the only taxes likely to bring in sums substantial enough to contribute to avoidance of inflation are not confiscatory taxes on the rich or fancy taxes on profiteers, but plain honest taxes that hurt plain honest people. Moreover, since the real economic necessity of war is to reduce consumption, even after the ordinary man has paid his taxes, his consumption must be further restricted, either by voluntarily or compulsorily increasing his savings or through the cost of living rising against him.

## SEVENTY YEARS AGO

NATURE, vol. 2, May 26, 1870

THE Admiralty have acceded to the request of the Royal Society by again placing Her Majesty's surveying steam-vessel the *Porcupine* at their disposal for another deep-sea expedition. A photometric apparatus has been contrived by Mr. Siemens to ascertain the depth to which solar light penetrates the sea.

THE Duke of Devonshire, the Marquis of Lansdowne, Sir John Lubbock [Lord Avebury], Sir James Kay-Shuttleworth, Bernard Samuelson, Dr. W. Sharpey, Prof. T. H. Huxley, Prof. W. A. Miller and Prof. [Sir] G. G. Stokes have been appointed to make inquiry with regard to Scientific Instruction and the Advancement of Science, and to inquire what aid thereto is derived from grants voted by Parliament or from university and college endowments, and whether such aid could be made more effectual.

## APPOINTMENTS VACANT

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

TEMPORARY LECTURER (WOMAN) IN EDUCATION AND PSYCHOLOGY—The Principal, Municipal Training College, Cottingham Road, Hull (May 30).

LECTURER IN MATHEMATICS, and a SENIOR MISTRESS for the Day School—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (May 31).

HEAD OF THE WOMEN'S DEPARTMENT of the Blackpool Technical College—The Director of Education, Education Offices, Stanley Buildings, Blackpool (May 31).

HEAD OF THE CHEMISTRY DEPARTMENT—The Principal, Municipal Technical College, Hopwood Lane, Halifax (May 31).

A REPRESENTATIVE to superintend and co-ordinate the work of the British Council in Bulgaria, Rumania and Yugoslavia—The British Council, 3 Hanover Street, W.1 (June 1).

TWO TEACHERS (MEN) OF ENGLISH for Yugoslav—British Institute Belgrade—The British Council, 3 Hanover Street, W.1 (quoting 'Belgrade') (June 1).

LECTURER IN BIOLOGY—The Secretary, Technical College, Sunderland (June 3).

LECTURER (MALE) OF PHYSICS—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7 (June 3).

ASSISTANT WOMAN GRADUATE FOR COMMERCIAL GEOGRAPHY in the Schools of Technology, Art and Commerce, Oxford—The Chief Education Officer, Education Offices, 77 George Street, Oxford (June 4).

MALE LECTURER IN ENGLISH at Oporto University, Portugal—The British Council, 3 Hanover Street, W.1 (quoting 'Portugal') (June 5).

HEAD OF THE SCHOOL OF ARCHITECTURE AND BUILDING—The Registrar, School of Architecture and Building, College of Arts and Crafts, Leicester (June 7).

INSPECTOR, Southern Education—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1, (quoting 'Inspector, Southern Education') (June 15).

MATHEMATICAL TUTOR in the Khartoum Secondary School—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting 'Mathematical Tutor') (June 15).

LECTURER IN CHEMISTRY in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting 'Lecturer in Chemistry') (June 15).

LECTURER IN ELECTRICAL ENGINEERING, and a LECTURER IN MECHANICAL ENGINEERING, at the School of Engineering, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting 'Lecturer in Electrical/or Mechanical Engineering') (June 15).

HEAD OF THE CHEMISTRY DEPARTMENT—The Clerk to the Governors, Technical College, Normanton Road, Derby (June 15).

CURATOR OF THE MUSEUM AND ART GALLERY—The Town Clerk, Town Hall, Leicester (endorsed 'Curator') (June 17).

CHIEF FISHERIES OFFICER, Palestine—The Director of Recruitment (Colonial Service), 29 Queen Anne's Gate, S.W.1 (June 22).

TEACHER OF PHYSICS at the Rugby College of Technology and Arts—The Principal and Organizer of Further Education in Rugby, 61 Chifton Road, Rugby.

TEMPORARY GRADUATE ASSISTANT (MAN or WOMAN) to teach Physics at the County Technical College, Dartford—F. L. Notley, 11 Essex Road, Dartford.



## FORTHCOMING EVENTS

[Meeting marked with an asterisk is open to the public.]

Saturday, May 25

BRITISH PSYCHOLOGICAL SOCIETY (at 55 Russell Square, W.C.1), at 3 p.m.—H. W. Durant: "A Critical Account of Public Opinion Measurement".

At 5.30 p.m.—J. G. W. Davies: "Individual Differences between Psychological Workers".

At 6.15 p.m.—Alec Rodger and Patrick Slater: Report on "Some New Non-verbal Tests".

Monday, May 27

ROYAL GEOGRAPHICAL SOCIETY, at 5 p.m.—A. Stephenson: "Graham Land and the Problem of Stefansson Strait".

Tuesday, May 28

ROYAL INSTITUTION, at 5.15 p.m.—Prof. V. H. Mottram: "Food and the Housewife".\*

Thursday, May 30

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY, at 2.30 p.m.—Physical and Biological Experiments with Neutrons. Dr. John Read: "The Production and Measurement of Neutron Radiation at the Mount Vernon Hospital"; Dr. F. G. Spear: "A Comparison of the Biological Effects of Neutrons and Gamma Rays"; J. C. Mottram: "The Action of Neutrons on the Growth of Bean Roots and upon the Mitosis of Bean Root Cells"; Dr. L. H. Gray: "Survey of Results so far Obtained by Different Workers"; Discussion.

At 6.30 p.m.—Annual General Meeting.

AUSTRIAN ACADEMY IN GREAT BRITAIN, at 5 p.m.—Prof. Dr. Ernst Freund: "Austria's Contribution to the Solution of Cancer Problems".

Friday, May 31

ROYAL INSTITUTION, at 9 p.m.—Prof. W. W. C. Topley, F.R.S.: "Bacteria in the Air".

## REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

### Great Britain and Ireland

St. Thomas's Hospital Reports. Edited by Prof. O. L. V. S. De Wesselow and C. Max Page, assisted by N. R. Barrett, Dr. J. St. C. Elkington and Dr. A. J. Wrigley. Second Series, Vol. 4. Pp. 198. (London: St. Thomas's Hospital.) 10s. [15]

The College of the Pharmaceutical Society. Annual Report of Research Work, 1939. Pp. 46. (London: Pharmaceutical Society.) [15]

Institution of Professional Civil Servants. Annual Report for the Year 1939. Pp. xii+74. (London: Institution of Professional Civil Servants.) [15]

Department of Scientific and Industrial Research. The National Physical Laboratory Report for the Year 1939. Pp. iv+100. (London: H.M. Stationery Office.) 2s. 6d. net. [15]

University of London: University College. Annual Report, February 1939–February 1940. Pp. 54. (London: Taylor and Francis, Ltd.) [15]

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1939. Pp. 32. (York: Yorkshire Museum.) [35]

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 4: Some Ecological Aspects of the Intertidal Area of the Estuary of the Aberdeenshire Dee. By Dr. Alec Milne. Pp. 107–139+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 5s. [35]

Ministry of Health. Emergency Medical Series, Memorandum No. 3: Procedure on the Admission, Transfer, Discharge or Death of Casualties, and for the Provision of Out-patient Treatment. Second edition. Pp. 27. (London: H.M. Stationery Office.) 6d. net. [35]

A New Map of the Karakoram: with Range and Peak Names approved by the Karakoram Conference 1937. Drawn by F. J. Batchelor under the direction of Prof. Kenneth Mason. Scale 1:750,000 or 11.8 miles to 1 inch. 22.7 in. x 20 in. (London: Royal Geographical Society.) 7s. 6d.; 5 rupees. [35]

John Innes Horticultural Institution. Thirtieth Annual Report for the Year 1939. Pp. 20. (London: John Innes Horticultural Institution.) [85]

Annual Report of the Oundle School Natural History Society, 1940. Pp. 32. (Oundle: Oundle School.) [85]

### Other Countries

India Meteorological Department. Scientific Notes, Vol. 8, No. 86: Determination of Visibility at Night with the help of Wigan's or Bennett's Visibility Meter. By A. K. Roy. Pp. 23–30. 5 annas; 6d. Scientific Notes, Vol. 8, No. 87: A Discussion on some Aeroplane Ascents at Drigh Road (Karachi) on days of Duststorms, Thunderstorms and Dust Raising Winds. By B. N. Desai and S. Mal. Pp. 31–46. 8 annas; 9d. (Delhi: Manager of Publications.) [15]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 31: Studies in the Preservation of Fruits and Vegetables; an Investigation on the Methods of Preparation and Standardization of Tomato Ketchup. By Lal Singh and Dr. Girdhari Lal. Pp. 12+1 plate. (Delhi: Manager of Publications.) 7 annas; 8d. [15]

Union of South Africa: Department of Agriculture and Forestry. Science Bulletin No. 201 (Chemistry Series No. 157): Compost, its Preparation and Use; the Conversion of Agricultural "Waste Material" into Synthetic Manure. By Dr. E. R. Orchard. Pp. 28. 3d. Bulletin No. 212 (Chemistry Series No. 159): Removal of Sooty Blotch from Oranges. By C. P. Maude. Pp. 14. 3d. (Pretoria: Government Printer.) [15]

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 11: 500 Books for Children. By Nora E. Beust. Pp. vi+90. (Washington, D.C.: Government Printing Office.) 15 cents. [15]

Indian Forest Records (New Series). Botany, Vol. 1, No. 6: Notes on some Indian Species of *Lactuca*. By Dr. G. Ledgard Stebbins. Pp. 237–246+1 plate. (Delhi: Manager of Publications.) 8 annas; 9d. [35]

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Tests on the Liquefaction of Canadian Coals by Hydrogenation. By T. E. Warren and K. W. Bowles. (No. 798.) Pp. vii+106. 25 cents. Comparative Tests of Various Fuels when Burned in a Domestic Hot-Water Boiler, 1935 to 1938. By C. E. Baltzer and E. S. Malloch. (No. 802.) Pp. v+24. 25 cents. (Ottawa: King's Printer.) [35]

U.S. Department of the Interior: Bureau of Biological Survey. Conservation Bulletin No. 1: Attracting Birds. By W. L. McAtee. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents. [75]

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 45, Part 2: New Species and Genera of *Cercoptidae* in Japan, Korea and Formosa, with a List of the Known Species. By Shonen Matsumura. Pp. 35–82+3 plates. (Tokyo: Maruzen Co., Ltd.) [75]

Indian Forest Records (New Series). Entomology, Vol. 6, No. 2: Some *Cleridae* from India, Burma and Ceylon, with Descriptions of New Species and Notes on Others. By J. B. Corporaal. Pp. ii+17–40. (Delhi: Manager of Publications.) 14 annas; 1s. 3d. [75]

Pasteur Institute of India, Kasauli. The Thirty-eighth Annual Report of the Central Committee of the Association and the Audited Accounts up to September 30th, 1939, also the Report of the Director of the Institute. Pp. 45. (Kasauli: Pasteur Institute of India.) [75]

Field Museum of Natural History. Botanical Series, Vol. 9, No. 4: Flora of the Aguan Valley and the Coastal Regions near La Ceiba, Honduras. By Prof. T. G. Yuncker. (Publication 466.) Pp. 243–346. 75 cents. Botanical Series, Vol. 21: Travels of Ruiz, Pavón and Dombey in Peru and Chile (1777–1788). By Hipólito Ruiz. With an Epilogue and Official Documents added by Agustín Jesús Barreiro. Translation by B. E. Dahlgren. (Publication 467.) Pp. 372. 3.50 dollars. (Chicago: Field Museum of Natural History.) [75]

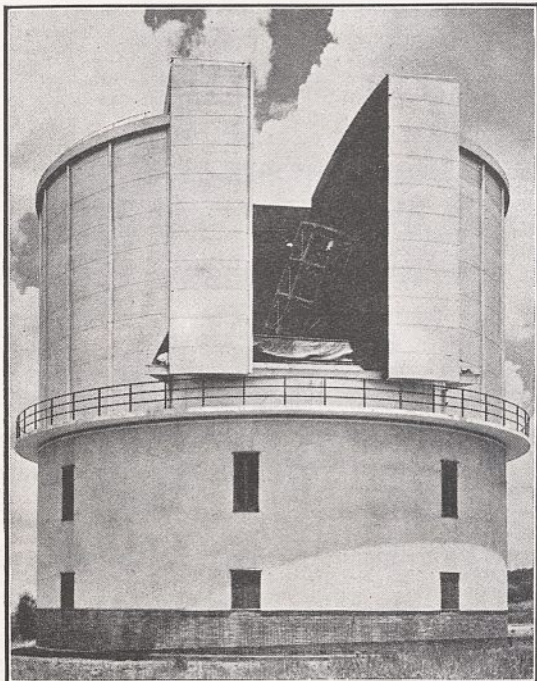
Australasian Antarctic Expedition, 1911–14. Scientific Reports, Series A, Vol. 2: Oceanography. Part 2: Tidal Observations. By Dr. A. T. Doodson. Pp. 61–86+3 plates. 4s. Part 3: Soundings. By John K. Davis. Pp. 87–102+2 plates. 2s. 6d. Part 4: Hydrological Observations made on board S.Y. *Aurora*. Reduced, tabulated and edited by Sir Douglas Mawson. Pp. 103–126. 3s. Part 5: Marine Biological Programme and other Zoological and Botanical Activities. Compiled by Sir Douglas Mawson. Pp. 127–168+9 plates. 7s. 6d. Series B, Vol. 5: Meteorology. Part 1: Records of the Queen Mary Land Station; Part 2: Meteorological Log of S.Y. *Aurora*; Part 3: Sledge Journey Weather Records; Appendix, Macquarie Island Weather Notes for 1909, 1910, 1911. Pp. x+282+4 plates. 40s. (Sydney: Government Printer.) [75]

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. No. 89: La transgression albiennaise et énonomanienne dans le Hainaut (Études paléontologiques et stratigraphiques). Par Dr. René Mainière. Pp. 440+8 plates. No. 90: Les tabulés du dévonien moyen et supérieur du Bord Sud du Bassin de Dinant. Par Dr. M. Lecompte. Pp. 230+23 plates. No. 93: Végétaux éodévoniens de la Belgique. Par F. Stockmans. Pp. 90+14 plates. Deuxième série, Fasc. 15: Résultats scientifiques des croisières du navire-école *Mercator*, Vol. 2. Pp. 218. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique.) [75]

Anthropological Records. Vol. 2, No. 4: Southern Paiute Shamanism. By Isabel T. Kelly. Pp. ii+151–168. 25 cents; 1s. 6d. net. Vol. 2, No. 1: The 1870 Ghost Dance. By Cora Du Bois. Pp. vi+152. 1.50 dollars; 9s. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [85]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 234: Contribution to the Flora of Egypt—Plants collected from Southern Sinai in April 1937. By J. R. Shabetal. Pp. ii+84. (Cairo: Government Press.) P.T. 8. [95]





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APPLICATIONS are invited for the post of FULL-TIME LECTURER in BIOLOGY, duties to commence in September 1940.

Candidates should possess a good honours degree in Botany and Zoology. Previous teaching experience and research desirable.

Salary in accordance with the Burnham (Technical) Scale. After three years' service an additional allowance may be made to the salary scale under clause 5(c) of the Burnham Award in respect of "special work of an advanced nature."

Further particulars and Forms of Application may be obtained (stamped, addressed foolscap envelope) from the Secretary, The Technical College, Sunderland, Co. Durham.

Applications should reach the undersigned on or before Monday, June 3, 1940.

W. THOMPSON,  
*Director of Education.*

Education Offices,  
15 John Street,  
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**NORTHERN POLYTECHNIC,  
HOLLOWAY, LONDON, N.7**

The Governors of the above Polytechnic invite applications for the post of full-time Lecturer (Male) of Physics.

Candidates must possess a good honours degree of a British University; some teaching experience is essential, and preference will be given to a candidate having experience in research.

The salary will be in accordance with the Burnham Scale (£276—£15—£528), less 5 per cent for Superannuation.

The Lecturer will be required to take up his duties on September 9, 1940.

Forms of application, together with full particulars, will be forwarded on receipt of a stamped, addressed foolscap envelope. Forms must be returned not later than June 3, 1940.

R. H. CURRELL,  
*Clerk.*

**THE COLONIAL SERVICE, PALESTINE**

A vacancy exists for a Chief Fisheries Officer, Palestine.

Salary £750 a year, consolidated pay. Candidates should be British subjects of European parentage, preferably between 30-40 years of age. They should hold an Honours Degree in Natural Sciences of a British University with Zoology as a principal subject, or equivalent qualifications, and should have had at least five years' postgraduate experience of different types of fishing craft and methods. The appointment will be on agreement for three years in the first instance, but may later be made permanent and pensionable.

Further particulars and forms of application may be obtained from the Director of Recruitment (Colonial Service), 29 Queen Anne's Gate, London, S.W.1. Completed applications must reach the Director of Recruitment not later than June 22, 1940.

**DERBY TECHNICAL COLLEGE**

Applications are invited for the post of Head of the Chemistry Department. A good honours degree in Chemistry of a British University is required. Teaching and industrial experience are essential. Salary £480—£20—£580. The selected candidate will be required to take up his duties on September 1, 1940. Application forms, which must be returned not later than June 15, 1940, may be obtained from the undersigned.

F. C. SMITHARD,  
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Technical College,  
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The Council is about to appoint two Assistant Lecturers in Physics (temporary). Salary at the rate of £900 per annum. Applications should reach the undersigned (from whom further particulars may be obtained) not later than June 10.

W. M. GIBBONS,  
*Registrar.*

**UNIVERSITY COLLEGE OF SWANSEA**

The Council of the College invites applications for the post of Professor of Metallurgy. Salary £1,000 per annum. The appointment will date from September 2 or October 1, 1940.

Further particulars may be obtained from the undersigned, by whom applications must be received on or before June 11, 1940.

Singleton Park,  
Swansea.

EDWIN DREW,  
*Registrar.*

**GRAHAM SCHOLARSHIP IN PATHOLOGY**

Applications are invited for a temporary appointment to the Graham Scholarship in Pathology, value £300 a year. The Scholarship is tenable at University College Hospital Medical School, W.C.1.

Applications must be received not later than June 1, 1940, by the principal, University of London, Royal Holloway College, Englefield Green, Surrey, from whom further particulars may be obtained.

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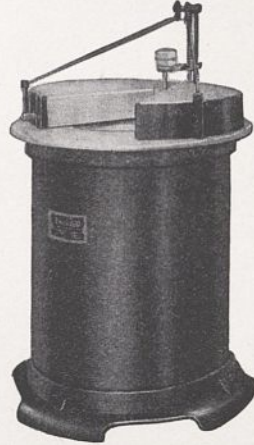
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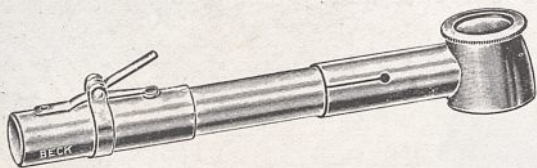
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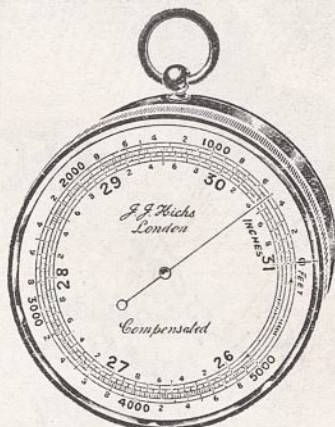
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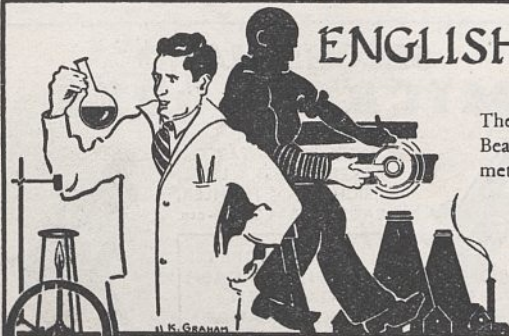
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