SUPPLEMENT: SHORT REVIEWS and NEW BOOKS LIST

NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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NATURE

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RESEARCH AND INVENTION IN UNIVERSITIES

UNIVERSITY authorities have for many years encouraged their staffs and students to do research work, the principal reason, especially applicable to the students, probably being that research is excellent educational training and therefore falls within the sphere of the primary activity of universities. A secondary reason, especially applicable to the staffs, is that research may produce results of great public benefit and is, to that extent, not inconsistent with the reason for existence of universities.

Research is, however, costly, and university authorities are not usually provided with funds on which there are not other demands, so that it becomes necessary either to obtain additional financial support or to limit the research. Although all kinds of research tend to grade into one another, it can be roughly divided into two classes, 'pure' research and 'applied' research, as is indeed indicated in the title of the "Department of Scientific and Industrial Research". While the mere publication of the results of any research may be of great public benefit, the direct financial reward thus obtained either by the research worker or by the university authorities is almost negligible. 'Pure' or 'scientific' research, however, differs from 'applied' or 'industrial' research, in that while there is no ready method of obtaining a direct financial reward for the results of pure or scientific research, applied or industrial research can generally be given a direct financial reward by means of the grant of a patent. A patent is granted for "any manner of new manufacture" in Great Britain, and, by enabling the patentee to prevent anyone else from using what is patented, confers on him the power to sell the right to manufacture it to any industrial organization willing to do so. By using the patent system in this way for the results of applied or industrial research, research workers and university authorities are able to obtain direct financial support from industrial organizations additional to any financial assistance given by Government or obtained in other ways. In all the great industrial countries, research workers and university authorities use their patent systems in this way, and the financial support thus obtained provides funds for the further encouragement of both classes of research. The methods by which different countries use their patent systems, however, have developed in different directions.

In Great Britain, university authorities have in general developed a method by which a professor is left entirely free to guide the research of his subordinate staff and the students under his care in the direction that he thinks best. He may feel that research in some particular line will give the students the best educational training or will afford the staff the best opportunity of conferring some public benefit, but in general he is left free to determine what, if any, use he will make of the patent system on the results of the research. Some professors merely publish the results made under their direction, while others take care to patent such results as seem likely to bring direct financial reward. In the former case the professor may feel that all the results of research should be freely dedicated to the public, and he may have, on this ground, an ethical objection to patenting any results. In the case of a professor who patents such results as seem likely to bring direct financial reward he may feel that by so doing he is ensuring

that the greatest public benefit will be obtained, because, as is frequently pointed out, results of research dedicated to the public merely by publication are often most effectively withheld from the public since no one will assume the business risk and the development expense necessary to commercialize an article over which he can have no control for a reasonable period. If these results of applied or industrial research are patented, there is often an arrangement between the professor and some industrial organization giving the organization first claim on the commercial exploitation of the results in return for some financial reward and in some cases benefaction to the university.

The development in the universities in the United States of their methods of using their patent system was indicated recently by Mr. A. A. Potter, of Purdue University, in his address on "Research and Invention in Engineering Colleges" as vice-president of the Engineering Section of the American Association for the Advancement of Science. In preparing his address Mr. Potter states that he obtained information from thirty-nine universities and colleges, of which seven had organized research foundations for administering desirable patent policies, three others had entrusted the handling of their patent matters to the Research Corporation of New York, two others had given the responsibility for patent administration to a State board, and thirteen others had formed committees or boards to deal with their patent policies. About two thirds of the universities and colleges consulted had definite patent policies and these, it is pointed out, were the universities and colleges that received the greatest support from industry. Mr. Potter reports that "those Universities and Colleges which have definite patent policies are of the opinion that both the social and economic welfare of the public are being enhanced by their methods of handling patents and of encouraging creative activity of their staff members." In his opinion there is a definite trend for universities "to set up research foundations of their own, which finance research and to which the inventor assigns all rights of his research findings. Such institutional research foundations are non-profit corporations organized for the purpose of encouraging creative talent by relieving the inventor of the financial burden and loss of time from his research interests, and by financing research from profits accruing from the sale or royalty on patents."

In Germany, the policies of the universities with regard to patents have been generally more nearly allied to those of British universities rather than to those of American universities.

The great difference between the methods of using their patent systems developed in the American universities and in British universities is remarkable, when the similarity between their ideals is borne in mind. Whatever causes have contributed to this difference and however suited to the American mind may be the policies of their universities, it is certain that the policies of British universities are more suited to the character of the British people than would be the policies of the American universities. The personal freedom and the direct responsibility which the policies of British universities in general confer on their professors are characteristics which are not found to the same extent in American universities and which we should be loath to lose.

These characteristics, although general in British universities, are not universal, for in some cases British research workers are severely discouraged from patenting the results of their research—not infrequently with unfortunate consequences to themselves and the universities. A more tolerant attitude towards the British patent system, for example, by the controlling authorities in the research by British workers on the use of ultra-violet rays in preparing anti-rachitic products of foods and medicines, would undoubtedly have resulted in much greater credit being accorded to British research workers and in thousands of pounds being received by Great Britain from all parts of the world instead of being sent from this and other countries to the United States, as has, in fact, been the case ; and this is only one example of many.

It may well be that the safest course to follow in all research of which the results are likely to be of applied or industrial use is that the research worker should be free to apply for patent protection immediately he obtains his results, and should be encouraged to do so. If the results are of no commercial use little or no harm is done, but if they can be exploited commercially some industrial organization will place them on the market and so make them available to the public, the research worker will be given the credit of his results, and the beneficial owner of the patent, whether it be the research worker, the university, or others by contractual arrangement with them, will reap the financial reward.

NATURE IN THE CLASSICS

Nature in Greek Poetry

Studies partly Comparative. By Dr. George Soutar. (Published for St. Andrews University.) Pp. xix+258. (London : Oxford University Press, 1939.) 10*s.* 6*d.* net.

THE University of St. Andrews, which offered us three years ago the second and more complete edition of the monumental "Glossary of Greek Birds", by Sir D'Arcy Thompson (which I had the privilege to review in these columns), presents now to the lovers of classic literature another important work, by the late Dr. George Soutar.

Mr. J. C. Smith contributes a long biographical notice on the author. George Soutar entered the University of St. Andrews with a University Endowments Association bursary, which he bettered next year by winning a Bruce bursary. At college as at school his favourite subjects were English and Greek, and he was fortunate in his professors, Thomas Spencer Baynes and Lewis Campbell. Mathematics afflicted him, but in the humanities he proved one of the best men of his year : he was first in rhetoric and second in logic, Latin and Greek, and crowned his career in 1888 by graduating with first-class honours in classics. He won a prize for a poem on "Immortality", and this was not his only adventure in verse. St. Andrews gave him something even better than book-learning and the cultivation of the Muse ; its small and friendly society gave a unique opportunity to his genius of friendship. His appointment as external examiner in English in 1896 made another link with St. Andrews for Soutar, and the connexion became permanent when in 1907 he was appointed to the staff of University College, Dundee, where, first as lecturer and after 1927 as reader in English, he served the University, until he retired in 1935. The official connexion did not end even then, for the University showed its gratitude by appointing him external examiner in English for a second time—an unusual compliment. The Senate designed yet another honour for him ; they meant to present to him at the 1939 graduation the degree of LL.D. ; but his death in February of that year frustrated their intention.

Soutar's students knew his great gifts as a teacher, but he published very little. The volume of selections from Pope and a "Book of Ballads", in collaboration with Mr. J. C. Smith, were all the books that appeared in his lifetime, although he also contributed two articles on Sir George Mackenzie and one on "Scot or Wyatt ?" to the *Scots Magazine*. The present volume, the manuscript of which he left behind him, was his thesis for the doctorate of letters. He worked over it at intervals for a long time and until his death, remodelling it and enriching it as his knowledge of literature increased. Perhaps, we may assume, a few parts of the book waited for a finishing polish from the elegant pen of the author.

It is generally thought, and not without good reason, that classics of the purest period are not very keen about Nature, and, anyhow, that their rather short and occasional descriptions of Nature have an epigrammatic character.* They are mainly used, as, for example, by Homer, in comparisons with aspects of human life. So the famous image in the "Iliad" :

"The race of man is of the race of leaves :
Of leaves, one generation by the wind
Is scatter'd on the earth ; another soon
In spring's luxuriant verdure bursts to light.
So with our race ; these flourish, those decay."

Or the other lines, also from the "Iliad", the beauty of which ranks among the jewels of classical poetry :

"As when in Heav'n, around the glitt'ring moon
The stars shine bright amid the breathless air ;
And ev'ry crag, and ev'ry jutting peak
Stands boldly forth, and ev'ry forest glade ;
Ev'n to the gates of Heav'n is open'd wide
The boundless sky ; shines each particular star
Distinct ; joy fills the gazing shepherd's heart.
So bright, so thickly scatter'd o'er the plain,
Before the walls of Troy, between the ships
And Xanthus' stream, the Trojan watchfires
blaz'd."

Homer's indifference to Nature is shown also, as Dr. Soutar remarks, by his lack of flower-sense. Although flowers are one of the outstanding beauties of Nature, not a single epithet of form or of colour is attached by him to any flower. Calypso's violets, the single and only mention of which in Homer makes Dr. Soutar exultant, are left uncharacterized by the poet. Crocuses and hyacinths form merely a bed "thick" and "soft"—πυκνὸν καὶ μαλακόν. Homer makes no allusion to the fragrance of flowers. They are not spoken of sentimentally as associated with human joy or sorrow, not regarded as significant symbols.

* Under the term "epigrammatic", I include all descriptive adjectives attributed by Homer to the sea, mountains, rivers or other natural features. Such epithets as "wine-dark" for the sea ; "shadowy" for mountains ; "deep-eddying", or "beautifully-flowing", for rivers ; and "starry" for the firmament ; all of them give but a flashing glimpse of the object, they do not constitute descriptions in the strict sense of the word.

Dr. Soutar consoles himself for this lack of flower-sense in Homer when he finds in the "Odyssey" (Book VII, 112–113) the luxurious description of King Alcinoüs' garden at the side of his palace. He gives a translation of his own of the passage, in prose, but I prefer to quote it here in the lines of Cowper :

"A spacious garden lay, fenced all around
Secure, four acres measuring complete.
There grew luxuriant many a lofty tree,
Pomegranate, pear, the apple blushing bright,
The honied fig, and unctuous olive smooth.
Those fruits, nor winter's cold nor summer's heat
Fear ever, fail not, wither not, but hang
Perennial, whose unceasing zephyr breathes
Gently on all, enlarging these, and those
Maturing genial ; in an endless course
Pears after pears to full dimensions swell,
Figs follow figs, grapes clust'ring grow again
Where clusters grew, and (ev'ry apple stript)
The boughs soon tempt the gath'rer as before.
There too, well-rooted, and of fruit profuse,
His vineyard grows ; part wide-extended, basks,
In the sun's beams ; the arid level glows ;
In part they gather, and in part they tread
The wine-press, while, before the eye, the grapes
Here put their blossom forth, there gather fast
Their blackness. On the garden's verge extreme
Flow'rs of all hues smile all the year, arranged
With neatest art judicious, and amid
The lovely scene two fountains welling forth,
One visits, into ev'ry part diffus'd,
The garden-ground, the other soft beneath
The threshold steals into the palace-court,
Whence ev'ry citizen his vase supplies.
Such were the ample blessings on the house
Of King Alcinoüs by the Gods bestow'd."

Unfortunately, this description is considered as spurious, a mere interpolation by a writer much more modern than the Homeric era, and of a period when romanticism invaded literature, superseding the naked simplicity of classical poetry, and it indulged in mellifluous evocations. As a matter of fact, it is remarked by one of the most learned commentators and editors of the "Odyssey", the late Victor Berard, that the existence of such a large garden, occupying an entire acre (because Cowper is mistaken in his translation of the Homeric area as implying four acres), in which the royal palace was situated is impossible. The excavations at Mycenae, Tiryns and elsewhere, prove convincingly that the enclosures containing the royal mansions, though strong enough for protection, were too small for a garden and orchard as described in the above lines.

Still, Dr. Soutar could stick for a genuine description of Nature in Homer to the few lovely lines in which his beloved, though uncharacterized violet flourished. May I be allowed to quote it here, again from Cowper's translation of the "Odyssey" (Book V, 68–74) :

". . . a grove on either side,
Alder and poplar, and the redolent branch
Wide-spread of Cypress, skirted dark the cave.
There many a bird of broadest pinion built
Secure her nest, the owl, the kite, and daw
Long-tongued, frequenter of the sandy shores.
A garden-vine luxuriant on all sides
Mantled the spacious cavern, cluster hung
Profuse ; four fountains of serenest lymph
Their sinuous course pursuing side by side,
Stray'd all around, and ev'ry where appear'd
Meadows of softest verdure, purpled o'er
With violets ; it was a scene to fill
A God from Heav'n with wonder and delight."

Leaving Homer, Dr. Soutar proceeds to the study of other poets. The Hesiodic poems, he says, are almost destitute of flowers. They are only mentioned in the garland put by Athena on the head of the maiden, "the beautiful evil" formed by Hephæstus ("Theog.", 576). Still this is not a description of Nature but only of an ornament. Archilochus is the first to mention "the fair flower of the rose-bush"—ῥοδῆς τε καλὸν ἄνθος, but the mere mention of the rose, with the simple epithet *kalon* (pretty), does not show, I think, much enthusiasm for the queen of flowers. We must reach the era of decadent poets of the "Anthology" and to Anacreon to find praise worthy of the subject. The epithet ἴοστέφανος, so well known later, is applied to Aphrodite in Solon and to the Muses in Theognis. To find something specifically and purely connected with flowers, Dr. Soutar rightly has recourse to the lovely choral song in "Œdipus at Colonus", where Sophocles extols the wooded hill near Athens :

"Thou hast come to a steed-famed land for rest,
O stranger worn with toil,
To a land of all lands the goodliest
Colonus' glistening soil.
'Tis the haunt of the clear-voiced nightingale,
Who hid in her bower, among
The wine-dark ivy that wreathes the vale,
Trilleth her ceaseless song ;
And she loves, where the clustering berries nod
O'er a sunless, windless glade,
The spot by no mortal footstep trod,
The pleasance kept for the Bacchic god,
Where he holds each night his revels wild
With the nymphs who fostered the lusty child.

"And fed each morn by the pearly dew
The starred narcissi shine,
And a wreath with the crocus' golden hue
For the Mother and Daughter twine.
And never the sleepless fountains cease
That feed Cephisus' stream,
But they swell earth's bosom with quick increase,
And their wave hath a crystal gleam.
And the Muses' quire will never disdain
To visit this heaven-favoured plain,
Nor the Cyprian queen of the golden rein."

Another early classical fragment, the famous tetrastich by Sappho, in which the poetess laments her lonely night, is quoted too by Dr. Soutar as a

description of nocturnal skies, when moon and Pleiads are set, as an evocation of Nature. But let us read the poem in the high-sounding music of its Doric idiom and we will see that it has little to do with moonlight and stars and much more with the despair of a soul—the incandescent soul of the poetess. Here is its rendering, but how inferior it looks to the original, how cold it is to the flame burning throughout the Greek lines :

"The moon is gone—And the Pleiads set,
midnight is nigh—Time passes on, and passes—
yet alone I lie down."

Those who can read Greek must take and recite the original aloud.* They will realize then the inimitable beauty of these four lines crying the desolation of a heart, insatiable of exaltation.

In spite of other examples and ample quotations in the book, the impression persists that mere descriptions of Nature and for the sake of Nature itself are rare in earlier and purely classical poets. The love of Nature instead becomes a more general feeling among post-classical poetry. There are striking examples of it, such as the lovely poem to the Cicala from Anacreon (which it should not be forgotten is the composition of some Alexandrian imitators, as Anacreon's work itself is entirely lost to us), with its charming first ten tines :

"Drunken with a drop of dew,
Happy, happy as a king,
We can hear thee twittering ;
Everything within thy view
From the tree-top, in the fields,
Everything each season yields,
O cicala, is thy dower ;
Dear to everyone thou art,
Dearest to the farmer's heart,
Prophet sweet of summer's hour !"

Instead, I do not really find descriptions of Nature in some translations from Greek poetry printed at the beginning of the book. The "Fishermen", from Theocritus, the fragments from the Second "Olympian" Ode of Pindar, an unspecified fragment from Euripides, and the "Lament for Adonis", from Bion, seem to have a rather remote connexion with Nature, and they are probably published here to show Dr. Soutar's ability for rhymed translations from the Greek, as in the absence of any contrary indication, I must presume that the rendering of these fragments are from his own pen.

If the chapter on the Greek anthology, which concludes the book, was not one of the two to which we understand the author had not the time to add the last touches, was to be adequately completed, how welcome would be in regard to the purpose of the book the reproduction of the charming description of the Grove by the River Iris, probably by Marianus Scholasticus, so felicitously rendered by A. J. Butler in his little volume "Amaranth and Asphodel" :

"This is the grove of Love, whose leafy bowers
Are rustling to the west-wind's gentle sound,
Where all the dewy mead is set with flowers
That lift their azure glory from the ground.
Here from three ledges on the hillock springs
A brook by fountain-nymphs shot down the glade,
While through yon copse the ancient Iris swings,
And soft-haired wood-nymphs court the noon-tide shade.
Here goodly olives, here the clusters twine
And hang their fruit above the sunny floor ;
Around to warbling nightingales divine
Cicalas quire and answering music pour.
Enter my home and share my lowly cheer."

Here, indeed, "when the Hellene", according to Dr. Soutar's own happy expressions, "has become a Hellenist, and he has drunk of the wine of the Orient, he undergoes a change in feeling, colouring his conception of external Nature with a more sensuous and subjective treatment".

It is to be regretted that in such a scholarly book some not unimportant omissions occur. The occasional reader, for example, will look in vain for many of the Greek quotations to be followed by a translation. The reader, with even a moderate classical training or a remnant of reminiscences of his Greek studies, will enjoy such quotations even if he is compelled to consult from time to time his Liddell and Scott. The outsider, however, will stop in despair at many passages, wondering what they mean and to what extent the author is justified in quoting them as characteristic in the scope of his work. Other fragments are published only in their English translation, not rarely without the respective reference to the original. The lack of an index constitutes also a drawback, fortunately so rare in English books, which, treasured after a first reading, may be enjoyed again and again in hours of need of comfort or relaxation, when some particular passage has left in the memory a faint scent, which one loves to inhale once more.

In spite of such reservations as the above, I loved the book and enjoyed it immensely. Many readers in their turn will delight in the fragrance of the flowers of this *Florilegium*, gathered and arranged by an expert hand into a bouquet of beauty and charm.

The printing of the Oxford University Press is, as always, irreproachable.

DEMETRIUS CACLAMANOS.

*The poem in the original Greek is printed here for them who would or could follow my advice.

δέδυκε μὲν ἀ σελάννα
καὶ Πληϊάδες - μέσαι δὲ
νύκτες, πάρα δ ἔρχετ' ὥρα -
ἔγω δὲ μόνα κατεύδω ÷

ROCK METAMORPHISM

Metamorphism

A Study of the Transformations of Rock-Masses. By Dr. Alfred Harker. Second edition, revised. Pp. x + 362. (London : Methuen and Co., Ltd., 1939.) 21*s*. net.

THE first edition of this book appeared in 1932. Dr. Harker had completed the revision of the text of this second edition only a few weeks before his death, which took place in July 1939. The modifications appearing in the new edition are chiefly minor changes, usually limited to a few words each, leading to certain clarifications. In addition, references to some of the work which has appeared between 1932 and 1939 are given, but little new matter is incorporated in the text. Among the more important alterations are the following : the cordierite-anthophyllite rocks of Kenidjack, Cornwall, are now considered with Eskola's Orijarvi analogues in the chapter dealing with pneumatolysis and metasomatism ; brief mention is made of recent experiments by Bridgman and Larsen on stress effects ; the inhibition of reactions through the presence of carbonaceous material, a notion rather frowned upon in the first edition, is now admitted to be possible ; there are certain additional remarks on the Inchbae aureole, adinoles, the oligoclase zone, eclogites, etc. The book thus remains essentially unchanged.

In its own field, Harker's "Metamorphism" is a masterpiece. It presents the essentially British contributions to the study of the metamorphic rocks, chief among these being Barrow's zonal work, and the notion of rock metamorphism as a series of progressive changes in response to changes of external conditions. Harker's presentation is reinforced by a wealth of personal observations and by perfect lucidity of expression. The book remains as a magnificent monument to Harker and his generation.

It is not ungenerous to suggest, however, that the field covered by Harker is a very restricted one, and that his outlook was essentially conservative. These facts should be realized by British students in particular, who should take this book as a partial and personal statement. There are wide realms of investigation in metamorphism that were scarcely touched upon by Harker. Such topics as migmatization and its relation to metamorphism, petrofabrics, the importance of metasomatic processes and so forth are not dealt with, and yet it is along these lines that future progress in the study of British metamorphic rocks is likely to develop. Once the limitations of Harker's treatment are realized, however, his work can be used as a sure foundation for British metamorphic geology—a foundation not possessed by field-workers in other countries. Upon this firm base can be built all the more securely the future edifice of British contributions to the development of metamorphic studies.

H. H. READ

THE CHEMICAL BOND

The Nature of the Chemical Bond and the Structure of Molecules and Crystals

An Introduction to Modern Structural Chemistry. By Prof. Linus Pauling. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University.) Pp. xiv + 429. (Ithaca, N.Y. : Cornell University Press ; London : Oxford University Press, 1939.) 21*s*. net.

SINCE G. N. Lewis's fundamental paper of 1916, the electronic theory of valency has been amplified and applied so extensively as to create the need for a monograph every few years ; and every few years, so far, a monograph has been produced by a leading contributor to the subject. Lewis's own book "Valence and the Structure of Atoms and Molecules" (1923), Sidgwick's "Electronic Theory of Valency" (1927), and his "Covalent Link in Chemistry" (1933), set a high standard, and the present volume is a worthy successor.

In it the author discusses the nature of chemical combination in both molecules and crystalline aggregates. The treatment is based on the electronic theory of valency as rationalized and extended by quantum mechanics, special emphasis being laid on the resonance phenomenon. The fundamental types of combination are discussed very thoroughly. The one-, two-, and three-electron bonds are considered as involving resonance between alternative electron assignments among the bonded atoms. The directed bonds in polyvalent atoms involve additional resonance among the *s*- and *p*- or *s*-, *p*- and

d-orbitals of the polyvalent atom. Bonds of partially ionic character are represented as resonance between electron assignments corresponding to electrostatic and co-valent (2-electron) bonds. Metallic bonds are described in terms of resonance between alternative positions for one- and two-electron bonds. Finally, the specially important case of "resonance of molecules among several valence bond structures" (or mesomerism) is described and extensively illustrated.

No mathematics is introduced, conclusions which can be justified or made plausible only by arguments more or less mathematical in nature being stated without proof. The method of treatment is an excellent one for enabling much ground to be covered in a short space, and is a procedure that is wholly justified for the author, who (with E. B. Wilson) has already produced a first-class text of chemical quantum mechanics; but the reviewer hopes that a study of the more cursory treatment in the present text will not be regarded as an adequate alternative to an acquaintance with the elementary ideas of quantum mechanics as a foundation for the theory of the atom and of valency. More might have been written, for example, of the subjective nature of resonance, as shown by the general character of the variation theorem, or, more remotely, by the subjective aspect of much of quantal philosophy. The difficulties illustrated would be cured if readers of the book could be persuaded to read Prof. Pauling's other book, and his original papers, especially those which form the basis of the present work and were published under an identical title.

On the experimental side, one of the most valuable features of this work is the large extent to which it co-ordinates the mass of information that has in recent years accrued from the various physical methods of investigating molecular structure. The tables of ionic radii, bond lengths, valency angles, bond energies, etc., alone would be important, but they are made much more so by the synthetic and suggestive manner in which they are presented and discussed. Alike in this field and in the theory, the book is in large measure a record of Prof. Pauling's personal contributions, and it will be assured of as permanent a place as its three predecessors in the contemporary history of chemical science.

C. K. INGOLD.

THE STUDY OF HANDWRITING

Analysis of Handwriting

An Introduction into Scientific Graphology. By H. J. Jacoby. Pp. 286+27 plates. (London: George Allen and Unwin, Ltd., 1939.) 10*s*. 6*d*. net.

HANDWRITING is obviously a form of individual expression by hand gesture; no two children who have been taught to write from the same copy and even by the same teacher will ultimately develop identical handwritings. The differences in handwriting must, therefore, be due to personal characteristics—manual, æsthetic, emotional or intellectual—of the writers themselves.

The author makes no attempt to investigate the pictographic origin of writing, or to link it to other forms of expression by gesture, or with precision (or the reverse) in articulation—with which, in particular, handwriting might be expected to be associated. He claims that handwriting is significant of the writer's "general manner of working". But this, though possibly true as to craftsmanship, might not be true of other forms of work. Some very able individuals are notoriously 'butter-fingered'.

Many of the author's conclusions will be readily accepted, for example, that in handwriting, good spacing and regularity indicate orderliness and self-discipline: that exaggeratedly large writing denotes love of display, and that small and precise handwriting implies an unemotional or pedantic nature. Other dicta, such as that convex curves (arcades) indicate "shutting to the outside world", or that movements to the right manifest tendency towards the outside world (and *vice versa*) need further proof.

The book would be easier to read if the 161 illustrations—which are well reproduced—were more systematically related to the descriptive text. Fewer illustrations, more carefully chosen, would have been better. The index, too, could have been improved by additional headings.

The author claims for 'graphology' a high percentage (87–95 per cent) of correct judgments as to character, psychological condition, ability, etc. To check this claim, the Institute of Industrial Psychology, for example, might provide Mr. Jacoby with specimens of the handwriting of a number of cases examined by them, so that the correlation between the findings of graphology and of psychological analysis might be measured.

This book is certainly interesting, though somewhat discursively written.

R. A. S. PAGET.

INFRA-RED SPECTRA AND THE STRUCTURE OF MOLECULES*

BY DR. W. H. J. CHILDS AND DR. H. A. JAHN,
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WE have to go back only to 1800, to W. Herschel's discovery that beyond the red end of the sun's prismatic spectrum there is something capable of warming the bulb of a thermometer, to find the germ of a method which, through its contributions to our knowledge of molecular structure, is beginning to be of much importance both to chemistry and to physics. Herschel's discovery was accompanied by an error—that the energy maximum of the spectrum lay also outside the red—though this probably made it even more effective in stimulating the curiosity and imagination of contemporary men of science. In spite of this interest, for the rest of the century progress was slow, and this period is taken up first with the need of proving that the new rays are nothing other than invisible light and obey exactly the same laws; and then with the task of mapping the new region, to find out if and how the radiation is absorbed by matter.

On looking back, we see that the real advances are the improvements in technique, mainly concerned with increasing the sensitivity of radiation detectors. Towering above all in its effect was the discovery by Rowland of a method of making a perfect screw, and with it constructing the concave diffraction grating. These technical advances have made their permanent impression, and we find to-day that the thermopile and the diffraction grating in their modern improved forms are playing a leading part in infra-red research. At the beginning of the twentieth century, though many absorption spectra in the region 1–20 μ had been measured and it was known that every substance, with the exception of the diatomic homopolar molecules such as hydrogen and nitrogen had characteristic absorption bands in the infra-red, no success had attended the few attempts empirically to systematize this knowledge. Indeed it is only in recent years, following upon the successful disentangling of the spectra of diatomic molecules with the help of quantum theory, that infra-red absorption bands are being related to other molecular magnitudes.

The starting point of the theoretical interpretation of infra-red molecular absorption bands is the Faraday-Maxwell electromagnetic theory of radiation. Once it was clear that radiation consists of electrical oscillations, the absorption of infra-red radiation by molecules could be explained on the basis of resonance between the electrical oscillations of the individual molecules and the oscillations of the electromagnetic field. The occurrence of characteristic frequencies in the absorption spectrum pointed to the existence of a definite spectrum of frequencies possessed by, and characteristic of, each individual molecule, this again pointing to a definite mass distribution and force system in the molecule.

Before Rutherford's nuclear theory of the atom, however, very vague ideas were current about the distribution of mass in the molecule. Molecules were considered to be built up of spherical ions, and characteristic frequencies of the individual ions were often spoken of, as would be possible if there were a characteristic distribution of mass in the ion itself. With the advent of Rutherford's theory, the distinction was quickly made between electronic frequencies involving the electronic mass, and the much slower frequencies involving the nuclear masses. It is these latter frequencies which show up in the infra-red absorption bands. Thus, for example, the water molecule is to be regarded as consisting of three heavy mass points held together in their equilibrium positions by electrical forces. It is easy to see that such a mechanical system possesses three degrees of vibrational freedom, so that the water molecule should have (as is indeed the case) three different molecular frequencies showing up in its absorption spectrum. It was this clarification of the situation that enabled Bjerrum in 1914 to lay the foundations of the method of calculating molecular frequencies still in use to-day. It had been pointed out still earlier by Lord Rayleigh that if the electrical oscillations have definite fixed directions in the molecule, then the rotational frequencies of the molecule will also appear in the spectrum, since the carrying round of the fixed electrical oscillation by the molecule will be equivalent to a harmonic oscillation having the same period as the molecular rotation, which will thus appear combined with the vibrational frequencies in the spectrum.

For the purposes of review, we may conveniently separate infra-red spectrographs into two classes, low resolving power prism and high resolving power grating instruments. The prism spectrograph is adequate to measure band envelopes, but for the finer structure due to molecular

*Substance of a course of seven lectures delivered at the Royal Institution between November 3 and December 15, 1939.

rotation, and to separate overlapping bands in the 3 μ region, and above all for work in the very long wave infra-red in the region 30–100 μ, a grating instrument is essential. Thus these two classes, very broadly speaking, give us respectively information about molecular forces and molecular sizes. The prism spectrograph has usually a theoretical resolving power of some few hundreds, but this is reduced when in use (the need of using slits wider than the optimum is one reason) by a factor of from four to eight. There have been advances in design in recent years. Careful placing of the entrance and exit mirrors of the prism, so that the errors introduced into the beam by one are partially rectified by the other, has resulted in much improved definition in the spectrum falling on the exit slit. There is a noticeable tendency to place the whole spectrograph in an evacuated chamber, thus avoiding the loss of energy in those regions of the spectrum where strong absorption by the water vapour and carbon dioxide of the atmosphere occurs. For the prism and windows we are no longer dependent on natural crystals of rocksalt, as large enough crystals can now be grown from the melt. Crystalline potassium bromide obtained in this way has extended the range of prism instruments to nearly 30 μ.

Subsidiary apparatus has also been improved. Thermopiles with only one or two elements are constructed to have a resistance and speed of response to match the galvanometers with which they are to be used. The moving-magnet galvanometer has gone quite out of favour, and is replaced by a less sensitive but far more stable moving-coil instrument, connected by some form of photo-electric or thermo-electric amplifier to a second more rugged galvanometer from which the readings are taken. In some instances where careful design and construction have almost entirely eliminated disturbances and drifts, it has proved worth while to instal an automatic recorder.

With grating instruments the resolving power is usually of the order of several thousands, and although in practice the necessity of using slits wider than the optimum again sets the limit, nevertheless powers of 10,000 at 3 μ, and 300 at 80 μ, have been attained. The predominant type of grating is the 'echelette', with a predetermined groove-form to diffract the bulk of the energy in one particular direction. This property is a most desirable one, for the energy available is usually so meagre that its dissipation into spectra of more than one order cannot be tolerated. If it is desired to work in more than one region, several gratings must be employed, those for the longer wave-lengths having correspondingly wider grooves and thus, for the same resolving power, greater dimensions. Excellent gratings as large as ten inches by twenty inches have been produced for work at the longest wave-lengths, around 80 μ. The suppression of other orders and the scattered radiation of the more abundant shorter wave-lengths around 3 μ, which would so to speak 'fog' the thermopile, is achieved with judiciously selected filters, or by making use of selective *reststrahlen* reflections, or by a combination of both.

By using vacuum thermopiles, carefully screened conductors and evacuated spectrographs, disturbances and drifts are reduced to a minimum, but even so, automatic recording is not possible in the longer wave-length regions unless a special tuned amplifier is used. With this ingenious device the beam of infra-red radiation is interrupted periodically by a shutter so that the deflection of the primary galvanometer is also periodic. The amplifier is tuned to the same frequency and is thus insensitive to drifts and all disturbances of arbitrary period. The deflections of the secondary galvanometer may then be recorded photographically, since its zero remains steady.

It is possible to make measurements in the very short-wave infra-red, from the visible to 1·2 μ, with ordinary diffraction gratings and the specially sensitized photographic plates which are now commercially obtainable. The resolving power may be high, of the order of 20,000, but the relatively simple technique is unfortunately limited to a few types of bands of molecules containing hydrogen. In these cases alone is the absorption great enough to permit the use of absorption tubes of practical length.

The theoretical analysis of molecular infra-red absorption bands can be divided into two fairly distinct processes: the vibrational and the rotational analysis. This division follows quite closely the division of the experimental work into prism and grating spectroscopy respectively.

In the vibrational analysis we consider the molecule to be built up of point masses (the atomic nuclei) held together by elastic forces, and the major problem is to calculate the classical normal modes of vibration of such a system. Such a calculation necessitates a knowledge of the equilibrium configuration of the molecule and a knowledge of the elastic forces which are called into play when the atoms are displaced from their equilibrium positions. The geometrical configuration is usually fairly well established from chemical considerations or from the electron theory of valency, whilst the force system also in many cases goes hand in hand with the chemical formulæ. Thus a good part of the vibrational spectrum can be interpreted on the basis of

characteristic stretching constants for the individual chemical bonds. A molecule possesses, however, in addition to such valency vibrations, deformation modes in which only the angles between chemical bonds change. It is tempting to introduce individual characteristic elastic constants for the angles between the bonds, but such a procedure is beset with pitfalls. A good example of the difficulties involved is the calculation of the deformation frequencies of the acetylene molecule. If a simple potential is assumed, involving only such characteristic angle constants, one obtains a false assignment of the fundamental frequencies which can only be avoided by taking into account a term in the potential energy which couples the two angle oscillators. The importance of such coupling terms has often been overlooked in calculations of the low-frequency fundamentals of molecules.

The calculation of the fundamental frequencies of even relatively simple molecules is a lengthy and tedious business, which can, however, be greatly shortened by making proper use of the symmetry of the equilibrium configuration of the molecule. There is further a general theorem due to Teller and to Redlich, which enables one to obtain useful results about the frequencies of isotopic molecules without making detailed calculations. This theorem is based on the fact that the vibrational or reduced mass of a normal mode can be expressed in the form of the product of the individual atomic masses divided by the total mass of the molecule and its moments of inertia, these latter entering only if the vibration has the same symmetry respectively as a translation or infinitesimal rotation of the molecule. Since an isotopic substitution of hydrogen by deuterium does not change the potential, the effect on the frequencies is determined solely by the change in the reduced mass. Thus from the form of the vibrational mass the ratio of the products of frequencies of isotopic molecules can be deduced. The agreement is never perfect, owing to the fact that the observed frequencies require correction for the anharmonicity of the vibrations, but this general product theorem has been of great value in checking the assignments of frequencies without making lengthy calculations.

The rotational analysis is a much more involved problem than the vibrational analysis. This is due not only to the fact that a definite spectrum of rotational frequencies is an idea quite foreign to classical theory and can be explained only on the basis of quantum kinematics, but also to the classical effect that internal vibrations in a rotating mechanical system give rise to Coriolis or vibrational-gyroscopic forces which greatly modify the rotational motion. The Coriolis forces as well as the simple centrifugal forces depend upon the nature of the vibrational potential, so that we obtain perturbations of the rotational structure of the absorption bands which depend upon the characteristic vibrational potential of the molecule. Thus whilst the simple theory of rigid rotating molecules leads to a classification of rotational spectra into those of spherical, symmetrical and asymmetrical top molecules, according to the nature of the ellipsoid of inertia, the exact theory requires a separate treatment for each individual molecule. A glance at recent work of this nature suffices to show that the quantum dynamical considerations involved are as thorough as any that have been necessary in the interpretation of the finer details of atomic theory. Whilst this complication might on one hand be regretted, it is on the other hand very satisfactory that the technical progress of experimental infra-red investigation has been so rapid that this branch of science will soon take equal rank with the sister science of atomic spectroscopy.

Although the advance in recent years has been so rapid, there is much more remaining to be done. The paucity of energy for wave-lengths greater than about $10\,\mu$ in the spectra of heated bodies has been a factor which from the very beginning has retarded development. The technique, like any other concerned with the measurement of small quantities, is a difficult one, so that even to-day, in spite of the great potential importance of measurements in the infra-red both to pure science and to industry, the number of schools engaged in breaking new ground is very small. To this situation must be added the neglect of the commercial instrument maker which, though natural enough in the circumstances, means that every worker who wishes to be abreast of developments must be something of a precision instrument maker as well. Any improvement in design or technique which would enable measurements to be made with the same speed, reliability and ease with which they are made with photographic spectrographs would be an advance of the first magnitude.

An attack in this direction which promises well is the evaporograph, in which the spectrum is received on the blackened face of an extremely thin celluloid film, the reverse face of which is covered by a layer of oil molecules in equilibrium with the vapour phase. The minute differences of temperature caused by the energy variations in the spectrum produce changes in the thickness of the oil layer, which show up when its interference pattern is photographed with blue or ultra-violet light.

In a review as short as this, applications can be only briefly indicated. For industry, important advantages are, first, that a sample may be examined without destroying or indeed interfering with it, and that very small quantities are required, and secondly, that since the spectrum between, let us say, 1 μ and 30 is a unique property of any given substance, that spectrum may in principle be used to identify the substance in any mixture in which it remains unaltered. In favourable cases concentrations as low as 1 in 10,000 may be recognized. If the substance is modified in the mixture, by association or otherwise, then its spectrum reflects the change and may be used as a source of information about it. So far as pure science is concerned, the greatest application of infra-red research in the near future will probably be made in conjunction with isotope chemistry, at first with deutero-substituted compounds, but later with other isotopes, carbon, nitrogen and oxygen in particular, as fast as they are made available in quantity. With this technique a knowledge of reaction mechanisms will be obtained which would scarcely be possible by any other method.

THE FENLAND*

By Prof. J. Stanley Gardiner, F.R.S.

THE Fenland is an area of 73 miles by 36 miles, covering 1306 square miles, and comprises parts of the counties of Lincoln, Norfolk, Suffolk, Cambridge, Huntingdon and Northampton. It consists of Jurassic clays underlying glacial boulder clay, cut into basins and water courses by tidal and river actions. Some Jurassic islands were left, such as Ely, while peat formed in the swamps to the south, merging into a broad belt of silt against the sea. The area was not stable, and peat and silt in places alternate ; and often horizons of submerged forests are followed by swamp conditions. In the earliest period of history the Fenland was a flat expanse with scattered islands and ridges from the surrounding uplands, all these cultivated, while the swamps yielded rough produce for stock, the streams abundant fish, especially eels, and the marshes wild-fowl. Of course it must have been a paradise to the Romans by providing an outlet for their energies, the results of which are problematical. It is only certain that there was wide cultivation succeeded by decay. This was possibly due to the neglect of drainage works, complicated by a small change in land-level in progress towards the termination of the Roman occupation.

In the Norman period the condition of the Fenland may be inferred from the map of the Domesday settlements. It must have been affected by the relatively recent monastic foundations of Crowland, Ely, Ramsay, Thorney and Chatteris. For his recently issued studies on the Fenland, Mr. Darby has consulted all authorities, but they have helped little as to the economy in this Anglo-Danish period. His inferences are based on the Domesday settlement—peat lands do not allow of the building of house foundations—the sizes of parishes and the distributions of fisheries, salt pans, meadow and other lands. The Wisbech estuary now became silted up and inundations followed. At some uncertain date the Eastern and Western Ouses were diverted, partly by artificial channels, to reach the sea at Lynn. Traffic to the surrounding lands apparently thronged the waterways. In the fourteenth century the Fenland was many times more prosperous than the surrounding upland. Strategically, it might be a centre of rebellion or of refuge—a comparison with part of southern Finland to-day is not inappropriate—but disturbances were largely dictated by neighbouring barons. Socially, there was no isolation and its people were not "endowed with any qualities of desperate wildness extracted by some mystical influence from reeds and rushes". Mr. Darby's economic study of this time is excellent, but he could have made it plainer to his readers had he presented a picture of the Fenland as it really was, its meandering rivers, open pools, marshes, sedge and litter lands, thickets and woods. Its peat is not the well-known product of moss but of the decay of sedge and litter ; it is very alkaline.

The account of Tudor times in the Fens reveals a woeful condition of dire poverty. This was partially due to the upheaval that succeeded the dissolution of the monasteries, but every 'Court' was quite ineffective in maintaining the Fenland channels and drains. Parliament became interested in the matter and in 1534 passed the first Act for the preservation of birds ; wild-fowl were given a close season in June, July and August, and the taking of their eggs was prohibited "upon pain of imprisonment for one year". Later, there were great floods and many permanent 'drownings', and in 1570 the sea broke in near Wisbech. Drainage

* The Medieval Fenland. By H. C. Darby. (Cambridge Studies in Economic History). Pp. xvii+200+11 plates. (Cambridge : At the University Press, 1940). 12*s.* 6*d.* net.

The Draining of the Fens. By H. C. Darby. (Cambridge Studies in Economic History). Pp. xix+312+31 plates. (Cambridge : At the University Press, 1940). 21*s.* net.

thus became a matter of national rather than parochial interest, the first effort being concentrated on cleaning out the channels and repairing the banks near Wisbech.

The interest of King James resulted in a welter of ineffective activity. In 1630 the Earl of Bedford 'adventured' his money to drain the southern fens, now known as the Bedford Level. He employed that Vermuyden whom the Commissioners had previously refused to employ. His plan was to shorten the courses of the main streams so as to increase their gradients, erecting the necessary sluices to control the tides. In 1631 the Bedford River, a straight channel 21 miles long from Earith to Denver, was dug ; it was completed twenty years later by a strongly embanked second channel. I may say that in the nineteenth century it attained peculiar fame, for here a great controversy as to the rotundity of the earth was settled by A. R. Wallace (see NATURE, April 6, p. 561).

Other projects were a "Middle Level" from Peterborough and a "Northern Cut" ; the Earl of Lindsey was at work on the Lincoln fens. Everywhere there were disturbances as the whole economy of the region was upset, and "Mr. Cromwell" appeared at Huntingdon in 1638 as the chief opponent of King Charles, who was the "undertaker". Later Cromwell established himself at Ely, so that in the Civil War the Fens were not a harbour of refuge ; of course all work ceased and there was much destruction. Internal peace encouraged a resumption of drainage in the southern Fenland, and Cromwell, now the statesman and great patriot, supplied both Scottish and Danish prisoners as labour ; German prisoners were used similarly in 1917–18.

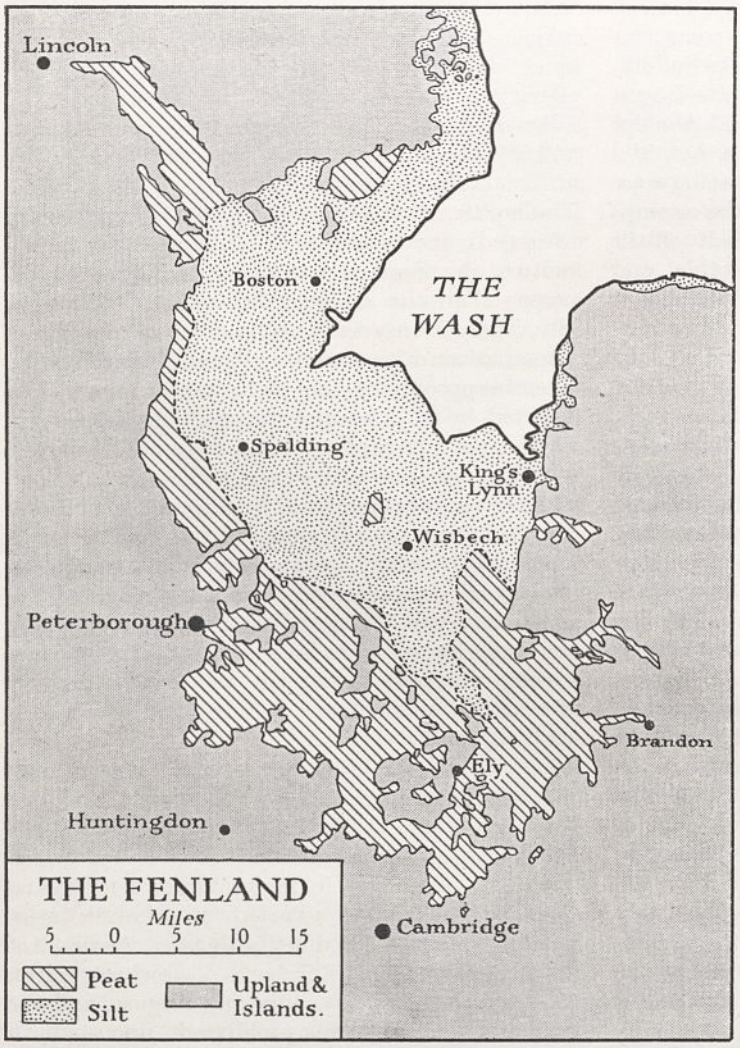

Fig. 1.
FROM "THE MEDIEVAL FENLAND".
THE PRESENT-DAY DISTRIBUTION OF THE LAND.

Innumerable difficulties were experienced in the eighteenth century due to the necessity of preserving channels for navigation, the inefficiency of the control of the outfalls to the sea, the looseness of the banks—this allowed a constant seepage—and, above all, the settling of the ground surface in the peat lands. The latter now lay considerably below the river-levels and the water channels that had been cut to carry the upland drainage into the rivers. Such shrinkage was experienced but slightly over the silt lands of Lincolnshire, so that the problems there were never so difficult as over the southern Fenland. For example, Wicken Sedge Fen is a catchment basin for the waters of its adjoining uplands, which are retained by means of the lodes and ditches surrounding it, while the surface of the peat lands of the neighbouring Burwell Fen now lies 7 ft. below, this difference representing the shrinkage*.

Nearer the centre of the Fenland in 1851 a column was inserted near Whittlesea Mere to the level of the peat surface. The mere was pumped by the new Appold system, and in three weeks 1,000 acres almost 3 ft. deep were drained ; the column now

* "On the Level of the Fens around Wicken", by W. S. Farren, "Natural History of Wicken Fen", 190 *et seq* (1926). This is the part of the Fenland which best retains the conditions preceding the drainage. The vegetation is considered by Messrs. Godwin and Tansley, and the animal life by Dr. A. H. Evans and more than thirty other authors. These volumes have escaped Mr. Darby's bibliography.

stands 11 ft. above the surface of the ground, and there is 11 ft. of peat below. "The better the drainage, the greater the wastage of the peat surface", as Darby expresses it. A remedy was found ; the picturesque wooden windmills being built in the eighteenth century replaced ponies in raising the water from ditches in the lower Fenlands to the drainage lodes, which were straightened still more and strengthened ; the outfalls with the necessary sluices were likewise improved.

Even at the end of the eighteenth century, conditions in respect to flooding were bad, as Young tells us, but the reclaimed land was the richest in England for corn and stock. Only a few years later the advent of the steam engine gave man the necessary power of control. An inscription on a pumping station of the New Bedford River reads :

These *Fens* have oft times been by *Water* drown'd,
Science a remedy in *Water* found.
The powers of *Steam* she said shall be employed
And the *Destroyer* by *Itself* destroyed.

Owing to railways, water traffic ceased to be important and coal became easily obtainable. The banks remained as the greatest danger, and, on occasions, even in the last decade every fenman near Ely has been called out to work both by night and day, while some houses were evacuated ; even troops and undergraduates from Cambridge were summoned to help in saving the banks, and hourly bulletins were issued. In these later days the control of the sea was better understood, but the problem here was vastly different from that of the Zuider Zee. The Fenland with its islands carried a considerable population, while the Wash, with its strong tides and open waters, makes the building of any large controlling dam, while quite unthinkable centuries ago, almost impossible even to-day.

Mr. Darby is to be congratulated on his remarkable study of the Fens. His every historical statement is supported by reference and selected with a real grasp of essentials. A chapter showing why the reclamation of the Fens became a national rather than a local matter would have helped in the study of his research. We should also like to know more of the Fenland peoples and their change from mainly pastoral to almost purely agricultural life. The principal crop in the eighteenth century was rape, its Fen name "cole". While at present it is only used for feeding purposes, particularly for sheep, its seed was then an extensive source of oil (rape, colza oil, etc.). The Fenland is no longer a grazier's country, but a land of corn, potatoes and beet. Occasionally mustard and buckwheat fields diversify the landscape, and in places horticulture, flower and fruit farmings have been extensively developed. As a whole, the Fens are prosperous, but many areas require scientific treatment, some perhaps a reclaying, others an attention to the water-level, and, surprisingly perhaps, others a retention of ground moisture that the addition of humus alone can give. Can we stimulate Mr. Darby to tell us, out of the abundance of his knowledge, a little of the more human side of the Fenlands, leaving aside for a time the technique of research ?

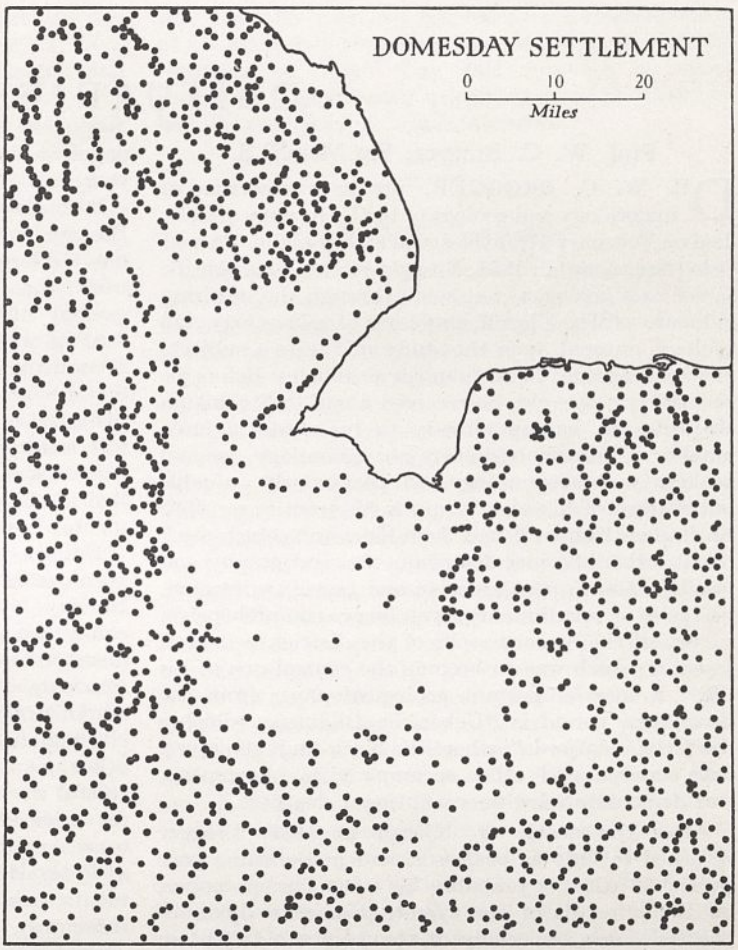

Fig. 2.
FROM "THE MEDIEVAL FENLAND".
THE SETTLEMENTS OF THE PEAT WERE UPON THE ISLANDS (SEE FIG. 1). THE BRECKLAND COUNTRY TO THE EAST WAS VERY SCANTILY SETTLED.

OBITUARIES

Prof. W. C. Brøgger, For.Mem.R.S.

DR. W. C. BRØGGER, professor emeritus of mineralogy and geology of the University of Oslo, died on February 17, at the age of eighty-eight. Born at Oslo (Kristiania) in 1851, Brøgger started his scientific career as a zoologist, but soon, through the inspiring influence of Th. Kjerulf, professor of mineralogy and geology, entered upon the study of the two subjects in which he was to accomplish so much. Before he was thirty years old, he received a call to Stockholm as professor, having already to his credit a large number of important papers on mineralogy, general geology and palæontology. A particularly valuable publication of his early years is his treatise on "Die silurischen Etagen 2 und 3 im Kristianiagebeit, etc." (1882), where besides describing the stratigraphy and fossils of the Upper Cambrian and Lower Ordovician, he gave a preliminary, yet very comprehensive, survey of the igneous rocks of the district, a field of research which was to become the central one of his life. A most important geological paper from the Stockholm period is "Ueber die Bildungsgeschichte des Kristianiafjords", where the block-fault structure, with breccia and other accompanying phenomena, was demonstrated with exceptional clearness.

After the death of Kjerulf in 1890, Brøgger returned to Oslo as professor, and in the same year published what is probably his most famous paper, on the minerals of the syenite-pegmatite dykes of the Oslo area, especially of the Langesundsfjord in the southern part. This monograph of about 700 pages, coupled with his previous works, brought Brøgger the Murchison Medal of the Geological Society of London and other high rewards. It deals not only with a wonderfully rich variety of minerals, but also with wide petrological and geological problems, and has made the district classical, attracting to it great numbers of mineralogists and geologists from many countries, who often enjoyed the personal guidance in the field of Brøgger himself.

In the course of his long life, Brøgger continued to publish papers, especially on the alkaline rocks of the Oslo area, which furnished him with magnificent examples of rock differentiation and with material for the original description of very numerous and characteristic rock-types (lardalite, larvikite, nordmarkite, etc.). He showed the close chemical and mineralogical relation of the vast variety of rocks involved, occurring as plutonic bodies, as sills and dykes, and as lavas, with, in the main, a change from more basic to more acid types. Together with his assistant, and later on successor, J. Schetelig, he published a series of valuable geological maps of the Oslo area. Other of Brøgger's petrological studies dealt with Archæan rock-suites from southern Norway, and with a most interesting series of igneous carbonate-bearing rocks in the Fen district, just outside the Oslo area. The paper on the Fen rocks, reaching several hundred pages in length, was published in his seventieth year.

It is a most imposing proof of the universality of Brøgger as a man of science that we also owe to him the largest and, we may add, the most important work, that has been published on the Quaternary geology of Norway, a book (published in 1900–1) dealing with the unconsolidated deposits occurring around the Oslo Fjord, with far-reaching conclusions on the geographical and climatic history of the district; and further, that he has given us the first full treatment (1905) of the relation of the Stone Age settlements to the varying height of the shore line in the same district—an achievement of fundamental importance to Norwegian archæologists.

Brøgger has not only in his personal research work been one of the most prominent men of science whom Norway has ever produced (his scientific honours could be counted in scores, including, among others, membership of the Royal Society and the Paris Academy of Sciences), but in addition, through his administrative abilities, he was able to promote Norwegian scientific life in general more than any other man. Of particular importance was his successful work in establishing a great number of funds for scientific research, some of them very large, together with his activities on behalf of the University at Oslo, which resulted in a number of new appointments, new buildings (including the natural history museums), etc. Brøgger was also, as a matter of course, for decades the central and leading personality in the Academy of Sciences at Oslo, the activities of which owed much to him in different ways.

Brøgger was a man with wide interests outside the realm of science. It is perhaps worth mentioning just now that so long ago as 1899 he was one of a committee of six outstanding representatives of European intellectual life who in St. Petersburg requested an audience with the Czar of Russia, in order to lay before him an address, signed by more than a thousand prominent men, in protest against new and oppressive regulations towards Finland. They were not granted an audience, but their effort gained for them the lifelong gratitude of the Finnish people.

OLAF HOLTEDAHL.

Prof. E. Mapother

PROF. EDWARD MAPOTHER, who died on March 20 at the age of fifty-eight, had been medical superintendent of the Maudsley Hospital since its opening. Under his wise and energetic control, it became the chief post-graduate centre of psychiatry in Great Britain. Mapother was selected to fill the newly created chair of clinical psychiatry in the University of London, tenable at the Maudsley, in 1936. This was a personal appointment, which he continued to hold after he had resigned from his post as superintendent of the Hospital last December; it was an

acknowledgment of the remarkably effective and far-sighted way in which he had used his position, from the beginning, to further psychiatric teaching and research.

Very great importance was attached by Mapother to this side of his work, and he felt strongly that it demanded the full time of one man, though it had been impossible for him to give it full time because of his administrative duties as superintendent, which were heavy. He fretted constantly at the restrictions which his other work imposed upon what he felt he ought to be doing in this regard, and more than a year ago he drew up a plan for the reorganization of the staff of the Hospital, which provided for the permanent separation, in different hands, of his two main functions. Owing to his tireless energy he accomplished much more, however, than he believed; and the influence of his teaching and of his guidance of the general lines of research was far-reaching.

Mapother was himself first and foremost a clinician; and all his investigations were primarily clinical, for example, into alcoholic morbidity, the mental effects of head injury, and the neuroses of war. He understood very well, though, that research must be conducted along many lines, somatic, psychological and social, if knowledge in this conspicuously difficult and complex subject was to be advanced, and he sought constantly to synthesize neuro-physiology and psychology. He recognized two important needs: to bring into psychiatry first-class men, and to ensure that they should have a good training both in clinical psychiatry and in whatever scientific methods they were going to apply to psychiatric problems. He was aware that, in the past, fewer able men have been attracted towards psychiatry than towards other fields in medicine, and he thought that the best way to remedy this was to build up an outstanding university centre the achievements of which, especially in research, would influence the standards and reputation of psychiatry. Through the help of the Commonwealth Fund of America, and especially of the Rockefeller Foundation, he was able to carry this project a long way; the London County Council showed a generous understanding of the value and importance of Mapother's efforts, which could not have been realized without its concurrence.

Mapother was a remarkably good judge of men, as was inevitable in so penetrating a clinical psychiatrist; he saw through empty professions and slipshod efforts, but was critically appreciative of good work. He therefore succeeded in gathering around him a group of able men who were glad to work under the conditions available at the Maudsley. He was determined that there should not be dilettante research in his hospital. He had seen the harm done by this, both in the more academic forms of research and in investigations into clinical problems, and he was careful, in the selection and training of his staff, to ensure that they should be thoroughly competent in the research methods employed. To his insistence on this must be largely attributed the high level of the research done under his stimulus and direction. He was happy to know, in the last few months of his life, that the War had not led to the disintegration of his staff, but that they were working, in the two hospitals to which they had removed, on those problems of psychiatry arising in war, to which he had himself paid so much attention.

Mr. E. T. Cottingham

SCIENCE, and more particularly the precision time measuring side, loses in the death of Mr. E. T. Cottingham one of the few outstanding men of Great Britain engaged in this research.

He was born at Ringstead, near Thrapston, and, although originally apprenticed to a tailor, his love for mechanical timepieces overcame his father's desires, eventually giving to Mr. Allen the task of teaching him to be a clockmaker in the village of Thrapston, where the whole of his life was spent.

Throughout, his interest has not been centred on one problem, for so varied were they that a few, such as church clocks, sewage pumping machinery, and fitting the surrounding blast furnaces with pyrometers, etc., occupied his attention. The proximity to Cambridge naturally gave him other problems which he so loved to solve. The advent of radio enrolled him as an early student and pupil and, I believe, he was one of the first to install his experimental set, dated October 1912. Wireless and time signals being inseparable, and from this to astronomical time-keeping, the care of the instruments at Greenwich in due course followed. He was also invited and accepted the invitation to accompany Sir Arthur Eddington in 1919 to Principe on the eclipse expedition. He will always be remembered for his simplification of the principles of Dr. Reifler's escapement, and the models he has left in the various observatories of the world stamp him as a genius in design and craftsmanship where simplicity is the keynote.

FRANK MERCER.

WE regret to announce the following deaths:

M. Nicholas Arnold, honorary general administrator of the Belgian Colonies, who had a large share in the development of the Congo under Belgian auspices, especially from a horticultural and botanical aspect.

Sir George Buchanan, K.C.I.E., consulting engineer especially concerning harbour, docks and river works, on April 14, aged seventy-four years.

The Right Hon. H. A. L. Fisher, O.M., F.R.S., warden of New College, Oxford, on April 18, aged seventy-five years.

Dr. A. C. Haddon, F.R.S., emeritus reader in ethnology in the University of Cambridge, on April 20, aged eighty-four years.

Prof. Heinrich Preiswerk, visiting professor of mineralogy in the University of Basle, aged sixty-four years.

Prof. W. R. Scott, F.B.A., Adam Smith professor of political economy in the University of Glasgow, on April 3, aged seventy-one years.

NEWS AND VIEWS

Prof. A. Virtanen: Helsinki

ON February 28, while the Russo-Finnish War was still in progress, the Editors wrote to Prof. Artturi Virtanen, of the Biochemical Institute, Helsinki, inviting him to send a message to scientific workers at large. Readers, and especially those interested in biochemistry as applied to agriculture, will be pleased to learn that Prof. Virtanen is safe and hopes to continue his scientific work. A letter, dated April 1, has just reached NATURE office, in which Prof. Virtanen writes: "I thank you for your kind letter of February 28, and am pleased to say that I have managed to retain my life during the war. My scientific work was, however, interrupted from the beginning of November. The danger to which my country and our civilization was subjected necessitated my taking up other kind of work. Our institute was emptied owing to the men joining the army and the young ladies being engaged on women's auxiliary labour. Three of my collaborators gave their lives for their country: L. Mansikkala, M.A., L. Eerola, M.A., and A. Arhimo, M.A., all men on whose forehead our Lord had written the word Honour. Together with Mr. Arhimo I have in this journal published two Letters to the Editors concerning the oxaloacetic acid and other keto acids in the plants. Following the destructive air bombing of Helsinki on November 30, I wrote my last letter to NATURE, as there was a possibility of my not being able to continue my work. Should circumstances permit, I hope to resume my reports to NATURE in the near future."

Prof. Alexander Findlay

FIVE years ago, Prof. Alexander Findlay published a characteristically comprehensive and interesting monograph on "The Teaching of Chemistry in the Universities of Aberdeen". His own approaching retirement from the chair of chemistry at Aberdeen, a chair which he has occupied with distinction for twenty-one years, inspires the thought that when some future scientific historian undertakes the task of bringing this volume up to date, he will find Prof. Findlay a subject as fascinating and as significant as any of his predecessors. A graduate himself of the University of Aberdeen and a research student under Ostwald at Leipzig, Findlay became recognized, very early in his career, as one of the leading promoters of physical chemistry in Great Britain and, before returning to his *alma mater*, held the positions of lecturer in physical chemistry in the University of Birmingham and professor of chemistry at the University College of Wales, Aberystwyth.

Pressure of teaching duties and lack of adequate laboratory facilities have unfortunately restricted Findlay's natural bent for original research, but ample compensation for this restriction is provided by the steady flow of text-books and 'popular' volumes of science with which he has instructed thousands of chemists and entranced multitudes of laymen. Few physical chemists of the present generation have not been nursed upon Findlay's "Phase Rule" or "Practical Physical Chemistry" (to mention only two out of many); no chemist of the present generation has attracted a larger outside following than Findlay in "Chemistry in the Service of Man" or "The Spirit of Chemistry". It is to be hoped that the greater degree of freedom afforded by the new phase of professor emeritus will permit him to delight the component body of his friends and admirers with many more such works of art.

Dr. H. Melville

DR. H. MELVILLE, of the Laboratory of Colloid Science, Cambridge, who has been appointed to succeed Prof. Findlay, is well known for his work on the mechanism of gaseous reactions. His first important series of papers dealt with the oxidation of phosphorus at low pressures, in which it was shown that the diffusion of active molecules or radicals to the walls of the reaction vessel is a dominant process in regulating the velocity of oxidation. Theoretical advance was also made by the discovery of a method for measuring the branching of reaction chains in the oxidation of phosphine, one of the essential processes in controlling explosions in gases. This was the first estimate of this coefficient. He has also contributed to our knowledge on the photo-decomposition of the hydrides, the low quantum yield being traced and proved to be due to the occurrence of the recombination of the primary products of decomposition; this investigation led naturally to a supplementary one on the kinetics of exchange reactions of deuterium with the simple hydrides.

Latterly most of Dr. Melville's work has been directed to the elucidation of the mechanism of polymerization reactions. Suitable polymerizations have been found which occur in the gas phase photochemically and are amenable to kinetic study. One of the interesting results has been the discovery of molecules which grow, after photo-activation, in the dark for very long periods. Molecules of any size can thus be produced. By studying interpolymerizations it has become possible to build molecular sandwiches. Methods have also been developed for determining kinetically the molecular weight of polymers and for examining in detail the molecular statistics of the individual steps in a polymerization reaction, thereby leading to the exact control of molecular growth.

Karl Toldt (1840-1920)

PROF. KARL TOLDT, an eminent German anatomist and anthropologist, was born at Bruneck in the Tyrol on May 3, 1840. He received his medical

(*Continued on page* 663)

NATURE

SUPPLEMENT

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SHORT REVIEWS

ANTHROPOLOGY

Akiga's Story

The Tiv Tribe as seen by one of its Members. Translated and annotated by Dr. Rupert East. (Published for the International Institute of African Languages and Cultures.) Pp. xv+436+24 plates. (London: Oxford University Press, 1939.) 21*s*. net.

IF support were needed for the policy of the International Institute of African Languages and Cultures in encouraging the African to express himself in literary form, it might well be drawn from this volume. The author has been engaged for more than twenty years in collecting information relating to the traditional customs of his people, the Tiv, who, to the number of more than half a million, live on the banks of the Benué in northern Nigeria. Although it is true that his action long preceded any possibility of encouragement by the Institute, which came in only at the latest stage, the result of his labour, or at least that part of it which has now been published in translation, is remarkable for its power of logical thought, its arrangement, and its grasp of the essential. If the efforts of the Institute succeed in discovering writers of anything like the same calibre among the peoples of Africa, even if their numbers are relatively small, the policy is wise, and energies have not been expended in vain.

Akiga was the first of his people to attend a school, and although a Christian, and an active preacher of Christianity among his people, he records the traditional customs and beliefs of his people in pagan days with an objectivity and detachment which should find favour in the eyes of the anthropologist. Where his narrative falls short of the requirements of an ethnographical treatise, as it does at times, his translator, Dr. East, has done much to make good the deficiency by his supplementary and explanatory notes, in which he endeavours to supply the background necessary for understanding in a reader who knows neither the country nor the people. Author and commentator, between them, supply an instructive picture of a state of society which now to a great extent has passed away, largely owing to the efforts of the administration to restrict the leaning of the Tiv towards a preference for variety in their forms of marriage, by admitting one form only as legal. From Akiga's story it will be learnt why the election of one particular form, though well-intentioned, was mistaken, and why the native holds the white man as responsible for the ruin of the country.

Europe and West Africa

Some Problems and Adjustments. By Dr. C. K. Meek, W. M. Macmillan and E. R. J. Hussey. (University of London: Heath Clark Lectures, 1939, delivered at the London School of Hygiene and Tropical Medicine.) Pp. v+144. (London, New York and Toronto: Oxford University Press, 1940.) 10*s*. net.

IN this, the eighth of the series of Heath Clark Lectures of the University of London, "the educational, cultural and humanistic aspects of the History, Development and Progress of Preventive Medicine and Tropical Hygiene" have been construed in the broadest sense. They deal with the cultural changes and adjustments which are and have been taking place in West Africa as a result of the impact of European civilization. Dr. Meek opens the course with two lectures in which he draws upon his experience as an administrator, mainly acquired, as he points out, in Nigeria, to give in broad outline a summary of West African racial and cultural conditions and to indicate some of the principal social and economic factors affected by or affecting the course of contact development.

Prof. Macmillan, from his wide experience of African social and economic problems, provides an acute and penetrating analysis of a situation arising out of the development of the mining and cocoa industries and the difficulties which confront administration in the mixed communities resulting. Finally, Mr. Hussey considers the contribution of education to the solution of the problem of African development, construing his terms of reference in so wide a sense as to examine the position of 'indirect rule' as a factor in education. Those who are interested in the future of African peoples will find much

stimulating food for thought in the indications afforded by both Prof. Macmillan and Mr. Hussey that indirect rule is not a magical formula which can be applied to all conditions and circumstances—as, for example, on the Gold Coast—without discrimination.

Astronomy

A Star Atlas and Reference Handbook (Epoch 1920-1950)

For Students and Amateurs. By Arthur P. Norton. The Reference Handbook by J. Gall Inglis and A. P. Norton. Seventh edition. Pp. xii+52+18 maps+xiv–xxii. (London and Edinburgh: Gall and Inglis, 1940.) 12*s.* 6*d.* net.

IN the fifth edition of this work the constellation boundaries were drawn in accordance with the scheme adopted by the International Astronomical Union in 1930, and this plan has been followed in the sixth and present editions. Among the additions to the seventh edition may be noted a revised and enlarged index to contents and also on the last page an index to constellations and charts. Precession tables on p. xvii with an example of their use is another addition which will prove useful. The chief enlargement in the work has been made in a greatly extended list of "Interesting Objects", the number having been increased from 130 in previous editions to 523. The positions of these objects are referred to the equinox of 1950.0, which will be a standard of reference for a considerable time. The first four sections of the "Reference Handbook" at the beginning of the work supply useful information on a large number of astronomical terms, while the fifth and sixth sections give hints to observers and instructions on the use of the telescope. The work is intended primarily for the use of the amateur observer whose telescope is mounted either on an alt-azimuth stand or as an equatorial without graduated circles. It will certainly fulfil its object, and every amateur who is anxious to do useful work should be in possession of this volume. M. D.

An Easy Guide to the Constellations

(Based on the work of the same name by Rev. James Gall). With a Miniature Atlas of the Stars. By J. Gall Inglis. Pp. iv+86. (London and Edinburgh: Gall and Inglis, 1939.) 1*s.* 6*d.* net.

THE original of this book was published more than eighty years ago and was based on illustrated talks given to working lads in Edinburgh. The present author—a grandson of the original author—enlarged and partly rewrote the book many years ago, and now he has extended its scope to include some of the recent developments in astronomy.

A brief outline is given of many useful facts in astronomy in simple language that will prove very helpful to boy scouts especially, but others interested in the elements of astronomy will also find much useful information. The star maps are clearly drawn and with each of these there is a brief description of the times in various months when they south; this will help the amateur to identify them if in doubt. A very important feature is a list of constellations, stars and planets with the pronunciation of their names. The little work will serve a useful purpose. M. D.

Biology

Practical Animal Biology

By T. L. Green. Pp. x+276. (London: Allman and Son, Ltd., n.d.) 4*s.* 6*d.*

A PRACTICAL book in animal biology for use in schools, of a simpler nature than that used by first-year university students, is assured of a welcome. Mr. Green has combined a study of living animal types with investigation of their morphology. Shorter sections deal with chordate embryology, histology and physiology. There are nearly one hundred text figures. The text is fully descriptive and should be adequate for the scholar. Questions to be investigated by him are suggested throughout. The experiments in the physiology section have been well chosen and will certainly interest him.

The book, however, seems to have been hastily put together; there are inaccuracies in the text, and in some places where the text is sound the accompanying figure is at variance with it. For example, Fig. 55 tells the student that the abducent nerve supplies the *superior* rectus muscle, whereas the text and Fig. 56 indicate that this nerve goes to the *external* rectus muscle. As this nerve is usually very difficult to trace, what is the pupil to believe? Or again, the description of the innominate artery (p. 171) is correct; but any observant pupil will soon find out that the figure of it (74) is wrong. In the text the sequence of the factors of the right anterior vena cava in the rabbit (p. 170) should be *b*, *c*, *d*, *a*, *e*, *f*, and not as arranged by the author. In the embryology section, the germinal layers are named ectoderm, mesoderm and endoderm, but thereafter, without explanation, though with occasional lapses, they are called epiblast, mesoblast and hypoblast. Such inaccuracies detract from the value of an otherwise useful book, and illustrate how difficult it is to write a good text-book.

Laboratory Outline for General Zoology

By Prof. George Edwin Potter. Pp. 276. (London: Henry Kimpton, 1939.) 8*s.* 6*d.* net.

THIS sheaf of loose leaves, perforated for filing, comprises notes and hints on dissection, interleaved with sheets for drawings. The type method is employed, the range being somewhat similar to that of a first-year course in zoology in Great Britain, with the notable absence of a mammal. There are questions on each type, and suggestions for demonstrating various points. Outline drawings and schematic sections have been printed, and the student is expected to fill in the detail. How far this will encourage the student to scamp genuine observation is a debatable point, and most zoologists in Great Britain would consider it inadvisable to do too much

for the student, however much time and labour for the teacher are saved thereby. The frog's skull, for example, has been drawn with every bone outlined, and all the student need do is insert the names and send in his sheet to be marked. The author aims at making the student "rely on his own judgment". Surely it is equally important to stimulate and train his powers of observation.

In the first insect type the name of the insect has been omitted, and the reviewer's copy has a duplicate page in this section. The descriptions are clearly expressed, and since scientific terms and new words are printed in italics, the student can look these up in the "Text-book of Zoology" previously published by the author.

Nature Parade

By Frank W. Lane. Pp. 316+53 plates. (London: Jarrolds, Ltd., 1939.) 15*s*. net.

BY far the majority of books which set out to describe events and happenings in nature are limited in that they are personal records of one or two observers only. The value of this book lies in the fact that the author has made a synthesis of innumerable records from various observers. The more general sections deal with subjects like animal food, toilet, sleep, leadership, strength, war and doctoring, while a considerable portion of the book is given over to a useful and original résumé of speed and locomotion in the animal kingdom. In a shorter section, which falls below the standard of the rest of the book, there is a rather verbose description of rare and mystical animals. "Nature Parade" rightly justifies its author's claim to be "a nature book with a difference" and contains much interesting information. It suffers by its too 'popular' and anthropomorphic approach and the absence of references to original documents. Some remarkable photographs by leading nature photographers do much to enhance the usefulness of the book. T. H. H.

A Contribution to the Biology of North American Vespine Wasps

By Prof. Carl D. Duncan. (Stanford University Publications, University Series: Biological Sciences, Vol. 8, No. 1.) Pp. 272+54 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 15*s*. net.

THIS memoir deals with North American paper-making wasps of the subfamily Vespinæ. It is divided into four sections: an introduction, a morphological section, a systematic section and a biological section. The morphology is concerned with the skeletal and muscular systems of *Vespula pennsylvanica*. The systematic part is concerned with genera and not species, while as regards biology numerous observations are given on habits, behaviour, nest-building and life-history. An extensive bibliography is appended, but the literature is not exhaustively reviewed, since the work is in no sense claimed to be a monograph.

Chemistry

Laboratory Exercises in Inorganic Chemistry

By Prof. James F. Norris and Prof. Kenneth L. Mark. (International Chemical Series.) Second edition. Pp. xiii+574. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 12*s*.

WITH the publication of a new edition of "Inorganic Chemistry for Colleges", Profs. Norris and Mark have now revised "Laboratory Exercises in Inorganic Chemistry" to make it complementary to the theoretical treatise. Additional experiments have been introduced to illustrate the chemistry of colloids, *p*H, and buffer solutions; otherwise the general plan of the book remains as before.

It is often said that experience is the best teacher, and the authors have fully supported this view in presenting a book which gives thorough training to students in all branches of practical inorganic chemistry. Very wisely, special emphasis is laid on the acquisition of fundamental bench technique as an early step in the student's training. This is followed by a systematic course covering the preparation and well-known reactions of many simple inorganic chemicals.

Each exercise consists of three parts: discussion, practical directions and questions. The last part is formulated in such a manner as to show that both the chemistry and the technique of the exercises have been mastered. An unusual feature of the book is the provision of blank pages for the students' notes. This system, which renders the book ultimately a combined text-book and note-book, should be of great value to the instructor.

The book can be heartily recommended to students entering on a chemical course. A careful study of the theory contained in the text and a mastery of the laboratory technique presented will prove a sound basis should the student desire to embark on more advanced chemical courses.

The Chemistry of Milk

By Dr. W. L. Davies. (Monographs on Applied Chemistry, Vol. 10.) Second edition. Pp. xiv+534. (London: Chapman and Hall, Ltd., 1939.) 25*s*. net.

IN reviewing the first edition of this book in NATURE, 138, 625 (1936), attention was directed to the rather large number of errors and inaccuracies in what should have been an indispensable and infallible weapon in the hands of the dairy technologist. So far as can be discovered, a few of these errors have been corrected in the new edition, but many remain. In addition to those cited in the NATURE review—and in others—may be mentioned a misquotation of Baumann and Steenbock (p. 490, last line but four), who found a 200 per cent variation in the vitamin A content of butter—not a 100 per cent variation, as stated by Dr. Davies.

The book remains the only work of its kind published in Great Britain. Every dairy chemist in the Empire probably possesses or has access to a copy. It is a national and imperial duty to secure that the

facts supplied in this book are correctly given and clearly stated. The duty devolves upon publisher and editor, but still more on the author. It is therefore up to Dr. Davies, now himself the head of an important dairy research institute—a post that his own work in the field of analytical dairy chemistry fully justifies—to see that the third edition, which will surely be required in due course, is free from the many blemishes that disfigured the first and the second. A. L. B.

Engineering

Electrical Engineering Experiments

Theory and Practice. By Prof. Henry R. Reed and Prof. George F. Corcoran. Pp. xii+500. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 22*s*. 6*d*. net.

THIS text-book will be very useful in electrical engineering laboratories. It covers a wide field, but most of the experiments have an individuality of their own and this gives a wide scope to the teacher, who will find much of the apparatus described and the instructions given in the book useful for physics and chemistry students. The large number of experiments described and the comparatively cheap nature of the apparatus required will be welcomed in colleges and technical schools which have only a limited equipment.

The text is divided into an introduction and seven sections. In the introduction the fundamental principles are first described, then direct current machines, alternating current circuits, transformers, synchronous machines, induction machines and electronics. Ample theory is given with each experiment, so that the reader can do most of them without detailed reference to other books. Exercises within the scope of a given experiment are so arranged that a portion or the whole can be performed, as time permits, without breaking up too much the continuity of the experiment. It will be particularly valuable to students taking a second year course in electrical, mechanical, chemical or telecommunication engineering.

The instructions given on how to write a report of the experiment done and the suggestions for further research work will save the teacher much trouble when the students ask him for hints as to suitable course work' to be marked for examination purposes. We can recommend the book to young graduates and others seeking for theses for higher degrees and to engineers who are beginning to forget the technique of laboratory research, and whose work makes it advisable that they should know it.

Instructions in Engineering Design

Vol. 2: Lattice Girder Bridge. By H. P. Philpot. Pp. viii+223+4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 10*s*. 6*d*.

IN the final stages of his study of engineering design, the student has the rather difficult task of working out a complete scheme for the construction of a machine or structure in accordance with a given specification. It is as if a soldier who had mastered the art of local tactics were required to prepare a strategic plan and the complete tactical operations involved in it. It is at this point that the text-books are found lacking, for they seldom show any one design worked out to its last and minutest details. These notes on the design of a lattice girder bridge have been prepared for the guidance of engineering students in response to many requests for a book to give them a lead in the methodical preparation of designs. The particular bridge dealt with has a span of 156 ft. between bearings and the girders are of the Pratt type. It carries a single line of rails and is of the 'through' type. The assumption is that it is being designed for the Indian railways and it is therefore necessary to follow the British Standard Specification for Girder Bridges, the Bridge Rules of the Government of India Railway Department and its Schedule of Dimensions, while the impact allowance conforms to the Indian loading.

Step by step the author works out the details and shows the application of the specifications quoted above, and it should be both instructive and satisfying for the student to see all the considerations involved being incorporated into a practical and efficient design. Beyond the mere calculations and results, the author's notes are of an explanatory nature, so that the progress of the design is made clear and the student is not placed in the difficulty of following quite obvious calculations without being able to see why this and not that method is employed. Not only is this a useful advanced class-book, it is also very suitable for the student or young draughtsman who has mastered the earlier stages of structural design.

Mathematics

Applied Mathematics in Chemical Engineering

By Prof. Thomas K. Sherwood and Prof. Charles E. Reed. (Chemical Engineering Series.) Pp. xi+404. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 24*s*.

FORMERLY, chemical science merely required, in general, a little elementary arithmetic and algebra, but to-day a vastly greater mathematical equipment is essential. The book under review, written by chemical engineers, gives a thorough survey of the actual type of mathematics now required.

The first of the nine chapters gives an introductory review of the mathematical processes to be developed. It shows that many of the generalizations constituting the basic laws of chemistry are, like those of physics, expressible in differential equations which depend upon much empirical information. Chapters ii and iii are devoted to the problems of constructing ordinary equations and of solving them. Chapter iv deals with partial differentiation with special reference to thermodynamics. Infinite series and their use in the solution of ordinary and partial equations form

RECENT SCIENTIFIC AND TECHNICAL BOOKS

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

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de Broglie, Louis. Materia e luce. Traduzione di V. Porta. 8vo. Pp. 296. (Milano : V. Bompiani, 1940.) 12 lire.

Burniston, A. Real Arithmetic. Senior Series, Pupils' Book 6. 8vo. Pp. 152. (London and Glasgow : Wm. Collins, Sons and Co., Ltd., 1940.) 1*s.* 6*d.*

Green, J. W., and Lewy, Hans. Aspects of the Calculus of Variations. Notes by J. W. Green after Lectures by Hans Lewy. Demy 8vo. Pp. vi +96. (Berkeley, Calif. : University of California Press ; London : Cambridge University Press, 1940.) 4*s.* 6*d.* net.*

Knox, Gordon D. The Bed of Procrustes. Ex. Cr. 8vo. Pp. 16. (Tenterden, Kent : The K.P. Press, Finchden Manor, 1940.) 1*s.**

Le Boitreux, Henri, et Boussard, Robert. Élasticité et photoélasticimétrie. (Ministère de l'Education Nationale : Centre National de la Recherche scientifique.) Roy. 8vo. Pp. ii +361. (Paris : Hermann et Cie., 1940.) 180 francs.*

Lemon, Harvey B., and Marshall, Fitz-Hugh. The Demonstration Laboratory of Physics at the University of Chicago. Sup. Roy. 8vo. Pp. iv +127. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1939.) 9*s.* net.*

Richards, T. T. A Physics Exercise Book. Cr. 4to. Pp. 30. (London : Edward Arnold and Co., 1940.) 8*d.*

Robson, A. An Introduction to Analytical Geometry. Vol. 1. Demy 8vo. Pp. xiv +410. (Cambridge : At the University Press, 1940.) 9*s.*

Schonell, F. J., and Cracknell, S. H. Right from the Start Arithmetic. Book 5. Demy 8vo. Pp. 128. (Edinburgh and London : Oliver and Boyd, 1940.) 2*s.* 2*d.*

Sokolnikoff, Ivan S. Advanced Calculus. Med. 8vo. Pp. x +446. (New York and London : McGraw-Hill Book Co., Inc., 1940.) 26*s.**

Tintner, Gerhard. The Variate Difference Method. (Cowles Commission for Research in Economics, Monograph No. 5.) Sup. Roy. 8vo. Pp. xiv +175. (Bloomington, Ind. : The Principia Press, Inc., 1940.) 2.50 dollars.*

Engineering

Camm, F. J., Edited by. Newnes' Short-Wave Manual. Cr. 8vo. Pp. 211. (London : George Newnes, Ltd., 1940.) 5*s.* net.

Camm, F. J., Edited by. Practical Wireless Service Manual. Second edition. Ex. Cr. 8vo. Pp. 288. (London : George Newnes, Ltd., 1940.) 6*s.* net.

Clark, the late **David.** Plane and Geodetic Surveying : for Engineers. (Text Books of Civil Engineering.) Vol. 1 : Plane Surveying. Third edition, revised and enlarged by James Clendinning. Demy 8vo. Pp. xvi +620. (London : Constable and Co., Ltd., 1940.) 27*s.* 6*d.* net.*

Coates, W. A., and Pearce, H., Edited by. The Switchgear Handbook. Vol. 2 : Application. Demy 8vo. Pp. ix +267. (London : Sir Isaac Pitman and Sons, Ltd., 1940.) 21*s.* net.

Crook, W. E. Electricity in Aircraft. Demy 8vo. Pp. 108. (London : Sir Isaac Pitman and Sons, Ltd., 1940.) 5*s.* net.

De Ville, Eric. Electricity Simplified. Ex. Cr. 8vo. Pp. 220. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1940.) 5*s.* net.

Fowler, W. H., Compiled by. Electrical Engineer's Pocket Book, 1940. Fcap. 8vo. Pp. 588. (Manchester : The Scientific Publishing Co., Ltd., 1940.) 3*s.* net.

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Sayers, Dorothy L. Begin Here : a War-Time Essay. Demy 8vo. Pp. 160. (London : Victor Gollancz, Ltd., 1940.) 6*s*. net.*

Shepherd, E. Colston. Britain's Air Power. (Oxford Pamphlets on World Affairs, No. 28.) Cr. 8vo. Pp. 32. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 3*d*. net.*

Szent-Györgyi, Albert V. On Oxidation, Fermentation, Vitamins, Health and Disease. (Abraham Flexner Lectures, No. 6.) Cr. 8vo. Pp. 109. (London : Baillière, Tindall and Cox, 1940.) 11*s*. 6*d*. net.

Wheeler, Charles E. An Introduction to the Principles and Practice of Homœopathy. Second edition. Demy 8vo. Pp. viii +344. (London : William Heinemann (Medical Books), Ltd., 1940.) 15*s*. net.*

the subject-matter of the next two chapters. The authors' aim in treating Fourier's series and the Bessel functions as simply and practically as possible has been well fulfilled. Chapter vii is concerned with the methods of fitting data to empirical equations, numerical integration and differentiation and interpolation. Illustrations are given in Chapter viii of the many graphical methods in use in chemical engineering design, together with a short section on alignment charts. The final chapter wisely discusses the theory of errors and the precision of measurements. A few practical exercises are placed in an appendix at the end and a good index is provided.

The subject-matter is very clearly treated and, as stated in the preface, "it should be possible for anyone with a good grounding in the calculus to follow the text without difficulty". The authors also commendably point out that there is no quick and easy method of gaining proficiency in any branch of mathematics without sustained, serious and concentrated study. This is a very necessary warning to all practical students, and especially to those for whom this valuable book has been prepared.

Mathematics for Actuarial Students

By Harry Freeman. (Published for the Institute of Actuaries.) Part 1: Elementary Differential and Integral Calculus. Pp. viii+184. 9*s*. net. Part 2: Finite Differences, Probability and Elementary Statistics. Pp. xiii+340. 25*s*. net. (Cambridge: At the University Press, 1939.)

THESE two volumes are designed to replace the author's "Elementary Treatise on Actuarial Mathematics", published in 1931. The replacement is rendered necessary by changes in the mathematical requirements of the examinations controlled by the Institute of Actuaries. Part 1 contains the chapters on trigonometry and elementary calculus taken, with little change, from the earlier book. Part 2 is almost a new work, for the remaining text of the former treatise has not only been re-written and expanded to bring it up to date, but also new chapters on elementary statistics have been added. The first nine chapters, occupying 203 of the 330 pages of text, are devoted to finite differences, and the treatment of this somewhat difficult subject is both interesting and sound. The four remaining chapters are concerned with an elementary discussion of simple probability and statistics. Here, again, the author has developed the subjects with clarity and skill.

In both books, the text is well illustrated by worked-out examples, and each chapter concludes with a good set of exercises for the practice of the student. In addition, each part contains a number of miscellaneous problems placed at the end. Answers to all the examples are also given.

The books are excellently printed and should not only be useful to candidates for the Institute's examinations, but also of practical value to all students of the important branches of mathematics dealt with.

Higher Mathematics

With Applications to Science and Engineering. By Prof. Richard Stevens Burington and Charles Chapman Torrance. Pp. xiii+844. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

WHILE special stress is laid, in the book under notice, on the practical application of mathematics to physics and engineering, yet the book compares favourably with a work on abstract rigorous analysis, although, as would be expected, the rigour is not carried so far as in a purely academic treatise. Of the nine chapters, the first four are concerned with the calculus of a real variable. These include the theorems of Rolle, Taylor, Green and Stokes; the Riemann theory of integration; ordinary and linear simultaneous differential equations with applications to electrical networks; numerical integration; brief discussions of Legendre and Bessel functions and series including the theorems of Féjer and Fourier. Chapter v is devoted to complex variables and elliptic functions, with applications to the pendulum and the rectification of an elliptic arc. Then follows in Chapter vi a consideration of determinants and matrices together with the elements of vector analysis, differential geometry and tensor analysis. Partial differential equations are dealt with in Chapter vii, whilst the last two chapters are devoted to the calculus of variations, analytical dynamics and an introduction to the theory of the real variable. The book concludes with a useful bibliography and a full index.

The text is, on the whole, clearly written, though obvious considerations of space have prevented a few topics from being as fully treated as might be wished. It is also well illustrated, both by carefully drawn figures and by fully worked-out practical problems, while numerous and judiciously chosen examples are provided for the student's practice. The authors have not only fulfilled their aim admirably but also have produced an interesting book, characterized by some excellent features, which should prove very useful to all students of applied science as well as to those of pure mathematics.

Medical Sciences

Fundamental Principles of Bacteriology

With Laboratory Exercises. By Prof. A. J. Salle. Pp. xiii+679. (New York and London: McGraw-Hill Book Co. Inc., 1939.) 24*s*.

THIS book, as the author is careful to point out, is intended to serve as a ground-work for those who are beginning the study of bacteriology as a biological science; it is in no sense an advanced text-book on the subject. In nearly seven hundred pages of excellent print the elementary principles are covered, ranging from the physiology and morphology of micro-organisms to the bacteriology of water, soil, air, food, etc., with short chapters also on infection and immunity and the diseases of plants and animals. An attempt has also been made to make the work a

combined text-book and laboratory manual. This has been done by including short experimental sections at certain points in each chapter. A useful bibliography of the more important text-books and original papers is included at suitable places throughout the text. The task of compiling a book of this nature is a formidable one for a single author, and no doubt, for this reason, some obvious defects have arisen. In certain sections the facts presented are either completely out of date or they are not, as yet, accepted by the majority of workers. On the whole, however, the material is well presented and should be readily assimilated by the student.

Dr. Salle's book may not readily find a place in the teaching departments of many of the universities in Great Britain, where bacteriology remains an *ad hoc* subject tacked on as required to larger branches of applied science. We have not, as yet, decided that as a separate branch of biological science it is a subject worthy of a secure position in the university curriculum. Nevertheless, the inclusion of this book in our libraries is to be recommended, if only to illustrate and direct attention to the advanced stage of the teaching of bacteriology, as a separate science, on the American Continent.

Tuberculosis and National Health

By Dr. H. Hyslop Thomson. Pp. xi+260. (London : Methuen and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THIS is a valuable contribution to the epidemiology of tuberculosis, by one who has had exceptional opportunities of becoming familiar with the disease in his capacity of medical officer of health and county tuberculosis officer for Hertfordshire, and of former tuberculosis officer or medical superintendent of sanatoria elsewhere. The subjects discussed include the incidence of tuberculosis in man and animals, the types of the disease, etiology and infection, housing and tuberculosis, relation of tuberculosis to milk supply, importance of early detection and treatment, modern treatment and after-care, and tuberculosis and the nursing service.

A bibliography of almost exclusively British and American writers, arranged according to each chapter, is appended.

Prevention of Venereal Disease

By Dr. Marie Carmichael Stopes. Third edition. Pp. xii+62. (London : Putnam and Co., Ltd., 1939.) 2*s*. 6*d*. net.

THIS book is a revised and enlarged edition of a work published under another, though similar, title in 1921, and since reprinted on several occasions. It deals with the causes and prevention of venereal diseases and discusses the relation of promiscuous sex intercourse to their spread. The author, though not medically qualified, has written many popular works on sex subjects, and gives, in this volume, several quotations of the views of medical men on the questions at issue. She describes the technique of disinfection to be applied when risks have been taken, a procedure in which she is a strong believer.

Some of the medical references are not quite up to date, and the new treatment for gonorrhœa, which is one of the most important medical happenings in recent years, is not mentioned.

The psychological effect of statements about the uncertainty of cure has presumably been considered by the author ; but those who have had experience of the phobias which the victims of these diseases are apt to develop would have preferred that vague assertions of this kind should not have been made.

Nevertheless, this book does a useful service in directing attention to diseases the causes and effects of which should be known to all young people, and concerning which there is still a denial of publicity through ordinary channels.

METALLURGY

The Physical Examination of Metals

By Bruce Chalmers. Vol. 1 : Optical Methods. Pp. viii+181+4 plates. (London : Edward Arnold and Co., 1939.) 14*s*. net.

METHODS which have not yet become part of the metallurgist's technique are the subject of this book. After a short introductory chapter on the properties of light, the applications of geometrical optics are discussed with special reference to the examination of metal surfaces, the measurement of reflectivity and the optical properties of thin films. Two chapters are then devoted to wave optics, under the headings of interference and diffraction phenomena. The principles of parallel and inclined plate interferometers are explained, and some applications, reaching a pinnacle of elegance in the author's precision extensometer, are described. Methods of examining films and coatings on metals involving interference colours and fringes are also described. Applications of diffraction phenomena include the measurement of fine meshes and particle size of powders, and an explanation of microscope resolving power.

Chapter v is devoted to the theory of polarized light, the experiments of Tronstad and of Lavery, and microscopical technique for identifying inclusions and determining state of strain. The final chapter deals with two optical methods in which the source of the light is the point of interest, namely, radiation pyrometry and spectrography. There is more 'meat' in this book than is revealed by a casual survey ; the author has evidently taken great care in his selection of material, and, with his gift of clear expression, has enabled the average metallurgist to absorb quite a lot of physics without too much labour. Incidentally, one is still permitted to believe in an 'aether' for the purpose of the book.

Principles of Metallography

By Prof. Robert S. Williams and Prof. Victor O. Homerberg. (International Chemical Series.) Fourth edition. Pp. ix+339. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 23*s*.

THE popularity of this book is explained by the way in which the authors have succeeded in combining clarity with brevity. The treatment of

fundamentals is, however, a little superficial in some respects. In the new chapter on plastic deformation, for example, no hint is given that metallic crystals are anything but perfect in structure, and one would prefer to see the early chapters, on the equilibrium diagram, extended at the expense of the final chapter on laboratory methods. The list of alloys given in the appendix might be replaced with advantage by a select bibliography. Printing, illustrations and binding are excellent.

Miscellany

Science and Civilization

By Dr. Bernard Lovell. (Discussion Books, No. 63.) Pp. 150. (London and Edinburgh : Thomas Nelson and Sons, Ltd., 1939.) 2*s*. net.

DR. LOVELL can be heartily congratulated on the admirable way he has discharged a difficult task. Within a hundred and fifty pages, he has given us a lucid and balanced outline of the training of the man of science, the organization of research, and its interactions with society, the factors which impede scientific advance and social progress, and a glimpse of the possibilities science holds for civilization could these obstacles be overcome ; it should prove as stimulating to the general reader as to the scientific worker himself. This little book can be commended as a direct basis for discussion on the relations of science and society or as an introduction to the brief but growing scientific literature written with social consciousness. Its interpretation of scientific men and their work in the light of social responsibility, no less than its indication of the ways in which the frustration of scientific knowledge persists and indeed extends, and of the threats to intellectual liberty and life throughout the world, are well calculated to stimulate increasing numbers of scientific workers to consider the social aspects and responsibilities of their work, and attempt the interpretation of science in its social context.

The great value of the book is in its contribution to education for citizenship, whether of the scientific worker or of the general reader. It is therefore unfortunate that in his preface Dr. Lovell suggests that the universities should be re-directed to produce men educated as citizens *instead of* exact scholars. Great as may be the need for the universities to serve the community by providing graduates who are trained as citizens, competent to think accurately about the great problems of to-day and alive to the human issues underlying the decisions they are called upon to take, it must not, as Dr. Lovell's words seem to imply, be at the expense of either scholarship or the critical intelligence they are equally called upon to exercise. Changes in teaching or curriculum at the universities which will assist the development of personality and social consciousness are indeed desirable. They must not, however, be allowed to impair the integrity or exactitude of scholarship or scientific competence.

Civil Defence

A Practical Manual presenting with Working Drawings the Methods required for Adequate Protection against Aerial Attack. By Capt. C. W. Glover. Second edition, completely revised and enlarged. Pp. xviii + 764 + 74 plates. (London : Chapman and Hall, Ltd., 1940.) 36*s*. net.

THE defence of the civil population against air attack has become a science of considerable magnitude, in which the problems cover a wide range from structural engineering, chemistry and fire fighting to the control and psychology of crowds. This second and enlarged edition of Capt. Glover's book is a very useful and comprehensive manual of protection against aeroplane bombs, in which technical details, graphs, mathematical data and costs are given. It also deals with matters of general interest. The diagrams of bombs, twice the size of a man, and the fact that in some of the raids in the War of 1914–18 one third of the casualties were caused by fragments from our own anti-aircraft fire, will come as a revelation to many people.

A large part of the book is devoted to shelter protection in buildings, trenches and dug-outs, and comparative costs are given. Alternative solutions to the pressing problem of the replacement of crumbling sandbag parapets by such methods as sand-filled hollow concrete blocks are not, however, mentioned, and the difficulty of the all-important question of the draining of trenches and dug-outs receives little attention.

There is a fascinating chapter on camouflage, one on anti-gas measures, with appendixes giving the properties and effect of the various war gases, and another on factory protection.

In the chapter on the organization of A.R.P., diagrams show the organizations in France, Germany and England. The complexity and lack of co-ordination in the English organization compared with the Continental nations is very marked, and lends credence to the story that at a certain first aid post and party depot, one half was sandbagged and the other not, since the Home Office, which deals with first aid parties, said 'sandbags' and the Ministry of Health, which deals with first aid posts, said 'no sandbags'. E. H. K.

Problèmes de la vision

Par Armand de Gramont. (Bibliothèque de Philosophie scientifique.) Pp. 282. (Paris : Ernest Flammarion, 1939.) 22 francs.

THE title of this book is somewhat misleading, since in its short compass it covers the essential facts of how we see, and adds many suggestions which are not to be found elsewhere. It consists of three parts : (1) the eye and its defects ; (2) the spatial medium—points, lines, directions, optical delusions, surfaces, volumes, stereoscopic relief, and architecture ; (3) chromatic transmission—heterochromatic photometry, colour sensations and contrast, colour blindness, and the perception and transmission of colours.

The author writes with the remarkable clarity and scientific accuracy which we associate with the best French men of science ; but he is no slave to orthodoxy. Whilst the facts are accurate, the interpretation of function shows a bias towards the less generally accepted theories. Thus, owing to the acknowledged difficulties of the morphological discrimination of rods and cones, he is inclined to undervalue the physiological arguments in favour of the duplicity theory, which, indeed, receive less attention than they deserve. He rejects Helmholtz's theory of accommodation in favour of that of Tscherning, and also both the Young-Helmholtz and the Hering theories for one of piezo-electric resonance of his own.

These peculiarities do not detract from the value of the book, especially for those already *au fait* with the subject ; and its value is further enhanced by interesting applications of the facts to art and architecture. Thus he points out that oddities of drawing, such as those of El Greco—and it has also been said of Sargent—cannot be attributed, as has been done, to astigmatism of the painter's eyes. On the other hand he goes so far as to state that Vermeer's "View of Delft" shows characteristics which prove that the artist was myopic. These and other suggestions of a similar nature add greatly to the fascination of the book, reminding one of Shelford Bidwell's "Curiosities of Light and Sight".

Physiology

Sex and Internal Secretions

A Survey of Recent Research. Editor : Edgar Allen. Pp. xxxvi+1346. (London : Baillière, Tindall and Cox, 1939.) 54*s*.

THIS well-known book is sponsored by the Committee for Research in Problems of Sex of the National Research Council of America. The first edition, published in 1932 to celebrate the completion of ten years work by the committee, soon established itself as a standard work of reference ; the second edition is much larger than the first. It contains twenty-four chapters by different authors, most of whose names are known as the leading authorities in the fields with which they deal, and most of whom contributed to the first edition, though several new names have been added including that of an Englishman—W. H. Newton.

The field covered by this book is so wide that few people could properly appreciate all the different sections, which cover the genetic basis and embryonic development of sex, abnormalities of sex, the biology and chemistry of the testes and ovaries, the behaviour of spermatozoa, gonadotropic substances, the lactogenic hormone, the relation of vitamins to sex, and sex drive. There is a chapter on sex functions in man written from the clinical point of view, which deals not only with disorders of the sex organs, but also with the relation of sex to disorders in other parts of the body such as anæmia, hæmophilia and skin disease. There is a section on the biological assay of androgens and œstrogens which directs attention to the many sources of error in such assays, but which fails to emphasize the large chance errors associated with assays on small groups of animals, or to indicate the methods by which they can be reduced. The book will be invaluable to all serious students of the physiology of sex, but will not interest the dilettante.

Hearing and Equilibrium

By H. Macnaughton-Jones. Pp. viii+128+15 plates. (London : Baillière, Tindall and Cox, 1939.) 7*s*. 6*d*.

THE author has some original ideas on the working of the middle and inner ears, which he has illustrated by means of mechanical models. The book contains no account of recent work on the ear by other investigators, which is regrettable. It is difficult for the reader to solve for himself the problems which arise from an attempt to correlate the hypotheses put forward with the electrical effects which have been observed to occur when the ear is stimulated by sound.

Psychology and Philosophy

The Nature of Creative Activity

Experimental and Comparative Studies of Visual and Non-Visual Sources of Drawing, Painting and Sculpture by means of the Artistic Products of Weak-Sighted and Blind Subjects and of the Art of Different Epochs and Cultures. By Viktor Löwenfeld. Translated from the German by O. A. Oeser. Pp. xvii+272. (London : Kegan Paul and Co., Ltd., 1939.) 21*s*. net.

THIS most interesting book is a study in the investigation of the creative activity of poor-sighted and blind subjects combined with a comparative study of the art of different cultures. The first section of the book is devoted to the study of children's drawings, the second to those of the weak-sighted, the third to a generalized study. There are more than a hundred pages of illustrations of children's drawings, together with a selection of drawings from weak-sighted individuals and various representations of historical types of art. The artistic creations of the blind and weak-sighted are largely based on the sense of touch and other senses.

Psycho-Analysis

By Dr. Edward Glover. Pp. viii+139. (London : John Bale Medical Publications, Ltd., 1939.) 12*s*. 6*d*. net.

THIS small book, which is dedicated to the memory of Sigmund Freud, attempts to give in one hundred and thirty-three pages the theory and practice of psycho-analysis. It can be said at once that the author has succeeded very well. The book is divided into two parts, the first dealing with theory, the second with the application of the theory to clinical practice. The author's statement that the psycho-analyst's interest lies in the early recognition and prevention of psychotic breakdown may be very praiseworthy, but we wonder how many cases of psychoses have been prevented by psycho-analysis and how many precipitated thereby. It is a good little book and worth reading.

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education in Vienna where he attended the Josephinum under Hering and Lange. He qualified in 1864, and twelve years later was appointed professor of anatomy at Prague where he superintended the construction of an anatomical institute, and after his transfer to a corresponding chair in Vienna collaborated with C. Lange in creating a similar institute there. In 1877 he published a text-book on histology, of which the third edition appeared in 1888, and in 1896–1900, in conjunction with Alois Dalla Rosa, brought out an anatomical atlas which went through fifteen editions, of which the third was translated into English by M. Eden Paul in 1919. His other anatomical works included contributions to the study of fatty tissue, the structure of the mesentery, the anatomy of the human thorax and the growth of bone. After his retirement he devoted himself to anthropology, his most important work on this subject being on the form of the occiput in the population of southern Germany. He died on November 13, 1920.

Science and the Future of Man

THE social contacts and obligations of science, which was a subject of frequent reference in the proceedings of the recent meeting of the American Association for the Advancement of Science at Columbus, Ohio, notably in the addresses by Dr. Wesley C. Mitchell, retiring president, and Dr. Julian S. Huxley (*see* NATURE, February 10, p. 207, and March 2, p. 330), furnished an important thread in the argument when Dr. Kirtley F. Mather discussed the prospects of human survival in his Sigma Xi lecture on "The Future of Man as an Inhabitant of the Earth". On geological, palæontological and biological grounds he is prepared to allow man a future of probably at least some thousands of years. Even if this present age is an interglacial and not a post-glacial, man's specific adaptability to extremes of climatic environment, he maintained, would enable him to survive. There is, however, he argued, one circumstance which militates against man's prolonged survival. This is the fact that in his conquest of the material world, which is the fundamental characteristic of his recent progress in civilization, man is using up his capital, such as oil, at a far higher rate than he is using his income, that is, the products of natural increase; and a further and even more alarming feature is that that capital expenditure is increasing progressively as the enjoyment of its amenities extends to the less sophisticated peoples. Hence, Dr. Mather concludes, exhaustion of capital in possibly seventy years or less may seriously curtail man's future.

Notwithstanding this depressing outlook, Dr. Mather does not despair of the future entirely in this respect, for he points out that science in its practical application has come to the rescue, and it may be anticipated will do so even more, by the provision of substitutes which will take the place of the capital material now being expended. He gives as an instance the substitutes for the oils, notwithstanding cost, and the same applies to other non-renewable resources. Another consequence of the activities of science in providing substitutes for these capital resources, of even greater topical interest at the moment, is that by liquidating international rivalries in pursuit of the policy of 'grabbing' the sources of supply, science will liquidate the basis of international jealousies and "may make it truly practical to beat our 'swords into ploughshares, our spears into pruning-hooks'." Finally, in regard to the organization of society, Dr. Mather pointed out that in the present rivalry of ideologies, the man of science as citizen must in the future give more thought to the social consequences of his work. He must determine the uses to which the tools he devises may be put, and ensure the wise use of knowledge and constructive application of energy. In a democracy this can be achieved only when the majority of its citizens have the scientific attitude towards social problems and act in accordance with that attitude of mind—a Herculean but not impossible task for education.

Norwegian Fauna

HOSTILITIES in Norway threaten some of the most interesting of European mammals, especially so the large deer, the numbers of which have already been reduced by excessive hunting, and which may be exterminated there as a result of food shortage, just as the European bison was exterminated from many of its European haunts in the War of 1914–18. In Norway, the European moose or elk (locally known as the elg or stordyr) has its strongholds in Sorlandet in the south-east, Ostlandet in the east and Trondelagen in the middle of the country. In some parts of the country it had received total protection by law and in other parts sportsmen were allowed to shoot only a limited number of bull moose during a short season at the end of September. In recent years more than a thousand moose have been shot in Norway in a year, compared with four or five hundred wild reindeer and two or three hundred red deer. There are also roe deer, lynxes and other mammals and a 20,000 acres national park existed for their protection at Sognligaard.

In recent years, Dr. Hj. Broch and the Nature Protection Society of Norway have done much to protect and increase such interesting birds as the osprey, kite, honey-buzzard and hen-harrier, whose nesting numbers were threatened. The 1932 Norwegian game laws protected all owls except the eagle and snowy owls, swans, pheasants, partridges, eider duck, woodcock, and gave a nesting season protection to most useful species. The smew nests in the north of the country, goosanders and mergasers on the waters, puffins, black guillemots and eiders about the rocky coasts, and there are also eagles, brent geese, herons, ravens, crossbills, bullfinches, shrikes, wrynecks, terns and divers. The Scandinavian peninsula has been shown to be the nesting haunt of many of the redwings, fieldfares, common gulls, starlings, wood-pigeons and woodcock visiting Britain in winter. The black woodpecker which nests here has been recorded in Britain on more than twenty occasions, including the last winter, and many ornithologists contend that these may be wild visitors.

Witchcraft in Swaziland

DURING the past week the Judicial Committee of the Privy Council has had before it the appeal of a Swazi subordinate chief, Fakisandhla Nkambule, against a judgment of the Swaziland court, by which he was convicted of having through a witch-doctor procured the death of one of his wives, his brother and his brother's wife. Among the grounds of appeal, it was submitted that the plea of guilty by the witch-doctor had been allowed to prejudice his case. The statements in the case throw an interesting, if somewhat lurid, light on the strength of Swazi belief in witchcraft, which the British administration has for long made strenuous efforts to suppress. It would appear that during the ceremony of placing the ghost rope over a grave to prevent the egress of the ghost, some twenty persons who were present, seated around a cauldron over a fire, partook of 'medicine' into which it is alleged commercial arsenic had been introduced. In the result, it was claimed, three of them had died.

Some hesitation was expressed by the appellant's counsel, Mr. Horace Douglas, in accepting the statement that in Swaziland a rope was believed to be an efficient barrier to a ghost's emergence from the grave; but he was reassured on finding the Greeks and Romans had used rope to keep evil spirits from their houses. Had the learned counsel referred to the works of Sir James Frazer, he would have found ample confirmation in many varied forms. In Swaziland itself the efficacy of the grass rope as a protection against the spirit of the departed is vouched for by the fact that for a certain period the widowed man or woman always wears a grass rope, the 'grave rope', around waist or neck, and this must on no account be removed until the ceremonial period has elapsed.

Austrian Academy in Great Britain

AMONG the thousands of refugees from Central Europe who have arrived in Great Britain during the past eight years or so have been many Austrians, debarred from their own country by their political opinions or by their race. Their numbers have included many eminent scholars, who have been allowed to make their homes in Britain; they feel now that they can discharge a part of the debt of gratitude they owe by contributing to the intellectual life of the country a fuller knowledge of the cultural achievements of Austria. To this end an Austrian Academy in Great Britain has been founded, the honorary president of which is Sir George Franckenstein, formerly Austrian Minister in Great Britain. The Academy is arranging lectures, which will be delivered, as a rule, in English, and will be open to the public, on Austrian culture, and it is hoped to organize exhibitions and other activities in collaboration with the Austrian Circle for Arts and Sciences.

The inaugural meeting of the Academy will be held at the Royal Institution on May 2; among the speakers will be Prof. Gilbert Murray, Prof. E. Schrödinger (for the Austrian Academy) and Sir William Bragg. A "Society of Friends of the Austrian Academy" has been established to collaborate with the Academy and to further its scientific and cultural activities. Members of the Society will be admitted free of charge to all regular lectures, and will have special privileges for other functions arranged by the Academy. The annual contribution is one guinea. Application for membership and subscriptions should be sent to the Hon. Vice-President of the Committee of the Austrian Academy in Great Britain, Baron Guido Fuchs, 15 Portman Square, London, W.1.

Industrial Health in War-time

THE Industrial Health Research Board of the Medical Research Council has published a short report on this subject (Emergency Report No. 1. H.M. Stationery Office. 6*d*. net). It is a summary of research findings, and it is claimed that by adoption of measures recommended, the efficiency, health and comfort of factory workers can be improved, production increased and discontent and fatigue avoided. Recommendations respecting work and fatigue suggest the avoidance of over-long hours and continuous work without intervals for rest, maintenance of Sunday rest and ordinary holidays, alleviation of boredom and elimination of unnecessary movements and effort. For efficient working, sufficient illumination and its proper control and distribution are necessary. Proper heating, the temperature varying with the kind of work, should be maintained, together with adequate ventilation and air movement, and a relative humidity not generally exceeding 70 per cent. A study of the causation of accidents is needed, from which may emerge means for their diminution and prevention. Lastly, recording and analysis of causes of sickness absence and accidents may contribute much information on loss of efficiency and well-being.

Chemistry of Foods

DURING the twelve years in which the Medical Research Council has supported Dr. McCance and his colleagues, the scope of their inquiries has been extended from determinations of the amount of carbohydrate in foods used in the treatment of diabetes to determinations of all the important organic and mineral constituents of foods, with the exception of the vitamins ("The Chemical Composition of Foods". By R. A. McCance and E. M. Widdowson. Med. Res. Council Special Report Series, No. 235. H.M. Stationery Office, 1940). Foods have been analysed, both raw and as prepared for the table, and studies have been made of the losses introduced by cooking.

The present volume includes previously published figures (Reports Nos. 135, 187 and 213), and contains all the quantitative data, in tabular form, likely to be required for work involving detailed knowledge of the chemical composition of British foods. Various facts receive comment. For example, 'Bovril' contained more potassium (3·59 per cent) than any other food examined, parmesan cheese more calcium (1·22 per cent), 'Marmite' more phosphorus (1·89 per cent), carrageen moss more magnesium (0·63 per cent) and sulphur (5·46 per cent), curry powder more iron (0·075 per cent), liver more copper (0·0058 per cent), and Gruyère cheese more nitrogen (5·9 per cent).

Vegetarianism in War-time

So closely is vegetarianism linked in many minds with food 'faddism' that one runs the risk of being regarded as eccentric if the consumption of more vegetables is strongly advocated. Nevertheless, the slogan 'Eat more Vegetables' is not only to form a central feature of the nutritional policy of the Ministry of Food during the War, but also, it is hoped, will be prominent in the post-War campaign to erradicate malnutrition from Great Britain. One simple fact stands out. Wholemeal cereals, vegetables, potatoes and milk or cheese provide all that is required for building a sound body and for maintaining good health. A little book of useful recipes, written primarily, one imagines, for vegetarians, entitled "Food in War-Time" (edited by W. H. White. London: G. Bell & Sons, Ltd., in conjunction with the London Vegetarian Society, 1940. 6*d*. net), should be widely read and used. It describes many dishes which would be valuable additions to our diet in ordinary times as well as in the special times for which it has been written.

Plastic Materials in the *Yankee Clipper*

A LARGE amount of plastic materials is used in the construction and furnishing of the American machines of the *Yankee Clipper* class, used in the trans-Atlantic air service. According to an article in the *Electrician* of March 8, colour plays an important part in the furnishing and decoration of these machines. The average American traveller is very critical of his travel-surroundings, and as he is relatively a prisoner in the machine for long hours on end, it is essential that his liking for cheerful surroundings be satisfied. Plastic decorations have been found to be most useful by the designers.

The dining-room has dome lights made of cellulose and giving a diffused light. The rear compartment, sometimes known as the 'bridal suite', is very luxurious, and is furnished with a dressing-table, etc. The lighting around the dressing-table has shades made of another type of cellulose acetate material. The dressing-table top is of synthetic resin laminated material. On the other hand, the wash-basins and table-tops in the ladies' dressing-room are in a blue vinyl material. The upper wall fabric is protected with sheets of transparent methyl material. Similarly, the cabin windows and the navigator's turret are 'glazed' with methacrylate. Plastic materials are also used for passenger signal flashing lights, for fuel tank gauges, and for some of the control knobs. The walls are made of opaque vitryl resin sheets, differing in colour in the various cabins and departments. Laminated material is used for some of the control pulleys, for spacers of various kinds and for certain bushings, and plastic materials form the basis of most of the paint and lacquer used on the machines.

The National Institute of Agricultural Botany

THE annual report of the National Institute of Agricultural Botany, Huntingdon Road, Cambridge, for the season 1938–39 has been issued. Much of the Institute's work concerns the trial of new varieties of crop plants, and the farmer who takes advantage of the frequent reports issued by the Institute can save himself a considerable amount of time, trouble and expense in trying things out for himself. Many of the notes supplied in the present report relate to types which are still only in the early stages of trial, but are none the less interesting because of that fact. At a time when high production per acre is a question of more than usual importance, the Institute's tests of the ability of certain varieties of wheat to respond to high levels of manuring without lodging will be followed with particular interest. The report indicates that seed of a carefully purified stock of Spratt-Archer barley and of a selected high-yielding strain of Rivet wheat have been recently made available to the seed trade.

Royal Geographical Society Awards

THE King has approved the award of the Royal Medals of the Royal Geographical Society as follows: Founder's Medal to Mr. and Mrs. Harold Ingrams, for their exploration, travel, and studies in the Hadhramaut; Patron's Medal to Lieutenant Alexander R. Glen, for his expeditions in Spitsbergen and North-East Land. The Council has made the following awards: Victoria Medal to Mr. O. G. S. Crawford, for his archæological maps prepared for the Ordnance Survey and his work on the Tabula Imperii Romani; Murchison Grant to Mr. Peter Mott, for his surveys in West Greenland; Back Grant to Mr. Gerald Seligman, for his glacier studies on the Jungfraujoch; Cuthbert Peek Grant to Mr. John Hanbury-Tracy, for his work in south-eastern Tibet with Mr. Kaulback and his journey in the north of South America; Gill Memorial to Mr. Alexander King, for his work in Jan Mayen in 1938.

Lectures on Food and its Use

A SERIES of lectures under the general title "The Nation's Larder" have been arranged at the Royal Institution with the approval and support of the Ministry of Food. The first was delivered on April 23 by Prof. J. C. Drummond, who spoke on food in relation to health in Great Britain during the past two hundred years. The remaining lectures of the series, which are being given on Tuesdays at 5.15, are on medical aspects of the use of foods (Sir Robert McCarrison), national food requirements (Sir John Orr), home production of food (Sir Frederick Keeble), manufacture, preservation and distribution of food (Dr. L. H. Lampitt), food and the housewife (Prof. V. H. Mottram) and the feeding of children (Dr. J. C. Spence). The lectures are to be published later in book form. Admission is by ticket obtainable, free of charge, from the Royal Institution, Albemarle Street, London, W.1.

Eighth American Scientific Congress

AN illustrated descriptive programme is now available of the Eighth American Scientific Congress, to be held in Washington, D.C., during May 10–18 (see NATURE, December 23, 1939, p. 1056). The Congress will be opened by President Roosevelt on May 10; and the first plenary session takes place on May 13.

Sectional meetings of the eleven sections occupy the remainder of the week, and the final plenary session will be on May 17. Government delegates of the other American Republics will be entertained by the United States Government at an official luncheon and at a banquet. The headquarters of the Congress will be at the Pan American Union, Washington.

Recent Earthquakes

ON April 13 there were further aftershocks of the Anatolian earthquake of December 26, 1939, in the region originally affected. The shocks were strong and felt as far away as Ankara. Great damage was caused to fifteen villages, six being completely destroyed. Sixteen persons were injured and four children are believed to have been buried beneath the wreckage. In the Caucasus, according to a report in *The Times*, the River Kars has overflowed, causing damage to the town of Kars. It is conceivable that with such extensive disasters as Turkey has recently suffered there may be some ground tilting even as far distant from the scene of the original disaster as the Caucasus.

On the night of April 17, a severe earthquake was experienced at Patras at the entrance to the Gulf of Corinth and to the north of the Island of Morea. No information is available as to the damage caused, if any, at the time of writing. The earthquake was felt in the Agrinion district, and more severely in the Missolonghi district, where in 1824 the poet Byron died fighting for Greek independence. It is well known that minor earthquakes are common in Greece, and destructive ones are by no means uncommon. It will be remembered that on April 22, 1928, at about 20h. 14m. G.M.T., a severe earthquake somewhat to the north of Corinth partly destroyed that city. More information is required before the epicentre of the present shock can be accurately determined.

The Night Sky in May

BY the middle of May, the night (sunset to sunrise, London) is of 8½ hours' duration. The moon is new on May 7 at 12h. and full on May 21 at 13h. Mars is in conjunction with the moon on May 10 and Venus on May 11. Jupiter and Saturn are now both morning stars but too close to the sun for observation. Venus is the brilliant evening star, setting less than one hour before midnight U.T. (that is, 1h. summer time). Its greatest brightness is reached about May 20, when its magnitude is $-4{\cdot}2$. Under favourable atmospheric conditions, it should be possible to see the planet in the daytime. Its time of meridian passage and altitude is given for May 5, 12, 19 and 26 —15h. 3m. (65·8°), 14h. 58m. (65·7°), 14h. 49m. (65·2°) and 14h. 35m. (64·5°). A telescopic view of Venus at this time will show the planet as a crescent, $\frac{1}{3}$ full in the middle of May and $\frac{1}{5}$ full at the end. Venus, with respect to size and mass, is almost the twin of the earth. A dense atmosphere evidently surrounds the planet and screens its surface from observation. Direct telescopic scrutiny shows almost a complete absence of markings, but ultra-violet photographs have recorded belts and bright spots which are probably high-level phenomena. Thus the rotation period of the planet remains in doubt, though probably one rotation takes nearly a month. Venus is the cynosure of the western evening sky, but as night comes on a glance may be spared for the stars Capella, Procyon, Castor and Pollux in the west; Regulus and Arcturus on the opposite side of the southern meridian; Spica low in the south, while Vega is above the north-eastern horizon. About May 4, members of the Eta Aquarid meteor shower (believed to be associated with Halley's Comet) may be seen in the early morning. On May 25, the 4th magnitude star, ρ Sagittarii, is occulted by the moon, the disappearance as seen from Greenwich taking place at 1h. 23·1m. at 90° from the north point of the moon's image; the reappearance being at 2h. 40·9m. at position angle 253°.

Announcements

DR. STANLEY B. BAGLEY has been elected president of the Society of Glass Technology in succession to Dr. C. J. Peddle.

IT is announced in *Science* that Prof. F. Joliot and Madame Irene Curie-Joliot, co-workers in the Radium Institute, Paris, have been awarded the 1940 Barnard Gold Medal for "meritorious service to science" bestowed by Columbia University every five years. The medal was established by the will of Frederick A. P. Barnard, president of Columbia during 1864–1889, and is awarded "to the person, if any, whether a citizen of the United States or any other country, who within the five years next preceding has made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as in the judgment of the National Academy of Sciences of the United States is esteemed most worthy of such honor".

IN future the identification tag that every soldier in the German army must wear round his neck must indicate the blood group to which he belongs.

MIGRATION during 1939 increased the population of Australia by 12,537 persons, 1,636 of these being British. German nationals—almost all refugees—numbered 4,857. The gain to Australia of British migrants is the largest since 1929, when the depression stopped assistance to immigrants.

ACCORDING to *La Riforma Medica* of February 10, the annual birth-rate per 1,000 inhabitants in the chief capitals is as follows: Rome, 22; Buenos Aires, 18; Copenhagen, Budapest and Amsterdam, 15; New York, Berlin and London, 14; Warsaw, 13; Paris and Stockholm, 11; and Brussels, 10.

ERRATUM. NATURE, January 27, p. 148, letter entitled "First Benedicks Effect in Gas-free Mercury, as Influenced by the Mean Temperature", for the formula $u = K \cdot \frac{3}{\Delta t}$ read $u = K \cdot \sqrt[3]{\Delta t}$.

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.

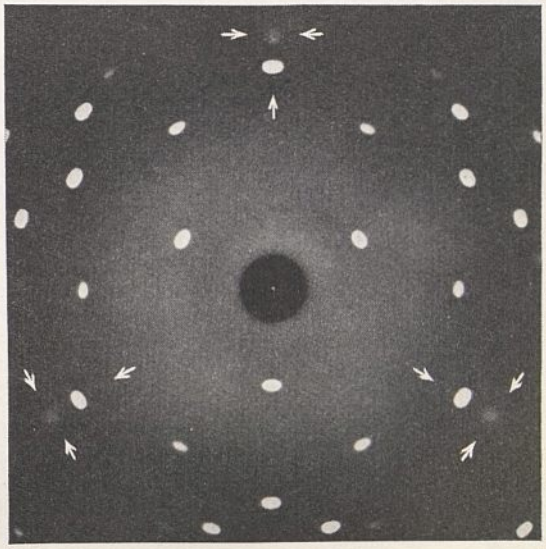
Notes on points in some of this week's letters appear on p. 673. Correspondents are invited to attach similar summaries to their communications.

Specular Reflection of X-Rays by High-Frequency Sound Waves

The principle that a regularly stratified medium selectively reflects a monochromatic beam of radiation incident on it at the appropriate angle is well known and forms the basis for the X-ray analysis of crystal structure. The spots appearing in a Laue diffraction pattern are, of course, due to such selective reflections of the incident X-rays by the periodic stratifications which represent the static structure of the crystal. A specular reflection of X-rays may, however, also result from stratifications of density which are not static but dynamic in character, and which may be considered as equivalent to stationary sound waves of very high frequency. We have observed and studied numerous examples of this special kind of X-ray reflection, but will content ourselves here with giving a single illustrative example chosen for its simplicity.

The accompanying reproduction represents the Laue pattern due to a crystal of diamond which has the form of a plate with faces parallel to an octahedral cleavage of the crystal, and through which passes a narrow pencil of X-rays from a tube with a copper anticathode and nickel filter. The pattern, as is to be expected, shows trigonal symmetry, the three spots marked with radial arrows in the figure being the reflections from the (111) planes, which are inclined to the trigonal axis at an angle of 19° 28′. Three other spots (indicated by tangential arrows) are also noticeable in the figure. The sharpness of these spots shows them to be specular reflections, but they are clearly not Laue spots, as is to be seen from the difference in their shape, as well as from the fact that there are no planes in the crystal which could give rise to reflections in the directions observed. These auxiliary spots must therefore be explained as arising from stratifications of density in the crystal which are of a dynamic nature.

The origin of these spots becomes clear when we consider the effect on the structure of the diamond of its characteristic internal vibration. This is a periodic movement of the two interpenetrating lattices of carbon atoms with reference to each other in any arbitrary direction and with a very high frequency corresponding to 1332 cm.$^{-1}$ in spectroscopic units. If this vibration has a direction normal or nearly normal to an octahedral cleavage face of the diamond, stratifications of density are induced which vary periodically with time and have a spacing equal to that of the (111) planes in the crystal, but with an orientation variable within wide limits. These stratifications are therefore in a position to give a selective reflection of the monochromatic copper K_α radiation present in the incident pencil of X-rays. The observed position of the spots is in agreement with that calculated from the known spacing and wave-length. The explanation indicated is further confirmed by the fact that, using unfiltered radiations, we get two spots in each case, corresponding to the copper K_α and K_β radiations, and occupying distinct positions, as is to be expected.



Laue pattern of diamond along a trigonal axis (copper K_α radiation).

We shall return in another communication to various other aspects of this new type of X-ray reflection.

C. V. Raman.
P. Nilakantan.

Department of Physics,
Indian Institute of Science,
Bangalore.
April 3.

Barometric Co-efficient of Extensive Cosmic Ray Showers

COUNTER experiments, intended to measure the rate of shower-producing radiation associated with extensive showers at sea-level, have given us an opportunity of measuring the barometric effect of showers up to 20 metres in mean diameter.

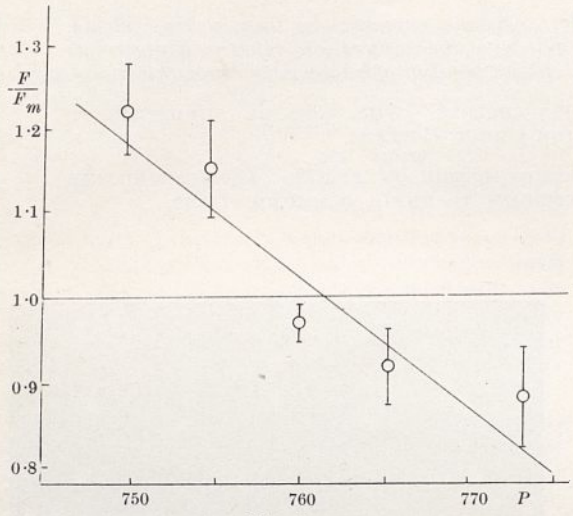


Fig. 1

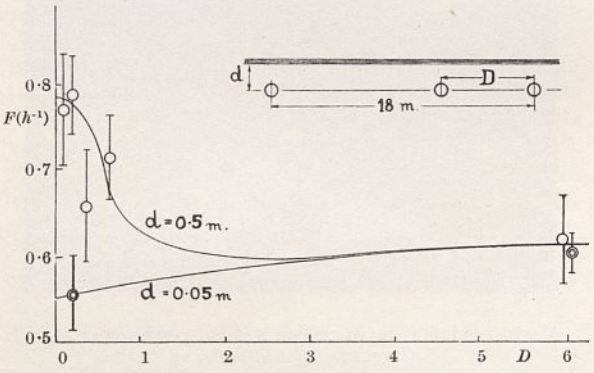


Fig. 2

We found that the barometric coefficient increases quickly with the diameter of the showers: for a barometric variation of 1 cm. of mercury, we found a corresponding variation of the frequency of showers of 4–5 per cent for 0·3 metre diameter showers: 8 ± 3 per cent for showers 12 metres in diameter, and 16 ± 3 per cent for showers 18 metres in diameter.

The measurements were made by means of a set of three counters, each of 120 cm.² effective cross-section, under or above a thin tile roof.

Fig. 1 refers to a continuous run of four months, with daily recording. (D = 18 m.)

Comparison between measurements above and at different distances under the tile roof shows that, at sea-level, an important part of the soft rays associated with 20 m. showers are produced in the roof as ordinary secondary showers.

This is clearly shown in Fig. 2, which demonstrates the secondary coherence of most of the rays. No such increase was observed above the roof.

Thus, the distribution of rays in space follows closely the Poisson law above the roof and at several metres beneath; but the proximity of the roof introduces a secondary coherence between the rays. This explains the apparent discrepancy between the results of Auger[1] and those of Janossy and Lovell[2], for even a thin roof produces a large secondary coherence.

More experiments, now in progress in our laboratory, are needed before trying to reach quantitative conclusions.

MAX G. E. COSYNS.

Physical Laboratories,
Fondation Medicale Reine Elisabeth,
Brussels.
March 8.

[1] Auger, P., and Maze, R., *C.R. Acad. Sci.*, **207**, 671 (1938).
[2] Janossy, L., and Lovell, A. C. B., NATURE, **142**, 716 (1938).

Volume Integration of Dosage for X- and γ-Radiation

IN radiation therapy as practised in this institution at the present time, the underlying principle adopted in the planning of treatment is to give a uniform tumour dose between 4000 r. and 6000 r. To achieve this, in deep-seated lesions, a multiple field technique has to be employed, and much radiation is absorbed which contributes not to the destruction of the tumour itself but to that of the normal tissues of the body. In the following note, methods are given for integration of dosage in a volume through which a beam passes.

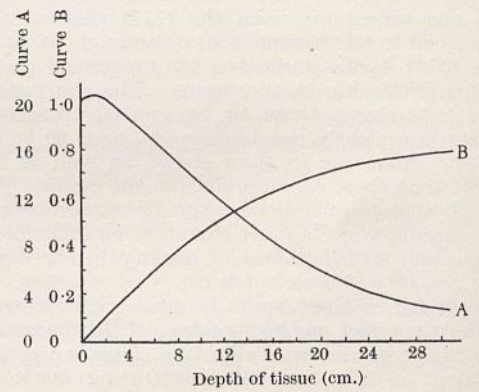
If at any point in a volume V, r is the dose of radiation in roentgens, then in that volume the integrated radiation dosage R is given by

$$R = \int_0^V r.dv, \qquad . \quad . \quad . \quad . \quad (1)$$

where R is measured in E.S.U. of charge.

To evaluate R. (*a*) In a series of complete isodose curves[1], the integrated radiation dosage can be evaluated graphically; the results of this method of calculation will be published in detail elsewhere. The few results already obtained are in agreement with the theory of section (*b*).

(*b*) In the case of radiation from a point source



CURVE A: $\frac{rx}{r_0} \cdot \frac{(40+x)^2}{40^2}$

CURVE B: $\int_0^x \frac{rx}{r_0} \cdot \frac{(40+x)^2}{40^2} . dx$

(for the purposes of the following discussion the X-ray beam considered is that from a 200-kv. Metropolitan-Vickers X-ray tube filtered through 1 mm. copper, 1 mm. aluminium at a focal skin distance of 40 cm.)[2], a simple method of computation of R has been evolved and the results are given below.

Curve A in the graph shows how the central ray of a large application (20 cm. × 15 cm.) is absorbed if its original area is 1 cm.^{2} at the surface of a 'water phantom'. The ordinates are the product of the depth dose[1] r and the geometric cross-section of the beam $\frac{(40+x)^2}{40^2}$ expressed as a fraction of the maximum incident skin dose r_0, in a solid angle of $1/40^2$. The final expression is $\frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2}$, where x is the thickness of absorbing material. The area enclosed under the curve gives the ratio of the integrated dosage and the saturated skin dose per cm.^{2} of incident radiation, that is, $\int_0^x \frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2} \cdot dx$. The integrated dosage for any depth of tissue can be calculated from curve B as the product

$$R = Ar_0 \int_0^x \frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2} \cdot dx, \quad . \quad . \quad (2)$$

where A is the area of the applicator. This holds equally for all areas of irradiation and r_0 remains constant, being the maximum skin dose for a large applicator. For large fields, however, A represents the area of the spherical surface instead of its tangential plane, and if flat filters are used a correction is also required for oblique filtration at the edge of the beam.

From the graphs an approximate working formula for volume integration of dose may be obtained, for thickness of absorbing material x is greater than 5·6 cm. (exponential absorption only occurs after a depth of 5·6 cm.)

$$R = Ar_0 \times 5{\cdot}6 + \frac{Ar_0}{\mu}\left(1 - e^{-\mu(x-5{\cdot}6)}\right), \quad . \quad (3)$$

where μ is the absorption coefficient 0·085 cm.$^{-1}$.

This method can be applied also to point sources of γ-radiation, but in the case of radium beam therapy[3], where the source is not a point, the method of section (a) has to be applied. It is proposed to deal more fully with the problem of integrated dosage at a later date.

FRANK HAPPEY.

Physics Laboratory,
Radium Centre,
Sheffield.
March 18.

[1] Parker, H. M., and Honeyburne, J., *Brit. J. Rad.*, **8**, 684 (Nov. 1935).
[2] Allibone, T. E., and Bancroft, F. E., *Brit. J. Rad.*, **7**, 65 (Feb. 1934).
[3] Grimmett, L. G., and Read, J., *Brit. J. Rad.*, **8**, 702 (Nov. 1935).

The Cyclol Hypothesis

FIVE sets of experiments have been reported in the past few years which have been claimed to bear on the cyclol hypothesis.

In a study of the infra-red spectrum of crystalline diketopiperazine, Kellner[1] found that the molecule is not in the enol form and is entirely or for the most part in the *lactam* rather than the *lactim* form. It is difficult to see the relevance of this result to the cyclol hypothesis, which has nothing to say as to the structure of such molecules.

It has been suggested that the study of the conditions under which CO–NH groups polymerize (dimerically to give double peptide bonds and trimerically to give triple peptide bonds) may prove to be a fruitful approach to protein synthesis[2]. The fact that α-piperidone is found to be monomeric in water and dimeric in benzene[3] does not conflict with this suggestion, which I desire to re-emphasize. Still less does it provide any evidence against the cyclol hypothesis, as has been claimed[4]. It seems in fact illegitimate to state, on the basis of these experiments, that "two experiments designed to test the cyclol hypothesis failed to support it"[5]. It has yet to be demonstrated in which respects, if any, diketopiperazine and α-piperidone can be regarded as models for the protein, or even as throwing any light on protein structure.

Analogous considerations apply to the unsuccessful attempt of Meyer and Hohenemser[6] to obtain *l*-leucyl, *l*-leucine and glycol glycine by mixing *l*-leucyl glycine and glycyl *l*-leucine. In this investigation no evidence was offered that a triazine intermediate was formed; the cyclol hypothesis does not require that dipeptides should form a triazine; had it been formed, the cyclol hypothesis does not require that it should break down into the dipeptides referred to. This experiment has in fact no relevance to the cyclol hypothesis.

The spectroscopic observations of native and digested serum by Haurowitz and Astrup[7] have also been cited as evidence against the cyclol hypothesis[4]. Here I need only direct attention to the work of Holliday, of which a preliminary account has recently been given[8]. It is necessary, in his opinion, before using such observations as arguments for or against the cyclol hypothesis, to distinguish change of absorption of the aromatic amino acids from the appearance of new absorbing centres.

A striking point of divergence between the classical and cyclol theories is the replacement of some or all of the skeletal CO and NH groups in the former by C(OH)–N groups in the latter[2,9]. In an attempt to settle whether or not the postulated cyclol OH groups occur in the native protein, Haurowitz[10] has studied experiments on the methylation and acetylation of proteins in which reagents such as acetic acid, acetyl chloride, acetic anhydride, dimethyl sulphate, diazomethane, ketene, etc., were used. His experiments, which repeat the results of the previous investigators, show that such OH groups, if present, are apparently not acetylated when the protein (egg albumin) is boiled (in the absence of a catalyst) with acetic anhydride, and are not methylated when the protein (egg albumin, horse hæmoglobin) is treated with dimethyl sulphate.

From these and the previous experiments, Haurowitz draws the conclusion that no cyclol OH groups exist in the native protein. But it is, in fact, very doubtful whether any conclusions regarding the presence or absence of these groups can be drawn from these negative findings. To do so it is necessary to assume that during these experiments the fine structure of the native protein remains intact, a very doubtful premise. Even if this assumption be made, it is further necessary to assume that the techniques used would certainly methylate or acetylate the cyclol OH groups, if they were present. In view of the fact that few $\geq$C–OH groups are at present

known whose atomic environment bears any resemblance to that in the cyclol fabric, any such prediction seems dangerous. In point of fact, the nearest analogues to the cyclol $\geq$C–OH groups seem to be those in the 1,3,5-trimethyl-2-phenyl (or alkyl)-2-hydroxy-4, 6-dioxohexahydrotriazines recently synthesized[11]. These compounds, it was found, are inert towards diazomethane and phenylisocyanate. These facts, *inter alia*, show that it cannot be dogmatically asserted that the cyclol OH groups, if present, would respond to the reagents listed above. In consequence, the negative findings under discussion go no way at all to proving the non-existence of the special type of skeletal OH groups postulated on the cyclol hypothesis.

Implicit in much of the criticism directed against the cyclol hypothesis is the curious argument that the fact that the cyclol structures contain features new to organic chemistry in itself constitutes evidence against the hypothesis[4]. This fact necessarily makes it difficult and probably impossible to test the hypothesis by such techniques as methylation and acetylation, even if difficulties relating to denaturation prove surmountable. However, since proteins have not yet been synthesized, and since they constitute a class of compounds which in many respects has unique qualities, the argument seems (if significant at all) to be in favour of the hypothesis. Failure to synthesize what have been called "simple substances with cyclol structure"[4] (a phrase which may prove to be a contradiction in terms) is also no evidence against the hypothesis. Criticisms of this type overlook the fact that all known proteins having molecular status contain thousands of atoms per molecule, and are by no means restricted in their constituents to one or two types of amino acids.

It appears then that the criticisms discussed above—in particular the five experiments—provide no evidence against the cyclol hypothesis. No statement of the case for the hypothesis is necessary, since an authoritative account[12] has already been given of the way in which it satisfactorily explains many of the well-known properties of the native proteins.

DOROTHY WRINCH.

Chemistry Department,
Johns Hopkins University,
Baltimore,
Maryland, Feb. 25.

[1] Kellner, NATURE, **140**, 193 (1937).
[2] Wrinch, NATURE, **137**, 411 (1936) *et seq.* *Proc. Roy. Soc.*, A, **160**, 59 (1937), *et seq.*
[3] Jenkins and Taylor, *J. Chem. Soc.*, 495 (1937).
[4] Pauling and Niemann, *J. Amer. Chem. Soc.*, **61**, 1860 (1939).
[5] Bergmann and Niemann, *Ann. Rev. Biochem.*, **7**, 110 (1938).
[6] Meyer and Hohenemser, NATURE, **141**, 1138 (1938).
[7] Haurowitz and Astrup, NATURE, **143**, 118 (1939).
[8] Holliday, NATURE, **143**, 895 (1939).
[9] Wrinch, *Phil. Mag.*, **25**, 705 (1938).
[10] Haurowitz, *Z. physiol. Chem.*, **256**, 28 (1938).
[11] Sobotka and Block, *J. Amer. Chem. Soc.*, **59**, 2606 (1937).
[12] Langmuir, *Proc. Phys. Soc.*, **51**, 542 (1939).

Demonstration of Thermal Diffusion in Liquids

CONSIDERABLE attention has recently been paid to a separation method for gases and liquids, which involves thermal diffusion and syphon action. In particular, the experiments of Clusius and Dickel[1] with carbon dioxide – hydrogen, and bromine – helium mixtures may be mentioned, while promising results in the separation of isotopes have also been reported[2]. Further, the same method gives good separations with aqueous solutions of inorganic salts[3] and mixtures of organic liquids[4].

Simple apparatus for illustrating these separations in the case of solutions has been constructed as follows. The solutions were enclosed by means of short rubber tubes within the vertical annular space between two concentric glass tubes. The diameter of the inner tube was 7 mm., its length 150 cm., and the annular space 0·5 mm. in thickness. Cold water was passed through the inner tube and steam through a surrounding jacket. With a solution of copper sulphate containing 330 gm. per litre, almost complete disappearance of the blue colour, indicating, therefore, a marked reduction in concentration, was observed at the top of the apparatus after eight hours treatment, while increase in concentration was sufficient to induce crystallization at the bottom of the tube.

A second apparatus, in which the annular space was only a few tenths of a millimetre in thickness, gave rapid separations with copper bromide and with cobalt chloride. The former is brown in concentrated and greenish blue in dilute solution, while the latter gives a blue colour in moderately concentrated hydrochloric acid which, on dilution, reverts to the characteristic pink. With initial solutions of intermediate tint, the anticipated colour changes clearly developed in the upper and lower sections of the tube in each case within two to three hours.

DUNCAN TAYLOR.
MOWBRAY RITCHIE.

Chemistry Department,
University of Edinburgh.

[1] Clusius and Dickel, *Naturwiss.*, **26**, 546 (1938).
[2] Clusius and Dickel, *Naturwiss.*, **27**, 148, 487 (1939); Watson, *Phys. Rev.*, **56**, 703 (1939).
[3] Clusius and Dickel, *loc. cit.* in 2.
[4] Korsching and Wirtz, *Naturwiss.*, **27**, 110 (1939).

Sirius and the Constellation of the Bow

THERE is rather a remarkable coincidence (if it is a coincidence) in connexion with the ancient constellation figures to the south-east of Sirius, occurring in Babylonia, China and Egypt.

In the Chinese "Star Classic", reputedly of the third or fourth century B.C., but reassembled in the ninth century A.D., there is the phrase "The Bow and Arrow are nine stars to the south east of the Wolf" (the Wolf is Sirius)[1]. Schlegel shows in his diagram the arrow pointing towards Sirius, which might even be regarded as the tip of the arrow.

In Babylonia "in the late period Kaksidi [Sirius] was imagined as an arrow. Behind it stood the constellation Bow. Sirius is the shining point of the arrow; presumably one or more stars between this and the bow marked the shaft"[2].

On the Denderah round 'zodiac' from the small temple on the roof of the Great Temple of Denderah, now in the Louvre, there is a figure just to the left (east) of the Cow in the Barque (Sirius) which represents the goddess Satet bearing a bow and arrow[3].

HERBERT CHATLEY.

17, Victoria St.,
London, S.W.1.

[1] Schlegel, G., "Uranographie Chinoise", **1**, 430–34.
[2] Burrows, E., "Hymn to Ninurta as Sirius", *J. Roy. Asiat. Soc.*, Centenary Supplt., 38 (Oct. 1924). Kugler, "Sternkunde", *Ergaenz.*, 26, 30, 39, etc.
[3] "Description de l'Egypte", Antiq., Plates, IV, Nos. 18–21.

Acetyl Content of Marinobufagin, Arenobufagin and Acetyl-marinobufagin

FOR marinobufagin, first isolated by Abel and Macht[1] from *Bufo marinus* and afterwards by Deulofeu and Mendive[2] from *B. paracnemis*, Slotta and Neisser[3] suggested the formula $C_{27}H_{38}O_6$, at variance with $C_{24}H_{32}O_5$ accepted by Jensen in many of his papers. They supposed that marinobufagin could contain one propionyl group.

The determination of the volatile acid content of several samples of marinobufagin by the Kuhn and Roth method[4] has given values lower than 1 per cent, so that acetyl or propionyl groups seem to be excluded from its constitution. Analysis of the samples gave carbon and hydrogen values according with Jensen's formula $C_{24}H_{32}O_5$.

When the same method was applied to acetyl marinobufagin[5], the acetyl content was found to be about 18 per cent, pointing to two acetyl groups in the molecule (calculated 17·76 per cent). Two easily esterifying alcoholic groups seem to be present (primary or secondary). On the basis of its elementary analysis, acetyl-marinobufagin has always been considered a mono-acetyl derivative. This difference will be further investigated.

From *B. arenarum*, Chen, Jensen and Chen[6] isolated a substance melting at 220° (correct.), to which formula $C_{25}H_{34}O_5$ was assigned. Jensen[7] states that the acetyl group is present, as by alkali hydrolysis acetic acid was detected as the silver salt.

We have isolated from the crude venom of *B. arenarum* another compound melting at 231–233° with a formula $C_{24}H_{32}O_6$ (elementary analysis) and without acetyl group (less than 1 per cent). Only further research on both compounds will explain the relationship between them.

That the method employed for the determination of acetyl groups is reliable results from the work of Wieland, Hesse and Hüttel[8] on bufotalinine, where correct acetyl values were obtained.

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March 5.

[1] *J. Pharm. Exp. Therap.*, **3**, 319 (1911).
[2] *Ann.*, **534**, 288 (1938).
[3] *Mem. Int. Butantan*, **11**, 89 (1937).
[4] *Ber.*, **66**, 1274 (1933).
[5] Jensen and Chen, *J. Biol. Chem.*, **87**, 755 (1930).
[6] *J. Pharm. Exp. Therap.*, **49**, 1 (1933).
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[8] *Ann.*, **524**, 203 (1936).

Substrate Specificity of Yeast Zymase

IN a recent paper[1] further and seemingly conclusive proof was given that hydrolysis of maltose to glucose is not a necessary condition of maltose fermentation by living yeast cells. It may be noted that one of the findings upon which this conclusion was rested has now been independently confirmed[2]. Results since obtained suggest that not only is the mechanism of maltose fermentation *in vivo* different from, but also that it is not inclusive of, the glucose fermentation mechanism.

(1) It has been found that maltose fermentation by maltase-poor baker's yeast is strongly inhibited by the presence of methyl α-glucoside, but that under the same conditions glucose fermentation is unaffected.

The inhibiting action is not due to an inhibition of maltase since fermentation by maltase-rich brewery yeast and hydrolysis by maltase preparations of either baker's or brewery yeast are not subject to inhibition by methyl α-glucoside under the same conditions. It follows, therefore, that the mechanism of maltose fermentation includes a component which is not present in glucozymase and is not maltase.

(2) Conditions have been realized in which maltose ferments more rapidly than glucose. It is known that in aqueous or dilutely buffered medium, brewery yeast may ferment maltose and glucose at about the same rate. High salt concentrations depress the fermentation-rate of both sugars but have been found to do so more markedly in the case of glucose. The fermentation rate ratio of maltose to glucose in concentrated solutions of phosphate-citrate or other buffer salts may still be near 1·0 when fresh yeast is used, but far exceeds 1·0 when yeast which has been allowed to age is used.

The markedly superior fermentability of maltose in high buffer concentrations is proof that maltozymase is not merely maltase plus glucozymase. The same finding also offers support, though it does not itself constitute conclusive proof, for the view that maltozymase does not include glucozymase.

This conclusion is not opposed to any known fact of maltose fermentation, and finds further support in several observations which reveal primary differences in the fermentation mechanisms of maltose and glucose[3,4,5]. Also it should be mentioned that the *p*H-activity curve of maltose fermentation by baker's yeast is not given by glucose, and, as has been confirmed by us, is essentially different also from the *p*H-activity curve of either cell-bound or free yeast maltase[2,1].

The question may therefore be put whether the time-honoured term 'alcoholic fermentation of sugar' does not in fact cover processes which are different for different substrates.

It is intended to give a fuller discussion of this problem, details of the present experiments and a report of experiments on the alcoholic fermentations of sucrose, raffinose, and lactose in a later paper.

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Hebrew University,
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March 10.

[1] Leibowitz and Hestrin, *Enzymologia*, **6**, 15 (1939).
[2] Schultz and Atkin, *J. Amer. Chem. Soc.*, **61**, 291 (1939).
[3] Guillement, *Bull. Soc. Chim. Biol.*, **18**, 941 (1936); *C.R.*, **209**, 255 (1939).
[4] Sobotka and Holzman, *Biochem. J.*, **28**, 734 (1934).
[5] Schultz, Atkin, and Frey, Ninety-eighth Meeting of the Amer. Chem. Soc., Div. of Biological Chemistry, 60 (1940).

A Decalcification Fluid

SINCE my former communication[1], I have had opportunity to conduct a number of experiments with the sodium hexametaphosphate decalcifying fluid reported.

Using the formulæ given by Gray[2], I find that a 25 per cent solution of the sodium hexametaphosphate is miscible in all the basal fixing solutions mentioned,

except those containing alcohol. I have not been able to test the platinum chloride ($PtCl_2$) solution. With alcoholic solutions, the sodium hexametaphosphate apparently forms an emulsion which separates out in a short time. This immiscibility with alcoholic solutions is no great drawback, since all of the usual fixatives containing alcohol also contain acetic acid. The object of the sodium hexametaphosphate is to avoid the 'gasing' caused by acid fixatives when used on calcareous material, and hence, as a rule, these would not be used. Chromic acid fixatives do not cause appreciable gasing, and can be used to advantage.

To those fixatives which in Gray's paper are prepared by the addition of a large volume of water to the basal fixing solutions, I recommend adding instead the same volume of 25 per cent sodium hexametaphosphate solution. In other cases, the solution can be added as an addition to the normal fixative. In all cases where the material is in reasonably small pieces, decalcification takes place in the normal period of fixation.

I find also that the sodium hexametaphosphate solution is miscible with the usual solutions used for washing after fixation.

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Lincolnshire.
March 24.

[1] NATURE, **142**, 958 (1938).
[2] *J. Roy. Micro Soc.*, **53** (1933).

Carcinogenic Colouring Matters

PROF. J. W. COOK'S article on "Cancer-Producing Chemical Compounds" published in NATURE of March 2 raises questions of extreme importance for all those who employ artificial colouring matters in the manufacture of articles intended either for internal consumption or for application to the skin, or whose business it is—as in my own case—frequently to have to give advice about suitable colouring matters to use for either of these purposes.

May I suggest that it is highly desirable that a full report of the experiments mentioned by Prof. Cook should be published, and that the work should be continued ?

Prof. Cook's reference to a "limited range" of "permitted" food colouring matters in Great Britain is both puzzling, and, I venture to suggest, misleading. In Great Britain, unlike the United States of America, certain of the Dominions, and various other countries, there is no list of "permitted" food colouring matters. The use of certain metallic colouring matters, one colouring matter of vegetable origin (gamboge), and five specified coal-tar colours, is forbidden. These apart, food and beverage manufacturers are free to use any colouring matters they like so far as they are not injurious to public health.

A fairly considerable range of colouring matters is manufactured by firms specializing in the production of colours for the food industries. These include several azo-compounds, all of which are not sulphonated. Among the latter, special mention may be made of Yellow AB (benzene-azo-beta-naphthylamine), and Yellow OB (orthotoluene-azo-beta-naphthylamine). According to work reported by Prof. Cook, these two colouring matters should be regarded with suspicion ; but they are "permitted" colours in the United States, where legislation is far more stringent in the matter than in Great Britain.

There is a fairly general impression that toxicity of dye-stuffs is, at least in many cases, reduced or destroyed by sulphonation, which, at the same time, converts the substance from an oil-soluble dye into a water-soluble one. It is highly desirable to know, I suggest, whether this process also destroys any carcinogenic properties.

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March 18.

A FULL report of the experiments on the carcinogenic properties of 2 : 2′-azonaphthalene and its transformation products, and of the tests carried out on certain food colouring matters, to which reference was made in my recent article, is at present being prepared for publication. These experiments form part of an extensive series carried out by Prof. E. L. Kennaway and myself, with our collaborators, in the research laboratories of the Royal Cancer Hospital (Free), London.

I agree with Mr. Redgrove that my reference to "permitted" food colouring matters in Great Britain is a misrepresentation. Changes in my circumstances had deprived me of access to a correspondence which I had with the Government Chemist in 1936, when the tests with food colouring matters were begun. I have now been able to consult this correspondence and it is clear that the reference in my article to tests carried out with "a selection of these permitted dyes" should have read "a selection of the relatively few dyes in common use as food colouring matters".

The unsulphonated dyes mentioned by Mr. Redgrove undoubtedly require, and will receive, further attention. I was not aware that Yellow AB and Yellow OB are used in the food industries, and from inquiries which I have now made it would appear that these dye-stuffs are very little used in Great Britain.

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High Proportions of Homostyle Plants in Populations of *Primula vulgaris*

As part of a study of heterostyly in Primula, with particular reference to the fertility relations existing between the two normally occurring types, pin and thrum, counts of their proportions in natural populations have been made. My own data have been supplemented by some counts made by friends and colleagues in various parts of Britain.

By far the most striking of the populations of *P. vulgaris* so far discovered are some from Somerset. I received from Miss M. Ll. Jones a collection of flowers, one taken from each plant selected at random in Sparkford Wood. Out of a total of 323, 102 were pins, 11 were thrums, and 210 were long homostyles, that is they had the anthers in the thrum position, while the style was long with the stigma in the pin position. A few stigmas were examined microscopically, and they all had long papillæ.

There are further counts from the same district made by Mr. P. B. Pitman, but in none of these have I examined the flowers. In an area of Sparkford Wood, slightly overlapping the first, the proportions found were 145 pin, 15 thrum, 468 long homostyles. It appears that the population within the wood is far from uniform, and is thus not likely to be even approximately in a state of stability. In another wood about five miles away, 152 pin, 103 thrum, 177 long homostyles were found. In contrast to these, a count on two banks near Maperton, in the same district, showed 46 pin, 75 thrum, 7 long homostyles, and 41, 40, 2 respectively.

Three styles from the Sparkford flowers were dissected and stained, and it was found that the pollen which was on the stigma had grown well. The grains were large, of the thrum type, and because of the shortage of thrum plants in the wood may be assumed to have come from a long homostyle flower. The fact that the stigma is usually more or less in contact with the opened anthers makes it reasonable to assume that self-pollination is the rule in homostyle plants. Further, experiments with a long homostyle *Primula veris* in 1939 showed that it was quite self-fertile.

It seems likely, therefore, that long homostyles in *P. vulgaris* are always self-fertilized. If such plants appear in a population, their fate depends upon the viability of the homostyle homozygote. If it is inviable, the gene combination responsible for homostyly would be eliminated from the population if thrums were present; if only pins and long homostyles occur, then at stability these will be present in the ratio $1 : \sqrt{2}$. If the homostyle homozygotes are viable, the ultimate population should consist entirely of them.

If, then, a long homostyle appears in a normal population, it should spread, provided the homozygote is viable; thrums should decrease more rapidly than pins, but both forms should ultimately disappear. The striking heterogeneity in the counts from different populations in the same area would seem to be due to different stages in the evolution of a new state of stability in each population following the appearance of long homostyles in that district. It is possible that further counts in the same district might reveal an orderly heterogeneity of the populations, with a centre of high homostyle concentration surrounded by populations with concentrations decreasing with distance from the centre. That is, one might expect that the gene combination responsible for homostyly would migrate outwards from its point of origin.

Further data must be obtained upon the occurrence of homostyles in natural populations. The facts communicated above show that in the counting of Primula populations it is important that all plants should be examined both for anther position and style length; long homostyles in which the stigma is not readily visible will resemble thrums until the corolla is removed.

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April 17.

Points from Foregoing Letters

A LAUE pattern of diamond along a trigonal axis submitted by Sir C. V. Raman and P. Nilakantan shows additional sharply defined spots, which are believed to arise from dynamic stratifications of density in the crystal.

M. G. E. Cosyns finds that the barometric coefficient of extensive cosmic ray showers increases rapidly with the diameter. The particles of the extended shower produce numerous secondaries in even a thin roof, and these secondaries may account for anomalies in previous results on these showers.

A method has been devised by F. Happey for the calculation of integrated radiation dosage by considering the absorption of a saturated solid angle of beam of X-rays from a point source, and the results are expressed in a form which can be used clinically. A graphical method is also indicated for use with X- or γ-radiation.

D. Taylor and M. Ritchie describe some results obtained with a simple apparatus for demonstrating the Clusius-Dickel thermal diffusion effect in aqueous solutions. Striking colour changes in the upper and lower sections of solutions of copper sulphate, copper bromide and acidified cobalt chloride, jacketed in a long annular space between hot and cold surfaces, are very readily obtained.

For marinobufagin, the active principle from the venom of *B. arenarum*, the formula $C_{24}H_{32}O_5$ proposed by Jensen has been confirmed, but the acetyl derivative usually accepted as a mono-acetyl compound gave acetyl values that agree with a di-acetyl compound. From *B. arenarum* secretion a substance melting at 231–233°, and with formula $C_{24}H_{32}O_6$, has been isolated. It contains no acetyl, and it is different from the arenobufagin of Chen, Jensen and Chen.

It has been found by J. Leibowitz and S. Hestrin that by selective inhibition of the glucose fermentation rate through high salt concentrations, conditions could be realized in which brewery yeast fermented maltose far more rapidly than glucose. It is therefore concluded that maltozymase is not merely maltase plus glucozymase, and probably does not contain glucozymase.

Sodium hexametaphosphate, formerly reported by R. A. C. Wilks as a decalcifying agent, is miscible with all the usual fixatives, except those containing alcohol. Hence decalcification can take place at the same time as fixation, thus effecting a speeding up of these preliminary processes.

H. S. Redgrove stresses the importance of continuing the investigation on cancer-producing chemical compounds referred to by Prof. J. W. Cook in a recent article in NATURE, more especially in view of the use of azo dyes and derivatives of beta-naphthylamine for colouring foodstuffs and cosmetics. He points out that there is no list of 'permitted' colours for use in foodstuffs in force in Great Britain.

J. L. Crosby reports the occurrence in Somerset of populations of *Primula vulgaris* with very high proportions of long homostyles, and a considerable shortage of thrums as compared with pins. The effect of the appearance of such homostyles in populations consisting only of the normal forms is briefly discussed.

RESEARCH ITEMS

Measurement of the Nasion in the Living

OWING to the importance of determining the nasion in the living and the difficulties of so doing, special directions are given by the various authorities; these have been discussed and compared with his own elaboration of method by K. P. Chattopadhyay (*Amer. J. Phys. Anthrop.*, **25**, 2; 1939). Martin recommends light pressure with the lateral edge of the thumb up and down on the skin in the neighbourhood of the root of the nose, while Hrdlička, though also recommending the finger-nail or the point of a pencil, relies in the majority of cases on the experience of observation on skulls and dissecting room material. Lipiec and Oetteking worked on cadavera and skulls, and Ashley-Montague carried out experiments on "freshly-deceased human cadavera" with the purpose of their extension to the living, confirming his results by X-ray studies of ten living adult white males. But as the position of the superior palpebral sulcus, as used by Ashley-Montague as a point of departure of his horizontal tangential intersecting the mid-sagittal plane, has no constant relation to the nasion, a different approach has been tried. Ninety skulls of Bengal Hindus and twelve others in the University and Indian Museum were first studied, taking the distance between nasion and the intersection of the common tangent to the superior margin of the two orbits with the mid-sagittal plane. The mean value (all skulls) was found to be 5·311 mm. This method was adapted to conditions in the living whose nasal suture could be determined by palpation, by using caliper or tape and steel plate, with the tangent to the arched grooves when the eye is wide open as the line of reference. The result of the measurement of distance from nasion to the intersection of the tangent to the superior palpebral sulci with the median sagittal plane, with the eyes open, on one hundred Hindus is 5·39 mm.

Recent Advances in Insect Embryology

MITHAN LAL ROONWAL has contributed an extremely useful summary of the present state of knowledge of the embryology of insects (*J. Roy. Asiatic Soc. Bengal (Science)*, **55**, 17–105; 1938—issued 1939). The process of gastrulation, the origin of the mid-gut epithelium and, specially, the problem as to the extent to which the orthodox germ-layer theory is applicable to insects, are among those aspects of the subject that are still under dispute. Recent embryological evidence points to the conclusion that the head is seven-segmental owing to the presence of two somites—the labral and preantennary in front of that bearing the antennæ. Some prominence is given to the author's own idea of multiphased gastrulation and its implications. Whether this conception will ultimately find general acceptance or not is too early to predict. The carbolic acid and water technique evolved by Slifer and King is commented upon as a definite advance on the practical side of embryology, since it has made the difficult and laborious process of sectioning yolky eggs a much simpler matter. The bibliography for nearly seven hundred references accounts for practically everything that has been written on insect embryology from the earliest papers up to and including many of those published in 1938 and later. There is also a classified list under which are grouped references to works on the embryology of separate orders, on experimental embryology, on bacterial symbiosis, etc. The author's name and the year of publication are given, thus enabling the reference to be traced in the alphabetical list.

A New Anaspid Fish

ERIK A:SON STENSIÖ deals with an interesting Ostracoderm of the order Anaspida ("A New Anaspid from the Upper Devonian of Scaumenac Bay in Canada, with remark on the other Anaspids", *Kungl. Svenska Vetenskapsakademiens Handlingar*, Tredje Serien, **18**, No. 1; 1939). *Endeiolepis Aneri* n.g., n.sp. although only two specimens are available, both imperfect, throws much new light on the Anaspids in general. The head, adjacent anterior part of the trunk and certain posterior parts of the caudal fin are lacking, but enough is preserved to show very definite structure. A survey is made of the Anaspids in general and the genus Euphanerops A. S. Woodward, of which only one specimen exists, is redescribed and shown to be well distinguished from the other genera. An important and striking feature in Endeiolepis is the remains of a paired row of long, freely projecting ventro-lateral scales developed from the gill-region and reaching to the anal opening. The anterior part of this row represents the pectoral spine apparatus and the ventro-lateral scales overlap each other and form together a paired, strong ridge, covered by a fold of skin, agreeing fundamentally with the ventro-lateral scales in the Cephalaspids. The author is of the opinion that Endeiolepis "had a real paired fin-fold strengthened with ventro-lateral scales, a paired fin-fold which according to its extent must comprise homologues both of a pectoral fin, respectively pectoral spine apparatus, and a ventral fin".

Algæ from the Iranian Gulf

DURING 1936–37 the Danish botanist, Mag. Køie, accompanied the Danish Fishery Investigation to the Iranian Gulf, and the algal collections have been named and collated by F. Børgesen (Danish Scientific Investigations in Iran. Part 1. 1939). A small collection in the Kew Herbarium from the Persian Gulf has also been examined. Previous to this, only about half a dozen algæ had been described from the Gulf, and the present gatherings also show that the flora is very poor and in strong contrast to the rich algal flora from Dwarka on the other side of the Arabian Sea. Børgesen ascribes this to the shallow depth of only 50 m., the high temperature of the water with a mean of 24° C. and the associated high salinity; the coastal waters are not removed by any ascending currents and also the general muddy or sandy type of bottom is unsuitable for algal growth. About 6 km. south of Bushire a coral reef showed a considerable algal growth with zones ranging from high on the littoral zone, *Cladophora nitellopsis* nov. spec. as the dominant type, through

an *Enteromorpha compressa* zone, a broad belt of Colpomenia and then one with *Enteromorpha clathrata* with *Ulva Lactuca*; in all these zones a number of smaller red algæ were also present. Rocks farther out supplied Sargassum spp. and an Ectocarpus. On coral reefs on the island of Kharg, corals from 1–2 m. depth had numerous small algæ attached, but many of these were sterile and so poorly developed as to be impossible to determine. A rather richer vegetation was collected from the Bahrein Islands. The algæ of this gulf are probably mainly of interest as indicating the types which are able to survive under such unfavourable conditions.

Incompatibility in Antirrhinum

IT has been known since Lotsy's work in 1911 that the peloria flower of Antirrhinum sometimes segregated in a 1 : 1 ratio in place of 3 zygomorphic : 1 radial flowers in the selfed F_2 of a cross between these forms. If, however, the F_1 plants were intercrossed, a segregation of 3 zygomorphic : 1 radial could be obtained. Brieger has shown that peloria and the incompatibility factors S_1—S_F were closely linked and therefore the 1 : 1 segregation was accounted for. He claimed that a fertility factor in *A. majus* was not allelomorphic with the *S* factors. Marta Sharman (*Z. Ind. Abst. Vererb.*, 77, 3–17; 1939), however, shows that the usual allelomorphic series of S_1, S_2—S_F, where S_F is a fertility factor, will account for all the data on the inheritance of fertility and radial flowers in species crosses in Antirrhinum, and therefore Antirrhinum may be brought into line with the general rule of inheritance of self-incompatibility on East's hypothesis.

A Beneficial Pathogen

AN interesting positive value of a parasitic fungus is revealed by S. H. Ou (*Sinensia*, 9, Nos. 5–6; September 1938). The plant *Zizania latifolia* is cultivated as an aquatic crop throughout China, the hypertrophied stem-tips serving as food. The fungus *Ustilago esculenta* is invariably present in the field crop. Characteristic swollen shoot tips are not produced, however, when the fungus is killed in the rhizomes by hot water treatment at 54° C. for 15 min. Zizania therefore owes its food value to the presence of a smut fungus.

Density of Seismograph Stations

A MOST interesting table concerning the above topic has been prepared by H. Landsberg for *Earthquake Notes* (11, No. 3; Jan. 1940). It appears that for the whole earth there are 478 seismograph stations with an approximate average of one per million square kilometres of surface. Europe has 159 stations with 14 per million square kilometres; Asia 156 with 3·7 per million square kilometres; America 110 with 2·7 per million square kilometres; Australia and New Zealand 22 with 2·6 per million square kilometres; and Africa 9 with 0·3 per million square kilometres. For individual countries, Japan has the most with 127, followed by the United States, 59, and Italy, 39. Several small countries only have one. Countries with the greatest number per million square kilometres are Japan, 322·0, Switzerland, 145·3, and Italy, 125·7. England and the Channel Islands (presumably Great Britain, Ireland and the Channel Islands) are reported as having 15 stations with a density of 99·3 per million square kilometres.

Raman Spectra of Co-ordination Compounds

AN examination of the Raman spectra of 4- and 6-co-ordinated compounds of platinum (2- and 4-valent) and rhodium (3-valent) salts has been made by J. P. Mathieu (*J. Chim. Phys.*, 36, 308; 1939), supplementing previous studies with tin, zinc, iron, cobalt, nickel, palladium and iridium salts. The Raman spectra of complex compounds of metals with the same co-ordination number and analogous electronic structures show similarities; the force constant *f* increases with the atomic number. A comparison of the cyanides or nitrites of elements of neighbouring atomic numbers but different co-ordination numbers (for example, Rh and Pd, and Ir and Pt) shows that *f* has very similar values for the two metals of each pair. This establishes a parallelism between *f* and the strength of co-ordinate linking as defined by Pauling, which remains constant in all octahedral complexes on one hand and in all square complexes on the other, whatever may be the outer electronic layer of the central atom ($3d$, $4d$ or $5d$), but increases on passing from the square complex to the octahedral complex. The paper contains a detailed examination of the modes of vibration in molecular models $[M(XY)_4]$, $[M(XY)_6]$ and $[M(XY_2)_4]$ in square or octahedral structures.

Absorption within the Stellar System

AMONGST the astronomical papers presented before the Columbus meeting of the American Association in December, was one by J. Stebbins, C. Hugger and A. Whitford on the colours of early-type stars near the poles of the galaxy. Evidence already exists for a thin absorbing layer of interstellar material near the galactic plane. The absorption is most conspicuous towards the line of the Milky Way, where it produces the great rift and various dark lanes in which the stars are partially blotted out. This general absorption is accompanied by the reddening of distant stars known to be intrinsically white from the character of their spectrum lines. Conversely, from the colours of these distant white stars, an estimate can be made of the amount of absorbing dust in space along the line of sight. The colours of about two hundred white stars near the galactic poles have been determined at the Washburn and the Mount Wilson Observatories. The results have been used to measure the absorption towards the galactic poles where we look through as little of the layer as possible; in other words, a measure is obtained of the optical thickness of the layer in the vicinity of the sun. From fifty of the stars with well-determined spectra, the measured space reddening corresponds to a total photographic absorption of 10 per cent at 300 light years from the galactic plane. The detection of absorption at greater distances will depend upon the accurate determination of the spectra of fainter stars. The present result agrees with previous measures of stars at greater distances along the galactic plane, where it is found that the absorption at three thousand light years is about one stellar magnitude; that is, the stars are reduced to about two fifths of their real brightness. Beyond three thousand and up to six thousand light years towards the anti-centre of the system, there is little further effect, indicating that the dark material thins out. Toward the centre of the galaxy, however, the absorption and space reddening are greater, and there is no evidence that we can penetrate to the end of the dark material in that direction.

EDUCATION IN WORLD CITIZENSHIP

THE League of Nations Union has recently established a Council for Education in World Citizenship which held its inaugural meeting at Oxford during April 11–15. The meeting, which took the form of a National Conference of Local Education Authorities and Teachers, dealt with "Problems of Education To-day in Relation to World Settlement after the War".

Some obviously uninformed views are abroad concerning the *raison d'être* and work of the newly formed Council and it may be appropriate to say here something of the reasons that have led to its formation.

The Education Committee of the League of Nations Union was formed some twenty years ago to instruct children in the aims and activities of the League of Nations. Throughout its existence it has had official approval and has enjoyed the support of many influential and important bodies within the Empire. Junior branches of the League of Nations Union have been formed in schools throughout the country with the approval and support of the local educational authorities concerned, and it would need an article in itself to outline the other activities of the Education Committee in sending children to Geneva, in providing summer schools and camps, in arranging courses of lectures, in making contacts with the youth of other nations, in a hundred and one ways endeavouring to break down those barriers of nationalist feeling which have, alas, culminated in the tragedy which overshadows our world of to-day.

All this good work went on with apparent success for some eighteen years, despite the deterioration in international affairs which succeeded what Dr. Gooch has called the "sunshine of Locarno". But of late years certain difficulties have become increasingly apparent. The League of Nations Union is, in its very essence, a policy-forming as well as an educational body. The Education Committee is, emphatically, not a policy-forming body—its functions are educational first, last and all the time.

Nevertheless, when the League of Nations Union found itself, on occasion, acting in opposition to the policy of the Government in office, this opposition was said (quite incorrectly) to be reflected in the policy of the Union's Education Committee, which was accused of dabbling in politics.

The issue was brought to a head by the Munich crisis of 1938, when many junior branches seceded, giving as their main reason that they wished to study international affairs without necessarily subscribing to the tenets of the League of Nations Union.

It seemed therefore desirable to form a council which, while being in general sympathy with the ideals which inspire and guide the work of the League of Nations Union, should have complete autonomy in the management of its affairs.

Hence the appearance of the new Council. Its objects are to foster mutual understanding and habits of co-operation between the peoples of the different countries and to take steps to ensure that students are trained in the principles of international co-operation, including the aims and activities of the League of Nations, and the terms of its Covenant. To these ends the council will encourage and assist such teaching of school subjects as will lead to an understanding of world affairs, the growth of civilization, the chief characteristics of nations and of national governments, the factors that unite and the differences that divide nations and the responsibilities of citizenship; will assist both students and teachers in studying the causes of war and the means whereby a more just and stable world order may be created; will seek to provide opportunities for pupils to appreciate the best in other peoples, and to make friendly contacts with boys and girls of other nations; will seek to ensure that nothing in our colleges and schools shall arouse hatred and contempt of other peoples; and will teach the principles of freedom and justice, co-operation and good faith as the foundations of the good society in the home, school, State and world community.

Here, surely, is a programme with which every lover of freedom and justice will find himself wholeheartedly in agreement.

The proposed membership of the Council is wide enough to absolve it from any charge of sectarianism. It includes representatives from practically every important educational body, most of the administrative bodies connected with education, adult educational associations, committees of the British Broadcasting Corporation, the British Film Institute and representatives of the Guides and Scouts movements.

The inaugural meeting's success was qualified by only one untoward happening. Prof. Susan Stebbing was forced to cancel, by reason of illness, her paper on "Training in Clear Thinking on Public Affairs". Otherwise, the meeting's success far exceeded the anticipations of the organizers. Syllabuses are notoriously dull, but the scope of the meeting is best indicated by a résumé of the titles of the addresses heard by the three hundred delegates who attended the conference. The opening address, on "World Citizenship; the Growth of an Idea", was delivered on Thursday evening by the chairman of the Council, Prof. Gilbert Murray. On Friday a discussion on "The League of Nations; what next?" was opened by Mr. Noel-Baker. On Friday afternoon Mr. H. G. Wells and Prof. Allan Ferguson opened a discussion on "The Teaching of World Unity; what is being done and what might be done in the schools". In the evening, Prof. C. E. M. Joad delivered an address on "Proposals for Federal Union". On Saturday morning, Señor de Madariaga, M. Jan Masaryk, M. Maheu (chief representative in Great Britain of the French Ministry of Information), Count Jean Balinski Jundzill (Deputy Director of the Polish Research Centre, London), Dr. Rudolf Olden (formerly assistant editor of the *Berliner Tageblatt*), Mr. A. C. F. Beales, Mr. Ivor Montagu and Mr. W. Arnold Forster took part in a round-table discussion on "Some Guiding Principle for the next Peace Settlement". On Saturday evening Miss Dymond (Principal of the Portsmouth Municipal Training College) presented a report on "The effects of the War on the Minds of Children". On Sunday afternoon, Miss Charlesworth presided over

a conference on "The Work of the Council", and on Sunday evening the delegates were addressed by the Headmaster of Rugby (Mr. P. H. B. Lyon), who took as his subject "The Spiritual Foundations of World Citizenship". The final session of the Council, to sum up the work of the Conference, was held on Monday morning, and the concluding address was given by Mr. Kenneth Lindsay, Parliamentary Secretary to the Board of Education.

Throughout the meeting the addresses and discussions attained and preserved a high level of interest. The opening address by Prof. Gilbert Murray, with its insistence on the futility of any form of political or economic co-operation which is not backed by a real will to brotherhood—by an intellectual co-operation having a firm ethical basis—marked a line of thought which dominated the subsequent proceedings of the conference and which emphasized at once the difficulties and hopes attending any advance towards world unity.

So, too, the Headmaster of Rugby in his Sunday evening address. Therein he deplored the tendency of modern teaching to over-emphasize the ethical, and to lay too little stress on the religious outlook. In internationalism shorn of the religious habit of mind there was little driving force, and "as sentiments grew wider they grew shallower". He urged that religious education should be regarded as a fundamental necessity.

Mr. Noel Baker's address was an eloquent plea for a strengthening of the terms of the Covenant of the League. The League had not failed, in any true sense of the word. It had many successes to its credit, and, where its machinery had apparently broken down, the reason was to be found in the fact that commitments had been undertaken, had not been repudiated, but had remained unfulfilled. The address provoked a lively discussion.

In the afternoon's session on the teaching of world unity, Mr. H. G. Wells was as stimulating and provocative as ever. The present state of affairs in the teaching world (in particular the meagreness of the resources which the teacher had at hand in the matter of encyclopædias, books and apparatus) came in for some vigorous criticism. World unity was a fact; war was civil war; the non-combatant had disappeared, and the neutral was fast disappearing; League and Federal notions might well lead to failure, in the latter case because federated *blocs* might result, leading to war on a larger scale. It should not, however, be impossible to bring into one world opposition the oppositions which existed in the governments of all civilized countries, and so to persuade sovereign States to relinquish the control of matters which otherwise they would not relinquish. From the point of view of the teacher, old-fashioned history should be replaced by the study of the science of human ecology, the relation of man to his external surroundings—children should be taught, not by telling them little stories of kings and queens, but by showing them their relation to the world as a whole.

Prof. Ferguson pointed out that science teaching provided an ideal medium for fostering the international outlook, and for exhibiting some of the most important relations of the individual to the community of which he formed a part. They had heard much of the effect of the aeroplane and of other inventions and discoveries in annihilating distance, but there were other and hitherto rather neglected topics about which equally fascinating stories could be told. He instanced some of the details concerning the transport and storage of food, and the new and rapidly growing industry of plastics. As regarded the teaching of history, a little investigation had shown that many teachers in training colleges and in public and secondary schools were fully alive to the necessity for teaching the subject from the point of view of world history, and that experiments in the improvement of international understanding by way of camps, tours abroad, junior branches of the L.N.U., and exchanges of visits and of letters were by no means unknown. In the primary schools, too, the teaching of history had changed remarkably in recent years. Any widening of outlook must be based on accurate knowledge oriented by an emotional appeal.

Undoubtedly, high though its general level had been, the culminating point of the Conference was reached in Saturday morning's round table discussion, and the varied views and high qualities of statesmanship shown therein made a deep impression on the delegates. The prevailing impression left on the minds of many hearers was that, although some approaches to world unity may, on paper, seem preferable to others, yet, granted good will, almost any scheme would work; that the gravest task which faces the statesmen burdened with the responsibility of realizing any future proposals for peace is that of ensuring that the proposals shall be carried out in a spirit of mutual helpfulness; that hatred shall be reserved for the sin, rather than for the sinner; and, to that end, that the peace proposals shall be worked out in detail after an armistice period which might extend over a period of some years. The Polish speaker, in the course of a moving speech, suggested that in addition to the closer union of Britain and France which might be regarded as initiating a new world order, a similar union might be contemplated between Poland and Czechoslovakia.

Mr. Arnold Forster, who summed up the discussion, was not in favour of a long armistice, and suggested that four stages should be contemplated in the making of peace—a period of conversation, an armistice, a period for the drafting of the peace treaty, and, finally, a world conference at which the terms of a general settlement should be discussed.

Saturday evening's meeting, to which Miss Dymond presented a report on "The Effects of the War on the Minds of Children", evoked very general interest. The number of pupils who were the subject of experiment was 317, and all were in the 12-year age-group. Pupils were asked to write (without preparation) a half-hour essay on 'Why we are at war with Germany'. There was a majority (62 per cent of the boys and 60 per cent of the girls) who stated clearly that the war was due to German aggression.

Asked, "Who is your favourite hero?", the members of the group showed surprisingly little interest in the outstanding figures of the day. Mr. Chamberlain scored four votes, Mr. Churchill three. Most of the boys voted for Nelson and Drake.

There were few reactions to war-professions in the answers to the question, "What would you like to be when you grow up?—none at all among the girls, unless a desire to take up nursing be correlated with the War.

Perhaps the most interesting and illuminating answers were those given to the question, "What was the most important day of your life?" Some

11 per cent of the boys and 12 per cent of the girls who had been evacuated mentioned the day of evacuation or that of the outbreak of war. On the other hand, a very large number voted for the day on which they sat for the junior scholarship examination.

Asked to continue a story which began, "There was a loud bang, Pat's heart beat fast," the boys tended towards adventure stories not necessarily connected with the War, girls to air-raid stories.

To the question, "In what period of history would you have preferred to live ?", the majority answered "The present time", and the surprising reason given was, "Because it's more comfortable." A significant number of girls chose a period in which they could wear a picturesque dress.

A free-association test, in which the significant words were "bang, ship, enemy aeroplane, shell", showed a strong war connexion with 'enemy' and 'bang', and it is interesting to note that 'shell' often evoked associations with the sea-shore.

Generally, the investigation showed that the War has had a considerable but not an overwhelming effect on the minds of children.

The impression which the conference as a whole has left on the mind of the writer of this review of its work is that the future of any successful approach to world unity lies in the hands of the teachers, and primarily in the hands of those responsible for the training of our youth below the age of fourteen ; that we must rid ourselves of the delusion that there is a ladder of education with the primary school on the lowest rung, and the university on the topmost, and must realize that by far the most important years of education are those passed in our primary and senior schools, and that what happens in later stages is a divergence, rather than a climb ; that there is an urgent need for the raising of the status and for the broadening of the training of those destined to become teachers in elementary schools ; that the education of such teachers should not be regarded as ending with their period of training, but that every encouragement should be given to their making contacts with the world of thought which lies outside their school ; that it is a desirable thing to teach school subjects from a point of view wider than that of mere nationalism, but that such knowledge must be exact, and must, moreover, be informed by spiritual forces supplied, indirectly, in the home as well as in the school ; forces, too, which the teacher must experience in his own home and college ere he can make their influence felt by those whom he is later called upon to teach ; that the council is fully alive to these considerations ; and that the council will be on the high road to success if its subsequent deliberations are informed with as much knowledge backed with as high an enthusiasm as was shown at its inaugural meeting.

ESKIMO OF LABRADOR*

IN the course of the Rawson-MacMillan Subarctic Expedition of the Field Museum (1927–28), Dr. W. Duncan Strong secured a large series of measurements and observations of living Labrador Eskimo and a small group of Montagnais-Naskapi Indians. When obvious mixed bloods and sub-adults are eliminated, the numbers were 137 Eskimo (58 males, 79 females) and 18 Indians (11 males, 7 females). Labrador Eskimo skeletons were also obtained, including thirty-two measurable skulls (17 males, 15 females), many with associated skeletal parts. Measurements made by Shapiro, Boas, Pittard, Duckworth and others have been added in this study. An unusual series is thus made available, comprising (1) an old stone grave series, pre-white, and earlier than 1770 ; (2) a mid-nineteenth century grave series (early Mission period) ; and (3) recent living (1880–1928).

The material is drawn from the Eskimo of the north-east coast of Labrador, a remnant of a population once extending to the Gulf of the St. Lawrence. While the influence of the Moravian Mission has been directed to the preservation of Eskimo culture and habits, adoption of Caucasian types of food appears to have introduced modifications of physique, especially in reduction of stature and in general bodily habit of fat.

In the investigation of the Eskimo of Labrador, the evidence of physical character must be invoked to aid in the elucidation of the archæological question. Briefly and in very general terms, the archæological problem is to determine the relation in the cultural sequence of pre-Thule, the Dorset and Thule cultures, and recent Eskimo. The evidence of physical anthropology is subject to very definite limitations, not least owing to the absence of skeletal material to be assigned to the Dorset culture.

It would appear that the culture of the Labrador Eskimo was most closely related to that distributed over the central Arctic, but retained more of the Thule culture than has survived in the central regions proper (T. Mathiassen). The Thule culture in the eastern Arctic is present only on pre-contact sites, except for a group on Southampton Island. Although Thule is considered to be the original Eskimo culture of the eastern Arctic, evidence has been presented suggesting that Thule may have been preceded by the Dorset people, though possibly in some places contemporaneous (D. Jenness).

In north-eastern Labrador evidence has been found of an earlier stone culture with Eskimo-like stone *ulus*, ground slate points and chipped scrapers. It contains almost nothing of the bone, antler, ivory and steatite artefacts characteristic of Thule, Dorset, and Labrador Eskimo (W. D. Strong) ; and this leads to the suggestion that the Eskimo cannot have been in Labrador for more than four hundred years.

By fitting ethnological detail into this succession of eastern Arctic cultures extending back into the prehistoric, several theories of Eskimo origin and migrations have been formulated, in which the crucial difference is the position to be assigned to

* Anthropometric Observations on the Eskimos and Indians of Labrador. By T. Dale Stewart. Material and Data collected by William Duncan Strong. (Anthropological Series, Vol. 31, No. 1) (Publication 462). Pp. 164+16 plates. (Chicago : Field Museum of Natural History, 1939.) 1·75 dollars.

the Caribou Eskimo of the interior, west of Hudson Bay. These people, in the view of K. Birkett-Smith, are a relatively unchanged remnant of the population from which all other Eskimo arose, while Matthiassen regards Thule as the original Eskimo culture and the first to spread eastward over the Arctic coast of America. D. Jenness, on the other hand, has recently put forward the suggestion of a triple division of the present-day Eskimo of Canada in which the natives of the Mackenzie River delta descend from old Thule people who migrated from Alaska to the eastern Arctic a thousand or more years ago, dropping colonies on the way; a second division on the Barren Grounds behind the Hudson, the inland Eskimo, survivors of the primitive Caribou; and descendants of the Eskimo who, about A.D. 1200, flowed out of the inland 'reservoir' and occupied the whole coast-line from Coronation Gulf to Labrador, overwhelming the earlier coast dwellers.

On the grounds of cultural succession, it seems best to assume two reservoirs of population at the beginning of the Christian era, one in Alaska and one in the central Arctic, which must once have been united, presumably before the development of the earliest known culture in the west, the old Bering Sea culture.

Hence it follows that for interpretation of the Labrador physical type comparison with (*a*) the "Old Igloo" (Birnirk) type from Point Barrow, the oldest known, which has been identified by Hrdlička; (*b*) the Thule; and (*c*) the Dorset physical types is an essential. Unfortunately, as already mentioned, the Dorset type is unknown, while the Thule type was identified only recently (Fischer-Möller, 1937).

The indications of comparative study of the measurements as a whole are that the Labrador skull is small. Metrically, Greenland bears the closest resemblance to Labrador. The main physical changes indicated in a comparison of the old stone grave material and that of the recent grave series is that, as compared with the pagans, the Christians have smaller and shorter heads with longer and narrower faces, relatively higher orbits and relatively narrower alveolar arches. It is uncertain whether the nose has changed. Stature reconstructed from the measurement of the long bones is as follows: old stone graves, 161·4 (male), 150·3 (female); recent graves, 161·2 (male), 149·8 (female). This suggests that Eskimo stature has decreased in Labrador since the eighteenth century, a conclusion borne out by the findings on the living. Two stature groups can be distinguished: (1) a low-statured group averaging in the males about 160–162 cm., found chiefly in the east (Labrador, southern Greenland), and (2) a high-statured group, 164–166 cm., in the males, found chiefly in the west, but also among the Thule people in the east.

To sum up, it may be said that these data on the prehistoric Labrador Eskimo establish more firmly the fact that the physical type represented is much the same as that predominant in Greenland; it differs materially from that of the western longheads (Old Ingloo). Also it contrasts with that of the Thule. Assuming that Labrador was populated originally by Thule people, the type did not survive. Whether the Labrador and Greenland type was derived from a mixture of the Thule and Dorset peoples, or a representative of the latter alone, cannot be decided until the Dorset type is identified.

SEVENTY YEARS AGO

NATURE, vol. 1, April 28, 1870

Early Torpedoes

THE first of a series of articles on "The Science of Explosives as applied to Warlike Purposes" appears, and deals particularly with history of the use of explosives as floating or submarine mines and torpedoes.

The earliest form of marine mine appears to have been the 'explosion ship' used by the Dutch to destroy a boom or boat-bridge constructed across the Scheldt in 1585. Several flat-bottomed vessels loaded with gunpowder were sent against the boom, exploding when they reached it. A development of this was the 'floating petard' used by the English during operations in Rochelle in 1628; this consisted of a sheet-iron case filled with powder which was exploded by a match-lock mechanism set off by contact with an obstacle.

An American, Robert Fulton, seems to have been the first to use the term 'torpedo'. His device consisted of a metal vessel holding about 100 lb. of gunpowder and fitted with clockwork to release a flint-lock at a determined time. The machine was partly encased in cork so that it was a little heavier than water, and was attached by a line to a box float. The torpedoes were carried in harpoon boats, and connected by long lines with harpoons fired from small guns at the ship to be attacked. If the harpoon was successfully planted, the torpedo was drawn into the water by the line, the clockwork firing mechanism released, and the torpedo exploded by the time it had drifted near the vessel attacked. Demonstrations with these torpedoes were carried out before English naval authorities in 1805. A diagram of a torpedo and its harpoon is printed.

Extensive use was made of mines, or torpedoes as they were called, in the American Civil War, both mechanical and electrical means of ignition being used.

Legislation and Nature

"THE effect of Legislation upon Nature is one of those far-reaching subjects which men are only just beginning to investigate in a practical spirit. . . . Neither directly nor indirectly, in fact, can we touch Nature by our laws, without beginning a new chain of causes, the end of which we cannot foresee."

Mr. E. Goadby is discussing an item in the Budget introduced by Mr. Lowe. "The freedom of firearms from taxation affects their number in any district, the number of guns determines the number of small birds, and the number of our small birds affects the immunity of our fields from grasshoppers, cricket-moles, beetles, locusts, slugs, etc. Mr. Lowe was concerned for the security of life, for the prevention of early quasi-poaching habits, but his 1 *l.* tax may effect a revolution all the same."

Another topic also discussed by Mr. Goadby is the rating of woods and plantations. He refers to the incidence of insects in relation to trees, and concludes: "Disafforesting threatens to become as common in the nineteenth as enclosuring was in the sixteenth century. Are we wise to hasten it?"

THIS issue of NATURE completes the first volume of twenty-six weekly issues, price 4*d.* each. The volume includes 558 pages of text and 110 pages of advertisements.

FORTHCOMING EVENTS

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

Monday, April 29

PHYSICAL SOCIETY, jointly with the CAMBRIDGE PHILOSOPHICAL SOCIETY (in the Cavendish Laboratory, Cambridge), at 3 p.m.—Discussion on "The Liquid State" (to be opened by Prof. J. E. Lennard-Jones, F.R.S.; other speakers: Prof. E. N. da C. Andrade, F.R.S., Prof. Allan Ferguson, J. Corner, Prof. J. D. Bernal, F.R.S., Prof. W. L. Bragg, F.R.S., Prof. R. H. Fowler, F.R.S., Prof. N. F. Mott, F.R.S.

Tuesday, April 30

ROYAL INSTITUTION, at 5.15 p.m.—Major-General Sir Robert McCarrison: "The Medical Aspects of the Use of Food".*

INSTITUTE OF PHYSICS (in the Lecture Hall, Kodak, Ltd., Harrow), at 7.30 p.m.—Prof. N. F. Mott, F.R.S.: "Oxidation of Metals and the Theory of Protective Films".

Thursday, May 2

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 p.m.—Prof. R. J. S. McDowall: "The Circulation in Relation to Shock".

Friday, May 3

PHYSICAL SOCIETY (in the Physics Department of the Imperial College of Science), at 5.15 p.m.—Discussion on "The Teaching of the Fundamentals of Electric and Magnetic Theory" (opening paper by Dr. G. B. Brown).

ROYAL INSTITUTION, at 9 p.m.—Prof. W. L. Bragg, F.R.S.: "The Symmetry of Patterns".

APPOINTMENTS VACANT

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

TEMPORARY ASSISTANT LECTURER IN AGRICULTURE at the Essex Institute of Agriculture, Writtle—The Clerk to the Essex County Council, County Hall, Chelmsford (April 30).

TEMPORARY FULL-TIME LECTURER IN PHYSICS—The Principal, West Ham Municipal College, Romford Road, Stratford, E.15 (May 6).

DIRECTOR OF RESEARCH to the Institution of Automobile Engineers—The Chairman, Automobile Research Committee, 12 Hobart Place, S.W.1 (May 6).

SENIOR LECTURER IN CIVIL ENGINEERING at the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (May 15).

SCIENTIFIC ASSISTANT IN THE WATER EXAMINATION DEPARTMENT—The Clerk to the Metropolitan Water Board, New River Head, 173 Rosebery Avenue, E.C.1 (quoting 'Scientific Assistant') (May 24).

TEMPORARY ASSISTANT CIVIL ENGINEER—The Borough Engineer, Town Hall, Eastbourne.

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9114).

ENGINEER TRANSPORT OFFICER by the Government of the Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9320).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Air Force for the Peace Front. A Plan prepared by the Military Research Committee of the New Commonwealth Institute. (Published for the New Commonwealth.) Pp. 39. (London: The Peace Book Co.) 6*d*. net. [24

Report of the Rugby School Natural History Society for the Year 1939. (Seventy-third Issue.) Pp. 67. (Rugby: George Over, Ltd.) [44

Other Countries

U.S. Department of the Interior: Geological Survey. Professional Paper 189-G: Foraminifera, Diatoms and Mollusks from Test Wells near Elizabeth City, North Carolina. By L. G. Henbest, K. E. Lehman and W. C. Mansfield. (Shorter Contributions to General Geology, 1937.) Pp. ii+217-228. 10 cents. Professional Paper 189-I: Fossil Plants from the Colgate Member of the Fox Hills Sandstone and adjacent Strata. By Roland W. Brown. (Shorter Contributions to General Geology, 1937.) Pp. ii+239-276+plates 47-63. 15 cents. Professional Paper 192: Areal Geology of Alaska. By Philip S. Smith. Pp. iv+100+18 plates. 1.25 dollars. (Washington, D.C.: Government Printing Office.) [293

U.S. Department of the Interior: Geological Survey. Bulletin 906-A: Gravel and Sand Deposits of Eastern Maryland adjacent to Washington and Baltimore. By N. H. Darton. (Contributions to Economic Geology, 1938-39.) Pp. v+42+10 plates. 1.25 dollars. Bulletin 906-B: Geology and Coal Resources of the Minot Region, North Dakota. By David A. Andrews. (Contributions to Economic Geology, 1938-39.) Pp. iv+43+84+plates 11-15. 50 cents. Bulletin 909-D: Geophysical Abstracts 95, October-December 1938. Compiled by W. Ayvazoglou. Pp. ii+151-222. 15 cents. Bulletin 916-A: Transit Transverse in Missouri. Part 1: Southeastern Missouri, 1903-37. Pp. x+124+xi-xiv. 20 cents. Bulletin 917-A: Mineral Industry of Alaska in 1938. By Philip S. Smith. (Mineral Resources of Alaska, 1938.) Pp. ii+113+1 plate. 35 cents. (Washington, D.C.: Government Printing Office.) [293

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 836-C: Artesian-Water Levels and Interference between Artesian Wells in the vicinity of Lehi, Utah. By G. H. Taylor and H. E. Thomas. (Contributions to the Hydrology of the United States, 1938.) Pp. iii+107-156+plates 12-14. 15 cents. Water-Supply Paper 836-D: Ground Water in the United States; a Summary of Ground-Water Conditions and Resources, Utilization of Water from Wells and Springs, Methods of Scientific Investigation, and Literature relating to the Subject. By Oscar Edward Meinzer. (Contributions to the Hydrology of the United States, 1938-39.) Pp. v+157-232+plate 15. 15 cents. (Washington, D.C.: Government Printing Office.) [293

Smithsonian Miscellaneous Collections. Vol. 91, No. 30: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Cornucopina (Bryozoa) from the West Indies. By Raymond C. Osburn. (Publication 3584.) Pp. ii+4+2 plates. Vol. 91, No. 31: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Genus and Species of Eel from the Puerto Rican Deep. By Earl D. Reid. (Publication 3585.) Pp. ii+6. Vol. 99, No. 3: Ritual Ablation of Front Teeth in Siberia and America. By Aleš Hrdlička. (Publication 3583.) Pp. ii+32+5 plates. (Washington, D.C.: Smithsonian Institution.) [14

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 2: Parent-Education Programs in City School Systems. (Being Chapter IX of Vol. 1 of the Biennial Survey of Education in the United States, 1934-36.) Pp. v+35. 10 cents. Bulletin, 1939, No. 7: Individual Guidance in a CCC Camp; its Effect upon Participation and Quality of Work in a Voluntary Educational Program. Pp. vii+43. 10 cents. (Washington, D.C.: Government Printing Office.) [14

Field Museum of Natural History. Anthropological Series, Vol. 25, No. 3: Craniometry of New Guinea. By Wilfrid D. Hambly. (Publication 465.) Pp. 81-290+plates 31-74. (Chicago: Field Museum of Natural History.) 2.50 dollars. [14

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 857: Surface Water Supply of the United States, 1938. Part 7: Lower Mississippi River Basin. Pp. v+197+1 plate. 25 cents. Water-Supply Paper 860: Surface Water Supply of the United States, 1938. Part 10: The Great Basin. Pp. iv+103+1 plate. 20 cents. Water-Supply Paper 863: Surface Water Supply of the United States, 1938. Part 12: Snake River Basin. Pp. vi+238+1 plate. 30 cents. (Washington, D.C.: Government Printing Office.) [24

Palaeontologia Sinica. New Series D, No. 6 (Whole Series No. 117): Bone and Antler Industry of the Choukoutien *Sinanthropus* Site. By Prof. Henri Breuil. English translation by Miss M. E. Boyle. Pp. viii+40+26 plates. New Series D, No. 9 (Whole Series No. 120): The Upper Cave Industry of Choukoutien. By Pei Wen Chung. Pp. 41+8 plates. (Peiping: Geological Survey of China.) [34

Connecticut Agricultural Experiment Station. Bulletin 417: Commercial Fertilizers Report for 1938. By E. M. Bailey. Pp. 56+viii. Bulletin 418: The European Red Mite and its Control. By Philip Garman and J. F. Townsend. Pp. 34. Bulletin 419: Hibernation of the Corn Ear Worm in Southern Connecticut. By G. W. Barber. Pp. 28. Bulletin 420: The Native Elm Bark Beetle *Hylurgopinus rufipes* (Eichhoff) in Connecticut. By B. J. Kaston. Pp. 40. Bulletin 421: Annual Report for the Year ending October 31, 1938. Pp. 68. Bulletin 422: Tobacco Sub-station at Windsor—Report for 1938. By P. J. Anderson, T. R. Swanback and O. E. Street. Pp. 50. Bulletin 423: The Soil Characteristics of Connecticut Land Types. By M. F. Morgan. Pp. 64+35 maps. Bulletin 424: Chemical Investigations of the Rhubarb Plant. By Hubert Bradford Vickery, George W. Pucher, Alfred J. Wakeman and Charles S. Leavenworth. Pp. 158. Bulletin 425: Commercial Feeding Stuffs—Report on Inspection, 1938. By E. M. Bailey. Pp. 100. Bulletin 426: The Forty-third Report on Food Products, and the Thirty-first Report on Drug Products, 1938. By E. M. Bailey. Pp. 56. Bulletin 427: Volume Tables, Plantation Grown White Pine, *Pinus strobus* L., in Connecticut. By Henry W. Hicock, Arnold D. Rhodes and A. Richard Olson. Pp. 14. Bulletin 428: Connecticut State Entomologist—Thirty-eighth Report, 1938. By Dr. W. E. Britton. Pp. 122. Bulletin 429: Seasonal Water and Nitrate Leachings in relation to Soil and Source of Fertilizer Nitrogen (A Second Report on Windsor Lysimeter Series 'A'). By M. F. Morgan and O. E. Street. Pp. 44. (New Haven, Conn.: Connecticut Agricultural Experiment Station.) [34

OFFICIAL ANNOUNCEMENTS

UNIVERSITY OF LIVERPOOL

FACULTY OF ENGINEERING

Dean: Professor R. G. Batson, M.Eng., A.K.C., M.Inst.C.E., M.I.Mech.E.

Prospectus and full particulars may be obtained, on application to the Registrar, of Courses designed for Students desiring to qualify as Mechanical, Electrical, Civil or Marine Engineers, as Naval Architects or as Metallurgists and Metallurgical Engineers.

METROPOLITAN WATER BOARD

APPOINTMENT OF A SCIENTIFIC ASSISTANT

The Metropolitan Water Board invite applications from suitably qualified men, between 28 and 35 years of age, for the appointment of a scientific assistant in the Water Examination department.

The appointment will in the first instance be made on probation at a salary of £400 per annum, but on the completion of twelve months' approved service the person selected will be eligible for appointment to the permanent staff as a senior assistant, Grade B (salary £500 to £750 per annum), and subsequently to the higher scientific grades and positions.

Candidates must be in possession of a degree in chemistry or chemical engineering obtained at a recognised University, and special consideration will be given to candidates with some knowledge of bacteriology and the chemical treatment of water supplies.

The duties attaching to the position will consist primarily of the supervision and control of the chlorination of water, and in the performance of laboratory and field investigations in connection with chlorination and other purification processes. The officer appointed will be required to devote the whole of his time to the service of the Board, and to perform, in addition to the duties mentioned, such other duties in the Water Examination department as may be allotted to him by the Director of Water Examination.

The selected candidate will be required to pass a medical examination by the Board's Chief Medical Officer, and to undertake in writing to join the Board's Superannuation and Provident Fund.

The person appointed will be subject to the Board's Standing Orders, regulations and rules in force from time to time.

Applications, which must be made on the prescribed form, a copy of which may be obtained from the Clerk of the Board on receipt of a stamped addressed foolscap envelope, should be addressed to the Clerk of the Board in envelopes endorsed "Scientific Assistant," so as to be received not later than Friday, May 24, 1940.

Canvassing will be held to be a disqualification.

Head Offices,
New River Head,
173 Rosebery Avenue,
London, E.C.1.
April 22, 1940.

R. P. MORGAN,
Clerk of the Board.

THE INSTITUTION OF AUTOMOBILE ENGINEERS

RESEARCH DEPT., GREAT WEST ROAD, BRENTFORD, MIDDX.

The Automobile Research Committee invites applications for the position of Director of Research which will shortly be vacant. Candidates must have gained an Engineering Honours Degree in a British University and find proof of a satisfactorily wide experience of research work upon materials and mechanical details such as are embodied in automobile or similar practice.

The Director's duties include the control and supervision of technical, abstracting and administrative staff at present numbering about 30 persons; he will also be responsible for directing and keeping contact with extramural research as and when necessary.

The salary offered is £1,000 per annum (plus additional superannuation contribution of 10 per cent of salary) or more according to experience and qualifications.

Applications, stating age, present position, with full statement as to education and career, and copies of two recent testimonials, are to be addressed to:

The Chairman,
Automobile Research Committee,
12 Hobart Place, London, S.W.1,

on or before Monday, May 6, 1940.

GLOUCESTERSHIRE EDUCATION COMMITTEE

TEMPORARY ADVISER IN HORTICULTURE

Applications are invited for the post of Temporary Adviser in Horticulture (male or female) at a salary of £250 to £300 per annum according to experience and qualifications.

Applicants must possess recognized technical qualifications, preferably a University Degree in Horticulture or the National Diploma in Horticulture, and should have had a sound practical training.

On receipt of a stamped, addressed envelope further particulars and form of application are obtainable from the Agricultural Organizer, Berkeley House, Berkeley Street, Gloucester, by whom applications must be received not later than April 30, 1940.

RICHARD L. MOON,
Clerk of the County Council.

THE UNIVERSITY OF SHEFFIELD

Applications are invited from **Physicists or Physical Chemists** to investigate factors affecting the **formation and stability of dust clouds** with special reference to dust in Coal Mines.

The appointment will be made as the result of a bequest from the late Mrs. Habershon.

Subject to satisfactory service, its duration will be three years at a salary of £300 per annum and the work will be done in the Department of Mining of the University. Experience in similar work will be an advantage.

For full particulars apply, The Registrar, The University, Sheffield.

ISLE OF WIGHT COUNTY EDUCATION COMMITTEE

RYDE CENTRAL COUNCIL SCHOOL

The Committee invite APPLICATIONS from Trained Certificated ASSISTANT MASTERS with good qualifications in Science for service in this Selective Central School.

Forms of application and further particulars may be obtained (stamped addressed foolscap envelope required) upon application to the undersigned.

H. JERVIS, Director of Education.
County Hall, Newport, I.W.

MURDOCH TRUST

For the BENEFIT of INDIGENT BACHELORS and WIDOWERS of good character, over 55 years of age, who have done "something" in the way of promoting or helping some branch of Science.

Donations or Pensions may be granted to persons who comply with these conditions.

For particulars apply to MESSRS. SHEPHERD & WEDDERBURN, W.S., 16 Charlotte Square, Edinburgh, 2.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

The Laboratory, Plymouth

The following animals can always be supplied, either living or preserved, by the best methods:

Sycon; Clava; Obelia; Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Pleurobrachia (preserved); Leptoplana; Lineus, Amphiporus, Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus, Salpa (preserved), Scyllium, Raia, etc.

For prices and more detailed lists apply to:
Biological Laboratory, Plymouth. THE DIRECTOR.

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