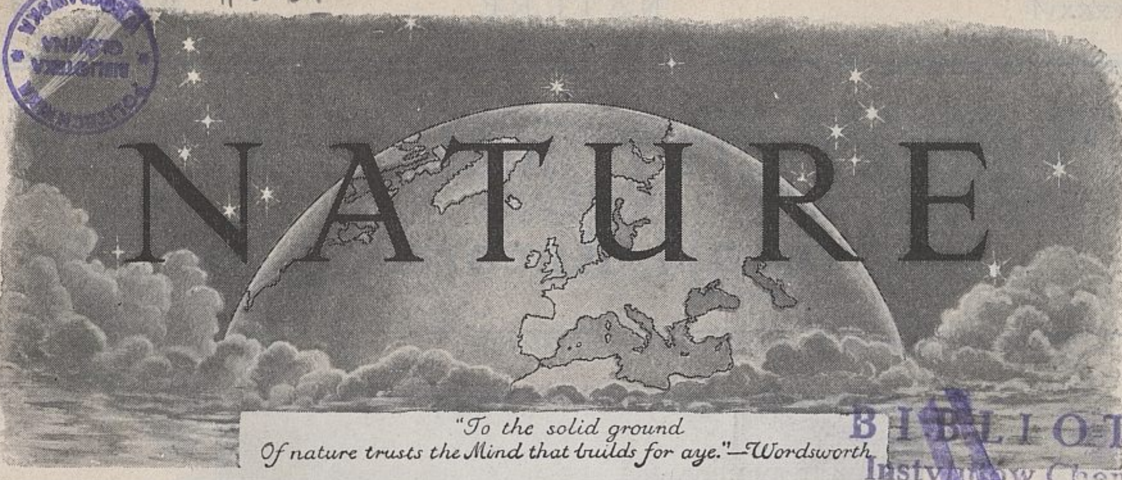

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EDUCATION FOR CITIZENSHIP

AN AMERICAN MANIFESTO

THE appearance of an American book entitled "Education for Citizen Responsibilities"* provides the British reader with an opportunity of comparing notes on a subject which has by no means been neglected in his own country. For some years we have had an active Association for Education in Citizenship, having as its professed aims the advancement of training in the moral qualities necessary for citizens of a democracy, the encouragement of clear thinking in everyday affairs, and the acquisition of a knowledge of the modern world. The Council of the Association includes many of the most distinguished persons in British public life, and the Association has to its credit a list of publications which comprises substantial volumes on education for citizenship in primary and in secondary schools, besides a number of useful pamphlets. Not only so, but we have also a body which, established by the League of Nations Union, looks farther afield, the Council for Education in World Citizenship, a Council which, it may safely be said, is representative of all educational interests. The exalted aim of this Council is "to promote throughout the educational system such studies and teaching as may best contribute to mutual understanding, peace, co-operation and goodwill between all peoples and so lead to the building of a world commonwealth". The Council appeals, in fact, to all men and women of goodwill to act as citizens of the world, so far as in them lies.

Now it must be confessed that the English tradition in education does not take readily to such an idea as training for citizenship. Just before war broke out, the High Master of Manchester Grammar School, in the course of an article written for the Educational Yearbook of Teachers College, Columbia University, aptly summed up the attitude of the English schoolmaster. He wants to teach the truth as it may be taught to imperfect minds ; he is conscious of the welter of opinions rampant in the world ; and he is very afraid of being unfair to other people's opinions. He knows that two and two make four, and that the subject of a Latin verb is in the nominative case, whether one lives in a democratic or a totalitarian State. To lose this relative detachment would be fatal. His ambition is to train his pupils to think, to reject ready-made opinions, to know the constitution under which they live, and to know how it was brought into being. This seems to him the liberal tradition, "neither pickling an old world nor hastily swallowing a new". Even at that date, however, the writer felt bound to ask—when systems other than the democratic are confidently and sometimes aggressively proclaiming their virtues—can we with justice to our democratic ideals remain silent ?

* Education for Citizen Responsibilities : the Roles of Anthropology, Economics, Geography, History, Philosophy, Political Science, Psychology, Sociology. By John M. Clark, Lloyd Allen Cook and Stuart A. Queen, Frank D. Graham, Richard Hartshorne, William Ernest Hocking, Roy F. Nichols and Arthur C. Bining, Frederic A. Ogg, Ernest Minor Patterson, Calvin P. Stone, Griffith Taylor, Wilson D. Wallis. Edited by Franklin L. Burdette. (Published for the National Foundation for Education in American Citizenship.) Pp. xiii+126. (Princeton, N.J.: Princeton University Press ; London : Oxford University Press, 1942.) 10s. net.

The last five years have provided a decisive answer to that question. The English schoolmaster of 1943 has no need to abandon his strictly judicial attitude in order to show up the totalitarian State for what it really is.

As we are reminded by more than one of the contributors to "Education for Citizen Responsibilities", the American tradition in education started from "the aristocratic and cultural plan of education" which was introduced from Europe during colonial times. Early American education, as recalled by these writers, reminds one of the Cambridge mathematician who deemed it the crowning glory of his newly discovered theorem that it could never be of the slightest use to anyone. Needless to say, they do not regret the passing from school curricula of so-called 'cultural' subjects which, in the words of one of them, "had few claims to admission other than that in the modern world they were all but useless, and must therefore be 'cultural' if anything". The reaction against the old cultural type of education was "a healthy expression of the democratic spirit, but like most reactions it fell into the trap of over-compensation". The American educational system has, in consequence, "concentrated on teaching adolescents how to make a living rather than how to live". In short, the United States, like ourselves, has yet to learn that education may be broadly vocational without ceasing to be liberal.

This is at bottom the theme of this remarkable collection of essays published for the National Foundation for Education in American Citizenship. The essays are the outcome of a conference arranged jointly by the National Foundation and the National Council for Social Studies. The contributors are a chosen band, all representing their subjects as professors in American universities. They see that Nazism to-day is "successful, dynamic, arrogant, bigoted, efficient and powerful", and that its completion can come only with the fall of free America. They ask what can American education do to meet the regimentation of totalitarian youth, and they proceed to discuss the respective "roles of anthropology, economics, geography, history, philosophy, political science, psychology, and sociology" in the enlightenment of American youth as to the high destiny of their country.

In offering comments upon these chapters we prefer to begin with philosophy, odd though the choice may at first sight seem. We certainly should not do so if the writer, Prof. Hocking of Harvard, belonged to the diminishing number who regard philosophy as "a luxury subject which is not any part of the daily bread of education". His view is the precise opposite. For him, philosophy is the daily bread of mature education, there being no subject which is so much every man's business. It is "the sum of a man's beliefs—the sum of his working beliefs, the beliefs that he is using. And as no man can live without beliefs, no man can live without a philosophy." The elementary school is the place for indoctrination, but the time comes when every boy and girl becomes a critic of the things he has received in home and church and school. This is the point at which philosophy comes in, for it is the examination of beliefs. It is guidance in the business of re-thinking. Here the sad reflection is inescapable that we in Great Britain have until now left the vast majority of our boys and girls with little or no guidance. The United States appears to be in like case. The chief of her educational failures, says Prof. Hocking, is the neglect of this moment of hunger for the means of self-judgment and for the re-examination of belief. The freer men's lives are to be, the more necessary it is that they be furnished with the technique of mature freedom, which is philosophy. Whether or not a person is led on to a study of the philosophical classics, he cannot escape from philosophy, for "every editorial, every play, every sermon, every novel—almost we might say every conversation—conveys in some way a bit of philosophy". On this view, the late G. K. Chesterton's witty remark, that a washerwoman's philosophy is the most important thing about her, is no exaggeration. Philosophy, says Prof. Hocking, "is not begotten solely by those who call themselves philosophers". He is right in implying that all his fellow contributors make philosophical assumptions because, besides being men of science, they are men. The tendency of our leading men of science, we do not say to stray into the paths of philosophy, but to feel driven to a philosophy which may be very different from that of the Victorian professors of the subject, is obvious, and conveys a lesson of wide applicability.

Scarcely less interesting than Prof. Hocking's chapter on philosophy is Prof. W. D. Wallis's on anthropology. At first sight the connexion may seem rather remote between the story of man's distant past and the education of the young American to-day, especially for a writer who holds that "a prime objective in education is fitting our citizens to be intelligent participants in a present-day world", or, perhaps more adequately, to fit them for "the world of to-morrow". The writer is cautious about that world of to-morrow, for "the impossibility of predicting in September 1939 the divagations which this war would take" strongly suggests caution. Assuming, however, that the democracies will shape the policies of peace, the United States will have "intimate contacts with peoples of varied cultures, dwellers in Oceania, Asia, and it may be Africa. . . . We shall rub shoulders and touch elbows with Europeans, Asiatics, Africans, and our South American neighbours. . . . To know them as bringers and bearers of culture will add a healthy corrective to the condescension with which a people of one culture are all too prone to view those of a different culture." The value of the broad results of anthropological research in a general education could scarcely be put more cogently.

The role of geography in education for citizenship is dealt with by two writers, one of them a Canadian. Prof. Hartshorne, of Wisconsin, brings out the broad fact that modern exploration and invention have combined to tie the world into a single unit in human geography, and that we are all citizens of a world unit, even though that citizenship has no formal political organization. He adds that "whatever view one may take of American foreign policy, no intelligent citizen can be indifferent to the problems of political geography called to mind by such place names as 'Manchukuo', 'Burma Road', 'Donetz coal basin', 'Dakar', or 'Iceland'". In the second chapter on geography, Prof. Taylor, of Toronto, gives evidence of the good fight that is being fought in order to raise the status of geography in Canadian education generally. The older geography was content to answer the question—where ? The newer geography proceeds to ask—why there ? "It is this insistence on causes which," says Prof. Taylor, "lifts our discipline from the plane of a schoolboy's task to that of one of the most interesting and valuable of the sciences." One gathers that in the United States the teacher of geography is counselled to make freer use than ever of the globe and the map of the world, and that in Canada efforts will be made to raise geography to the level of a science.

The writers of the chapter on history have no difficulty in showing how essential is that subject in an education for the responsibilities of citizenship. Education in contemporary problems without adequate historical introduction is, they truly say, like teaching only two dimensions to those living in a three-dimensional world. Only a knowledge of past errors will prevent their repetition. At the elementary stage they would have interest concentrated on the heroes of American history, their contributions to those qualities which have made the United States a great nation. At the high-school level, attention should be turned to European conditions, and then turned back again to American history in the light of the international position. At the university level, history should be less nationalistic and should become a branch of social science. Recent attempts to vitalize the teaching of history by means of discussions, problems, projects, supervised study and laboratory instruction are commended.

We turn now to the three excellent chapters on the role of economics, written by professors at Princeton, Pennsylvania and Columbia Universities. They are all unhappy about their subject as at present taught. Even graduates, says one of them, who have "taken" economics are as a rule illiterate in the subject, so that at present there is no supply of school teachers capable of treating it intelligently. They have no philosophy, that is, no clear conception of ends, as distinguished from those means which are the concern of science. There is a fatal confusion between (1) training for mere business efficiency, which may easily become anti-social, even to the point of tolerating despotism and slavery, and (2) the development and expression of all forms of socially legitimate power, and, as a corollary, of freedom and the truth that makes us free. There is too much of the former and too little of the latter. There is a tendency to dismiss as "impractical idealism" the obligations of good citizenship in economic dealings, and to insist that as realists all we can expect is the spirit of getting as much as possible and giving as little as possible. That way, says the Columbia professor, lies the death of liberty. To all teachers in colleges and in schools the general message of these three economists is that "there is no greater present danger than the 'realistic' view that freedom means irresponsible self-seeking and nothing else".

The writer of the chapter on political science makes the point that the legal obligations of citizenship are at last made crystal clear by the War, and that the hour of trial and sacrifice will bring to this generation a better comprehension of the relations between citizen and government than has ever prevailed before in the United States. One of the essentials in educational effort, indeed the chief of them, is that the future citizen "be made to see unmistakably that if on one side of the shield are written *rights*, on the other are indelibly inscribed *duties*". The teaching of political science has made great headway in American universities during the last twenty years. The results in secondary schools remain to be seen. One of the results hoped for is the improvement of what are here described as barren courses in "civics".

The writers of the chapter on sociology agree with others that school curricula in the past have been too little concerned with the needs of real life, and have in fact been undemocratic in their operation. They recognize, however, that teachers do teach sociology after a fashion just as they speak prose, that is, without conscious awareness. That, they believe, is the most useful function of sociology in school education, although the point would be argued by most sociologists and by many educators. Similarly, the writer of the chapter on the role of psychology recognizes "the growing practice of introducing psychological materials without designating them by the traditional captions of academic psychology"; and if there were no other reason against systematic courses of psychology in the secondary schools, there would remain the convincing fact that well-qualified teachers of the subject are not to be had for years to come.

Though written with strict regard to the conditions of American education, this remarkable book should become known to English teachers and administrators, especially to those who regard education for citizenship as the highest aim.

AMERICAN WORK ON THE ULTRACENTRIFUGE

The Ultracentrifuge

By D. A. MacInnes, W. J. Archibald, J. W. Beams, W. B. Bridgman, Alexandre Rothen and J. W. Williams. (*Annals of the New York Academy of Sciences*, Vol. 43, Art. 5.) Pp. 173–252. (New York: New York Academy of Sciences, 1942.)

WHEN Svedberg and Pedersen wrote their book on "The Ultracentrifuge" (Oxford: Clarendon Press, 1940), they regretted the impossibility of including all the American work as well as their own, and they hoped that the American workers would provide a supplementary monograph to fill the gap. For this reason the publication of contributions to a conference on the subject arranged by the New York Academy of Sciences is an excellent step, though it falls short of the detailed reference book which is needed.

In addition to discussing the whole field, the conference had two special aims. These were to see whether Archibald's integration of the sedimentation equation could be put to practical use, and to discuss the adoption of 0° Centigrade as the standard temperature for the measurement of physical properties of proteins. The decisions on these points are not stated; but the two unanimous decisions which were made are both praiseworthy. One was to dedicate the monograph to Svedberg, and the other was to adopt, as a convenient practical unit for sedimentation constants, the *Svedberg*, to be denoted by the letter S and equal to 10^{-13} times the absolute units, which are in seconds. In my opinion, however, there is one flaw in the details of the latter decision. The letter S has hitherto been used by Svedberg and others to denote the sedimentation constant itself, not the unit, and a change in this convention can only cause inconvenience. For example, if the contributors were loyal to their own decision, the statement of Rothen on p. 238 that "$S = 14{\cdot}2 \times 10^{-13}$" would have to read "the sedimentation constant = 14·2 S", since no symbol for the constant was suggested to replace S. Surely it is better to keep S for the constant and to use "Sved" as a distinctive abbreviation for the unit.

The first article is by Beams, thanks largely to whom ultracentrifuges are now easier to make, to install, and to run, and occupy less space, than the Svedberg ones. These desirable properties have been obtained with little or no loss in accuracy by using a vertical axis of rotation, air- or electromagnetic thrust bearings and drive, a thin flexible shaft passing through a vacuum gland, and a duralumin rotor. The first three diminish the friction so much that the power needed for steady running is small compared with that for acceleration. The vacuum gland allows the rotor chamber to be evacuated independently of the driving system. The duralumin rotor (instead of steel) requires less power to accelerate or decelerate it, which in turn allows the use of the thin shaft and of less elaborate protection against explosions. Air-drive has the advantage over oil-drive that circulation is unnecessary. The recent electrical drive is the most convenient of all, and seems to be fairly efficient. The highly accurate speed control which accompanies it seems, as Beams remarks, "at first sight a bit complicated". There is still some truth in Svedberg's early criticisms that duralumin has a slightly lower bursting speed than steel in rotors carrying cells, that the vertical axis is less convenient optically, that the flexible shaft may introduce errors through a shift in the axis of rotation, that air-drive is inefficient compared with oil-drive (though this is unimportant if little power is required), and that the whole outfit is not much cheaper than his since much of the expense is in accessories such as compressor, vacuum pump, lenses, etc., rather than in the centrifuge itself. Nevertheless, the American view that these drawbacks are outweighed by the advantages is probably correct so far as construction and installation are concerned.

The optical systems used for observing sedimentation are described in detail by Bridgman and Williams; but it may be remarked that they omit two of the chief factors limiting the accuracy of the *schlieren* method, namely, diffraction and stray light. The form of self-plotting *schlieren* method which I published, in which the diagonal stop is a single edge, not a slit, was chosen to avoid diffraction bands. The more obvious slit form, later proposed by Svensson, is in my opinion only preferable, if ever, when the solution absorbs light of the wave-length used. In that case a self-plotting absorption method is available (*Biochem. J.*, **33**, 1707; 1939).

The most original contribution to the conference comes from Archibald, who describes the integration of the sedimentation equation under the complicated conditions intermediate between those giving the sharp moving boundary used in the velocity method and the steady exponential distribution used in the equilibrium method. The successful solution of this problem is a fine achievement, and one can only regret that the conference did not carry out the suggestion of Dr. D. A. MacInnes (chairman of the conference) of discussing how these important results can best be used. A point which puzzles a non-mathematician is why a problem of this sort cannot be solved mechanically by the differential analyser. One would expect that where it is simply a question of tabulation the machine should be superior to the human brain.

A useful exposition of various points concerning the accuracy and interpretation of results is contributed by Rothen. His discussion of density and shape-factor is particularly clear. The most controversial and interesting part is his criticism of the evidence for the so-called "Svedberg unit" of protein molecular weight (which is quite unrelated to the proposed unit of sedimentation constant). Svedberg and co-workers remarked on an apparent regularity in their list of molecular weights, in that they approximated to simple multiples (mostly powers of 2) of 17,600. Rothen considers the more general question whether they approximate to any multiples at all of 17,600, and points out that with present-day accuracy this can only be tested with molecular weights below 100,000. Although the hypothesis of the "Svedberg unit" in both the above forms has often been discussed, no one seems to have devised a statistical test of its validity, possibly because both sides think that their view is too obvious to require statistics. It is desirable that such a test should be performed, since as Rothen points out elaborate speculations on protein structure have been based on the "Svedberg unit".

The work of MacInnes on electrochemical effects of centrifugal fields lends variety to the proceedings. It is nice to have this very neat example of the inevitability of thermodynamics; and the technique provides, as he says, a new way of measuring transference numbers which in some cases may be superior to the old ways. J. ST. L. PHILPOT.

SCIENTIFIC APPROACH TO HISTORY

History and its Neighbors

By Prof. Edward Maslin Hulme. Pp. ix+197. (London, New York and Toronto: Oxford University Press, 1942.) 11*s*. 6*d*. net.

THIS is an interesting and on the whole a sound book by an emeritus professor of history of Stanford University in California. The author has read very widely and thought with an open mind about the various aspects of his subject. What he means by the 'neighbours' of history are the various subjects which contribute to or are in some way related to what he calls 'history', such as economics, law, religion, psychology and a dozen other topics which almost cover the whole field of human knowledge. That there should be so many and that he calls them 'neighbours' suggests in fact the philosophical weakness of the book—the author does not probe quite deeply enough and does not in his various suggested definitions of 'history' appreciate the vital relation between what he so describes and science or human knowledge as a whole. It is on this point that it may be useful to say a few words, without in any way disparaging Prof. Hulme's book, which would be found extremely useful by anyone studying in one of the so-called 'History Schools'.

The question which occupies a large part of Prof. Hulme's book and receives as a matter of fact a good many different answers—namely: What is history ?—is, of course, primarily a dictionary question, a matter of convention. It meant originally—as a Greek word—an inquiry. It has come to mean in the modern dictionary the written record of public events in the past. Thus 'pre-historic' happenings are those before the invention of writing, or before the use of writing for keeping records of those happenings which the men of the time thought most worthy of being kept in mind. We might, if we liked, include all happenings in the past under the title of 'history'. This would be the most philosophical view, which Prof. Hulme does not adopt. What is most important, from the educational point of view, from the point of view of the progress of humanity, is that the best and most important things in the past should be recorded, studied and kept alive in the present for the sake of the future. It has not been so hitherto, and Prof. Hulme would improve his book and his general outlook by including some of his 'neighbours' in history itself and applying to the whole that test of valuation which has just been suggested.

A written and studied record of the whole of the past is of course impossible, or rather inconceivable. The obviously right canon for choosing what part shall be recorded and studied most is that part which, so far as we can judge, has led most directly to the advancement of mankind. Clearly that has not been the canon by which recorders of history have always, or even mainly, worked in the past. Nor is it the canon by which we choose the parts of history which we present to the young as an item in their school education. It is quite another spirit which prompts the egoistic rock inscriptions of Assyrian kings or later conquerors, or the learning by heart of all the kings of England and their most successful battles. These earliest examples of what is called in the conventional sense 'history' are, of course, commemorations of the god-king whose servant-priests alone were able to use the art of writing for his glorification. The Greeks were the first to break this tradition and conceive of history as a social thing, describing and moralizing about the doings of their own people and others with whom they had to do. It is for this reason that Herodotus and Thucydides have always been regarded as the fathers of history, while, coming a little later, we may find among the Greeks, reflected in Lucretius, the idea of a general progress of mankind from savagery to civilization. Unfortunately, so far as the progress of either science or history is concerned, the brilliant Greek overture was not followed up for hundreds of years. During the nominal supremacy of the medieval Popes the records kept were mainly of their names, claims and achievements, and for many years their dependants—mostly the monks—were the only persons qualified to make written records at all. Quite naturally their temporal opponents, the sovereigns of the rising nationalist States, had at least an equal desire that their names and performances should fill the pages of recorded history. Hence we have, as the bulk of the history handed down and imparted to each successive rising generation, that list of kings and queens and their conflicts with other nations with which we are familiar and under which we have groaned.

But if we apply to it the canon of value in history which is suggested above, how little of our popular history would attain it ? In this matter, as in many others, the Renaissance is a turning point. From then onwards—let us say from Copernicus and Columbus—things begin to happen and to be recorded, which were more important to the advancement of humanity than the death or marriage of a king, but unhappily the old traditional way of recording the supposedly chief events of the past still lingered on and is by no means yet transformed. It will be a long and difficult task but, if our premises are true, mankind will steadily accomplish it and learn to look upon the past as the long and often broken ascent to a state of greater knowledge, union, power over his surroundings and happiness in the enjoyment of beauty and love. Clearly no one would forbid the study of the dark and broken passages in the past. It is in fact imperative to study and, if possible, understand them. But they are the by-ways and not the main onward track. Can we imagine man as a rational being burying himself in the story of a Nero or a Hitler and leaving aside the story of an Archimedes, a Leonardo, a Livingstone or a Darwin ? Yet we can still find approved and much used summaries of history in which the latter and similar great builders of humanity are entirely omitted. To alter this and make our popular history throw light on the future is one of the most burning, difficult but fruitful problems of the day. The world crisis in which we live has done much to make the task more apparent.

F. S. MARVIN.

BLOOD GROUPING AND ITS MEDICO-LEGAL SIGNIFICANCE

Medico-Legal Blood Group Determination

Theory, Technique, Practice. By Dr. David Harley. (Researches from the Inoculation Dept., St. Mary's Hospital, London, W.2.) Pp. ix+119. (London: William Heinemann (Medical Books), Ltd., 1943.) 12*s*. 6*d*. net.

THIS book is divided into three sections, the first of which consists of a general survey of the international (*A*, *B*, *O*) system of blood grouping and the various theories of inheritance of blood groups. This section also deals similarly with the agglutinogens, *M* and *N*, and with the occurrence of the agglutinogens *A* and *B* in saliva, semen and other secretions. The concluding chapter surveys the medico-legal applications of blood group tests.

This part of the book appears to the reviewer to suffer somewhat from over-condensation, but investigators interested in the theoretical and genetical aspects of the subject would normally refer for a more expanded treatment to Weiner's standard work on blood groups, to which the author acknowledges his indebtedness in the preface.

The second section, dealing with the actual technique employed by the author, is admirably lucid and is obviously the outcome of wide practical experience. This section is illustrated both by clear line drawings and by photographs produced by direct printing from slides used in actual tests.

The third section deals with the history and present position of blood group tests in cases of disputed paternity, and also gives details of its application in a number of criminal cases. Reference is also made to a small number of criminal cases in which semen and saliva have been grouped in connexion with criminal proceedings.

The author very rightly stresses the true significance of blood and secretion tests, since there is still a widely prevalent misconception as to this among the general public. Where the blood group of the victim agrees with that on the suspect, it does not prove that the two blood specimens came from the same original source but merely that this possibility exists. All that can be said is that they may have done. If, on the other hand, they differ, the evidence is of the utmost value from the point of view of the defence, since the stains on the clothing of the suspect could not possibly have come from the victim.

It is perhaps unfortunate that the author seems to suggest (p. 113) that "when the tests show that the stains in question could not have come from the victim the prosecution *naturally* [reviewer's italics] does not present that evidence". The function of an expert witness is to present the whole of the relevant facts for the information and guidance of the court, and it would indeed be regrettable if the public gained the impression that evidence favourable to the accused had been suppressed.

H. S. HOLDEN.

AN UNKNOWN ISLAND

Inagua

Which is the Name of a Very Lonely and Nearly Forgotten Island. By Gilbert C. Klingel. Pp. 316+28 plates. (London: Robert Hale, Ltd., 1942.) 18*s*. net.

THIS book is not great pioneering science, like the "Voyage of the Beagle" or "Wanderings in the Malay Archipelago"; it is perhaps lighter metal than Bates or Waterton or Hudson used, but it is fine stuff all the same. It reads like one of the great sea stories, with a vast deal of natural history thrown in, and it carries the reader along as Smollett or Michael Scott knew how to do. The first chapters set one longing for the sea. Two friends had set their hearts upon a ship which could be manned by two men and sailed by one, in any weather; and the little craft they got, a cutter 38 ft. long, "with stout hull, stately mast and billowing canvas", was the spit image of the one which Captain Slocum had sailed single-handed round the world some fifty years before. But unlike his, their voyage was ill-fated and short; it began with a long spell of dense fog down the coast from Chesapeake Bay, and ended in shipwreck after days of hurricane. The two explorers struggled ashore, like Robinson Crusoe, on an unknown island, from which came the pungent scent of innumerable flowers; lizards scurried ahead; a flock of flamingoes flew by; a turtle scuttled seaward from her early morning egg-laying; and a humming-bird swooped out of a cluster of prickly pear and buzzed like an angry bee. There was only one thing to do: to stay on, and explore this strange, unknown island. It turned out to be Great Inagua, a huge, scantily populated, poverty-stricken place, largest and southernmost of the Bahamas, and, in parts, a "scene of almost unbelievable beauty".

The naturalist may eke out this popular book by Mr. Klingel's other writings, for example, his papers in the *Bulletin of the American Museum of Natural History*; but there is plenty of good reading here, The dwellers in the surf, the worms, sea-anemones. sea-urchins, Grapsus-crabs, mussels with long silky byssus, have a chapter to themselves; the great caverns, which hold a teeming population of leaf-nosed bats, get another. The flamingoes are so brilliantly described that not even Mr. Abel Chapman did them better. The "utter tameness of the island birds", the gay fishes of the coral-reef, the shoals of octopuses, the multitudinous sharks (for which the author has a good word to say)—all these things and many more are described with the true naturalist's eye, and the pen of a ready and very skilful writer.

In olden times the West Indies were a happy hunting-ground for the naturalist. Hans Sloane spent a busy twelve-month in Jamaica two hundred and fifty years ago. A few great books were written, by men like Catesby and Ramon de la Sagra; and Philip Gosse wrote as beautifully and intimately about Jamaica as of his native Devonshire. Many things have been done since then. Godman and Salvin have given us their great volumes, and Fawcett and Rendle have written their "Flora of Jamaica". But of the old carefree traveller's natural history there had been little or none, since Gosse wrote it just a hundred years ago, until Mr. Klingel told the story of Inagua.

D'ARCY W. THOMPSON.

MOLECULAR TINKERING AND TAILORING

Order and Chaos in the World of Atoms

A Survey of Modern Chemistry. By B. C. Saunders and R. E. D. Clark. Pp. x+266. (Bickley: English Universities Press, Ltd., 1942.) 8*s*. 6*d*. net.

IN a sentence, this is a sound and interesting sketch of the atomic and molecular make-up of matter, told in simple language and well illustrated with diagrams. The authors, who are attached to the University Chemical Laboratory at Cambridge, open with a brief historical allusion to the development of ideas concerning the atom; the historical note is struck lightly at intervals throughout the composition, a slight dissonance being noticeable only in a reference (p. 60) which might lead a lay reader to infer that Boyle knew of the existence of chlorine. The historical introduction leads on to an outline of the present-day picture of atomic structures and of the various forces that enable atoms to hold together. The role of the chemist as architect and manipulator of these infinitesimal entities is then depicted, a super-brobdingnagian figure a hundred thousand miles high, with enormous hands, and moon-like eyes fifteen hundred miles across, being visualized in his tinkerings with carbon atoms an inch in width.

Notwithstanding the elusive nature of his stock-in-trade, the chemist (with the help of the physicist) has been strikingly successful in separative operations, even when dealing with the ultra-refined differences between isotopes. He has been equally fortunate in unravelling some of the fascinating secrets of the crystal, in dissecting natural molecular structures, and in weaving complex molecular patterns of his own design. Moreover, he has undertaken what the authors term the 'tailoring' of big molecules, such as those of silks and nylons, so as to bring them into arrangements to suit the needs of man. The 'untailored' molecules of plastics also come in for discussion. Finally, there are interesting chapters on the chemistry of photography and foods of the future. The development of soilless plant crops, the application of the growth hormones of plants, and the increasing use of the sea and air as sources of organic material offer fertile domains for speculations on future food supplies.

The epilogue points the moral that although the chemist has made so much progress in the synthesis and marshalling of molecules, yet "the building and the tailoring of the molecules will not of themselves ensure the continuation of civilization. The battle of the conquest of the world is a battle of the spirit of man." In other words, the man of science must be more than a molecular tinker and tailor: he cannot afford, in the interests of civilization, to neglect his wider obligations as a citizen of the world.

This is a modest book that will inform, entertain and stimulate any intelligent person of ordinary education having an interest in the contemporary position and trend of physical science. Layman and expert alike will derive pleasure from the clear and simply phrased expositions of a welter of subjects, ranging from alcohols to metastable states, from chewing-gum to the mastication of rubber, from periscopes to surface reactions, and from guncotton to the dangers of mathematics—to select only a few of the numerous 'untailored' combinations afforded by the index. In these latter days there are many who talk of bringing science to the man in the street: the authors of this book are among the doers.

JOHN READ.

HUMAN INSTINCTS

Are there Human Instincts ?

By Prof. T. H. Pear. (Reprinted from the "Bulletin of the John Rylands Library", Vol. 27, No. 1, December 1942.) Pp. 32. (Manchester: Manchester University Press, 1942.) 1*s*. 6*d*. net.

THE unfortunate habit (which is apt to persist even among those with a scientific training) of discussing verbal questions as if they were questions of fact has been responsible for much waste of time and paper in controversy over the problem of human instincts. How much of this controversy has been verbal may be seen from the fact that many of the opponents of the conception of human instincts have been willing to reintroduce essentially the same conception under some new name such as 'drive', 'urge', etc. Yet behind the mists of verbal controversy, as Prof. T. H. Pear reminds us, there is a real problem of fact—whether or not a man's behaviour is the product of a small number of inherited general dispositions such as sex, pugnacity, acquisitiveness, etc., or whether, on the contrary, the system of his motivation is acquired and the apparently deep-seated dispositions are simply reflections of the motives approved by the 'pattern' of the society in which he was born. Obviously both may be true in part, and the question of fact is then the quantitative one of how much of man's behaviour is to be explained in one way and how much in the other.

These questions of fact are perceived by Prof. Pear to remain important ones, although the current of academic fashion has set strongly against the belief in the usefulness of continuation of the discussion of human instincts which took place in the years after McDougall had popularized the conception by his "Introduction to Social Psychology". In the world of practical affairs, decisions momentous for the future are urged on us for reasons which depend not merely on the belief that there are unchangeable human instincts, but even on the idea that certain national groups have inborn characteristics which persist through the ages. To Prof. Pear, it seems that the offering to our people as a guide to international policy of "this grotesque doctrine . . . of national 'instincts' " is sufficient reason for psychologists not to regard the problem of human instincts as a dead one.

There is also the topical and very living question of whether war is caused by instinctive human aggressiveness. This is very seriously bound up with the practical problem of how we are to avoid future wars when the present War is won. That war is a result of instinctive aggressiveness is often assumed by popular writers and by psycho-analysts. It is not generally realized how dubious are the assumptions on which this opinion is based, and how much there is available even to common observation which throws doubt on whether this can be a considerable factor in the causation of war. Prof. Pear very properly points out that part of military training is directed towards developing aggressiveness in the soldier. Part of the object of war propaganda is to increase the aggressive feelings of the civilian. This is not what one would expect if the war situation were the result of the strength of inborn human aggressiveness. One may also consider that if aggressiveness towards the enemy is the approved pattern of behaviour in war-time and co-operativeness towards the enemy is suppressed, it is also true that co-operativeness within the national group is the approved pattern of behaviour in war-time and that aggressiveness within the national group is suppressed. If members of an army are not allowed to fraternize with the enemy, neither are they allowed to fight with each other. Much of the talk about war and human aggressiveness seems to lose sight of this double problem of war attitudes. War might indeed be as well regarded as the supreme example of human co-operativeness as the supreme example of human aggressiveness.

There are still many questions to be asked about human instincts before the problem can be regarded as finally settled.

R. H. THOULESS.

THE STRUCTURE OF THE UNIVERSE*

By SIR JAMES JEANS, O.M., F.R.S.

THE earliest astronomy was geocentric, the earth being supposed to be the centre of the whole universe. This view was not based on astronomical evidence, but had its roots in man's self-esteem, in his want of imagination and in the meagreness of his scientific knowledge. It met its end in the arguments of Copernicus and in the observations of Galileo.

It was succeeded by what we may call a heliocentric astronomy, in which the sun was supposed to be at or near the centre of the galactic system, and possibly also of the whole universe. This view did not result from any human frailty; there seemed to be good scientific evidence for it. For a superficial study of the sky shows that those stars that appear brightest to us, and so are presumably nearest to us, are scattered fairly uniformly in the different directions of space, while the Milky Way divides the sky into exactly equal halves, and itself looks about equally bright in all its parts. All this seemed to indicate a disk-shaped system of stars, with the sun lying in the central plane of the disk, and fairly close to its centre. Such a view of the structure of the galaxy appeared to find confirmation in the pioneer researches of the two Herschels, and in the later investigations of Kapteyn, Seares and others.

We know now that it was entirely wrong. It was wrong because these investigators had assumed that space was entirely transparent to light. We know now that the whole galactic system is permeated by a patchy fog of obscuring matter which is not dense enough to affect the light of the nearer stars appreciably, but blots out the more distant stars entirely. This fog makes the greater part of the galactic system invisible to us; if our predecessors thought they were at the centre of the galactic system, it was as a man who is in a forest in a thick fog may think he is at the centre of the forest, although in truth he is only at the centre of the small group of trees he can see through the fog.

We now know that the centre of the galaxy is far removed from the sun, and that the sun, like all the rest of the galaxy, is revolving around this distant centre. Observation shows that the sun's period of rotation is about 250 million years, and that its orbital speed is of the order of 270 km. a second. These purely observational data show that the galactic centre must be at a distance of about 36,000 light-years from the sun.

It used to be thought that our own particular galaxy was far larger than any other in the sky, but it is now clear that all galaxies are very similar in size, and also very similar in mass. Our own galactic system can be weighed by calculating the gravitational force it exerts on the sun to keep this moving in the orbit already described; the requisite mass comes out at about 150,000 million suns. It is also possible to weigh a close pair or cluster of galaxies by calculating the gravitational force they must exert on one another so as to prevent the more rapidly moving members running away into space. The average mass needed usually comes out at about that just mentioned for our own galaxy, most estimates ranging from 95,000 million to 200,000 million suns. On the evidence at present available, the galaxies seem likely to differ far less one from another than the stars of which they are composed, and we are led to picture the astronomical universe as consisting of a number of similar units—our own galaxy and the other galaxies—rather like the molecules of a gas.

* Discourse delivered at the Royal Institution on March 26.

On pointing a telescope in different directions in space, we see fields of stars which differ greatly from one another—a consequence of the finite size and definite structure of the galaxy. No comparable variations are to be found in the fields of galaxies seen in different directions in space. Clusters may be seen here and there, and also bare patches in places, but broadly speaking the galaxies seem to be scattered fairly evenly through space, the average distance of neighbours being something more than a million light-years. We do not know whether this uniformity of distribution persists through the whole of space or not. For the galaxies that we can see may perhaps form only a small part of some grander system, built on such a scale that no appreciable difference of structure occurs within the distances accessible to our telescopes.

If, however, the distribution is uniform throughout the whole of space, then space must be finite; otherwise it would contain an infinite amount of matter, and the gravitational force from this would be infinite, which is contrary to the fact. This alternative, then, brings us to consideration of the type of universe which Einstein contemplated in his original relativity theory. Space is curved with a positive curvature—like the surface of the earth—and is filled with matter of which the density, when averaged through a sufficiently large volume of space, is everywhere the same. On this theory the size of space is determined uniquely by this average density of matter, much as the size of an expanded balloon depends on the density, and so on the pressure, of the gas inside it. From the data already mentioned, we can deduce that the average density of matter in space must be of the order of 10^{-28} gm. per c.c., or about one atom to the cubic yard. With this density the radius of space would be about 3,300 million light-years—at least if the whole structure is at rest in a configuration of equilibrium. Thus the whole range of our biggest telescopes would be only a minute fraction of the size of space.

This seemed to provide a possible and consistent scheme until Friedmann and Lemaître showed that such a universe could not stand at rest in equilibrium. It would be unstable in the sense that space itself would have to start either expanding or contracting. Some time after this, Hubble and Humason found displacements in the spectra of distant nebulæ which, if interpreted in the simplest way as 'Doppler effects', showed that the distant nebulæ were all receding from us, and this seemed to suggest that space might actually be expanding just as Friedmann and Lemaître had predicted. Observation showed that the rate of expansion would be the same everywhere and such that, if it were maintained at its present value, the linear dimensions of space would be doubled in about 1,800 million years.

This in turn suggested that the universe might have started as an Einstein universe of the kind already described, and that the inherent instability of such a configuration had caused it to expand to its present dimensions. But the theory of relativity could not deduce the present dimensions, either from the present density of matter or otherwise, Einstein's relation between size and density referring only to a universe at rest in equilibrium.

Eddington has claimed to solve the problem by quite different methods. In brief, he believes that the total number of protons in the universe must be 136×2^{256}, there being also an equal number of electrons; he has produced arguments to show that the universe cannot, from the nature of things, be anything other than this.

Knowing the number of particles in the universe, and the mass of each, it is easy to calculate the total mass of the universe, and hence the dimensions, since we already know the average density to be about 10^{-28}; the radius of curvature comes out at some 2,000 or 3,000 millions of light-years. But if the universe started as an Einstein universe in equilibrium, then the total mass it contained—the known total mass of all Eddington's particles—would fix its curvature definitely and precisely. Eddington calculates that the radius of curvature would then be 1,068 millions of light-years. Thus the expansion of the universe up to the present can only have increased its dimensions some two- or three-fold, a process which would occupy only a few thousands of millions of years. This agrees well enough with what we know as to the age of the earth, for it seems probable that the earth came into existence between 2,000 and 3,000 millions of years ago, the sun then being at the very beginning of its existence as a star. It also agrees with what we know as to the ages of the stars in general; if present conjectures as to the mechanism of stellar radiation are right, the stars can scarcely have contained available energy to provide radiation for more than a very few thousands of millions of years.

The problem has been attacked on different lines by Milne, Dirac and others. After the geocentric and the heliocentric universes had been banished from astronomy, the apparent recessions of the nebulæ seemed to suggest a galacto-centric universe, with our own galaxy as the centre from which all others were moving radially away. Milne based his theory on what he described as the 'cosmological principle'—the universe is not in any way centred in our galaxy; this occupies no specially favoured position, so that the picture which an inhabitant of our galaxy draws of the large-scale features of the universe would be equally valid for any other galaxy.

With the help of this principle, Milne draws a picture which seems at first sight to describe something totally different from the expanding universe of Friedmann and Lemaître. But Kermack and McCrea claim to have shown that the two pictures differ only in the way in which two maps of the same country differ when they are drawn on different projections. If we compare the relativity picture to a spherical projection, then Milne's picture may be compared to a Mercator projection; and McVittie has recently advanced the claim that Milne's results do not really depend on the cosmological principle at all, but can all be deduced from assumptions which Milne has unwittingly introduced under an erroneous impression that they are axiomatic. This matter is still under discussion.

Another line of investigation was opened by Dirac, possibly under the influence of a remark which Eddington had made so far back as 1923. Physics provides a natural unit of force, namely, the attraction between the nucleus and the electron in the hydrogen atom. Astronomy provides another natural unit of force—the force with which the same two particles attract one another gravitationally. This latter unit is very small in comparison with the physical unit, the two standing in the ratio of $2{\cdot}3 \times 10^{39}$ to 1. This ratio is of course a pure number, and so is independent of the particular units we use for our measurements. We have already mentioned another large number—the number of protons in the universe, which Eddington claims must be $1{\cdot}54 \times 10^{79}$. The square root of this number is $3{\cdot}9 \times 10^{39}$, and so is very close to the ratio of the electric and gravitational forces just mentioned. Eddington and Dirac have both suggested that the agreement is too good to be the result of a mere coincidence; they prefer to think that it must result from some fundamental property of the universe.

Again, physics provides a natural unit of time. It can be expressed in a variety of forms, the simplest being that it is the time light takes to travel across the diameter of an electron, about $1{\cdot}25 \times 10^{-23}$ sec. Astronomy also provides a natural unit of time; it is the fictitious time that the various galaxies would take to reach their present positions if they were all to start simultaneously from a point and travel uniformly at their present speeds of motion. This time is the same for all galaxies, being about 1,800 millions of years. Again, the ratio of these two units is a very large number; this time it is $4{\cdot}5 \times 10^{39}$, which is very near to the large numbers already mentioned. Again we must assume that the agreement is not a mere accident, but must represent something in the order of Nature.

We do not know what is the explanation of these apparent coincidences, but they seem to conceal something not yet fully explained, which when fully understood may prove to be of outstanding importance. It is true that Eddington's researches provide an explanation, but only in a rather special and very recondite form; it looks as though this explanation may be only a special case of something simpler and far wider. The fundamental constants of Nature seem to be connected by some new and hitherto unsuspected relations.

Some investigators have gone further than this, and traverse, as it seems to me, very dangerous ground. The age of the universe, expressed in terms of the natural physical unit of time, proves once again to be of the order of 10^{39}, and the suggestion is made that this also can be no mere accident, but must express something in the fixed order of Nature. The weakness in this argument is, as it seems to me, that the basic fact on which it rests can be put in the simpler form that the age of the universe is some one, two or three times the time in which space doubles its dimensions; and that when it is so expressed, it is difficult to find any 'coincidence', either real or apparent. The supposed coincidence is seen to be merely a simple transformation of one which has already been dealt with, and we must not, so to speak, try to cash in on the same coincidence twice over.

Let us, however, waive the objection and accept the suggestion made. We have then to suppose that all the numbers of the order of 10^{39}, including the age of the universe, owe their approximate equality to something in the fixed order of Nature; when the universe attains to ten times its present age, the 10^{39} which measures its age will have increased to 10^{40}, and all the other big numbers will have done likewise. Thus, the ratio of electrical to gravitational attraction will be ten times what it now is, and so on, while the number of particles in the universe will have increased a hundred-fold, so that creation must still be in progress. In brief, some or all of the quantities that we used to regard as unalterable constants of Nature lose their quality of constancy, and must change continually with the time. Milne was led to the same conclusion by a very different road; he reached it from a study of his cosmological principle. By whatever road we arrive, we come into a fantastic new world.

We may avoid the need for a continual creation of matter by supposing that the natural physical unit of time changes *pari passu* with the age of the universe. Then the measure of the age of the universe stays always the same, as does also the number of particles in the universe. But we now find that either the mass or the charge of an electron must continually change.

All this seems strange to old-fashioned physics, but it simplifies some things and removes some difficulties. When, for example, we study the spectrum of a nebula at 250 million light-years distance, we are in effect watching the emission of light from the atoms of 250 million years ago. We find that the spectral lines all show a displacement to the red, its amount being strictly proportional to the age of the light. The simplest interpretation of what we see is that the atoms of those earlier days were not the same as the atoms of to-day. Atoms seem to have given out radiation of longer wave-length than they do now, and so were apparently larger—or perhaps their electrons moved more slowly in their orbits and so took longer to complete their revolutions, possibly because the electric attraction on them was less intense. There are many possibilities, each with its merits, but also with many demerits.

Whatever the final solution of this vast problem may prove to be, it is already clear that there is no solution on the lines of the kind of dynamics that we learned at school. The mechanical interpretation of the universe fails as completely in the large-scale world of astronomy as it has already failed in the small-scale world of atomic physics. The quantum theory has replaced mechanics in the physical world; we still do not know what is destined to replace it in the world of astronomy.

CULTIVATION OF THE DOUGLAS FIR IN GREAT BRITAIN

By ALEXANDER L. HOWARD

THE question of reconstruction after the War is uppermost in many thinking minds to-day, and reafforestation should be given an important place on the programme.

Until the year 1914 a period of nearly a hundred years elapsed, during which time in Great Britain only desultory planting of little importance was carried out. The War of 1914–18 came, bringing with it a merciless but unavoidable devastation of our forests, and subsequent efforts proved wholly inadequate to restore our position. If the situation was serious then, it is desperate now, as the huge demand for timber which has arisen since the outbreak of war in 1939 has dealt another crippling blow to the woodlands of Britain. It is easy to see how this grave situation has come about. In the years 1937 and 1938 (1939 was not a complete year) we imported from the U.S.S.R., Finland, Sweden, Poland, Norway and elsewhere (including Canada and America) the following:

	Softwoods	Money value (sterling)
1937	11,732,000 loads	£51,574,000
1938	8,660,000 ,,	35,853,000

So as to make the immensity of this problem clearer to those who are less acquainted with the matter:

The quantity imported in 1937 would weigh approximately, of our class of timber	17½ million tons;
The transport of which would employ (each with an average capacity of 6 tons, but which in practice generally would average, for timber, only half the quantity named.)	3 million trucks
If the full 6 tons were carried, this would require of the average carrying capacity of timber over the railways of Britain	133,400 goods trains.

These immense shipments were suddenly and completely cut off, and we were obliged to rely on those supplies which could still be obtained from Canada, the United States, and our own home-grown forests. The largest contribution, which has consisted of Douglas fir, has so far been provided by Canada, and perhaps admittedly or unknowingly by the United States.

The Douglas fir, which flourishes in the north-west coast of North America, is remarkable for its height and size, its rapid growth, and the amazing extent of its usefulness.

According to Pliny, when Xerxes first saw the plane tree (*Platanus orientalis*) in southern Europe, he halted his entire army of 170,000 soldiers to admire the "pulchritude and procerity" of one single tree. Well might he have done so when he beheld for the first time the majestic height and wonderfully straight bole of the Douglas fir. Although, however, in places other than its natural habitat its lower branches grow in a graceful sweep, for sheer beauty it cannot be considered a competitor with the plane.

Gibson, speaking of the Douglas fir, wrote: "The largest are 300 feet high, occasionally more, and from 8 to 10 feet in diameter. The average among the Rocky Mountains is from 80 to 100 feet high and 2 to 4 feet in diameter. The amount of timber yielded by one tree may be realised from the experience of Dr. Watney (of 'Buckholt', Pangbourne), who was present at the felling of one in Washington Territory, U.S.A. The height of the trunk was 250 feet and that to the lowest bough was 157 feet. The following were the diameters at different heights above the ground:

"83 inches at 7 feet, 65 inches at 37 feet, 52 inches at 107 feet, and 32 at 191 feet.

"The trunk was sawn off at a height of 7 feet above the ground (where it showed 420 annual rings), and 184 feet of its length yielded 21,503 feet converted, equalling 1,958 feet cube. It took nine railway trucks to convey the timber from London to Pangbourne. The timber contained practically no sap, very few shakes, but some of the planks contained dead knots. Large sections of the trunks (exceeding 7 feet in diameter) are familiar in England to those who visit Kew Gardens, and the Natural History Museum, South Kensington. The Douglas fir flagstaff formerly at Kew Gardens, which was presented by the Government of British Columbia in 1861, was well known. It was 159 feet in length, and measured 1 foot 8 inches in diameter at the base, and 5 inches in diameter at the small end. This is now surpassed by the flagstaff which was erected in 1919 and, like the former one, it was presented by the Government of British Columbia."

The present flagstaff at Kew towers to a height of 214 ft., half as high again as the Nelson Monument

—measuring more than a foot in diameter at the top, and about 3 ft. in diameter at the base. If we accept reports which date back many years, a record height of more than 400 ft. has been claimed for these trees. Such a tree would top the cross on St. Paul's Cathedral by 35 ft.

It would be impossible to overrate the importance of this wood in the exceptional and unexpected demand created by the present War, the figures of production of which amaze and frighten the imagination. When we reflect upon the steady and overwhelming destruction of the timber resources of the world, and the requirements of future generations, we almost wonder how civilization can survive.

Hitherto insufficient efforts have been made to establish Douglas fir trees (*Pseudotsuga Douglasii* and *Ps. taxifolia*) in large quantities in Great Britain. The tree was introduced by William Douglas in 1827, but although occasional efforts were made to plant on a large scale, their prominence and successful production to-day is largely due to proprietors such as the owners of Lythe Hill, Surrey, Murthly Castle, Taymount, Scotland, and Powerscourt, Ireland. Although in some areas success has been achieved, it is only during the last fifty years that attempts have been made to plant this tree for its useful qualities. While it does not thrive in some situations and on certain soils, we have evidence of the marvellous growth to which it can attain in a very short period. About seventy years ago a considerable area was planted with Douglas fir at Lythe Hill by Mr. Bicknell, then forester to the owner. On this same estate many other Douglas firs, in their rather tragic and shortened lifetime, reached a height of 100 feet and more. On the crest of the hill, and placed in such a position that it commanded a view of the whole forest, was an immense tree, known to those who frequented the site as "the monarch tree". It was also one of those planted by Mr. Bicknell about seventy years ago, an unusual specimen of white spruce (*Abies* sp., possibly *grandis*). It is not often that a man can plant a tree and during his lifetime actually see it reach a height of about 125 ft., with a straight bole moderately clear of branches to a length of 66 ft., with three leaders, bringing the full length of the bole to about 100 ft., and yet Mr. Bicknell had this satisfaction before he died in 1941. In all its glory the tree has unfortunately been felled. It contains 544 cub. ft. of useful timber, and as growing must have weighed about twenty tons.

It is worthy of notice that the original planter must have been actuated by a diligence and enthusiasm unknown since the time of John Evelyn, as there flourishes on the estate, side by side with the Douglas firs, a great number of unusual American trees, including *Sequoia sempervirens*, *Wellingtonia gigantia*, at least two sorts of maple, many Thuya, Cupressus, hemlock, juniper, *Cryptomeria japonica*, etc. The Sequoia also would seem to have found conditions favourable to its growth, since it has reached a great height and girth.

A magnificent Douglas fir can be seen at Powerscourt, Co. Wicklow, Ireland, planted by the present Viscount's father between 1865 and 1870. This tree measures to-day 130 ft. in height, with a girth of 14 ft. 10 in. at breast height—equal to a diameter of nearly 5 ft. It is interesting to note that this same tree is mentioned by Henry John Elwes in "Trees of Great Britain and Ireland", when the measurement taken by him in 1904 was recorded as 100 ft. in height, 9½ ft. in girth, with a diameter of 37 in. Other examples of exceptional growth can be seen at Puck Pits in the New Forest, the magnificent avenue at Murthly Castle, and those at Taymount. When it is realized that such trees can be produced in about seventy years, the planting of Douglas firs should be widely encouraged.

A careful inquiry as to the commercial value to-day of an average tree of 70–80 years growth displays the following :

			Per tree
Scots pine			
	(1)	My Report	27*s*. 0*d*.
	(2)	Forestry Commission Report ..	20*s*. 0*d*.
Larch			
	(1)	My Report	37*s*. 6*d*.
	(2)	Forestry Commission Report ..	33*s*. 0*d*.
Average of the Douglas fir at Haslemere more than			£6 0*s*.

Henry John Elwes, than whom there was never a more zealous planter, did not display his usual enthusiasm on the subject of Douglas fir, but it is probable that he was influenced by the result of experiments in Scotland and in the cold hills of Gloucestershire, and also because the conditions forty-two years ago were so different from those which obtain to-day.

Experiments have shown, as previously pointed out, that this particular tree can only be successfully reared in certain areas and soils, and under more scientific planting than has been practised heretofore—a handicap always unavoidable with the introduction of a tree the natural habitat of which belongs to a different country and climate.

A large quantity of cones are being collected from the Haslemere trees, which are producing good seed at a crucial moment, since the crop of Canadian seed is reported to have failed.

The vital importance of a sufficient reserve of timber supplies has been peculiarly forced upon us by a demand such as has never before been experienced in the history of Great Britain. Our woodlands, once our pride and glory, are being denuded, not only of their beauty, but also of their value, and it is therefore a national duty, incumbent upon every one of us, without delay, to pursue those measures necessary to repair the loss of such a vital necessity to the existence of the country. Among those other efforts which should be made, the planting of Douglas fir should take a prominent place.

GEOLOGY IN POST-WAR PLANNING

By Prof. P. G. H. BOSWELL, F.R.S.

FROM the reply of the Secretary of State for War to a question recently asked in the House of Commons, it seems that we have now arrived, in the fourth year of war, at the stage reached after the Gallipoli campaign of the War of 1914–18 ; for history is repeating itself in that water-divining in the Army is to be replaced by scientific methods of discovery (see NATURE, January 30, p. 118). A further, although belated, encouragement to geologists in their efforts to overcome public neglect of the science has just come from an American correspondent in the shape of news that the U.S. Geological Survey is actively co-operating in the preparation of maps for the North African campaign, and that geological staff officers are accompanying some of the U.S. task forces. If we do not relax our efforts it is perhaps not too much to hope that the staff of two geologists at present attached to the British Army may be increased to the total of five who were in commission in 1918—or perhaps even to the much larger number which alone would be adequate.

There are many who, like the writer, believe that the remedy for the present failure to utilize geology to the full is to be found only in broadening the basis of education, and that the cure will take a generation to be effected; but this conviction is no reason for failing to press the claim of geology as one of the primary considerations in national planning. There is still time to ensure that geologists shall take an active part in assisting with schemes of reconstruction. Their help is indispensable for the success of post-war planning, for geological knowledge is necessary whether the question is one concerned with raw materials, with the location of industries, with the allocation of land for particular purposes, or with water-supply and drainage. Certain of the large industrial organizations have wisely begun preparing for post-war conditions and demands (so far, of course, as current restrictions permit), and, in doing so, are seeking geological advice. Others will doubtless awake to the necessity for early preparation so soon as the Government announces its planning policy.

Local authorities responsible for town and country planning schemes may in some cases be unaware of geological repercussions, but if they are being advised by Prof. Patrick Abercrombie, such contacts are not likely to be ignored. At the moment, however, local authorities are also awaiting clarification of the Government's attitude towards the recommendations of the Scott and Uthwatt Committees and the Royal Commission on the Distribution of the Industrial Population (the Barlow Report). These authorities, through their planning committees, will probably have the responsibility within the framework of the Government policy, and subject to the approval of the appropriate Minister or Ministers, of determining how particular areas can best be utilized for the four respective needs of agriculture, other industries, housing and open spaces, taking into account both existing conditions and future requirements. Since geology is the science of the earth, it has a fundamental, although perhaps indirect, effect on the character and quantity of food supply by way of soil control; but it bears more directly on questions of water-supply, health and housing of the community, and the location of the industries by means of which we contrive to exist.

It is well known, of course, that the adjustment of various interests is no easy task in any scheme of planning. The responsibility for decisions will rest with the Minister of Town and Country Planning, but he will need the best advice he can command when he is faced by the problem of reconciling the conflicting claims that will inevitably arise. In many cases difficulties will be found inherent in the actual claims, apart entirely from the problems raised by particular vested interests. For example, it almost seems to be labouring the obvious to emphasize that the suitability of land for the various purposes mentioned above depends on sub-surface geological characters which cannot be altered. The characters which render land suitable for residential purposes are those desirable also for the maintenance of underground water-supplies; but houses, factories and made-up roads constitute an effective mackintosh and thus divert the rainfall. Reservation of land for agriculture and water-supply need not, it is true, lead to conflict, but scientific advice should be taken in every case. Also, the exploitation of the raw materials necessary for reconstruction must be on a huge scale; and here we should have in mind not so much the winning of coal and mineral ores, important as they are, as such common rocks as sand, gravel and stone for concrete and road metal, limestone and clay for cement, brickmaking, and chemical industries. These will require the reservation, at least for many years, of tracts of country which cannot be otherwise allocated, for example, for housing or open spaces. During the past fifty years, the tendency has been towards the abandonment of the small sand and gravel pits, village brickyards and lime-kilns worked by manual labour, and towards the concentration of these industries as large mechanized undertakings, frequently on the fringe of the conurbations. Already, in anticipation of the needs of rebuilding damaged cities and the probable expansion of their housing estates, interested parties are endeavouring to get a lien on resources of raw materials not too far distant from the markets. Further, the provision of water for public supplies and the ever-increasing needs of industry are often difficult to reconcile. Certain large works individually now require as much water as a big town or city of 100,000 to 200,000 inhabitants: if the supplies are derived from underground sources, considerable areas of the country are thus preoccupied. The development of new industries after the War of 1914–18 made heavy demands upon water-supply and in many districts upset the balance as between public and private requirements. The rayon industry with its high consumption of water is, we hope, but the forerunner of a vigorous plastics industry in Britain. Those types of plastics which will form an outlet for coal will obviously be favourably regarded, and in this connexion it is worthy of note that the raw materials, coal, limestone and water, are all abundant in Britain. But they are not all abundant in the same place, where power also must be available on a considerable scale: two of them can be economically transported, but not the third, which would involve great capital expenditure.

Much of the water required in industry is used for washing and cooling purposes, and is released again as effluent, often but little polluted, but sometimes unusable until naturally or artificially purified. The manner and ease of its disposal so as to do least harm to the community are dependent, like the location of cemeteries, sewage works and drainage generally, on the geological character of the terrain. In order to bring the partially or completely purified effluent back into service, a dual water-supply system is called for, but such a course is at present open to objection because of cost and public prejudice. No doubt many are familiar with the only too common misfortunes which have arisen from billeting, the establishment of camps, and the building of houses and works before the existence of the essential water-supply has been assured. Consultants are frequently asked to find substantial supplies of water, not only for growing communities, but also for works which were established before adequate resources were proved or where account had not been taken of the demands of expanding activity. Such lack of foresight frequently accompanies haphazard growth and is perhaps only to be expected in the absence of schemes of planning.

The effectiveness of wide-scale action during planning in the matter of allocating water-supplies is at present seriously hampered by the absence of national control. In accordance with the legal canon that there is no property in underground water, registration of wells and boreholes in Great Britain is not compulsory. Until the recommendations of the Ministry of Health Advisory Committees of 1925 and 1938 are implemented by legislation—perhaps by a system of licensing to bore (as for petroleum) and safeguarding from pollution—no protection of public or private water-supplies, either as regards quantity or quality, can be assured.

Before industrial works are located, consideration is usually given to the questions of proximity to markets, transport facilities, availability of power, and the sources of raw materials; possibly also to the local labour market and the matter of suitable housing. To these primary considerations there should always be added those of water-supply and drainage.

The requirements of various industries for other raw materials besides water are also liable to be mutually interfering: therefore, in order fairly to reconcile the competing claims, some amount of give-and-take or rationing may become necessary in particular areas. The earlier and almost unrestricted practice of "first come, first served", defensible as it may have been before districts became congested, has led to the situation which called for the setting up of many commissions and committees of inquiry, and is now less likely to commend itself to local authorities, however influenced they may be by prospects of increased income from rates.

It is not beyond the bounds of possibility that any plans for the future will have to take account of underground accommodation and storage. However high our ideals may be for post-war international relationships, common prudence may cause politicians to make provision to meet a possible breakdown. Geological knowledge in planning is therefore indispensable if we are to be ready, albeit unwillingly, to revert to a trogloditic phase.

Many of the mistakes of the war planning, which have led to great delays, loss of labour and wear and tear of valuable machinery, might have been avoided if geological advice had been sought; and the adverse effects could have been minimized if the co-operation between various Government departments had been more effective: that is, to use Sir Stafford Cripps's words, if there had been geological advice "at the highest level", the requirements of various war-time activities might have been more satisfactorily adjusted. The recent remark of Sir Philip Joubert at the Conference on the Planning of Science arranged by the Association of Scientific Workers should always be kept in mind: "If . . . the scientist never initiates any action and always waits to be asked a question . . . he will lose half his value". Therefore, one may feel the more encouraged in urging (especially at a time when 'science' seems in many quarters to be synonymous with physics) how important it is that a scientific advisory committee should be set up to assist the Minister of Town and Country Planning at the highest level. Such a committee, concerned with the strategy of planning, should include at least one geologist. The activities of the central planning authority will inevitably impinge on those of several Government departments. For that reason and in order to simplify the problem of co-operation, the geologist invited to serve should not be officially connected with any Government department. His independence would be a source of strength.

SOME CZECHOSLOVAK CONTRIBUTIONS TO GENETICS (1866-1938)

By Dr. GERALD DRUCE

ALTHOUGH the breeding and crossing of plants and animals has been in vogue for a long time, the scientific control and study of the processes belong to the twentieth century; even Mendel's early pioneer work was not appreciated for almost half a century.

Born of poor parents in 1822, Gregor J. Mendel showed promise at school and was admitted to the Augustinian monastery at Brno (Brünn) in Moravia. His scientific work began when he was sent, in 1851, to Vienna to study the natural sciences, for which he showed an aptitude. At Vienna he wrote two notes dealing with *Scopolia margaritalis* (1853) and *Bruchus pisi* (1854). Returning to Brno he taught science at the secondary school and spent eight years in a study of the crossing of peas. This work virtually ceased when he became prelate in 1868, and his after-life was clouded by a bitter controversy with the secular authorities over the taxation of the monastic domains.

Mendel knew of Darwin's theory of evolution, but did not entirely accept it. Darwin never knew of Mendel's work, which was published in the local natural history society's journal[1]. Among the very few biologists who knew of Mendel's work was the German, Nägeli, and he failed to recognize its significance. Mendel himself was depressed by the fact that his discovery was ignored. Only two minor references were made to it in his lifetime[2], and not until 1900 was its importance realized by several men of science simultaneously[3].

Mendel's experiments were carried out in a small corner of the monastery grounds where, over a period of years, he sowed his hybrid peas. He was aware of the difficulties in experimenting with hybrids, though nothing was then known of the number of possible types of offspring from any cross. No control had previously been made of separate generations nor were any reliable statistical data available, though crossing for improving stock had been practised in Bohemia, for example, at the Kladruby stud where horses had been bred since 1563. Also before Mendel's time local varieties of apples were obtained by selective crossing.

Mendel used peas because they possessed constant distinguishing characters and the hybrids were easily protected from cross-pollination. Moreover, the tedious process of artificial pollination in these plants did give good crops. A consideration of the results obtained over a number of generations are expressed in what are termed the Mendelian laws. Mendel expressed his conclusions in the following way: "In hybrids the relation of each pair of different characters (e.g., tall or dwarf, smooth or wrinkled) is independent of other differences in the original stocks"; and "the constant characters that appear in several varieties can be obtained by repeated artificial pollination in all possible associations according to mathematical rules".

He recognized that all the characters of a plant or animal must be transmitted to the offspring through the germ cells (in plants through the pollen grains and the ovules). To this he added the conception of alternative unit characters present in the germ cells. These are inherited as units, that is, are either present or entirely absent in the offspring according to whether they are what are now termed "dominant" or "recessive". Also, recessive characters can reappear in the second generation.

In 1902, Prof. B. Němec[4] gave an account of the beginning of modern work on heredity, and by 1910 it was possible to correlate data dealing with the inheritance of acquired characters, variability and crossing in fruit trees. Even at this time the study of genetics in the Czech lands was linked closely with cytology, as is clear from the publications of Němec and Vejdovský[5], particularly the work on mitosis and polyploidy in lower plants.

After 1919, work in this field developed rapidly, both academically and in its practical applications to agriculture. The Czechoslovak Experimental Agricultural Institute near Prague and the Biological Institute were founded and, among other matters, were concerned with the improvement of crop plants and the breeding of better-quality cattle. A barley with stronger stalks and fungus-resisting wheats were obtained partly through the work of Prof. J. Peklo, and work was in progress in connexion with varieties of tobacco and with plants the seeds of which were rich in oil, the object being to improve upon the qualities of existing ones. The Association of Sugar Manufacturers had its own seed selection and improvement station at Semčice in Bohemia, and from which emanated many publications relating to the production of disease-resisting beets with high sugar content[6]. State nurseries at Průhonice and large private ones at Blatná also conducted important experiments on the crossing of flowering plants. Large quantities of seeds of new varieties were distributed annually as a result of this work. They included in 1934:

6,356	quintals	of	spring wheat	from	8	stations
5,987	,,	,,	,, barley	,,	9	,,
3,274	,,	,,	,, oats	,,	7	,,
24,688	,,	,,	sugar beet	,,	4	,,
10·5	,,	,,	poppy seed	,,	2	,,
270	,,	,,	white turnip	,,	1	,,
120	,,	,,	peas	,,	2	,,
12·9		,,	white clover	,,	1	,,
148	,,	,,	winter barley	,,	1	,,
7,506	,,	,,	,, wheat	,,	9	,,

The breeding of sheep for wool, meat and milk (used in cheese-making) was conducted with some success under Prof. F. Bílek at the Zootechnical Department of the Agricultural Experimental Institute, whilst Dr. J. Kříženecky made much progress in the scientific control of results in poultry breeding.

The genetics of man received attention in Czechoslovakia both from its physical and its mental aspects. In the former came the work of Prof. J. Matiegka, Dr. V. Suk and Dr. J. Valšík[7], whilst Prof. K. Helfort was concerned with the mental side. The Czech Eugenics Society and the Genealogical Society both base their activities on genetics, and among genealogies recently compiled from old records are those of J. A. Komenský, J. E. Purkyně (Pourkinje) and other Czechs prominent in cultural and artistic fields.

Perhaps the most outstanding work on genetics in Czechoslovakia was that due to Dr. Arthur Brožek (1882–1934), the first professor of genetics in the Charles University of Prague[8]. Brožek early applied mathematical methods to the elucidation of biological data, especially in his crosses of *Mimulus quinquevulnerus* with *M. tigrinus*. He produced, among other hybrids, a mosaic variety, *M. tigrinoides* var. *Paulina*, during experiments that involved the emasculation and artificial pollination of thousands of specimens. He took more than 20,000 photographs and made still more records of details of the results of these crossings.

His experiments with albinos revealed that the phenomenon is not inherited according to Mendelian laws. Absence of chlorophyll is localized in the plastids and not in the chromosomes. Further experiments with *M. cardinalis* produced several multicoloured varieties of pure strain. Microscopic examination revealed yellow plastids in the cells of the floral leaves in addition to the red sap which is present. In yellow varieties the sap is colourless.

Apart from these researches with Mimulus, Brožek was engaged with Bílek in experiments with caracul sheep and other animals and he wrote an exhaustive work in Czech on genetics[9]. In 1924, he visited the United States and for a time collaborated with Prof. C. B. Davenport and Prof. T. H. Morgan in their work on Drosophila.

In some ways it is possible that Brožek's work suffers from a lack of appreciation, though not to the extent that befell Mendel's. At present Czechoslovak biologists are unable to continue their work for the advancement of science, but it is clear that when the nation is again in control of its affairs research in this and other subjects will be resumed.

[1] *Abhandlungen Verh. Naturforscher-Verein in Brünn*, **4**, 1 (1865). (A translation was given in *J. Roy. Hort. Soc.* in 1901.)

[2] Focke, W. D., "Pflanzenmischlinge" (1881). Peter, *Englers Bot. Jahrbuch* (1884), refers to Mendel's work on Hieracium published in the Brno journal, **8**, 26 (1869).

[3] Correns, *Ber. bot. Ges.*, **17**, 158 (1900). de Vries, H., *ibid.*, **18**, 435 (1900). Tschermak, E. von, *Z. landwirt. Versuch. Oest.*, **3** (1900).

[4] Němec, B., *Ziva*, **12**, 65 (1902); **13**, 129 (1903). ("Polyploidy in Algæ" and "Cytological Observations with Higher Plants").

[5] Němec, B., "Das Problem der Befruktungsvorgänge und andere Zytologische Fragen" (1910). Vejdovský, "Zum Problem der Vererbungsträger" (1912).

[6] Bartoš, V., *Věstník C. Jednoty Repáru*, 1–5 (1922).

[7] *Vlastivěda* (Prague, 1933). "Nauka o Plemenech" (1929).

[8] *Věstník C. bot. Spolecnosti*, **2**, 1 (1922).

[9] "Rostlinopis" (Vol. 5 of a comprehensive "Czech Handbook of Botany") (1930).

OBITUARIES

Prof. P. P. Bedson

IT was a shock to learn of the death of Prof. P. P. Bedson, emeritus professor of chemistry of the former Durham College of Science, on April 4 at Hove, two days after his ninetieth birthday and our sending him a congratulatory letter thinking he was enjoying reasonably good health at four score years and ten.

Peter Phillips Bedson was born at Manchester on April 2, 1853, the third son of George Bedson, his second Christian name being taken from his mother. He was educated at Manchester Grammar School and graduated at Owens College under Roscoe, continued his studies in London (Dalton Scholar 1875), and in 1876 proceeded to Bonn to work for two years with Kekulé. On his return he spent the years 1878–82 on Roscoe's staff and then at the age of twenty-nine was elected to the chair of chemistry in the College of Science, Newcastle-upon-Tyne, which he occupied for thirty-nine years. He thus saw the rise of the College from the small beginnings to near its present stature. His first published work was from Manchester (1876) on the double compounds of ether with titanium chloride and vanadium oxychloride. At Bonn he worked on substituted phenylacetic

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acids, an integral part of the indigo problem (1877).

On coming to Newcastle, Bedson showed courage in linking his chemical fortunes with those of the district by attacking the chemistry of coal. His pioneering work included the demonstration of the presence of paraffins up to pentane, the investigation of the wet oxidation of coal and the solvent action of pyridine. These methods have in later days proved of the utmost importance in the hands of Bone and Fischer. Other important aspects of his work were connected with the explosive nature of coal dust in air and the composition of colliery waters. He also demonstrated the presence of argon in rock salt, and as a regular lecture experiment he showed the rhythmic precipitation of copper ferrocyanide in gelatine many years before its rediscovery by Liesegang. With Charleton-Williams he translated Lothar Meyer's "Modern Theories of Chemistry" and in 1896 gave the Lothar Meyer Memorial Lecture in London.

Up to the end of last century, scarcely any student entering the College had any prior knowledge of chemistry, and as the numbers were growing rapidly, the staffing of his department invariably lagged behind the number of students to be instructed. Members of staff taught for thirty-five hours a week, including some evenings, and were fortunate to get Wednesday afternoon free for research ! By contrasting these conditions with those obtaining in universities to-day, Bedson's original work constitutes a remarkable achievement. In addition to the above handicap, he became necessarily more involved in the administration of the rapidly growing institution, of which he became vice-principal ; he was also later a justice of the peace.

Although of small stature, Bedson was of striking personality and a very successful teacher. His lectures, on the preparation of which he spared neither time nor trouble, were clear, logical and well illustrated by experiments. Cheerful and ever humorous, he was yet a strict disciplinarian of the old school, but was nevertheless loved and respected by his students, to whom he was affectionately known as 'Peter'. It is, however, alleged that on one occasion an errant student on being questioned by his professor replied that he was seeking salt-petre ! His chief recreation was music. He was a competent violinist and an ardent concert-goer.

He is survived by his lifelong helpmeet, Mrs. Bedson, and one son and one daughter, the former an eminent bacteriologist.

A few years after his retirement his successors founded "The Bedson Club" in honour of the man who had done so much to establish the School of Chemistry in the University of Durham. So his name goes on, though we mourn the loss of an able chemist and a father to King's College.

In the preparation of this note I have had the invaluable help of Dr. J. A. Smythe, for long a member of Prof. Bedson's staff. G. R. CLEMO.

The Rev. E. N. Neumann, S.J.

THE REV. EMMANUEL NAVARRO NEUMANN, *S.J.*, died on January 30, 1941, according to the Memorabilia Societatis Jesu of December 1941 (delayed on account of the War). The greater part of his research studies and labours was spent in the field of geodynamics. He operated observatories, issued bulletins, developed seismographs and published more than three hundred separate articles on seismology. With other Jesuit men of science he was exiled from Spain by the anti-clerical Government in 1931, and resided in Italy for some time. On August 11, 1938, the Cartuja (Granada) Observatory was restored to the Jesuits and Father Navarro Neumann was present. He was in poor health and experienced much physical suffering for many years, and in 1939 retired from active scientific work.

WE regret to announce the following deaths :

Dr. T. McFadden, senior demonstrator in physics at the Queen's University, Belfast, on March 25, aged twenty-six.

Dr. H. G. Rule, reader in chemistry in the University of Edinburgh, on March 15, aged fifty-five.

Prof. Warrington Yorke, F.R.S., Alfred Jones professor of tropical medicine in the University of Liverpool, on April 24, aged sixty.

NEWS and VIEWS

Ionospheric Variations during the Sunspot Cycle

IN a lecture entitled "Radio Exploration of the Ionosphere", delivered before the Wireless Section of the Institution of Electrical Engineers on April 7, Sir Edward Appleton described the results of an eleven-year series of ionospheric measurements just completed by Mr. R. Naismith and himself. The work began so far back as 1931, the critical frequency method of measuring the ionization density in the various atmospheric layers being employed (see NATURE, February 7, 1931). Measurements made by this method had not been in progress more than a couple of years before it was suspected that electron concentrations were varying in sympathy with solar activity. The need for continuing the observations for a complete sunspot cycle of just over eleven years was then realized and plans made accordingly. During the course of the cycle, other observers, in different parts of the world, have adopted the same method, and a world survey of the electrical state of the upper atmosphere by means of it is now in progress. The British observations have been made as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

The ionization in the E and F_1 layers has been found to increase by 50–60 per cent from sunspot minimum to sunspot maximum, indicating a corresponding increase of 120 per cent in solar ultra-violet light, which is known to be the ionizing agency in question. The ionization in the F_2 layer has varied even more markedly, especially in winter. Such a change has an important bearing on long-distance radio transmission, which proceeds by way of ionospheric reflexion. It is now clear that the range of short wave-lengths available for this purpose increases very substantially with solar activity. The international allocation of such wave-lengths for short-wave broadcasting after the War must therefore be based on the ionospheric results obtained during the last sunspot cycle.

The Logic of Question and Answer

IN the issue of *Mind* for January 1943, Prof. A. D. Ritchie, under the title "The Logic of Question and Answer", discusses problems connected with the use of hypotheses in scientific method. He begins by denying the existence of 'hard' facts, a denial which should be platitudinous now but is not. A single observation, he argues, does not by itself provide empirical information. This is the function of a plurality of observations in certain relations. He goes on to develop the contention (which he derives from Prof. Collingwood's philosophy) that every proposition which really contributes to knowledge is an answer to a question, and that the question arises out of pre-existing knowledge, this knowledge itself being the answer to a previous question or questions. The fundamental question is always "What have we here ?" If we ask the question about, say, a truck-load of coal, we find the answer by inspecting and testing samples. The number of samples we take and the way in which we take them will depend on knowledge we already possess about the coal, the method in which it is loaded in the truck, whether it is protected from the elements, etc. If we ask how we know that the samples are representative of the material, the answer is that we have chosen a way of sampling which answers the questions we were asking. If our questions are not answered, we must devise another method of sampling.

If all questions depend, in the way stated, on answers to previous questions, we must, it seems, at some point come back to absolute presuppositions. Prof. Collingwood drew this conclusion and further argued that each historical epoch had its own absolute presuppositions. Prof. Ritchie argues, first, that as we trace our questions and answers back we come to a point where what we have is some vague knowledge which is thrown at us by experience with a minimum of questioning and presupposition; secondly, that the presuppositions underlying the process of scientific discovery are purely formal, consist in something like Kant's list of categories, and must be common to all historical epochs because the process of scientific discovery is continuous.

Health Services in Great Britain

THE February issue of *Agenda* is noteworthy for an article by Prof. Henry Cohen, "A Comprehensive Health Service". Surveying the various reports on the health services which have followed the P E P report of December 1937, Prof. Cohen stresses the point that medical opinion should be considered expert only in relation to the organization and administration of health services. Questions relating to the various methods of raising the necessary finance are outside its special province. Next, he urges that any plan for the future health service of Great Britain must not overlook the vital factors of provision for the training of personnel (medical education) and of encouraging the advancement of medical knowledge (research). In regard to personnel, Prof. Cohen emphasizes the importance of the general practitioner, who should know not only the patient's body but also his job, his home, his relations. Neither patient nor practitioner should be forced unwillingly into a professional relationship. In addition to this personal relation of medical man and patient, and the maximum freedom of choice, every citizen should have the right to adequate and, so far as possible, the best available provision for the prevention and cure of disease and the achievement of positive health, covering all necessary domiciliary and institutional care, medical and post-medical.

The family should be the unit of health practice ; and the family practitioner must be the focal point of all health services—preventive, educational and curative. Practice must be limited so that it affords adequate rest, leisure and holidays and all opportunities for 'refresher courses', and should be so rewarded that freedom from want for the practitioner and his dependants is secured. The profession should be self-governed and independent of political pressure, and the fullest opportunities should be provided for medical education and research. These general propositions should be assured of much support outside the medical profession. Prof. Cohen also emphasizes the importance of regionalism : the State is too large a unit in medical services, and the local authority too small. What he has to say of teaching hospitals is of close interest to scientific workers other than those who are actually members of the medical profession, and he directs attention to the opportunity of determining the eventual form of the health service of Great Britain which the demobilization of thousands of younger medical men at the end of the War may well afford, by experimenting with different types of health services in different areas.

Biology and Health Education

THE importance of biological teaching in the schools as a basis for health education was stressed at a conference held in the City Museum, Leeds, on April 17. This, the first of a series being arranged throughout Great Britain by the Central Council for Health Education, was attended by some three hundred teachers, medical practitioners, youth leaders, social workers and educational and medical administrators. This fruitful co-operation between the two professions most concerned in health education was signalized by Dr. J. Johnstone Jervis (medical officer of health for Leeds) taking the chair during the morning session and by Alderman W. M. Hyman (chairman, West Riding Education Committee) during the afternoon session.

Dr. Robert Sutherland (medical adviser, Central Council for Health Education), speaking on "The Possibilities of Health Education", stressed the importance of the concept of health as a positive state of bounding well-being, rather than as a mere absence of disease. The address on "Health Habits and Hazards" given by Dr. J. F. Galloway (medical officer of health, Dewsbury) made the point that the greatest hope for the health of the future is in the schools. At the afternoon session, Mr. Cyril Bibby (education officer, Central Council) spoke on "The Methods of Health Education", and suggested ways in which parents, teachers, administrators, youth leaders, school doctors, dentists and nurses, health visitors, and by no means least, 'John and Jane Citizen', could co-operate. An open forum provided a very fruitful exchange of views between the various professions represented, and the conference closed with a display of health education films.

Summer School in Biology and Health

The Central Council for Health Education has been able to secure the services of eminent men of science and educationists for its Summer School in Biology and Health, to be held during August 4–14 at the Chelsea Polytechnic, London, under the joint direction of Mr. L. J. F. Brimble and Principal F. J. Harlow. Among the lecturers (subject to war emergency) will be Sir John Russell, Prof. C. W. Valentine, Prof. Winifred Cullis, Prof. J. R. Marrack and Prof. Lancelot Hogben. The mornings will be devoted to lectures by biologists and medical men; the afternoons to seminars, open forums and visits to museums, experimental stations, etc.; during the evenings lectures will be given on "Biology and Health", "Early Childhood", "Problems of Sex Education", "Social Aspects of Nutrition", "Biology as a Social Science", and "Agricultural Developments in the U.S.S.R.". Time will, of course, be left for recreation and social functions.

The first three days of the School should be of interest to all teachers, educational administrators, youth leaders, nursery school and play centre workers, school nurses, and indeed all who have to do with children. The final week will be planned specially for teachers of biology and those interested in that subject. The fee for the first three days only will be two guineas, and for the full ten days five guineas, in each case plus half a guinea registration fee. These figures include lunch, tea and dinner each day. The School has been approved by the Board of Education, and many education authorities will be prepared to consider applications for financial assistance to attend the course. Further details can be obtained from: Mr. Cyril Bibby, Education Officer, Central Council for Health Education, Tavistock House, Tavistock Square, London, W.C.1.

Rat Infestation on Vessels

Dr. Robert Olesen, medical director, and G. C. Sherrard, acting assistant surgeon of the United States Public Health Service, state that the records available at the New York Quarantine Station since 1924 show a considerable number of fumigations of ships though not an unduly high average of rats recovered from each vessel (*Public Health Rep.*, **57**, 1966; 1942). The influence of war on fumigation of vessels is shown by the fact that since 1940 the number of fumigations has gradually increased, and the average rat recoveries from each vessel have been greater than during previous years. In spite of the losses of trained staff, the Public Health Service maintains surveillance over vessels entering United States ports, though this is becoming increasingly difficult owing to rodent control being submerged by purely war effort.

Silkworm Rearing

We have received a copy of a small publication in paper cover entitled the "Silkmoth Rearer's Handbook", which has been produced as volume 6 of the *Amateur Entomologist* (price 5*s*., postage 4*d*.; from Miss P. L. Rogers, 19 Crescent Road, London, N.8). This little work of seventy-two pages contains four plates of photographs of different silkmoth larvæ and more than twenty text-figures of the moths, their cocoons, etc. It includes instructions on the making of rearing and forcing devices, how to overcome the difficulties of pairing these giant moths and of obtaining fertile eggs, the problems of moulting, pupation and emergence, obtaining initial stocks, hybridization and many other matters of practical value. Sixty-seven species are described in detail, the notes including short descriptions of all stages of many of the species, together with specific pairing and rearing methods, food-plants acceptable in Britain and other information. The book is a reference guide which should prove of interest to all lepidopterists.

The Badger in Britain

The Cumberland Nature Club of Cockermouth is organizing a nation-wide protest against the action of the Cumberland War Agricultural Executive Committee in including the badger in the list of 'vermin' recommended for destruction by the pests officer. The usefulness of the badger's habits has long been accepted in natural history circles, although in game preservation and rural circles it still suffers persecution for the misdeeds of the fox or occasional poultry raids by single individuals. The badger, with the fox and the stoat, is a natural 'brake' upon the rabbit population of the countryside. Its diet comprises fruit, roots, small rodents, contents of wasps' and bees' nests, rabbits, and sometimes small birds on the ground, and decaying animal or vegetable matter.

Polish Institute of Arts and Sciences in America

Further evidence of the indomitable determination of Polish men of science and men of letters to defeat the Nazi plan to destroy the cultural and intellectual life of Poland is given by the publication of the first number of the quarterly *Bulletin of the Polish Institute of Arts and Sciences in America*. As is explained in the introduction, the aim of this bulletin is two-fold. It will serve as the journal of the Institute itself and to replace, for the duration of the War, the *International Bulletin of the Polish Academy*. It contains a history of the struggle for Polish culture up to the foundation of the Polish Institute of Arts and Sciences in America, in December 1941, and gives details of the activities and programmes of the sections of that Institute: historical and political sciences; history of literature and arts; law and social and economic sciences; pure and applied sciences; and educational problems.

Papers and lectures delivered at the Institute (in some cases published both in Polish and English) include the inaugural address given by Prof. Bronislaw Malinowski, first president of the Board, who died suddenly on the following morning; a report by Prof. Oskar Halecki, director of the Institute: "Critical, Pre-Critical and Post-Critical States of Liquid Substances" by Wojciech Świetosławski; and "The Aerodynamical Explanation of Cosmic Vortices" by Gustaw Mokrzycki. A list of books, articles, and reviews published by members of the Institute, not only in the Institute's own publications but all over the world, constitutes a valuable record of Polish contributions to science and letters. Tribute is paid to the many Polish professors, lecturers and other scholars who have died under German occupation or in concentration camps, a record which cannot fail to stir a desire to assist in every way the efforts of those men who are striving to carry on, in Great Britain through the Association of Polish University Professors and Lecturers and in the United States through the Polish Institute of Arts and Sciences, the intellectual activities so essential to the future of their country.

Cooper Union for the Advancement of Science and Art

THE eighty-third annual report of the Cooper Union for the Advancement of Science and Art, New York, covers the year ending June 30, 1942, and includes the report of the director, Mr. E. S. Burdell, with the departmental reports of the School of Engineering, the Art School, the Library, the Division of Social Philosophy, and the Division of Business Administration. Dealing with the effect of America's entry into the War upon American education, Mr. Burdell hints that the United States Office of Education may assign a specific training task to each college in terms of its capacity, equipment and personnel. He further predicts the year-round operation of many colleges and particularly of engineering schools. The post-war demand for scientifically trained personnel for rehabilitation and reconstruction purposes promises to be as great as the existing demand for trained men for the armed services. Teaching staffs, however, must not be called upon to face a twelve-month academic year with rest periods on a catch-as-catch-can basis. Colleges which anticipate year-round operation should be prepared to adopt the 'quarter-off' system which already works successfully in the State universities now on a four-semester basis, where a member of the teaching staff may expect his non-teaching semester during any one of the four quarters, which usually correspond to the four seasons of the year.

A third great challenge which American colleges must face during or shortly after the War is in the field of co-operative education. Stressing the way in which the co-operative scheme of alternating school work and shop practice strengthens vocational orientation, and the union of theory and practice, Mr. Burdell points out that the present tendency is for longer periods of alternation between college and the industries and that the most important functionary in the operation of the co-operative system is the co-ordinator. The value of the system has been well demonstrated in the experience of the University of Cincinnati, the pioneer in this movement, and for engineers the system teaches the student to do his best naturally and as a matter of course, as well as affording an appreciation of the human factor in practical affairs. In the second part of his report, Mr. Burdell refers to the question of student health and suggests a comprehensive study of the effects of stress, continuous and prolonged, upon the physical and mental stamina of young adults, which the Cooper Union has under consideration.

Evolution of International Trade

IN an address before the Manchester Statistical Society on March 10, on some essential factors in the evolution of international trade, Prof. A. G. B. Fisher stressed the importance, if we wish to maintain or improve our standard of living, of being prepared constantly to adjust our export activities to meet the probable changes in circumstances arising through changes in the character of employment, and of being constantly on the alert to initiate changes on our own account which are likely to be advantageous to us. British export trade flourished during the nineteenth century because we were able to supply people in other countries with things which they were eager to purchase, and he urged a careful study of the figures for total and expanding exports with reference to other exports. We should consider how best we could prepare to make further adjustments after the War which would be suitable in the different conditions of world demand which will then exist. What is more, we should ensure that those adjustments would be made on a scale sufficiently large to assure us that balance of payments equilibrium at which we must aim. He stated that material progress will be impossible unless there is free admission into the occupations and industries where increased production is necessary to provide consumers with the things without which no increase in their real incomes will be forthcoming. Scientific and technical knowledge have always been the most important factors underlying economic progress, so the basis for the adjustments of the structure of world trade which will in any event be necessary is already available for us to build on. Such considerations are already receiving serious attention in other parts of the world, particularly in Switzerland, where Swiss industry is preparing to meet the new demands which peace will bring to it. Many industrial concerns there are strengthening their technical staff and increasing the number of their scientific collaborators, making resources available for research and constructing laboratories.

Ventilation of Electrical Substations

THE type of construction used for substations is generally governed by requirements, for example, fire and air-raid precautions, which may conflict with the maintenance of the atmospheric conditions necessary for keeping the equipment in good order. These conditions are not necessarily the same as those needed for human comfort, and the application of heat alone has often been found to be ineffective and costly. In a paper read in London before the Institution of Electrical Engineers, F. Favell and E. W. Connon record their experiences in overcoming substation ventilation problems in particular cases. Adequate and suitably planned ventilation will maintain substation equipment in a satisfactory condition with a far smaller use of heat than has generally been considered necessary. Further collaboration by manufacturers, for example, in designing gear which would be unharmed by the occasional condensation that might occur in an unheated building, might enable heating to be dispensed with entirely. It is not certain that present-day switchgear will be affected adversely by occasional bad conditions, and further investigation of this matter is required. Substation equipment and the buildings housing it should be designed and constructed as a complete unit. The paper discusses the subject under the headings of typical arrangement of a large indoor substation, conditions required in substations, the effects of unsuitable conditions, arrangements of ventilating plant, transformers inside buildings, and application to smaller substations.

Australian Antarctic Expedition

THE first volume of the "Scientific Reports (Series A) of the Australasian Antarctic Expedition of 1911–14" has now been published (Sydney, Government Printing Office, 1942. £3 17*s*. 6*d*). The long delay was due to many causes, of which the most important was the usual difficulty that scientific expeditions have to face, namely, lack of funds. This large volume contains 350 pages of text, more than a hundred illustrations and nine maps. The text is mainly the narrative of the expedition by Sir Douglas Mawson, and most of it has been long anticipated by the same author's popular volume entitled "The Home of the Blizzard" and Captain J. K. Davis's "With the Aurora in the Antarctic". Nevertheless, the official record of voyages, sledge journeys and discoveries should be valuable to future explorers. Most important, however, are the maps of various parts of the coast-line of Antarctica showing in full the details of the expedition's work. They include a large-scale plan of the surroundings of the expedition's main base at Cape Denison in King George Land, and maps of Queen Mary Land, King George Land, and the Charnockite coast east of Commonwealth Bay, and also track charts of the several voyages of the *Aurora*. Another useful feature is the inclusion of gazetteers of all names, giving not only the character of the feature, but also the origin of the name. The latter will be most useful for the future historian of the Antarctic. Only too often the origin of names given to features in polar regions is lost for want of such records by the explorers themselves.

Scientific and Industrial Photographers

The Birmingham General Branch of the Association of Scientific Workers arranged for a lecture by Mr. Herbert E. Zerkowsky, of the British Cast Iron Research Association, on April 13, at the Chamber of Commerce, Birmingham, in connexion with the exhibition "Photography in Science and Industry". Mr. Zerkowsky started by giving a review of the development of photographic technique and paid tribute to the research work done by the manufacturers of photographic materials in Great Britain and to the contributions made by those who employ photography daily as a tool, and also by the amateurs. Special reference was made to the question of the salaries of photographers in the Civil Service and in industry, which are generally far below the average pay of those employed in the darkroom and in portrait photography. Mr. Zerkowsky pointed out that those who use photography for technical and scientific purposes are required to have first-class technical and scientific knowledge besides their photographic skill and experience. These workers, which he suggested should be called 'research photographers', have no organization to look after their interests and to ensure facilities for further studies and training young people, apart from the Association of Scientific Workers. He suggested the formation of a Group of Scientific and Industrial Photographers within the Association.

Potato Virus Diseases in Victoria

Pamphlet No. 110 of the Commonwealth of Australia Council for Scientific and Industrial Research (314 Albert Street, East Melbourne, Victoria, 1941), by J. G. Bald and A. T. Pugsley, considers the effects of the potato virus diseases named X, A, Y, and leaf-roll, upon the most important varieties of that crop grown in Victoria. The variety Carman is almost entirely infected with virus X, is very susceptible to A and Y, and less so to leaf-roll. Up-to-date, like its namesake in Great Britain, is susceptible to most of the serious viruses, but in Victoria it possesses practical field immunity from virus A. The Snowflake variety is not very subject to aphis-borne virus diseases, though the stock is almost entirely affected with virus X. A survey of suitable districts for the propagation of disease-free potato stocks is being made, and further studies of the effects of multiple infection by the viruses mentioned above, and those denoted by F and G, are in progress.

Palæontographical Society

Tributes were paid to Sir Arthur Smith Woodward on his retirement from the presidential chair at the annual general meeting of the Palæontographical Society held in the Geological Society's rooms at Burlington House on April 21. Sir Arthur had been president for nine years, following thirty years as secretary of this Society. During his period of secretaryship, in addition to the ordinary duties of that office, he contributed two important monographs on Cretaceous fishes to the Society's series of volumes which describe and illustrate British fossils. In recognition of Sir Arthur's outstanding services to the Society, he has been elected an honorary member. He is succeeded as president by Prof. H. L. Hawkins, professor of geology in the University of Reading.

Sir Sidney Burrard

Prof. J. L. Simonsen writes: "In his brief obituary notice in Nature of April 10, p. 414, of the late Sir Sidney Burrard, Sir Gerald Lenox-Conyngham omitted to mention one very important contribution to the advancement of science in India which we owe to Sir Sidney. When the formation of the Indian Science Congress, now the Indian Science Congress Association, was under consideration in the years 1911–12, it is very doubtful if any progress would have been made had it not been for the enthusiastic support which the proposal received from Sir Sidney Burrard and Sir Henry Hayden. It was due mainly to their representations that this body was from the outset recognized by the Government of India and by the local governments. Sir Sidney was president of the Congress at Lucknow in 1916 and during the remaining period of his service in India he always followed its meetings with the greatest interest".

The Night Sky in May

New moon occurs on May 4d. 09h. 43m. U.T., and full moon on May 19d. 21h. 13m. The following conjunctions with the moon will take place: May 5d. 22h., Mercury 8° N.; May 6d. 15h., Saturn 3° N.; May 7d. 18h., Venus 6° N.; May 9d. 21h., Jupiter 3° N.; May 28d. 10h., Mars 2° N. Occultations of stars brighter than magnitude 6 are as follows: May 6d. 9h. 01·0m., α Tau. (D); May 6d. 10h. 07·0m., α Tau. (R); May 12d. 21h. 27·6m., ν Leo (D). The times are given for Greenwich and D and R refer to disappearance and reappearance respectively. Mercury is stationary on May 12 and in inferior conjunction on May 23. Venus sets at 23h. 30m. about the middle of the month and is a conspicuous object in the western sky. Mars souths at 8h. in the middle of the month, rising at 2h. 30m. The planet is in Aquarius and is rather low for good observation. Jupiter, in Gemini, sets about midnight in the middle of the month. Saturn cannot be seen as it is too close to the sun. The times refer approximately to the latitude of Greenwich. The Aquarid shower of meteors is active in the first week in May, but it is generally very feeble and supplies few meteors.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Absolute X-ray Wave-lengths

In a letter under this title, Messrs. H. Lipson and D. P. Riley[1] have made some suggestions regarding the values of the X-ray wave-lengths to be used in diffraction measurements. All wave-lengths in the X-ray spectra determined by crystal measurements are based on the value $d_1 = 3029 \cdot 04$ X.U. for *the lattice constant of calcite at* 18° and the corresponding values of d_2, d_3 . . . for the higher orders[2]. As secondary standards for the longer wave-lengths, quartz $d_1 = 4244 \cdot 92$, gypsum $d_1 = 7579 \cdot 07$ and mica $d_1 = 9927 \cdot 58$ X.U. have been used. Rock salt, which was used in the very first days of X-ray spectroscopy, was abandoned because the spectral lines obtained with this crystal did not have sufficiently good definition to allow the desired precision in the measurements.

As was first shown by Bäcklin[3], there is a discrepancy between the values of the X-ray wave-lengths from crystal measurements expressed in X.U. and those obtained with ruled gratings. Bäcklin pointed out that this could be explained by supposing that the value of the electronic charge was a few tenths per cent higher than the value commonly accepted at that time. As is well known, the more recent determinations of e have proved the correctness of this view.

Measurement of the X-ray wave-lengths with ruled gratings naturally gives their values in centimetres or Ångstrøm units ($= 10^{-8}$ cm.). Unfortunately, wave-length measurements in this region with ruled gratings do not yet give the same accuracy as those with crystals. As the large number of wave-lengths now determined by the crystal method in X-units form a consistent system, it is in my opinion inadvisable to make a general recalculation of them before we have a sufficiently accurate value for the conversion factor.

From the direct comparisons of some wave-length values determined both with crystals in X.U. and with ruled gratings in A.U. by Bäcklin, Bearden and Thyren[4], a conversion factor of $1 \cdot 00201 \times 10^{-3}$ is derived, with an error of some units in the last place. The X-unit, which then differs from 10^{-11} cm. by very nearly 0·2 per cent, may be retained for the scale employed to express crystal measurements. In the few cases where values in centimetres or A.U. are desired, the conversion factor just given may be used.

MANNE SIEGBAHN.

Research Institute for Physics,
Academy of Sciences,
Uppsala.
March 24.

[1] Lipson, H., and Riley, D. P., NATURE, 151, 250 (1943).

[2] Siegbahn, Manne, "Spektroskopie der Rontgenstrahlen" (2nd Edit., Berlin, 1931).

[3] Bäcklin, E., Dr. Diss., Upsala Universitets arsskrift, 1928; *Z. Phys.*, 93, 450 (1935).

[4] Thyren, F., Dr. Diss, *Nova Acta Regia Soc. Sci. Upsaliensis*, iv, 1 (1940).

We are glad that Prof. Siegbahn has been able to give his attention to this matter, as his opinion is certainly of great weight. The complication has arisen because crystallographers have not obeyed his original instructions to use the X-unit; this is inconveniently small for expressing lattice spacings and it has therefore been the general custom to quote all results as though they were in Ångstrøm units.

A copy of Prof. Siegbahn's letter arrived in time to be read at the Institute of Physics conference held in Cambridge on April 10. The consensus of opinion was the same as his—that it would be better to wait for a more accurate value of the conversion factor. Nevertheless, it seems to us that it cannot be assumed that the accuracy will increase with time. Because the angles involved in diffraction by ruled gratings are necessarily small, it is probable that the accuracy attainable will never reach that with which the angles of diffraction from crystals can be measured.

May we suggest the adoption of the following conventions? These will lead to factual correctness and to less confusion when the change to absolute measurements is ultimately made. When an accuracy not better than 0·1 per cent is claimed, the result should be given in Ångstrøm units, but for higher accuracy it should be given in X-units. Thus the lattice parameter of iron could be given as 2·86 A. or 2860·4 X., but not as 2·8604 A. The value of the wave-length adopted should always be explicitly stated.

It is, however, undesirable to have to use a unit or length that is not simply related to the C.G.S. system, and we are still of the opinion that the X-unit should be eliminated as soon as possible.

H. LIPSON.
D. P. RILEY.

Cavendish Laboratory,
Cambridge.

Renal Excretion of Pituitary (Posterior Lobe) Extracts

It is somewhat puzzling to notice that J. A. Shannon on p. 312 of the latest (1942) volume of the "Annual Review of Physiology" regards it as established that the kidney can excrete the antidiuretic principle of the posterior pituitary lobe, whereas J. P. Peters on p. 110 of the same volume appears to regard this as at least extremely doubtful. In neither case is the conclusion supported by a full reference to the work published on the subject. It may, therefore, be worth while to enumerate the papers concerned with the renal excretion of posterior pituitary extracts in the hope that such a survey will clear the issue.

After intravenous injection of posterior pituitary extracts, renal excretion of an antidiuretic activity has been observed in rats[1], rabbits[2] and dogs[3]. These results can be supplemented by those of Dale[4], Jones and Schlapp[5] and Larson[6,7], who reported the elimination of a pressor and an oxytocic activity after intravenous administration of posterior pituitary extracts. Opinions about the result of subcutaneous injections of posterior pituitary extracts are less unanimous. Gilman and Goodman[8] and Ingram, Ladd and Benbow[9] reported the urinary excretion of an antidiuretic activity after subcutaneous injections of large doses of posterior pituitary extracts into rats and dogs respectively. However, Walker's experiments[10] were positive in only two out of ten experiments on rats.

Summing up, there is satisfactory agreement that the kidney of all mammalian species investigated can excrete the posterior pituitary principles provided that the extract is administered intravenously and in sufficiently large amounts. All observers agree further that a fraction only of such large amounts finds its way into the urine and that the bulk of any activity is excreted within the first hour after injection. There is no doubt, therefore, that Shannon's conclusion as to the ability of the mammalian kidney to excrete the antidiuretic hormone is well supported.

However, Peters, in discussing the evidence for the renal excretion of posterior pituitary extract, says: "He [Walker[10]] was unable to detect pituitrin in the urine of rats after injection of the drug, in direct contradiction of the claims of Heller (1937)". He quotes no other papers and, in fact, his reference to the contested experiments is erroneous. They were not published by Heller in 1937 (*J. Physiol.*, **89**, 81) but by Heller and Urban in 1935 (*J. Physiol.*, **85**, 502). It may therefore be suspected that he failed to appreciate the difference in the conditions of the experiments. Heller and Urban injected posterior pituitary extract *intravenously* whereas Walker administered pituitrin by *subcutaneous* injections. To talk of "direct contradiction" seems therefore inadmissible, even if Walker's positive results in two of his experiments are neglected. There is ample evidence (see above) that a large fraction of intravenously injected posterior pituitary extract is inactivated in the body, and the *in vitro* experiments of Heller and Urban[1], Jones and Schlapp[5] and Larson[6,7] suggest that an enzymatic process is involved in this inactivation. It seems therefore reasonable to assume that, in the case of a preparation like posterior pituitary extract which blocks its own absorption from the subcutaneous tissue, considerably less will be excreted after subcutaneous than after intravenous injection. Considering the large doses used, this may be taken to mean that the blood concentration of the hormones has to be high to ensure excretion of sizable amounts in the urine. It is clear that a sufficiently high blood-level is less likely to be reached after subcutaneous injection.

The apparent discrepancy between Walker's and Heller and Urban's results would seem to be well explainable on this basis. However, it was decided to re-investigate the problem of the renal excretion of posterior pituitary extract by rats. Experimental conditions, so far as the dose of posterior pituitary extract and the mode of administration were concerned, were the same as those of Heller and Urban's[1] series, with the exception that the urine excreted by the rats injected with the posterior pituitary extract was not used as such but was adjusted to represent equal excretion periods of a control series of rats receiving only water. In another series the urines were adjusted to the same pH and specific gravity. Burn's method was used to test urines for antidiuretic activity. The following experiment may serve as an example.

Two rats received 1,500 mU. of posterior pituitary extract, B.D.H., by intravenous injection and 5 per cent of the body-weight of tap water by the mouth; two others received water only. The urine of these animals was collected up to 3 hours after water had been given, and the urine of the 'pituitary extract animals' (urine *A*) diluted to the same volume as that of the controls (urine *B*). Two groups of two rats were injected subcutaneously with 2·5 ml. per animal of urine *A* and two other rats with 2·5 ml. per animal of urine *B*. The times required to reach the 'mid-excretion point' were 300 and 270 min. for rats injected with urine *A*, and 90 min. for those injected with the control urine *B*.

Leaving the quantitative aspect of the problem aside, there can therefore be little doubt that *some* fraction of the intravenously injected pituitary extract appeared in the urine of the rats as an antidiuretic activity. The experiments of Heller and Urban[1] were thus fully confirmed.

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April 5.

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[3] Hare, K., Hikey, R. C., and Hare, R. S., *Amer. J. Physiol.*, **134**, 240 (1941).
[4] Dale, H. H., *Biochem. J.*, **4**, 427 (1909).
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[10] Walker, A. M., *Amer. J. Physiol.*, **127**, 519 (1939).

Terminology in the Geological Sciences

DR. R. H. RASTALL has stated his views concerning the ordinary educated citizen's lack of appreciation of the geological sciences[1]. At least a warning note has been struck. *Verbum satis sapienti.*

The unpopularity of biological science is attributable to various causes. The present century has witnessed a steady decline in the number of versatile amateur naturalists. True, the progress of science has involved complication of its fundamental alphabet and this, together with the ever-expanding literature, has invoked specialization, but it is doubtful whether this has embarrassed the would-be amateur. The amusements and social distractions of recent decades have robbed science of potential workers before they envisaged the complexity of nomenclature.

The usual course in geology for engineers and others is not calculated to perpetuate a love for the science. The fault lies in an unbalanced curriculum, which represents geology as a dull description of inanimate specimens. The average course in stratigraphy for the would-be professional geologist is destined to depress, but here the method of teaching is at fault.

Dr. Rastall blames the palæontologists. They have, however, made some progress despite the multiplying of names. We only need instance the work of Bisat, Trueman and Elles, and the resulting advances in Carboniferous, Silurian and Ordovician stratigraphy.

The subdivision of 'aristocratic' genera is frequently advisable, but the field-worker need concern himself only with trivial names; these are irrevocable unless they contravene the International Zoological Rules. Concerning the laws of priority, Dr. Rastall's 'sleeping dogs' might awaken at awkward moments. Such laws are essential if biological nomenclature is to avoid international chaos. Nothing is more troublesome than an obscure and undeciphered synonymy. Again, owing to possible synonymy, quotation of the author of a trivial name is utilitarian, though it could well be omitted from popular accounts.

Dr. Rastall states, "petrology and mineralogy get on very well without such a system". The problems confronting biological and mineralogical or petrological classification are scarcely comparable. Biology deals with necessarily variable material. Mineralogy and petrology are concerned with minerals which normally possess definite chemical compositions. The mineralogist would indeed be faced with the biological problem if his minerals were always members of isomorphous series, vastly more numerous than they actually are, and if they changed composition from horizon to horizon throughout the succession.

The palæontologist is necessarily at a disadvantage as compared with the student of living material where the species concept is concerned. The biologist can test a questionable case whereas the palæontologist can but judge the taxonomic value of observable characters.

It seems improbable that geological science will ever become popular, but better early education in general science, revision of university curricula and more flexible teaching at the university stage would do much to satisfy any future demand for geologists. Additionally, it would seem advisable to establish a Central Bureau of Geological Research, where research could be registered to obviate wasteful overlapping, and to which workers contemplating original views or institution of new names could state their reasons before publication is allowed.

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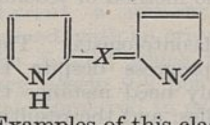
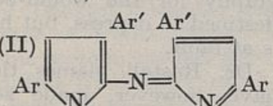
[1] NATURE, 151, 294 (1943).

Tetra-arylazadipyrromethines : a New Class of Synthetic Colouring Matter

WHEN two resonant systems can be linked by a methine bridge to form a single degenerate system, it is usually found that the methine bridge can be replaced by a bridge consisting of a single nitrogen atom, the resulting *aza* compound being at least as stable as the methine itself; the progressive replacement of the methine bridges in the porphins to form *aza*-porphins, and finally phthalocyanines, being an interesting example. It is therefore surprising that, despite the numerous examples of the class 5 : 5′-dipyrromethine (I, X = CH), there is no record of a 5 : 5′-*aza*-dipyrromethine (I, X = N).

(I) 

(II) 

Examples of this class of compound have now been made, the pyrrole rings being substituted by aryl radicals in the 2 : 4-positions (II). Two general methods have been used. In the first, the 2 : 4-diarylpyrroles (made by dehydrogenation of the pyrrolines, methods of preparing which are described in the literature) were converted into their 5-nitroso compounds, which condensed readily with the α-position of a second molecule of the pyrrole. The second method is a very remarkable one, the *aza*-methine being obtained by the action of formamide, or certain other simple ammonia-donating substances, on compounds of the type:

$ArCH(CH_2NO_2)CH_2COAr'$ or $ArCH(CN)CH_2COAr'$.

The reaction is complex, but some insight has been obtained as to the steps involved, which will be published elsewhere with the full details of this work[1].

The *aza*-dipyrromethines fulfil expectations as to colour and stability. The simplest member of the series which has been made is 2 : 2′ : 4 : 4′-tetraphenyl-*aza*-dipyrromethine (II, Ar = Ar′ = Ph), an intensely blue compound which sublimes with but little decomposition when heated in air, and with no decomposition when heated *in vacuo*. The *aza*-methines form metallic complexes analogous to those formed by the true methines, including 2 : 2′ : 4 : 4′-tetraphenyldipyrromethine itself, which is, as would be expected, red.

My thanks are due to I.C.I. (Dyestuffs), Ltd., for permission to publish this letter.

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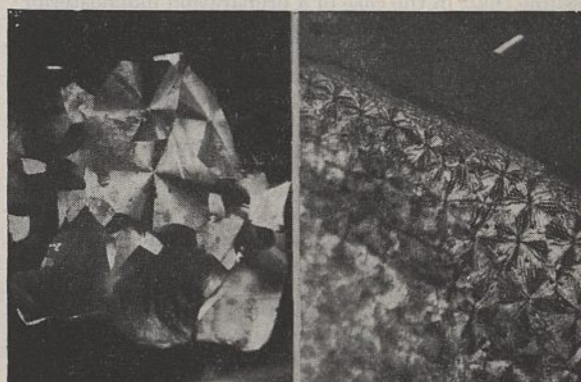
[1] Patent applications pending.

Occurrence of Crystals in the Skin of Amphipoda

THE difficulty in distinguishing some of the species of Amphipoda suggested that some means other than the usual ones of comparison of parts might be tried; after trying various chemical and physical tests I examined the skins in polarized light. The results achieved seemed at first sight to indicate that the method might be of considerable value. Unfortunately it was not found possible to separate species by this method.



a *b*

Crystal development in the skin of *Leucothoe spinicarpa*.
(*a*) Crystals at posterior end of body 5 min. after moulting;
(*b*) Arborescent pattern.

In general, the Amphipoda load their skins with crystals of calcium carbonate, which is laid down in the form of radiating needles. These crystals do not always give the same effect in polarized light so that it is possible to separate some families thereby, for example, the Gammaridæ and the Leucothoidæ. The crystals in the skin of the former between crossed Nicols show alternate dark and light wedges meeting at their apices (Fig. *a*). In the latter, the dark and light wedges are broken up into an arborescent pattern of dark and light lines (Fig. *b*).

More surprising still is the fact that though crystals are found in the skin of Gammaridæ taken from such extremes of environment as the sea and water of *p*H 4·8 (as in Lough Sure, Donegal), the Talitridæ contain no crystals at all, yet many of them live under conditions apparently similar to those of the gammarids.

The presence or absence of crystals, then, seems to bear no particular relation to the environment of the animals. Is it possible that the hardening of the chitin has to be done by calcium carbonate if the usual nitrogenous material is not available? It can scarcely be because the calcium is only occasionally available.

Another interesting point is that all members of the same family do not necessarily behave in the same way. Thus some of the Dexaminidæ, Aoridæ and Photidæ have crystals and some have not. (It has to be noted that, while the skin of *Leptocheirus pilosus* Zaddach shows no structure, that of *L. hirsutimanus* (Bate) shows a reticular network similar to that of *Amphithoe rubicata* (Montagu). This, however, is a matter quite distinct from that of the crystals.)

The rate of crystal deposition in newly moulted individuals is extremely rapid. *Gammarus pulex* (L.) kept in normal tap-water in the laboratory showed the usual crystals in the newly moulted skin. This process was watched, and five minutes after its completion the animal was killed and its new skin examined. It was found that the crystals were well developed, especially towards the posterior end of the animal (see Fig. *a*). Anteriorly, crystallization was not complete—the crystals were in the growing stage; the growth had started from centres and was passing outwards. At the edge of the piece examined the crystals had reached their normal size, but away from the edge the crystals growing from their centres had not met. Twenty-four hours after moulting, the skin had a complete layer of crystals which, however, does not mean that no more deposition would take place.

The time necessary for calcification seems to be much shorter than that suggested by Schumann[1], who estimated it at seventy-two hours after moulting.

I can find no evidence to show that calcium is withdrawn from the skin before moulting takes place. Therefore, unless it is stored in some other part of the body, the calcium necessary for the new skin must be drawn from the water or from the food-plants. It has been impossible to get samples of either from Lough Sure, but specimens of water, weed and *Gammarus pulex* from an acid loch in Inverness-shire showed that, though the water was *p*H 6·2 and the hardness 2·7 parts of calcium carbonate per 100,000 of water, and the calcium (reckoned as $CaCO_3$) in the plants was 2·05 per cent, there were crystals present in the Gammarus. Thus, though the water contained little calcium, the food-plants contained an abundant supply. Allowing for the other possible salts present (for example, those of sodium, potassium and magnesium) the concentration of $CaCO_3$ may well be below the solubility of this salt in neutral waters.

It has also been noticed that individuals of a species taken from the south coast of England may have crystals, while those of the same species taken from the north of Scotland may be without crystals. This has been found in the case of *Calliopius crenulatus* Chev. and Fage, and *Nototropis schwammerdami* (M.-Edw.).

It is hoped to return to these investigations when conditions return to normal.

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[1] Schumann, F., *Zool. Jahrb.* (*Physiol.*), 44 (1928).

Winter Sources of Vitamin C

IN view of the scarcity, in Great Britain, of vitamin C from natural sources during the months of January, February and March, it is suggested that the following analytical data on small, hardy plants may be of some interest in problems of human nutrition. The plants were examined under the same conditions and compared with two samples of watercress purchased in the open market.

Vitamin C was determined by titration with 2:6 dichlorophenol indophenol, and the results shown in the accompanying table were obtained:

Sample	Classification	Date analysed	Vitamin C as ascorbic acid per 100 gm. of fresh material
1 Australian cress	*Lepidium* (? *sativum*)	March 4	148 mgm.
2 American cress	*Barbarea verna*	March 31	108 mgm.
3 Italian corn salad	*Valerianella eriocarpa*	March 4	93 mgm.
4 Nüsslisalat (Swiss)	*Valerianella olitoria*	February 18 and March 23	55 mgm. 84 mgm.
5 Watercress	*Nasturtium officinale*	February 13 and March 4	37 mgm. 54 mgm.

In addition the Nüsslisalat and Italian corn salad were tested for riboflavin by the microbiological method of Snell and Strong, and were found to give a positive response to the growth of *Lactobacillus Casei* ε under the prescribed conditions of the test, though we are not prepared at this stage to give definite assay figures for these samples.

The seeds of the two cresses and the Italian corn salad were bought some years ago in Great Britain, and are most prolific when grown in garden soil and well established. The Nüsslisalat was obtained by Miss V. Crowe from the Bernese Oberland, where it grows all the year round and is a constant ingredient of winter salads. It is easily grown here and flourishes during the hardest winters.

Although Nüsslisalat and corn salad have a somewhat lower vitamin C content than the other plants, it would be possible to eat larger quantities of them as they lack the pungency of the cresses. All these plants have a good flavour and compare very favourably with watercress, which is the only really cheap salad plant available during the winter months. They have the undoubted advantage of not requiring special methods of culture and could be grown in odd corners and small gardens.

We are aware that some of the species examined are members of the natural British flora and hope to have an opportunity of examining related wild species. Dr. J. Ramsbottom of the British Museum (Natural History), and Dr. Coke of this clinic, kindly supplied the information as to nomenclature of these plants.

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X-RAY ANALYSIS IN INDUSTRY

THE second X-ray conference of the Institute of Physics was held in Cambridge during April 9 and 10. Sir Lawrence Bragg was in the chair, and in his opening address he particularly welcomed the foreign men of science present, and warm applause followed his greeting to Prof. V. M. Goldschmidt.

In the first session the relative advantages of the powder method with cylindrical and flat specimens were discussed. Dr. A. J. Bradley pointed out the necessity for the accurate measurement of intensities of spectra for determining structures, for investigating superlattices, for examining strained crystals, and for finding temperature factors and atomic scattering curves. The practical difficulties are not great when the spectra are well separated, but when there are many lines close together there are difficulties in finding the background. Dr. Bradley showed some examples in which the background has to be estimated from the values on either side of a group of lines, and he described the design of the photometer with which the curves were obtained. The main theoretical difficulty is the correction for absorption, and for a cylindrical specimen the calculation of the correction is very complicated; Dr. Bradley gave an outline of the method by which he has solved the problem.

Dr. G. W. Brindley pointed out that the absorption correction is more easily dealt with if a flat specimen be used. Nevertheless, the method is not popular, because certain reflexions do not reach the film and the focusing is poor except on one part of the film. This latter property can, however, be used to increase the accuracy; by making the weakest line the sharpest, the peak intensities of the lines can be brought nearer together and so kept within the range of linear response of the film. Not only is the absorption correction simple, but also the absorption coefficient does not enter into the calculation of relative intensities.

Dr. Brindley described the construction of a flat-specimen camera designed to expose two specimens alternately, and explained how absolute intensities can be measured by means of a standard such as aluminium. He showed some results of measurements on potassium chloride, copper and cold-worked rhodium and copper.

Prof. J. M. Robertson spoke on the measurement of the intensities of spots on single-crystal photographs. He said that, while visual estimates of intensities can often be used to fix atomic parameters with surprising accuracy, it is sometimes important to obtain more exact data. He recommended the use of very small specimens, and the reduction of the background with moving-film cameras or by crystal-reflected radiation. There is still difficulty in comparing intensities over a range of about 3,000 : 1, and the comparison of the β-spots of the strong reflexions with the α-spots of the weaker ones can be used to overcome this. The presence of β-spots is, however, undesirable for other reasons, and alternatively one can use a shutter that allows the lower orders to be exposed for only a certain fraction of the total time of exposure. A still simpler method is to expose five films together in series so that each spot is recorded in five known ratios. The stronger spots on the last film can then be compared with the fainter ones on the first. Prof. Robertson gave some of the practical details to be taken into account in this method.

In the ensuing discussion, Dr. W. Hume-Rothery directed attention to the possibility of film shrinkage during exposure, and said that in order to overcome it he finds it necessary to store his film at constant humidity and to maintain this humidity in the camera. Errors in lattice parameters can be overcome by fixing the films near the high-angle ends, but this may affect the measurement of the low orders. Mr. H. P. Rooksby and Dr. A. H. Jay recommended that the films should be stored in a lead-lined box near the X-ray tube, but Dr. Hume-Rothery said that he has not found this satisfactory.

In the evening, Mr. C. W. Bunn gave a lecture entitled "Towards Atomic Photography". He spoke on the problem of producing images of atoms. A magnification of at least 10^7 would be required and the resolution would have to be great in proportion. Abbe's treatment of the resolving power of a microscope, however, leads to the conclusion that the waves used must be smaller than the details one wishes to see, and visible light is therefore much too coarse to detect atoms. X-rays have much smaller wave-lengths, but they cannot be effectively refracted in order to form an image. A beam of electrons, however, also has a short wave-length and can be refracted by electric or magnetic fields. This has led to the construction of the 'electron microscope', with which large molecules can be resolved. But this instrument is still far from being able to detect single atoms.

The formation of an image by optical methods can be resolved into the formation of a diffraction pattern, and the subsequent recombination of the diffraction spectra to form a final image. It is easy enough to get a diffraction pattern with X-rays, but we cannot continue with the second process. It is possible, however, to collect the X-ray diffraction data and to perform the second process with light. Unfortunately, it is not possible to measure the phases of the X-ray spectra, and Mr. Bunn showed how this affects the results in the case of the image of a regular object in a microscope; as the microscope is racked back the image changes, but there is always some detail that might be mistaken for the real image. In some special cases the difficulty can be overcome, and Mr. Bunn showed a copy of Sir Lawrence Bragg's photograph of the atoms in diopside, $CaMg(SiO_3)_2$.

Mr. Bunn also showed some further developments of the application of optical methods to structure analysis, such as the determination of structure amplitudes by what he termed the 'fly's eye' method. A regular array of pin-hole images is formed photographically; the diffraction pattern of the structure to be examined then gives a complete zone of spectra, and this may be compared with the observed X-ray spectra. In a similar way we can find the effects of faults in a structure when this cannot be done by calculation.

The third session began with a discussion of the proposal to change X-ray wave-lengths to absolute values. Dr. H. Lipson explained that the current Ångstrøm unit is now known to be in error by 0·2 per cent and suggested that it should be corrected. He read a letter from Prof. M. Siegbahn [see p. 502] who suggested that the question be deferred until the error has been determined more accurately. This seemed to be the general view, and Mr. Rooksby suggested that a change should not be made without international agreement on the conversion factor. Sir Lawrence Bragg therefore proposed that the question be raised with the American Society for X-Ray and Electron Diffraction, and this was agreed to.

Then followed a series of papers on recent developments. Dr. A. H. Jay explained the significance of the formation of superlattices in alloys, and explained how they can be detected by X-rays. He stated that the formation cannot be regarded as a phase change because there is no radical change in structure.

Dr. Kathleen Lonsdale, who spoke on "Thermal Effects and Allied Phenomena", showed some slides illustrating the decrease in intensity of the main reflexions with rise of temperature, and the corresponding increase in intensity of the 'diffuse' reflexions. These reflexions may be regarded as arising in the following way. X-rays have such a high frequency that from their point of view all the atoms are stationary, although owing to thermal motion they may be displaced from their mean positions. Each of the elastic waves in a crystal can be regarded as producing a superlattice, and it is the combination of large numbers of superlattice reflexions that produces the diffuse reflexions.

Dr. Lonsdale emphasized the usefulness of the concept of reciprocal space for the study of this effect in particular and crystal structures in general, and showed how beautifully the fine detail can be explained by the theory. Jahn's formula for the isodiffusion surfaces has been verified experimentally on lithium, sodium, lead and tungsten single crystals, and it may soon be possible to find the elastic constants of a substance by this method.

Dr. Lipson introduced the subject of "Side-Band Formation" by saying that it is an example of a phenomenon for which the theory had been worked out many years previously to its discovery. In brief, the side-bands are essentially the same as *one* of Dr. Lonsdale's elastic waves 'frozen in', but in this case the wave is due to the incipient separation—in an alloy of copper, iron and nickel—of two phases similar in structure to the parent phase, but with different lattice parameters. Dr. Lipson also showed how the positions of the side-bands can be satisfactorily accounted for in reciprocal space, and that the wave-length and direction of the periodic variation can be found in this way. The intensities do not agree with the theory, however, without a correction for extinction ; he thinks that the extinction effect was not given sufficient prominence during the first day of the conference.

Dr. Lipson then showed some results obtained by Dr. Vera Daniel on the decomposition of an alloy with time, and said that entirely new information about phase changes is being obtained.

In the discussion, Sir Lawrence Bragg remarked that the structures that give the side-bands are promising objects for the electron microscope. Mr. K. Hoselitz pointed out that the information is just that needed for the correlation of coercivity and crystal structure, and Dr. Lipson agreed that it would be useful to make the necessary magnetic measurements. Mr. H. J. Goldschmidt said that he had observed a similar phenomenon in certain magnetic alloys.

Prof. Goldschmidt spoke of photographs of radioactive deposits that have been disintegrating for about a million years, and said that they show imperfections because of the recoil of the uranium atoms. Dr. P. P. Ewald directed attention to the similarity of Dr. Lonsdale's work to the examination of the diffraction of light waves by a crystal carrying ultra-sonic waves. He also asked about the effect of a periodic variation of the structural parameters of a crystal, but Dr. Lonsdale said that such effects would appear too far from the reciprocal lattice points to be easily detected. The question of whether superlattice formation should be included on equilibrium diagrams was raised by many speakers ; Sir Lawrence Bragg gave his opinion that it is not necessary to discuss whether the formation is a phase change or not, as now that we know the exact nature of the change it does not matter what name is given to it.

The last part of this session was devoted to a report on the preparation of the X-ray index proposed at the meeting held at Cambridge last year. Dr. A. J. C. Wilson presented the report ; he gave a brief history of the index and explained the exact nature of the collaboration between the various bodies concerned.

At the opening of the final session, Dr. C. Sykes reported a resolution by the organizing committee that an X-Ray Crystallography Group of the Institute of Physics be formed. After assurances that the group would welcome chemists and others and was only to be regarded as a temporary measure, the resolution was carried.

The main subject of the final session—"Quantitative Treatment of Line Broadening"—was introduced by Dr. F. W. Jones. He showed that the problem of estimating line breadths is complicated by the broadening due to other causes such as the divergence of the X-ray beam and the geometry of the camera. He explained his method of using a standard substance which gives no diffraction broadening, so that, by suitable treatment, this part of the broadening can be allowed for in the broadened lines. He pointed out that this method is unreliable when the diffraction broadening is small compared with the geometrical broadening.

Dr. Wilson spoke on "The Effects of Distortion and other Imperfections". Among the possible causes of line broadening he listed small particle size, heat motion, 'mistakes', and distortion due to cold work. The broadening due to heat motion is different in appearance from the others ; Dr. Lonsdale's diffuse reflexions are a manifestation of it. 'Mistakes' are errors in the building up of a lattice, and have been found in hexagonal cobalt, chrysotile, and $AuCu_3$. The theory of mechanical distortion is far from complete, and on account of the difficulties, which Dr. Jones mentioned, of estimating the actual diffraction broadening of the spectra, it has not been found possible to settle unequivocally whether the broadening due to cold work is primarily due to fragmentation or to variation of lattice parameter. The experimental evidence tends towards the latter, and the differences between the various spectra can be satisfactorily accounted for in terms of elastic anisotropy.

In the discussion, Dr. Brindley pointed out that his results are in agreement with this view, and said also that the amount of extinction present in some practical cases cannot be accounted for if the crystals are very small. Dr. W. A. Wood, however, presented some new results which, he claimed, support his theory of fragmentation. On the other hand, Dr. E. Orowan showed a photograph from a bent wire, and another from the wire when it had been straightened, and said that these led to the other conclusion.

This discussion, on the whole, provided the best illustration of how such conferences help in allowing the exponents of different theories to state their views to each other, and in bringing their differences into relief so that the points to be settled can be more clearly seen.

An exhibition of apparatus and films was arranged by Dr. Wilson with the main purpose of illustrating points in the lectures. For example, the Cambridge Instrument Company showed photographs of its latest types of microphotometer, and Dr. Bradley's laboratory produced a set of powder cameras the diameters of which vary from 2·5 cm. to 35 cm.—a graphic demonstration of the way in which this type of camera has developed in the last twenty years.

Mr. Bunn showed some photographs illustrating the method of evaluating structure-amplitudes optically. Sir Lawrence Bragg's 'X-ray microscope', which may be said to have heralded this tendency to return to optical principles for solving crystal structures, was also on view, and was used to show diffraction by a three-dimensional grating as well as several of the effects described in Mr. Bunn's lecture.

In connexion with the papers on "Recent Developments", photographs from superlattices were exhibited; Dr. Lonsdale showed a beautiful series of prints of her 'diffuse reflexions', and Dr. Vera Daniel showed some of the photographs with which the 'side-band' effects have been studied.

The discussion on "Line Broadening" was illustrated by an exhibit by Mr. A. R. Stokes showing the broadening caused in the several ways enumerated by Dr. Wilson. In addition, Dr. D. P. Riley produced a series of photographs of coals taken with crystal-reflected radiation. These photographs show a spreading of the central beam—'low-angle scattering' —that can be correlated with the actual particle-size in the specimen, as distinct from the crystal size that most X-ray measurements produce.

There were several other exhibits of general and metallurgical interest, and as a practical example of the working of an X-ray laboratory the Crystallographic Laboratory of the University was also open for inspection.

BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION

THE twenty-second annual report (E.R.A./T.331) of the British Electrical and Allied Industries Research Association summarizes the work which has been carried out during the year ended September 30, 1942, and, like its predecessor, lists by titles the various research reports which have been issued during the period. The work is reviewed under eighteen major classifications, among which, as was pointed out on the previous occasion, are again the important ones of dielectrics, cables and overhead lines, electric control apparatus, steam-power plant and condensers, magnetic materials, transformers, surge phenomena and rural electrification.

The report shows that the work of the Association is now carried on by 112 technical sections, subcommittees and panels comprised of technicians and scientific workers engaged in industry and in universities and other training institutions. Fifty-seven technical reports on a variety of subjects have been issued by the Association during the year, and fifty-one others were in an advanced stage of preparation at the end of the year. These may be divided as follows, giving, in each instance, first new reports and, secondly, reports in preparation: dielectrics, 20, 15; cables and overhead lines, 8, 4; electric control apparatus, 15, 16; steam-power plant and condensers, 2, 2; communication interference, 3, 2; magnetic materials, 2, 2; transformers, 0, 1; surge phenomena, 4, 3; safety problems, 0, 3; rural electrification, 1, 1; transformer noise, 2, 2.

The Information Bureau has been particularly active during the year, and Government and Service Departments are now making increasing use of its services. The Association's card index now contains nearly 30,000 special references, and current matter is being added at a substantial rate. The first half of the complete analytical index to the contents of E.R.A. reports, covering electrotechnical materials, has now been completed. Close co-operation has been effected with the British Standards Institution in connexion with the electrical engineering section of the Universal Decimal Classification and with the Institution of Electrical Engineers in connexion with *Science Abstracts*.

The work of the Association has outgrown the capacity of the Perivale Laboratory in spite of the large amount of work which is still carried out by other bodies under its auspices, and this now necessitates removal of the laboratory to another site.

The E.R.A. is largely employed in finding specific answers to clearly formulated questions, and the former are of immediate value. Even more important contributions are being made by the E.R.A. in those fields in which the need for guidance is foreseen but the questions cannot yet be clearly put. It may take the industry many years to absorb a result of researches of the latter type, because this may involve a minor revolution in outlook and practice. Certain researches in hand fall definitely into this category; for example, some of those concerned with the phenomena of arcing, dielectric phenomena, properties of circuits, interference with communication circuits, surge phenomena, transformer design, magnetic materials and surface tension.

Notwithstanding the pressure of direct war work, serious fundamental research on dielectrics has been maintained. Industry in war-time has co-operated with and utilized the E.R.A. in dealing with many immediate problems affecting the successful utilization of particular insulating materials.

Of prime interest to the electricity supply industry are the long-range researches designed to increase the reliability, efficiency and safety, and heighten the performance, of plant used for the generation and distribution of electric power. The larger part of the work done falls within this category, and is linked closely with the user interest. Work on problems of electricity supply technology has been brought into increased activity and, in general, co-operation with authorized undertakings has been increased.

The investigation of breakdowns of plant and the devising of steps for prevention of the recurrence are the responsibility of engineers immediately concerned, but in so far as they generally involve surge phenomena, phenomena of arcing and questions of the properties of circuits, members can consult the E.R.A. Such work is not only of benefit to the member concerned but also benefits others similarly situated, and assists the investigators in establishing a true perspective as to the needs of the industry.

Continuous progress has been made in establishing liaison with all concerned with post-war reconstruction in the field of agriculture, and there has been increased appreciation of the contributions that the E.R.A. is making.

AGRICULTURE AND WORLD NUTRITIONAL NEEDS

PROF. J. R. MARRACK delivered on April 16 the third of a series of lectures arranged by the Harpenden Branch of the Association of Scientific Workers on "Agriculture and World Nutritional Needs". On the subject of "Food, Relief and Reconstruction", Prof. Marrack said that at the best, supply of food in the continent of Europe when fighting ceases will be as low as in November 1918. It is quite probable that the Nazis will spoil and lay waste large areas and leave the population completely destitute. The provision of adequate relief will be limited by two factors, namely, transport and supplies. The transport problem will be particularly acute, when a considerable area of Europe has been freed and fighting still continues, as transport will still be supplying the Army. When fighting has ended in Europe shipping will still be needed to carry supplies on the long voyage to the Far East. The problem of supplies will become most acute when the whole of Europe is freed. Nearly 500 million people will need to be provided with at least one third of their calories. It may be possible to accumulate stocks to meet this need; but they will be even shorter of animal foods than of total calories, and there is little prospect that stocks of suitable foods will have been accumulated. Pork products, large amounts of which will be available, are mainly fat and do not meet the need for protein.

Vitamin deficiencies will not be equally distributed. There should be sufficient supplies of concentrated preparations (with the exception of riboflavin) for treating the more severe manifestations of vitamin deficiency, but not for indiscriminate broadcast.

It is obvious that during this period of extreme shortage, which will last up to the next harvest, production, transport and distribution of food must be controlled and rationing of individual consumption may be more severe than it is now. But the shortage, particularly of animal foods, will continue for some years, and if we set out to abolish the fear of want we must aim at changing the character of the world's food supply. On the average, it provides enough, or nearly enough, calories; the fault is lack of animal foods, fruit and vegetables. Until a change in the type of food produced has taken place, it will be essential to maintain the supply of calories, at least. Otherwise peasants will continue to wring the maximum number of calories from the soil by cereal culture. The change in diet aimed at is qualitative. But the change in food production is, in the end, quantitative, since animals are poor converters and it takes ten or more calories of feeding stuffs to produce one calorie of human food.

For the immediate future we must accept the distribution of the world's population, with densely populated and sparsely populated areas. Production should be planned to ensure that the densely populated areas produce the perishable animal and vegetable foods for their own consumption and import the portable cereals from the sparsely populated areas. To ensure that the food is produced as needed and that those who need it can buy it, it will be necessary to have a Supreme Economic Council that will control production and distribution and will adjust purchasing power to requirements.

LOCUSTS AND OTHER MIGRATORY INSECTS IN INDIA

IN a land of continental features like India there are major insect pests which have the capacity of spreading from one part of the country to another. Where such pests appear more or less regularly and are of relatively confined distribution the provincial entomologists should be well fitted to study them and devise control measures. In the case of the desert locust, for example, swarms may appear in the Punjab, the United Provinces and Rajputana, and are known to have been derived from outbreak areas in Baluchistan, Iran and Arabia. Similarly, locusts from Rajputana and the Punjab may migrate as far afield as Assam and Madras. It will be clear that, in such cases, the provincial entomologist would be severely handicapped if he had to attempt the control of an insect the origin of which was in a distant province of India.

This subject is fully discussed by Rao Bahadur Y. Ramchandra Rao in his presidential address to the Section on Agricultural Sciences at the thirtieth Indian Science Congress in Calcutta, 1943. It is pointed out in this discourse that an All-India agency is necessary for dealing with pests of this kind, and one of its functions would be to circulate timely warning to those provinces likely to be affected. For the past three years such an agency has been functioning in so far as the desert locust is concerned. The Bombay locust and the migratory locust are of sufficient importance to merit similar centralized methods of attack.

There are also several migratory species of Lepidoptera the larvæ of which entail great damage. Thus the paddy armyworm (*Spodoptera maurita*) appears in huge numbers on young paddy, especially in Malabar, causing enormous damage. It appears so suddenly and disappears so speedily from the scene of its activities that there is scarcely any time for taking remedial measures. In many cases there are definite indications that such infestations had come into existence by the appearance of flights of the parent moths from some distant land, followed by prolific deposition of eggs on the paddy crop. On issuing from the pupæ the resulting moths would appear to have flown to some other area.

In Bihar, the cutworm, *Agrotis ypsilon*, appears in numbers on autumn crops, but is not to be found in the plains between April and August. It is surmised that it migrates to the hills during spring and summer and returns to the plains in the autumn. Similarly, the cabbage white butterfly (*Pieris brassicæ*) breeds on the plains of northern India only in winter and spring, disappearing during April and apparently migrating to the hills for summer breeding.

Examples of this kind where pests are capable of spreading from one province to another require investigation by some central agency that can have access to all affected areas. Mr. Ramchandra Rao discusses the Bombay locust (*Patanga succincta*) in detail and points out that very little is known regarding its habits and phases. The real need at present, he stresses, would appear to be for a system of planning out research on an all-India basis of those problems that cannot obviously be attacked by a provincial agency. In the course of the last two decades various committees have been constituted on such a basis for research on various crops, including some of their insect pests. In this manner a considerable advance of knowledge has resulted in several cases, notably in the investigation of various cane-borers, financed by the Imperial Council of Agricultural Research. What is advocated in this address is the extension of the same principle to those migratory pests already mentioned and to some others of widespread occurrence in India. It is only by some such centralized method of approach that present anomalies are likely to be overcome. As an example it would seem that no organization in particular is responsible for investigating the Bombay locust, which is a pest of all-India importance that is largely neglected. The present time, when swarms of this locust are in abeyance, is opportune to begin such a line of approach by collecting the essential knowledge that alone can place India in a better position to face a new outbreak. A. D. IMMS.

FORTHCOMING EVENTS

Monday, May 3

FARMERS' CLUB (at the Royal Empire Society, Craven Street, Strand, London, W.C.2), at 2.30 p.m.—Mr. J. D. Trustram Eve: "Planning of the Countryside".

Tuesday, May 4

FREE GERMAN INSTITUTE OF SCIENCE AND LEARNING (at 16 Buckland Crescent, London, N.W.3), at 8 p.m.—Kath Weaver: "New Trends in Soviet Education".

Wednesday, May 5

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. M. Crowther: "Agriculture To-day and To-morrow", 9: "The Maintenance of Soil Fertility".

Thursday, May 6

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Dr. Karl T. Compton: "The Organization of American Scientists for the War" (Pilgrim Trust Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (INSTALLATIONS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. J. F. Shipley: "The Protection of Structures against Lightning".

Friday, May 7

ROYAL INSTITUTION, at 5 p.m.—Prof. W. N. Haworth, F.R.S.: "What are Sugars and Starches?"

APPOINTMENTS VACANT

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

LECTURER IN MINING AND FUELS—The Principal, Huddersfield Technical College, Huddersfield (May 7).

LECTURER (WOMAN) IN GEOGRAPHY in the Brighton Municipal Training College—The Education Officer, 54 Old Steine, Brighton (May 8).

ADVISORY PHYSICIST TO THE RADIOTHERAPEUTIC CENTRE—The Secretary-Superintendent, Addenbrooke's Hospital, Cambridge (May 10).

LECTURER IN MECHANICAL ENGINEERING in the Leeds College of Technology—The Director of Education, Education Department, Leeds 1 (May 10).

SENIOR POST UNDER THE AERONAUTICAL INSPECTION DIRECTORATE (applicants must possess a Degree in Metallurgy or recognized equivalent)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Ref. O.N.F. 1155), Alexandra House, Kingsway, London, W.C.2.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Part-time Day Education for the Adolescent: Past Experience and Future Developments. A Report of a Conference held at the College of Technology and Arts, Rugby, September 29th, 1942, by the British Association for Commercial and Industrial Education. Pp. 44. (London: British Association for Commercial and Industrial Education.) 1*s*. [223

A Report on the Organization of the River Flow Records of the Ness Basin. By W. N. McClean. Pp. 11. 2*s*. 6*d*. The Water Resources of Loch Quoich. By W. N. McClean. Pp. 12. 2*s*. 6*d*. Hydro-Electric Development in Scotland and the Need for Inland Water Survey. By W. N. McClean. Pp. 4. (London: The Author, 39 Phillimore Gardens, W.8.) [223

Conference on Nature Preservation in Post-War Reconstruction. Memorandum No. 3: Nature Conservation in Great Britain. Report by the Nature Reserves Investigation Committee. Pp. vi+25. (London: Society for the Promotion of Nature Reserves.) 6*d*. [223

Marine Biological Station, Port Erin. Annual Report (No. 55) for 1942. Pp. 4. (Port Erin: Marine Biological Station.) [233

Town and Country Planning Association. Forty-fourth Annual Report. Pp. 8. (London: Town and Country Planning Association.) [243

World Waste and the Atlantic Charter. A Lecture by Sir James Marchant at Union Society's Hall, Oxford. Pp. 16. (Oxford: B. H. Blackwell, Ltd.) 1*s*. net. [253

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences), Vol. 61, Part 3, No. 17: Axiomatic Treatment of Kinematical Relativity. By Dr. G. C. McVittie. Pp. 210–222. (Edinburgh and London: Oliver and Boyd.) 1*s*. [263

John Innes Horticultural Institution. Thirty-third Annual Report for the Year 1942. Pp. 18. (London: John Innes Horticultural Institution.) [293

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 7: Pollination in *Tsuga pattoniana* and in Species of *Abies* and *Picea*. By Joseph Doyle and Ann Kane. Pp. 57–70+plates 2–3. 3*s*. Vol. 23 (N.S.), No. 8: The Chemical Constituents of Lichens found in Ireland.—*Lecanora parella* Ach.—The Constitution of Variolaric Acid. By Dr. D. Murphy, Dr. J. Keane and Dr. T. J. Nolan. Pp. 71–82. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [293

Institution of Chemical Engineers. Annual Report of the Council for the Year ended December 1942. Pp. 6. (London: Institution of Chemical Engineers.) [313

University of Leeds. Report of the Librarian for the Session 1941–42. Pp. 5. (Leeds: The University.) [313

Other Countries

Proceedings of the United States National Museum. Vol. 92, No. 3155: The Late Cenozoic Vertebrate Faunas from the San Pedro Valley, Ariz. By C. Lewis Gazin. Pp. 475–518. (Washington, D.C.: Government Printing Office.) [223

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 24: Contributions towards a Knowledge of the Insect Fauna of Lower California, No. 7: Coleoptera, Tenebrionidae. By Frank E. Blaisdell, Sr. Pp. 171–288. (San Francisco: California Academy of Sciences.) 1.50 dollars. [223

Indian Forest Leaflet No. 32: Indian Kapok. By T. P. Ghose. Pp. ii+10. (Dehra Dun: Forest Research Institute.) 8 annas; 9*d*. [253

U.S. Office of Education: Federal Security Agency. Vocational Division Leaflet No. 10: Professional Nurses are Needed; a Plan for Secondary Schools and Schools of Nursing to supply Professional Nurses Urgently Needed for Wartime Service. Pp. ix+28. (Washington, D.C.: Government Printing Office.) 15 cents. [253

Records of the Geological Survey of India. Vol. 77, Professional Paper No. 7: Crystalline Limestone Deposits near Sankaridrug, Salem District. By Dr. M. S. Krishnan. Pp. 11. (Calcutta: Geological Survey of India.) 7 annas; 8*d*. [263

Proceedings of the United States National Museum. Vol. 93, No. 3158: A New Fossil Reptile from the Upper Cretaceous of Utah. By Charles W. Gilmore. Pp. 10–114. (Washington, D.C.: Government Printing Office.) [263

Publications of the Dominion Observatory, Ottawa. Vol. 13: Bibliography of Seismology. No. 12: Items 5357–5439, July to December 1942. By Ernest A. Hodgson. Pp. 201–214. (Ottawa: King's Printer.) 25 cents. [293

Bulletin of the American Museum of Natural History. Vol. 80, Art. 10: A Revision of the Mongolian Titanotheres. By Walter Granger and William K. Gregory. Pp. 349–389+plate 31. Vol. 80, Art. 11: Notes on some Mammals of the Southern Canadian Rocky Mountains. By Peter E. Crowe. Pp. 391–410+plates 32–34. (New York: American Museum of Natural History.) [293

Field Experiments on Sugar Cane in Trinidad. Annual Report for 1942. By P. E. Turner; with a Tentative Grouping of Trinidad Sugar-Cane Soils on the Basis of their Moisture Relationships, by C. F. Charter. Pp. 232. (Trinidad: Government Printer.) [293

Indian Lac Research Institute. Annual Report for the Financial Year 1941–42. Pp. iii+26. (Namkum: Indian Lac Research Institute.) [293

Smithsonian Institution. War Background Studies, No. 8: Siam—Land of Free Men. By H. G. Diegnan. (Publication 3703.) Pp. iv+18+8 plates. (Washington, D.C.: Smithsonian Institution.) [54

U.S. Department of Agriculture. Technical Bulletin No. 838: Hibernation of the Corn Earworm in the Central and Northeastern Parts of the United States. By R. A. Blanchard. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents. [54

Catalogues

Ethisterone B.D.H. Pp. 2. (London: The British Drug Houses, Ltd.).

Londex Floatless Liquid Level Control 'Lectralevel' System. (List No. 94.) Pp. 4. (London: Londex, Ltd.)

Ambient Temperature Recorder. (Publication TR.10a.) Pp. 2. (London: Sunvic Controls, Ltd.)

Flow Operated Switches. (R.19.) Pp. 4. (London: Negretti and Zambra.)

Three important Items, consisting of a remarkably Fine Collection of Old English Plays, the Newton Library, and Newton's copy of Euclid. Pp. 4. (London: Henry Sotheran, Ltd.)

Laughlen Reagent B.D.H. Pp. 2. Pheniodol B.D.H., a New Cholecystographic Agent. Pp. 2. Testosterone Propionate B.D.H. Pp. 4. (London: British Drug Houses, Ltd.)

Ilford Products for Industrial Applications of X-Rays and Gamma Rays. Pp. 16. (Ilford: Ilford, Ltd.)

Old and Rare Books—Old Science and Medicine. Pp. 26. (London: E. Weil, 28 Litchfield Way, N.W.11.)

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